

Bucharest University of Economic Studies

Proceedings of the 2nd edition of the
**International Conference on Economics –
Challenges and Opportunities**

2nd edition

Centrul de Perfectionare Complex Predeal „Ion Gh. Roșca”

October 9-11, 2025

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Contents

The Economic Dimension of Food Inequality: from the Real Consumption Basket to Nutritional Equity Antonia-Gabriela MALOȘ	11
The Legal Dimension of the Minimum Consumption Basket: Towards an Integrated Regulation of Emotional and Nutritional Consumption Antonia-Gabriela MALOȘ, Corina CREȚU	35
Nutritional Dimension of the Food Basket: Accessibility, Quality, and Equity Challenges in Transition Antonia-Gabriela MALOȘ	53
Impact of direct payments on small farms in Bulgaria Bozhura FIDANSKA.....	75
The Contribution of European Rural Development Funds to Generational Renewal Simona TAPALAGĂ, Raluca Mihaela DRĂCEA.....	85
Economic Barriers to Healthcare Digitalization: Lessons from Estonia and Romania Abigaela BÎLBÎIE.....	105
Circular Bioeconomy as a driver of economic resilience in the EU dairy sector Dadiana DABIJA.....	127
Artificial Intelligence and Sustainable Tourism: A Bibliometric Analysis of Research Trends and Future Perspectives Ioan Bogdan BACOS, Flavia-Dana OLTEAN	149
Digitalisation of Education as a Public Good: Implications for Human Capital Formation and Economic Growth Alexandra CONSTANTIN, Alexandra-Paula PUIU	165
Balancing Growth and Green: Exploring Rural Development in Bulgaria Silvia TOMOVA-ZAHARIEVA	179
Foreign Workers in Romania: Economic Contributions and Legal Implications Andrei POPESCU, Loredana EFTIMIE, Anastasia-Cristiana DUMITRU.....	191

Shaping the Future of Teacher Education Through Entrepreneurial Learning Models Vladimir-Aurelian ENĂCHESCU	207
Psychological Wellbeing and Academic Motivation in Higher Education: An Evidence-Based Educational Approach Vladimir-Aurelian ENĂCHESCU	229
Sport, Health and Economic Development: Building Intersectoral Education Policies Cristian BĂLTĂREȚU, Răzvan BĂRBULESCU, Robert Alexandru MIHAILĂ	245
Economic Forecasting in a Post-Pandemic World: The Role of Interdisciplinary Evidence-Based Policy Răzvan BĂRBULESCU, Vladimir-Aurelian ENĂCHESCU, Bogdan COSTACHE	263
Bridging Management and Education: Competency-Based Leadership in Higher Education Bogdan COSTACHE, Răzvan BĂRBULESCU, Petru MUNTEANU	283
AI-Driven Solutions for Economic Equity in Health and Education Dora-Maria CRAIU, Gheorghe Cătălin BEJINARIU, Vlad Cristian SOARE	299
Economic Optimization in Sports Education: Strategic Models for Performance Development Cristian BĂLTĂREȚU, Monica Elisabeta PĂDURARU, Vlad Cristian SOARE	315
Digital Transformation in Teacher Training: An Econometric Perspective on Competency Development Monica-Elisabeta PĂDURARU, Monica-Ioana VULPE, Petru MUNTEANU	331
Innovative Strategies for Human Capital Development in Teacher Education: A Longitudinal Mixed-Methods Study Monica Elisabeta PĂDURARU, Maria CRAIU, Cristi LATEA	347
Digital Health Policies and Their Economic Impact: From Public Strategy to Community Wellbeing Costin PETCU, Cristi LATEA, Cristian BĂLTĂREȚU	365
Health Economics and Preventive Policies: A Multidisciplinary Model for Strategic Public Health Management Costin PETCU, Bogdan COSTACHE, Maura-Andreea MATEI	383
AI-Enhanced Econometric Models in Public Education Policy Design Monica-Ioana VULPE, Răzvan BĂRBULESCU, Costin PETCU	399
The Role of Artificial Intelligence in Sustainable Economic Growth: An Interdisciplinary Perspective Monica-Ioana VULPE, Monica Elisabeta PĂDURARU, Robert Alexandru MIHAILĂ	415
Modelling R&D Investment and its Macroeconomic Impact in an Agent-Based Framework Chiril BABINCIUC	431
The Role of Exports in Romania's Economic Development Nicoleta-Ștefania DRĂGAN	449
Resilience and Digital Literacy in Post-Pandemic Education Systems: An Economic Evaluation Alexandru Robert MIHAILA, Petru MUNTEANU, Monica-Ioana VULPE	465

Strategic Management in Economic Crisis: Adaptive Models for Organizational Resilience Bogdan COSTACHE, Costin PETCU, Cristian BALTARETU.....	481
Particularities of the Recruitment and Selection Process of Human Resources in Companies in Romania Florentina Emilia MARIN (PASCU), Cristian Virgil MARINAȘ, Daria Maria MIU.....	501
Heterogeneity and Typologies in EU Agri-Food Trade with the US and China: Evidence from Latent Class Analysis Rareș-Mihai NIȚU, Robert-Ștefan URICARU, Florentina PASCU.....	523
Circular Economy and Digital Innovation in Education: A Strategic Framework for Emerging Markets Cristi LATEA, Razvan BĂRBULESCU, Maria CRAIU	539
Strategic Policy Planning for Sustainable Development in Romania: An EU Governance Case Study Maura-Andreea MATEI, Razvan BĂRBULESCU, Vladimir-Aurelian ENĂCHESCU	553
Policy Transfer and Local Adaptation: Economic Mechanisms Behind Effective Educational Reform Maura-Andreea MATEI, Bogdan COSTACHE, Monica Elisabeta PĂDURARU.....	571
Determinants of Participation in the Informal Economy: A Logistic Regression Analysis Based on Eurobarometer Data Ionuț Laurențiu PETRE, Elena Theodora ION, Gabriela Loredana DINULESCU	587
The international tax challenges raised by the rapid growth of the digital economy Roxana CIORTIN GANGOȘ.....	597
Policy, Law, and Education in The European Economic Area: Building Human Capital Resilience Cristi LATEA, Cristian BALTĂREȚU, Vladimir-Aurelian ENĂCHESCU	611
New Economics of Educational Innovation: Between Inclusion, Equity and Digital Strategy Razvan BĂRBULESCU, Vladimir-Aurelian ENĂCHESCU, Gheorghe Cătălin BEJINARIU	629
Educational Equity and Economic Sustainability: Intersections in Contemporary Teacher Education Policies Alexandru Robert MIHĂILĂ, Vladimir-Aurelian ENĂCHESCU, Dora Maria CRAIU	645
Legal-Tech Solutions in Higher Education: Governance, Data Protection, and Academic Integrity Vlad Cristian SOARE, Maura-Andreea MATEI, Cristi LATEA	663
Transformative Leadership and Educational Culture in Times of Systemic Uncertainty: A Strategic Outlook on Human-Centered Governance Costin Aurelian MINOIU, Bogdan COSTACHE, Vladimir-Aurelian ENĂCHESCU	683
Assessing the Socioeconomic Impact of National Education Policies in EU Peripheral Member States Petre MUNTEANU, Răzvan BĂRBULESCU, Vlad Cristian SOARE	697
Sustainable Economic Development and the Role of Digital Public Education Systems Maria CRAIU, Costin PETCU, Robert Alexandru MIHĂILĂ.....	713

Public Policy Innovation in Times of Global Economic Crises: A Governance Perspective Petru MUNTEANU, Costin PETCU, Vlad Cristian SOARE	731
Research on the Agri-food Trade Balance of Romania Elena Theodora ION, Steliana MOCANU, Tudor HOLERGA.....	747
The Impact of Uncertainty on Liquidity and Capital Governance in Capital-Intensive Firms: Comparative Study of the EU and US Michaela ATANASSOVA	763
Legal Frameworks for Sustainable Business in the Digital Era: Implications for Economic Resilience Vlad Cristian SOARE, Vladimir-Aurelian ENĂCHESCU, Gheorghe Cătălin BEJINARIU.....	789
Not There Yet: Support for EU Cohesion Funds are not a Predictor of Legitimacy for the European Union Corina CREȚU	807
AI in Higher Education: Adoption, Ethical Challenges, and Leadership Perceptions in the Digital Age Gheorghe Cătălin BEJINARIU, Monica Elisabeta PĂDURARU, Robert Alexandru MIHĂILĂ.....	817
Health Literacy and Economic Sustainability: Building Integrated Education–Health Systems Gheorghe Cătălin BEJINARIU, Vlad Cristian SOARE, Maura-Andreea MATEI.....	831
The Illusion of Choice: Behavioral Pitfalls in Everyday Economics Cezara-Georgiana RADU, Mihai-Ciprian DORU	849
Value-Based Education and Human Capital Development in Health and Legal Sectors: Toward Integrated Policy and Management Frameworks Costin Aurelian MINOIU, Razvan BĂRBULESCU, Vlad Cristian SOARE.....	857
Independent Versus Political Boards in State-Owned Enterprises: Evidence, Risks, and Policy Lessons from Europe Adrian LUPUSOR, Alexandru STRATAN	871

The Economic Dimension of Food Inequality: from the Real Consumption Basket to Nutritional Equity

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Abstract. *This paper examines food inequality from an economic perspective using a novel composite indicator: the Food Effort Index (FEI). The FEI integrates the share of food expenditure in household budgets and the relative level of food prices (EU=100) to provide a more comparable assessment of economic pressure on food consumption. A comparative analysis across 20 European countries reveals significant disparities. Romania records the second-highest FEI (5.95), trailing only Bulgaria (6.03). This outcome indicates a structural vulnerability where insufficient incomes fail to support a balanced diet despite prices being below the EU average. Grounded in capability theory, the study captures the gap between the economically-constrained food basket and the optimal nutritional basket. The FEI is presented as a practical tool to design targeted policies, such as differentiated VAT and targeted vouchers, aligning with SDG 2 and SDG 10 for food equity.*

Keywords: food inequality; Food Effort Index; nutritional equity; food expenditure; public policy; Sustainable Development Goals.

JEL Classification: I32; Q18; D63.

1. Introduction

The food basket refers to the set of agri-food products regularly consumed by households, reflecting not only dietary habits but also the economic and logistical constraints of food access. In this study, the food basket is employed as a proxy for analyzing food equity and the nutritional quality of diets.

In a global context marked by overlapping crises – recurring pandemics, economic volatility, climate degradation, and geopolitical tensions – access to adequate nutrition has become a systemic issue of social equity, food sustainability, and economic justice (FAO, 2023; Headey & Alderman, 2023; HLPE, 2020). Recent scholarship demonstrates that food security cannot be reduced to resource availability or national agricultural performance (Pinstrup-Andersen, 2009). Instead, it crucially depends on economic accessibility – the real capacity of households to sustain a balanced and nutritious diet through available income (Stiglitz, 2012; Laborde et al., 2022).

This economic dimension, often marginalized in public policies, is central to understanding food inequality within the European Union. Differences in income levels and relative food prices generate subtle forms of food exclusion and hidden malnutrition (Darmon & Drewnowski, 2008). Romania illustrates such structural vulnerability: despite food prices below the EU average, the share of household expenditure on food remains among the highest in the Union (Eurostat, 2024; INSSE, 2024; FES, 2024). This situation reflects not a competitive advantage but a severe limitation of the real freedom of dietary choice. As Amartya Sen (1999) emphasized, effective freedom entails not only the opportunity to choose but also the economic means to exercise that choice.

Within this framework, the food basket should not be regarded merely as a consumption indicator, but as a barometer of economic equity, the redistributive performance of public policies, and the functionality of the food system (Atkinson, 2015; Marmot, 2005; Popkin & Reardon, 2018). Yet, existing tools remain insufficient to quantify the budgetary pressure of food consumption in a comparable and operational way. Traditional indicators such as the Engel ratio or the Food Insecurity Experience Scale capture this reality only partially: the former ignores differences in relative prices, while the latter relies on subjective perceptions that fail to reflect the actual tension between income and food costs (Laborde et al., 2022).

To address this methodological gap, the present study introduces the Food Effort Index (FEI) – an original composite indicator that correlates the share of food expenditure with the food price index (relative to the EU average = 100). The FEI provides a standardized, comparable, and directly applicable measure for assessing economic food vulnerability. The analysis is grounded in the capability approach (Sen, 1999), welfare economics (Stiglitz et al., 2009), and the literature on the global nutrition transition (Popkin & Reardon, 2018; FAO & WHO, 2023). It examines the gap between the real food basket – shaped by economic constraints and imbalanced market offerings – and the optimal nutritional basket, defined by scientific guidelines and public health standards. Territorial disparities (urban–rural) and intra-household inequalities are also considered, as they

influence the distribution of food resources and have direct consequences on health, education, and social cohesion (Quisumbing et al., 2015; Marmot, 2005; World Bank, 2023).

The primary aim of the paper is to investigate the discrepancy between the actual structure of food consumption and scientifically validated nutritional standards, with a view to identifying hidden forms of food inequality. Particular attention is given to the Romanian case in relation to the European Union average, in order to highlight East–West polarizations in nutritional equity. Building on this premise, the research question explores the extent to which the proposed FEI formula can more accurately capture the economic pressures households face with regard to food consumption compared to traditional indicators. The working hypothesis is that integrating the FEI into food policy analysis could support the design of more equitable, better targeted, and context-sensitive public interventions.

2. Literature Review

Classical scholarship grounded the analysis of food consumption in Engel’s Law, which establishes the inverse relationship between income levels and the share of food expenditure (Engel, 1857; Atkinson, 2015). While foundational, this approach focuses primarily on income elasticity and captures only one dimension of economic pressure, failing to account for critical variables such as cross-regional differences in food prices or the substitution effect toward less nutrient-dense options driven by income constraints.

To overcome the limitations of single-variable analyses, perception-based instruments emerged. The Food Insecurity Experience Scale (FIES) (FAO, 2023) and the Household Food Security Survey Module (HFSSM) provide globally and nationally standardized measures, respectively. However, these are measures of outcome or subjective experience, relying on household self-reporting. They fail to directly reflect the structural economic tension between household income and the objective cost of acquiring a healthy diet, thus limiting their utility for cross-country policy formulation.

Another significant strand of literature has examined the nexus between food costs and dietary quality, forming the basis of nutritional economics. Studies by Darmon and Drewnowski (2008) and Drewnowski and Specter (2004) compellingly demonstrate that nutrient-dense foods tend to incur a significantly higher cost per calorie than energy-dense foods, thereby exacerbating inequalities for low-income households. This finding directly relates to the Capability Approach (Sen, 1999), where economic constraints compromise a household’s capability to achieve optimal nutritional functioning. Recent research reinforces this link, connecting rising food costs and reduced affordability to the risk of hidden malnutrition.

At the global and European levels, organizations like FAO (2023) and the World Bank (2020, 2023) report alarming figures, with billions unable to afford a healthy diet. In the European context, studies consistently highlight the persistence of East–West disparities where relatively higher food prices, combined with lower average incomes, generate

structural food vulnerability. In parallel, the literature emphasizes the critical role of social determinants – food infrastructure, distribution, and nutrition education (Loopstra and Tarasuk, 2013; Popkin, 2021) – in deepening these socioeconomic inequalities.

The general conclusion of this literature is that income, food prices, and nutritional access are interdependent variables, yet a methodological schism persists. Existing instruments fail to integrate the objective economic effort required for food acquisition into a single, standardized, and internationally comparable measure. It is precisely within this methodological and normative gap that the present article positions its contribution: the Food Effort Index (FEI). By combining the share of food expenditure with the relative price index, the FEI offers an innovative, objective methodological tool with both normative and practical value for assessing food inequality and informing evidence-based public policy.

3. Methodology

This study adopts a quantitative and comparative approach, grounded in the capability framework (Sen, 1999) and welfare economics (Stiglitz, 2012), with the objective of analyzing food budgetary pressure and nutritional inequalities within the European Union. To this end, an original composite indicator is proposed and applied – the Food Effort Index (FEI) – which correlates the share of household food expenditure with the relative level of food prices in each member state, benchmarked against the EU average (=100).

The mathematical formulation of the indicator is as follows:

$$FEI = [\text{Share of food expenditure (\%)} \times (100 - \text{Food Price Index, UE}=100)]/100$$

Through this formula, the FEI provides a synthetic and comparable measure of the economic tension generated by food costs, adjusted according to relative price levels (Loopstra & Tarasuk, 2013). A particular feature of its construction is that in countries where the food price index exceeds the threshold of 100, the indicator may take negative values. Rather than representing a methodological limitation, this outcome serves as an analytical signal, highlighting the additional burden imposed by food costs above the EU average and pointing to heightened economic vulnerability. Overall, the FEI enables a standardized assessment of economic food vulnerability and offers an integrated perspective on structural disparities in effective access to a balanced diet (FAO, 2023; Popkin, 2021).

The guiding research question asks how food budgetary pressure can be measured and classified across the European Union, and what Romania's position is within these structural inequalities. Building on this question, the analysis assumes that significant differences exist among member states in the level of budgetary effort devoted to food in relation to relative prices; that Romania faces a high level of structural food vulnerability despite food prices below the European average; and that the FEI constitutes a viable methodological instrument for comparative assessments of food equity and the design of corrective public policies.

The data used were drawn from official, internationally comparable sources. The share of food expenditure was taken from Eurostat's Household Budget Survey (2021–2024), while the relative food price index was extracted from Eurostat's Price Level Indices (2024). This analysis was supplemented with national data from INSSE (Average Monthly Household Expenditure, 2024), as well as additional indicators from FAO's Food Security Indicators (2023), the Friedrich Ebert Foundation (2024), and OurWorldInData (2024).

The analytical method consists in calculating the FEI for 20 European Union member states and classifying food vulnerability into four levels: very low ($FEI < 5$), low (FEI between 5 and 10), moderate (FEI between 10 and 15), and high ($FEI > 15$). The results are presented in both tabular and graphical form and are interpreted in light of East–West disparities and Romania's position within the broader European context. In addition, the FEI is correlated with disposable income levels and with data on the cost of an optimal food basket, in order to highlight the gap between economic accessibility and the nutritional quality of diets (FAO & WHO, 2023; Popkin & Reardon, 2018).

The methodology also incorporates a differentiated rural–urban analysis, integrating dimensions such as territorial equity, food infrastructure, and nutrition literacy (Quisumbing et al., 2015; Marmot, 2005). Methodological limitations of the indicator are also addressed, including the lack of qualitative measures of consumption and the absence of intra-household data. In this respect, the FEI is proposed as a complementary tool to other internationally established metrics such as the Food Insecurity Experience Scale (FIES), Diet Cost Metrics, and the Household Dietary Diversity Score (HDDS).

Overall, the FEI emerges as a robust, comparable, and applicable instrument for food policy analysis, with significant predictive and evaluative potential for integrated economic, nutritional, and social research.

4. Results

Responding to the need for a synthetic instrument capable of capturing the economic tension that food access places on households, this study introduces the *Food Effort Index (FEI)* – a composite indicator inspired by the *food effort ratio* (FAO, 2023), but methodologically recalibrated by integrating the food price index ($EU = 100$) and by employing a specific classification of vulnerability (high, moderate, low, very low). Its purpose is to provide a comparative, standardized, and operational measure of food budgetary pressure across European Union member states, sensitive to structural differences between disposable income levels and the relative cost of food.

In Romania, European data confirm an accentuated economic vulnerability: 24.8% of household budgets are allocated to food and non-alcoholic beverages, compared to the EU average of 14.3% (Eurostat, 2024). This indicator – the *food effort ratio* – directly reflects the risk of food poverty and the financial pressure experienced by consumers (FAO, 2023). In the literature, values exceeding the 20% threshold are associated with systemic

vulnerabilities (Reeves et al., 2021). Romania's figure of 24.8% therefore underscores the persistence of a structural tension in access to a balanced diet.

To situate this discrepancy within a broader European comparative framework, the following section presents a synthesis of the share of household food expenditure and the food price index across 20 EU member states.

Table 1. *Food Vulnerability Index in the European Union (2021–2024)*

No.	Country	Share of food expenditure (%)	Food price index (EU=100)	FEI	Classification
1	Bulgaria	20.1	70	6.030	Low vulnerability
2	Romania	24.8	76	5.952	Low vulnerability
3	Lithuania	20.4	77	4.692	Very low vulnerability
4	Poland	19.6	81	3.724	Very low vulnerability
5	Slovakia	19.6	83	3.332	Very low vulnerability
6	Hungary	19.5	85	2.925	Very low vulnerability
7	Czechia	16.0	90	1.600	Very low vulnerability
8	Greece	16.1	105	-0.805	Very low vulnerability
9	Italy	14.2	103	-0.426	Very low vulnerability
10	France	13.2	110	-1.320	Very low vulnerability
11	Spain	13.0	95	0.650	Very low vulnerability
12	Belgium	12.3	112	-1.476	Very low vulnerability
13	Germany	11.6	106	-0.696	Very low vulnerability
14	Sweden	11.3	109	-1.017	Very low vulnerability
15	Austria	10.9	108	-0.872	Very low vulnerability
16	Luxembourg	9.0	125	-2.250	Very low vulnerability
17	Netherlands	8.6	112	-1.032	Very low vulnerability
18	Ireland	8.3	118	-1.494	Very low vulnerability
19	Denmark	8.2	129	-2.378	Very low vulnerability
20	Finland	8.1	121	-1.701	Very low vulnerability

Source: Eurostat (2024); FAO (2023); authors' own calculations

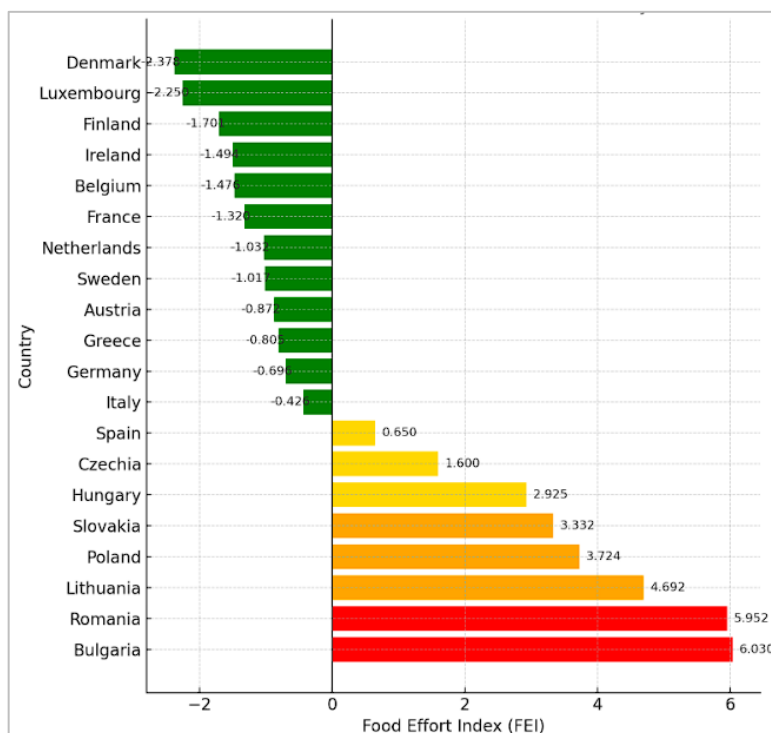
This quantitative synthesis provides a robust comparative perspective on the budgetary pressure exerted by food consumption within the European Union, allowing for the identification of structural patterns of economic vulnerability. The values of the *Food Effort Index* (FEI) do not simply reflect a mechanical relationship between expenditure and prices; rather, they highlight systemic imbalances between disposable income and the real capacity of households to access nutritionally adequate diets. In this regard, the FEI emerges as an essential diagnostic tool for food equity, with explanatory value for socioeconomic, nutritional, and public policy analyses.

In the absence of an official indicator directly correlating price incidence with the share of food expenditure, the *Food Effort Index (FEI)* provides an original methodological contribution. It enables a comparative assessment of food vulnerability, offering relevant applications not only for the analysis of nutritional equity and household resilience, but also for evaluating the effectiveness of public policies in the field of food security.

Food vulnerability was classified according to operational thresholds: very low (FEI < 5), low (5–10), moderate (10–15), and high (>15). In cases where the food price index exceeds the EU average, FEI values become negative. These have been categorized as “very low” since they express a reduced budgetary effort relative to expenditure share, but they also

reveal another dimension of vulnerability: high food costs limit accessibility even when the proportion of household expenditure remains small.

Figure 1. Food Effort Index (FEI) in the European Union (2024). Classification of structural food vulnerability based on the share of food expenditure and the food price index



Source: Eurostat (2024); FAO (2023); authors' own calculations

Nevertheless, the FEI is not without limitations. First, it does not capture dietary quality – such as nutrient distribution, nutritional density, or actual food value – which are critical factors for evaluating nutritional equity and hidden malnutrition. Second, it does not account for physical access barriers (*food deserts*), which are particularly prevalent in rural or peripheral areas (Loopstra & Tarasuk, 2013). The indicator also fails to reflect the intra-household distribution of food resources, thereby overlooking internal inequalities that disproportionately affect women, children, and the elderly (Quisumbing et al., 2015). Moreover, cultural, affective, or seasonal dimensions influencing food choices remain outside its scope.

For these reasons, the FEI should be used in conjunction with other internationally validated indicators, such as *Diet Cost Metrics*, the *Food Insecurity Experience Scale (FIES)*, or dietary diversity scores. Even with these limitations, its applied value is considerable, owing to its comparability, replicability, and operational design.

By construction, the FEI facilitates the diagnosis of food insecurity and nutritional poverty risks, the evaluation of public policy impacts (e.g., differentiated VAT, vouchers, targeted subsidies), and the monitoring of food equity levels across different territorial contexts. In

this way, the indicator addresses a pressing need: the quantification of real economic freedom of access to food, offering a robust benchmark for developing public policies aimed at food justice, social inclusion, and sustainability.

Table 1 synthesizes a set of significant structural discrepancies regarding household food budget effort across the European Union, based on the composite *Food Effort Index (FEI)*. This index correlates the share of household food expenditure with the relative level of food prices (EU = 100), thereby providing a standardized measure of the economic pressure associated with food access.

The data presented in Table 1 and Figure 1 highlight profound structural disparities among member states with respect to the level of structural food vulnerability, as quantified by the FEI. This composite indicator captures in an integrated manner the economic pressure exerted by food consumption on household budgets by correlating food expenditure shares with relative price levels benchmarked against the EU average (EU = 100).

The results outline a clear geographical polarization between Eastern and Western/Northern European countries, suggesting an unequal geography of economic access to food within the European Union. Bulgaria (FEI = 6.030) and Romania (FEI = 5.952) register the highest values, signaling a critical and persistent budgetary pressure on households despite relatively low food price levels (price indices of 70 and 76, respectively). This apparent contradiction underscores a troubling socio-economic reality: the very low level of disposable incomes cancels out the advantage of lower prices, exposing households to the risks of food poverty and hidden malnutrition. A systemic vulnerability thus emerges, in which the food budgetary burden becomes disproportionate relative to real consumption capacity.

At the opposite end of the spectrum, countries such as Finland, Denmark, Ireland, and the Netherlands, despite facing the highest food prices in the EU (indices between 115 and 129), record the lowest FEI values (below 0.8). These results reflect strong budgetary resilience and genuine economic freedom in food choice, supported by high income levels and a balanced expenditure structure in which food does not represent a significant budgetary constraint.

Between these extremes lies a group of countries with moderate vulnerability, such as Poland (FEI = 3.724), Slovakia (3.332), and Hungary (2.925). These economies in socio-economic transition exhibit intermediate levels of food pressure, where well-calibrated public policies – such as reduced VAT on food, support for low-income households, or targeted nutritional assistance programs – may play a decisive role in preventing a worsening of food insecurity.

The empirical analysis demonstrates that food vulnerability is a complex phenomenon that cannot be explained solely by absolute price levels. It results from an interaction of incomes, costs, consumption structures, and redistributive policies. In this context, the FEI proves to be a comparable and easily replicable tool, useful for monitoring food equity and evaluating the impact of public measures. Its applicability extends from macroeconomic analysis to targeted interventions, offering a quantifiable benchmark of real economic freedom of access to adequate nutrition.

In comparative terms, an East–West axis of food inequality becomes evident across the European Union, where the budgetary effort devoted to food reflects not only cultural preferences or consumption patterns but, more importantly, structural economic imbalances shaped by income distribution, effective access to nutritious products, and the efficiency of public policies. Within this framework, the *Food Effort Index (FEI)* emerges as a valuable analytical instrument, capable of quantifying real economic freedom of dietary choice, identifying systemic inequalities, and supporting the assessment of social equity and the performance of food protection policies in contemporary Europe.

In contrast, the experience of countries such as Mexico, the United States, and Brazil demonstrates that public policies oriented toward nutritional support can substantially reduce food budgetary pressure. Programs such as food vouchers, subsidies for minimal food baskets, or reduced VAT on staple foods cover a significant share of household expenditures on healthy products. The impact of these measures is not only economic but also nutritional: they reduce inequality in access to quality food, increase the consumption of fresh and nutrient-dense products, and contribute to the prevention of malnutrition-related diseases (FAO, 2023; WHO, 2022).

These examples illustrate the potential of well-calibrated interventions to mitigate structural vulnerabilities and provide a useful model for the European Union, where East–West disparities in food equity remain pronounced. Adapting such policies to the socio-economic specificities of each member state could represent a decisive step toward strengthening food security and social cohesion.

Although food prices in Romania are approximately 24% below the EU average, this apparent advantage is nullified by low purchasing power and income polarization, which amplifies the economic pressure on the food basket (INSSE, 2024). In 2023, average monthly expenditure on agri-food products reached 495 RON per person, with projections of 549 RON per person in Q4 2024 – an increase of more than 180% compared to 2014, in a context of stagnant real incomes in many households (OurWorldInData, 2024).

A breakdown by place of residence further accentuates structural disparities: in urban areas, food expenditure rose by 164%, from 239 RON per person in 2014 to 630 RON per person in 2024, while in rural areas the increase was even sharper – 219%, from 145 RON to 464 RON per person. This accelerated rise, particularly in rural regions, marks a profound transition from traditional food self-sufficiency to a greater dependence on the agri-food market, with direct implications for nutritional balance, household autonomy, and everyday economic vulnerability.

Beyond disposable income, physical accessibility also shapes the composition of the food basket. The concept of *food affordability* refers to the ratio between the cost of healthy food and available income, while the phenomenon of *food deserts* describes the absence of outlets offering fresh products in certain rural or peripheral areas (Loopstra & Tarasuk, 2013). In Romania, the lack of commercial infrastructure in many rural localities increases reliance on small neighborhood shops with limited assortments and higher prices, thereby exacerbating food vulnerability.

In this context, the minimum basket for a decent standard of living becomes an essential benchmark for assessing quality of life. According to the September 2024 update by the Friedrich Ebert Foundation, its value is estimated at 10,450 RON per month for a family of two adults and two children – an increase of 4.7% compared to the previous year. This normative basket encompasses not only food but also other essential components of a decent life: housing, health, education, recreation, and social protection (FES, 2024). By comparison, many Romanian households fall below this threshold, pointing to a structural gap between declared standards of well-being and actual economic realities.

The food basket thus acquires a dual significance: a functional one, by indicating real access to nutritious and diverse products, and a symbolic one, as an expression of the right to adequate food and of social participation through consumption.

Moreover, the analysis of the food basket must also take into account the internal distribution of resources within households. Recent research highlights the existence of intra-household inequalities in access to food, with a disproportionate impact on women, children, and the elderly (Quisumbing et al., 2015). Such internal discrepancies undermine the concept of food security at the individual level, even within households that appear to meet average consumption thresholds.

Price increases during the 2022–2024 period, exacerbated by energy crises and international market volatility, disproportionately affected vulnerable groups (FAO, 2023; World Bank, 2020). Food has increasingly become a differentiating good, reflecting socio-economic status and the ability to access healthy products.

In particular, the severe food inflation recorded between 2022 and 2024 – driven by energy crises, geopolitical tensions, and disruptions in global supply chains – has accentuated price volatility and exposed the fragility of the Romanian agri-food system. Being dependent on imports for strategic food categories, Romania faces systemic vulnerability in the absence of resilience policies and incentives for sustainable domestic production (World Bank, 2023).

At the same time, the analysis of physical consumption reveals a marked nutritional polarization: in urban areas, consumption of fruits, vegetables, dairy products, and eggs is on the rise, while in rural areas restrictive patterns persist, with nutritional deficiencies and unbalanced caloric substitutions. These discrepancies validate Engel's Law, which posits that the share of food expenditure decreases as incomes rise – an inverse relationship in Romania, where the persistently high share of food expenditure reflects the absence of real freedom of choice (Popkin & Reardon, 2018).

Findings from PwC Romania (2025) further indicate that in the current socio-economic context, Romanian consumers' purchasing decisions continue to be governed primarily by economic factors but are increasingly influenced by qualitative and axiological considerations. Price remains the dominant determinant, cited by 59% of respondents, followed by quality (51%) and promotions or discounts (45%). The importance of geographic proximity (34%) confirms the role of commercial infrastructure and territorial distribution in food accessibility, particularly in rural areas where diversity and frequency of supply are limited. Experiential and reputational dimensions, such as the shopping

experience (29%) and transparency regarding product origin and quality (24%), suggest a gradual transition from a strictly rational-economic behavior toward a more complex, multisectoral one, where perceived food security and symbolic satisfaction play an emerging role.

Beyond functional motivations, a significant share of consumers gravitate toward products with non-economic added value. Thus, 43% report choosing healthy and sustainable products more frequently, while 37% prefer local brands and producers, supporting proximity economies and reducing logistical footprints. The rise in online food purchases (35%), particularly in urban areas, confirms the global trend toward digitalization of food retail, while 29% of consumers appreciate brands engaged in social responsibility and ethical practices, and 25% align their choices with brand values and the overall consumer experience. This dual motivation – both functional and symbolic – aligns with FAO's observations on the emergence of the “hybrid” consumer, who integrates economic criteria with sustainable values, especially in urban contexts with medium and high incomes.

At the macroeconomic level, FAO (2023) reports indicate that Romania ranks among the European countries with the lowest food elasticity, which implies that any increase in prices exerts a disproportionate impact on consumption behavior and household well-being. In this context, food poverty emerges not only as a manifestation of material deprivation but also as a structural determinant of social exclusion and the erosion of human capital, with cumulative effects on educational performance, public health, and development sustainability (Marmot, 2005).

Data from PwC Romania (2025) confirm this structural vulnerability, showing that under conditions of persistent inflation and economic volatility, consumers adopt defensive strategies: 56% reduce the frequency of shopping, 48% constantly monitor promotions and discounts, and 41% substitute premium products with more affordable alternatives. Nevertheless, a resilient segment, representing 22% of respondents, remains willing to pay a higher price for products perceived as healthy, authentic, and sustainable. This polarization of consumption behavior reflects a significant rural–urban divide: urban households have the resources and access to integrate ethical and nutritional criteria into food choices, whereas rural households remain predominantly constrained by price and by the limitations of supply infrastructure.

In line with the *capability approach* (Sen, 1999), real freedom to choose a healthy diet requires not only affordable prices but also infrastructure, nutritional education, legal protection, and favorable environmental conditions. In the absence of these factors, the shopping basket becomes an expression of systemic constraint rather than informed preferences.

From this perspective, fiscal and commercial regulation plays a crucial role. Unlike other European states (France, Finland, Denmark), Romania does not apply a differentiated fiscal policy to encourage nutrient-dense products and discourage ultra-processed foods. The lack of supportive interventions – such as vouchers for healthy foods or zero VAT on fruits and vegetables – further perpetuates food inequities.

Against this background, a rethinking of public intervention in access to healthy food is required. International examples demonstrate that measures such as subsidizing the basic food basket (Mexico), providing vouchers for nutritious products (USA), or applying differentiated VAT based on nutritional density (France) can substantially reduce inequalities. Adapting these mechanisms in Romania would require an integrated, evidence-based approach that combines fiscal incentives, direct support for vulnerable households, and regulatory measures favoring sustainability.

According to the 2030 Agenda for Sustainable Development, the shopping basket is directly related to Goal 2 – Zero Hunger, Goal 10 – Reduced Inequalities, and Goal 12 – Responsible Consumption and Production, reflecting the interdependence between food security, social equity, and the sustainability of consumption models (UN, 2015). Thus, it becomes not only a tool for measuring consumption but also a mechanism for assessing economic justice, social equity, and food sustainability.

The shopping basket should reflect informed and diversified choices rather than economic constraints or systemic imbalances. When it becomes an expression of vulnerability and the absence of real options, it no longer signals individual preferences but rather the equity limits of the economic system and the fragility of social cohesion. Its analysis goes beyond simple statistics: it represents a window into social participation, food autonomy, and the effectiveness of public policies.

4.1. The real basket versus the optimal basket: between economic constraint and nutritional justice

In contemporary societies marked by economic polarization, food inflation, and nutritional precariousness, the structural gap between the real food basket – determined by socioeconomic constraints – and the optimal nutritional basket – defined by scientific recommendations – reflects a profound systemic tension between the declared right to adequate food and the effective possibility of exercising it. This opposition between the real and the optimal basket is anchored in its ultimate outcome: health. While the real basket is shaped by budgetary restrictions, cultural routines, and market availability, the optimal basket derives from validated standards designed to support public health and the prevention of non-communicable diseases.

According to FAO and WHO (2023), an optimal food basket requires dietary diversity, high nutritional density, a balanced intake of essential macronutrients and micronutrients, and regular consumption of fruits, vegetables, legumes, whole grains, dairy products, eggs, fish, and unsaturated fats. This dietary model is aligned with the Mediterranean and Planetary diets, both recognized as benchmarks for sustainable eating. By contrast, the real basket often reflects unbalanced consumption, dominated by ultra-processed, calorie-dense but nutrient-poor products, selected under the pressure of price and entrenched food routines.

Moreover, the optimal basket should also be evaluated through the lens of food sustainability, in line with Sustainable Development Goal 12 (*Responsible Consumption and Production*), promoting the selection of foods with low environmental footprints, local origin, and minimal impact on biodiversity (FAO, 2022).

In Romania, this discrepancy becomes evident in the context of a high share of food expenditure in household budgets – 24.8% in 2024, compared to the EU average of 14.3% – combined with low disposable income levels. The minimum consumption basket for a decent living, estimated by the Friedrich Ebert Foundation in 2024 at 10,450 RON per month for a family with two children, includes a food component that covers basic needs but is constructed more on the basis of caloric saturation than on nutritional quality or diversity. This difference is not merely statistical; it expresses a structural gap between the formal right to adequate food and the actual capacity to exercise it.

A direct comparison between the real and the optimal basket highlights not only a gap in food quality but also a systemic divide between what is accessible and what is recommended. In Romania, the real basket is composed of financially accessible but nutritionally poor products – such as white bread, processed meat, potatoes, and margarine – chosen primarily for their price–satiety ratio rather than for nutritional value. In contrast, the optimal basket consists of varied and balanced foods – vegetables, fruits, legumes, whole grains, fish, and dairy – at an estimated cost nearly twice as high: between 22 and 25 RON per day per person. This economic threshold generates not only barriers to access but also a form of food exclusion, in which healthy choices become a class privilege.

To synthesize these contrasts and highlight their multidimensional implications – nutritional, economic, legal, and sustainable – a comparative table between the two types of baskets is presented below:

Table 2. *The Real Food Consumption Basket vs. the Optimal Nutritional Basket – Structural Differences and Multidimensional Implications*

Analytical Criterion	Real Food Consumption Basket	Optimal Nutritional Basket
Dominant Composition	Ultra-processed, inexpensive, calorie-dense foods (white bread, margarine, processed meat, potatoes)	Whole and fresh foods: vegetables, fruits, legumes, dairy products, fish, whole grains, healthy fats
Nutritional Quality	Low: poor intake of fiber, vitamins, minerals, and essential fatty acids	High: optimal balance of macronutrients and micronutrients, increased nutritional density
Estimated Cost (Romania, 2024)	10–12 RON/day/person	22–25 RON/day/person
Economic Accessibility	High: foods chosen based on price and satiety	Low: inaccessible for households with below-average incomes
Health Impact	Negative: associated with increased risk of obesity, diabetes, cardiovascular diseases, and nutritional deficiencies	Positive: supports metabolic and cognitive health, reduces risk of non-communicable diseases
Food Sustainability	Low: reliance on products with high ecological footprint and intensive processing	High: selection of foods with low environmental impact and local origin
Determinants of Choices	Financial constraints, seasonal availability, routinized food habits	Scientific recommendations, nutritional education, ecological awareness
Legal Basis	Indirect reference: “minimum consumption basket for a decent living” (Law No. 174/2020)	International foundation: right to adequate food (Art. 11 ICESCR; FAO; WHO; EFSA Codex Alimentarius)
Social-Normative Function	Survival, avoidance of hunger, subsistence diet maintenance	Promotion of well-being, food equity, and sustainable health

Source: FAO; WHO; Friedrich-Ebert Stiftung; authors’ own calculations

At the global level, according to FAO (2023), the average cost of a healthy diet exceeded USD 4.5 per day per person, rendering it inaccessible for approximately 3.1 billion people – a reality that transforms the nutritional challenge into a global crisis of social and economic equity.

The literature has emphasized the impact of this divide on population health, educational performance, social cohesion, and economic productivity (Darmon & Drewnowski, 2008; Marmot, 2005). Chronic food insecurity does not merely imply nutritional deficiencies or caloric malnutrition; it also entails psychological exhaustion, social stigmatization, and the loss of food autonomy.

The normative reconstruction of the food basket requires moving beyond the restrictive paradigm of subsistence. The optimal basket must be defined not only by caloric values or isolated nutritional criteria but through an integrative approach that encompasses economic accessibility, sustainability, cultural diversity, and psycho-affective balance. It should reflect the right to adequate food, as recognized in the International Covenant on Economic, Social and Cultural Rights (Art. 11), and be supported by equitable, multisectoral food policies.

Although national legislation does not explicitly define the notion of an “optimal food basket,” Law No. 174/2020 refers to the minimum consumption basket for a decent living, which includes food as an essential element of a dignified life. However, this framework is not harmonized with WHO, FAO, or EFSA standards, making it necessary to establish an official “reference nutritional basket” that could serve as a foundation for social, fiscal, and educational policies.

In this regard, public policies should aim to redefine statistical indicators of food poverty in line with updated nutritional recommendations, while simultaneously ensuring financial support for access to the optimal basket through mechanisms such as food vouchers, targeted subsidies, and reduced VAT for nutrient-dense foods. Equally important is the integration of comprehensive food education that addresses not only the nutritional but also the affective and decision-making dimensions of consumption. Finally, these measures must be accompanied by the development of equitable distribution infrastructure, particularly in vulnerable and rural areas, in order to reduce territorial disparities and strengthen food equity.

In an equitable society, the shopping basket should not reflect the precariousness of resources but rather the state’s capacity to effectively guarantee the right to adequate, diverse, and sustainable food.

4.2. Territorial Food Inequality: The Rural vs. Urban Basket

Territorial disparities in the structure and quality of the food consumption basket reflect a critical dimension of nutritional equity and the effective realization of the right to adequate food. In Romania, as in many EU member states, the food basket differs significantly between rural and urban environments, not only in terms of value and composition but also with respect to physical accessibility, food diversity, nutritional density, and supporting infrastructure.

According to data published by INSSE (2024), rural households allocate a proportionally larger share of their budgets to food but have limited access to nutrient-dense products such as fresh fish, specialized dairy, exotic fruits, or organic products. This limitation is not merely economic but also logistical and educational.

By contrast, urban areas benefit from extensive infrastructure – supermarkets, central markets, delivery networks, and food education initiatives – that facilitate diverse options more closely aligned with the model of an optimal nutritional basket.

To deepen the analysis of territorial food inequalities in Romania, the following section presents a comparative overview of the structural characteristics of rural and urban food baskets.

Table 3. *Rural vs. Urban Food Basket: Comparative Characteristics (Romania, 2024)*

Analytical Criterion	Rural Areas	Urban Areas
Access to food infrastructure	Limited (mixed shops, occasional local markets)	Extensive (supermarkets, delivery services, central markets, specialized stores)
Dominant basket composition	Basic products (flour, potatoes, oil, processed meat) + self-supply	Diversified products, including organic, international, ready-to-eat
Food diversity	Low, dependent on seasonality and own production	High, including out-of-season products
Access to nutrient-dense foods	Low (logistical limitations, higher prices for specialized products)	High (including promotions, brand variety, sustainable alternatives)
Estimated intake of essential micronutrients (iron, calcium, vitamin C, omega-3)	Low – unbalanced intake, dominated by empty calories and frequent deficiencies	Moderate–high – greater variety, better intake of essential nutrients
Predominant dietary pattern	Hypercaloric–hypo-nutritional, focused on satiety and price	More nutritionally balanced, with options aligned with dietary guidelines
Estimated daily caloric value	2200–2500 kcal/person/day, but unbalanced	2000–2300 kcal/person/day, with more balanced structure
Dominant caloric structure	Carbohydrates 60–65% (mainly from flour-based products), fats 25–30%, proteins 10–12%	Carbohydrates 50–55%, fats 30%, proteins 15–18% – including varied and high-quality sources
Food education and information	Low (lack of targeted campaigns, poor access to information)	Present (media, social media, educational initiatives in retail and schools)
Average estimated basket cost	Lower, but less varied and nutritionally unbalanced	Higher, but closer to the optimal nutritional basket

Source: authors' own processing based on qualitative data and the specialized literature – FAO (2023); INSSE (2024); Darmon & Drewnowski (2008); Marmot (2005).

The discrepancies are also supported by quantitative data:

Table 4. *Territorial Food Inequalities in Romania (2024): Average Monthly Household Expenditure on Food, by Area of Residence*

Indicator	Urban (RON/household/month)	Rural (RON/household/month)	Relative difference urban vs. rural (%)
Total consumption expenditure	4,349.65	3,367.48	+29.1%
Expenditure on food and beverages consumed	1,401.60	1,263.60	+10.9%
Value of self-supplied consumption	314.59	308.28	+2.0%
Expenditure on purchased food products	1,087.26	955.30	+13.8%

Source: authors' own processing – INSSE, Average monthly household expenditures by categories and areas of residence, Statistical Yearbook of Romania (2024).

The evidence presented in Tables 3 and 4 highlights a systemic rural–urban divide in Romania that transcends the economic dimension and manifests profoundly in nutritional, social, and educational terms. These differences are not merely quantitative – reflected in monthly expenditures or the number of accessible products – but qualitative, involving disparities in food infrastructure, dietary diversity, nutritional information, and overall diet quality.

The extended comparative analysis (Table 3) underscores structural contrasts between rural and urban food baskets that go well beyond logistical and financial aspects. In rural areas, dietary patterns are predominantly hypercaloric yet hypo-nutritional, marked by reliance on energy-dense but nutrient-poor foods such as white bread, potatoes, processed meat, and margarine. Average daily caloric intake ranges between 2,200–2,500 kcal/person, but the macronutrient structure is unbalanced: carbohydrates account for 60–65% (primarily from flour-based staples), fats 25–30%, and proteins 10–12%. At the same time, frequent deficiencies are observed in key micronutrients such as iron, calcium, vitamin C, and omega-3 fatty acids – nutrients essential for maintaining metabolic and cognitive health, particularly among children and the elderly.

By contrast, the urban basket is characterized by greater dietary diversity and a closer alignment with optimal nutritional standards. Macronutrient distribution is more balanced (50–55% carbohydrates, 30% fats, 15–18% proteins), and the availability of healthier alternatives – including organic, vegetarian, or international options – offers households the possibility to approximate recommended dietary guidelines. Estimated caloric intake is relatively similar (2,000–2,300 kcal/person/day), but nutrient density is higher overall. Nevertheless, this relative advantage is strongly mediated by income and nutritional literacy, and remains out of reach for low-income urban households.

Nutritional education emerges as a significant differentiator. In rural settings, limited exposure to awareness campaigns, clear food labeling, and formal nutrition education means that choices are primarily driven by price and routine rather than nutritional value. In urban environments, consumers benefit more from media exposure, social media, and educational initiatives in schools and retail spaces, though this too is unevenly distributed – especially between central and peripheral neighborhoods.

The average estimated cost of the food basket further illustrates this duality. While lower in rural areas, it carries a high “nutritional cost” in the form of increased risk of hidden hunger and non-communicable diseases. In urban settings, higher costs can translate into more efficient nutritional outcomes, but only where education and real access to nutrient-dense foods are ensured.

At the same time, expenditures on purchased food are nearly 14% lower in rural areas, reflecting a dual constraint: a budgetary limitation (reduced purchasing capacity) combined with a logistical barrier (restricted access to diversified markets). This combination perpetuates an imbalanced dietary pattern dominated by cheap, calorie-dense, and nutritionally poor products. Consequently, the rural–urban divide extends beyond a mere difference in consumption behavior, taking the form of an institutionalized food inequality that undermines real access to adequate, healthy, and diverse diets.

This situation is further aggravated by structural factors, including the underdeveloped retail infrastructure in rural areas, the absence of short and sustainable supply chains, the lack of targeted information and educational programs, and higher prices for nutrient-dense products in isolated regions. Paradoxically, while rural households report lower overall expenditures, their “nutritional cost” is higher due to chronic exposure to hypercaloric and hypo-nutritional foods. This raises the risk of hidden hunger, non-communicable diseases, and territorial patterns of food exclusion.

A comprehensive interpretation of these discrepancies calls for a reconfiguration of food policies that go beyond poverty indicators or average consumption metrics to explicitly integrate the dimension of territorial equity. In this sense, the food basket becomes a genuine barometer of social justice and an instrument for monitoring economic rights, which must be recalibrated to account for geography, infrastructure, and local cultural capital.

Reducing this inequity requires expanding rural food infrastructure through mobile markets, cooperatives, and accessible retail units, as well as adapting fiscal policies to guarantee equitable access to nutrient-dense products – for instance, by applying reduced VAT rates in disadvantaged areas. In addition, targeted food vouchers and nutrition education programs tailored to the cultural and geographical specificities of rural communities could decisively contribute to narrowing the rural–urban gap. Without such measures, the difference between rural and urban food baskets will no longer be merely a matter of consumption, but rather the expression of a deeper and systemic form of food inequality. Reconstructing an equitable food basket must therefore take into account the territorial dimension of access to food, understood not only as an economic resource but as a fundamental right.

4.3. Projections on intended changes in household food expenditure

As illustrated in the following table, projections regarding intended changes in household spending on major food categories indicate a significant anticipated increase in products perceived as having higher nutritional and functional value. Fresh fruits and vegetables are expected to grow by +60% (compared to the CEE average of +51%), poultry by +44% (vs. +33%), dairy products by +43% (vs. +31%), and cereals by +40% (vs. +30%). In parallel, food supplements are projected to rise by +40%, reflecting a reorientation of consumer preferences toward nutritionally signaled products and perceived health benefits.

In contrast, sharp reductions are anticipated for ultra-processed snacks (–37%) and alcoholic beverages (–30%), suggesting a shift in demand toward nutritionally favorable products and a potential decline in low-value-added segments. From an economic and public policy perspective, these trends point not only to adjustments in the internal demand structure but also to strategic repositioning among producers and retailers: diversifying portfolios with certified and traceable products, expanding “fresh” and “health-oriented” segments, and adapting supply chains to support increasingly sophisticated consumer demand. Overall, these projected dynamics suggest a transition toward a nutritionally richer food model, with direct implications for agri-food sector competitiveness, food equity, and long-term economic sustainability.

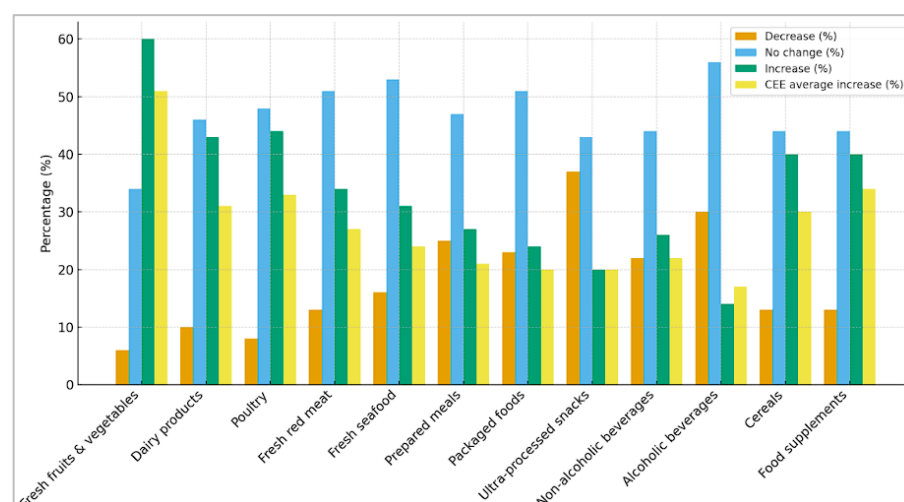
Table 5. *Projections on intended changes in household food expenditure by category, July–December 2025*

Food category	Decrease (%)	No change (%)	Increase (%)	CEE average – Increase (%)
Fresh fruits and vegetables	6	34	60	51
Dairy products	10	46	43	31
Poultry	8	48	44	33
Fresh red meat	13	51	34	27
Fresh seafood	16	53	31	24
Prepared meals	25	47	27	21
Packaged foods	23	51	24	20

Food category	Decrease (%)	No change (%)	Increase (%)	CEE average – Increase (%)
Predominantly ultra-processed snacks	37	43	20	20
Non-alcoholic beverages	22	44	26	22
Alcoholic beverages	30	56	14	17
Cereals	13	44	40	30
Food supplements	13	44	40	34

Source: PwC (2025), authors' own calculations

Figure 5. Projections of intended changes in expenditures for different food categories, July–December 2025

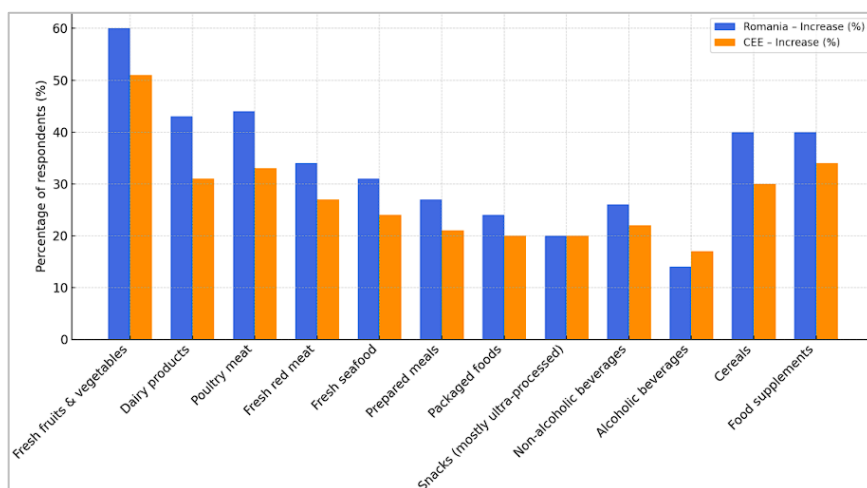


Source: PwC, 2025, own processing

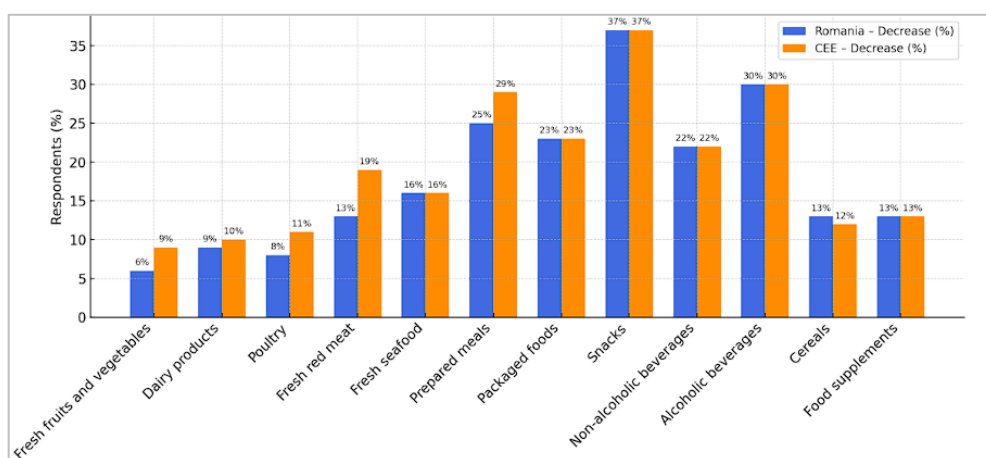
The data presented in Table 5 and Figure 5 highlight clear directions in the reconfiguration of budget allocation for different food categories, with a marked shift toward fresh and functional products, to the detriment of ultra-processed ones. These changes cannot be analyzed in isolation but must be considered in relation to the structural differences between urban and rural settings.

At the same time, disparities in accessibility and purchasing power between urban and rural households may intensify the polarization of consumption behavior, reinforcing the tendency of urban households to integrate premium and sustainable products, while rural households remain constrained by price and availability. Thus, these projections reflect not only individual preferences but also outline strategic directions for economic, commercial, and public health interventions.

From a demand-segmentation perspective, the urban–rural polarization is likely to deepen: urban households, more exposed to “health & sustainability premium” influences, will allocate additional food budgets toward certified products with traceability and health benefits; by contrast, rural households, limited by price and accessibility, will experience a slower transition toward these segments. For the FMCG sector, these dynamics create strategic opportunities to optimize the nutritional profile of products, develop ready-to-eat meals with higher nutritional value, and reposition the product offering based on perceived quality, authenticity, and sustainability.

Figure 6. Projected expenditure growth by food category, July–December 2025 – Romania vs. CEE comparison

Source: PwC, 2025; own processing

Figure 7. Projections of expenditure decrease by food category, July–December 2025 – Romania vs. CEE

Source: PwC, 2025; own processing

The analysis of data from the *PwC European Consumer Insights Pulse Survey – Central and Eastern Europe dataset (2025)*, combined with statistics on the average structure of the food basket published by Eurostat and the National Institute of Statistics, highlights clear differences between Romania and the CEE average in terms of consumption orientations for the next six months.

In the growth projections (Figure 6), Romania exceeds the CEE average across all core categories: fresh fruit and vegetables (60% vs. 51%, +9 pp), dairy products (43% vs. 31%, +12 pp), and cereals (39% vs. 25%, +14 pp). Together, these three categories account for over 46% of the value share of the average Romanian food basket, compared with 39% in

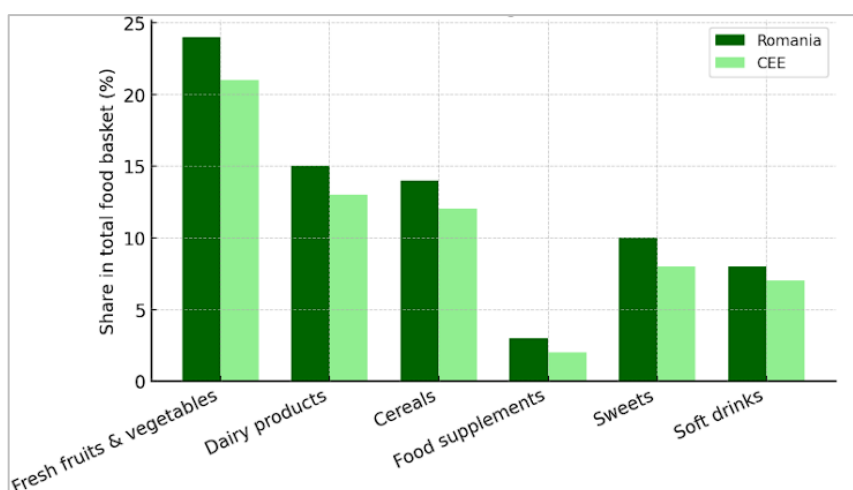
the CEE. This overweight share explains both the heightened sensitivity of Romanian consumers to price fluctuations in these segments and their tendency to prioritize them over other expenditures. The projected increase for dietary supplements (+6 pp compared with CEE) is linked to the expansion of the functional foods segment, also reflected in retail data, particularly amid rising awareness of disease prevention and dietary optimization.

In the decrease projections (Figure 7), Romanians and the CEE average converge in reducing spending on discretionary products (snacks – 37%; soft drinks – 22%). However, Romania reports more moderate decreases for fresh fruit and vegetables (–4 pp compared with CEE) and dairy products (–1 pp), indicating that these products remain budget anchors even in the context of financial adjustments. Structurally, these categories are inelastic to consumption decline due to their essential character and their significant weight in the daily diet.

The average structure of food expenditures shows that in Romania, the share of basic products (cereals, dairy, fruit, and vegetables) is 7–10 pp higher than in CEE, while the share of premium or discretionary categories (gourmet, ready-to-eat products, soft drinks) is lower. This profile explains why Romanian consumers' growth intentions are concentrated on essential foods and why these segments are less affected by intentions to reduce spending. Indirectly, this structure suggests food resilience based on staple products, but also vulnerability to price shocks in agri-food markets, given the heavy reliance on these items.

For retailers, these data indicate the opportunity to strengthen supply chains and optimize promotional offers for essential segments, while simultaneously innovating in the area of functional and health-oriented products. For policymakers, the results justify the development of public policies aimed at reducing price volatility for staple foods, stimulating sustainable local production, and supporting balanced consumption through nutritional education campaigns.

Figure 8. Comparative structure of the average food basket in Romania and CEE (2025)



Source: PwC, 2025, own processing

The chart compares the share of key food product categories in the total average food basket for Romania and the Central and Eastern European (CEE) average. The results show a stronger orientation of Romanian consumers toward fresh fruits and vegetables (+3.1 pp compared to the CEE average), dairy products (+1.9 pp), and sweets (+1.7 pp), suggesting both cultural preferences and potential differences in product availability. In contrast, the CEE average displays relatively higher shares for cereals and soft drinks, while differences in food supplements are minimal. These variations can be explained by factors such as disposable income, price structures, dietary traditions, and regional trade policies.

Overall, the results indicate not only shifting preferences but also a structural realignment of the food market, with direct implications for public policies, commercial strategies, and social cohesion.

4. Conclusions

In a context where economic, food, and social crises overlap, the food consumption basket can no longer be regarded as a simple statistical benchmark. It becomes a key lens for understanding structural inequalities, the fairness of resource distribution, and the real freedom of food choice. In this logic, the Food Effort Index (FEI) introduces an original methodological approach, quantifying the budgetary pressure of food by correlating the share of household expenditure with relative price levels (European Commission, 2020; FAO, 2023).

For Romania, the analysis highlights three central aspects. First, the country ranks second among the 20 states analyzed, with FEI = 5.952, immediately after Bulgaria (6.030). This positioning shows that, although food prices are lower than the European average, reduced incomes cancel out this advantage, exposing households to disproportionate budgetary pressure. Second, a clear gap emerges between the real consumption basket and the optimal nutritional basket: what is affordable does not coincide with what is recommended for a healthy diet. Third, territorial disparities, especially between rural and urban areas, generate unbalanced dietary patterns, with hypercaloric and low-nutrient foods predominating in vulnerable communities, thereby amplifying the risk of hidden malnutrition. To this is added a “psychological cost” associated with food insecurity – stress, anxiety, and reduced quality of life – felt most acutely by women and single parents (Tarasuk et al., 2023; Public Health Nutrition, 2024).

An important merit of the FEI is that it goes beyond traditional indicators (Engel ratio, FIES), offering a comparative, reproducible, and policy-adaptable measure. International examples (Mexico, USA, Brazil) show that measures such as food vouchers, differentiated VAT, or targeted subsidies can reduce budgetary pressure and nutritional inequalities (WHO, 2022). Romania could benefit from similar policies, centered on a “nutritional reference basket”, the development of rural food infrastructure, and tailored food education programs.

More than just a measurement tool, the food basket must be understood as an instrument of public governance and social justice. This interpretation aligns with the view that food

policies should integrate, alongside economic and nutritional dimensions, the emotional aspects of purchasing decisions – supporting consumers through reflexive tools that enhance, rather than restrict, their freedom (Maloş, 2016). Moreover, recent research highlights that the meat and dairy industries remain essential pillars of national food resilience, requiring investments to safeguard fundamental products such as milk across the life course (Maloş & Maloş, 2022a; 2022b).

In sum, the FEI proves to be a comparable and replicable indicator with transnational value, capable of guiding food policies toward equity, inclusion, and sustainability. Perhaps the most important conclusion is that the careful assessment of “food budgetary effort” is not merely a technical calculation but a necessary step toward building a fairer, more resilient, and more responsive food architecture aligned with the real needs of the population.

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The Legal Dimension of the Minimum Consumption Basket: Towards an Integrated Regulation of Emotional and Nutritional Consumption

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Abstract. *This paper proposes a normative reconceptualization of consumer protection in the food sector through the introduction of an innovative instrument – the emotional-informative label – inspired by the paradigm of behavioral law & economics (Sunstein & Thaler, 2008). Unlike traditional approaches focused primarily on informational transparency and nutritional safety, the study advocates for an expanded legal framework that integrates the affective, symbolic, and behavioral dimensions of consumer decision-making. The proposed label functions as a non-coercive mechanism, complementary to conventional nutritional labeling, designed to signal the degree of affective appeal, symbolic function, and risk of compulsive consumption associated with certain ultra-processed products. Grounded in a theoretical-normative analysis, the paper aligns European and national legal regulations with scientific evidence on emotional and symbolic influences shaping food behavior. The findings support the need for a soft legal nudge intervention aimed at protecting vulnerable consumers against persuasive commercial strategies, thereby fostering more conscious, equitable, and sustainable consumption. This proposal is consistent with SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production) and contributes to a reflexive governance framework in the food domain.*

Keywords: consumer protection; emotional-informative labeling; affective decision-making; food law; behavioral neuroscience; nutritional inequality.

JEL Classification: I18; K23; D91; Q18.

1. Introduction

In Romania, the analysis of the food sector reveals a series of structural imbalances that affect not only population access to healthy nutrition but also the quality of decision-making in the act of purchasing. Although supply chains have shown a degree of resilience in the face of recent crises, end consumers remain exposed to intense commercial pressures, particularly in the case of ultra-processed foods, where marketing strategies tend to privilege emotion over rationality (Monteiro et al., 2019; Popkin, 2021). These pressures go beyond price or product availability, directly interfering with the consumer's decision-making architecture through a combination of affective stimuli, sensory design, and amplified symbolic messages (Belk, 1988; Knutson et al., 2007).

Within this context, the literature highlights a pronounced transition from the rational consumer model toward an affective paradigm, in which decisions are increasingly shaped by emotional impulses, symbolic contexts, and unconscious mechanisms of value attribution (Mick & DeMoss, 1990; Sunstein, 2020). This gap between actual consumption behavior and the normative assumptions of the current legal framework becomes problematic, as both European and national legislation continue to operate under the presumption of informed, rational choice, disregarding the complexity of decisions in the face of products heavily promoted through emotional appeals (Thaler & Sunstein, 2008).

Building on this dissonance, the present article proposes a reformulation of public policies in the food sector by integrating the affective dimension into regulation. Specifically, it advances the idea of introducing an emotional-informative label, complementary to traditional nutritional labeling, that reflexively signals the degree of affective appeal, symbolic function, and potential for compulsive consumption associated with certain ultra-processed products. This label is not intended as a coercive instrument but rather as a normative nudge mechanism, designed to guide consumer choice in ways adapted to current cognitive and emotional realities (Sunstein, 2020; Thaler & Sunstein, 2008).

The article thus seeks to establish, within an interdisciplinary framework, the necessity of an innovative legal intervention addressing the affective vulnerabilities of the modern consumer. The guiding research question is: Can the current normative framework be expanded through a soft legal instrument capable of signaling not only nutritional risks but also the affective and symbolic dimensions of food consumption? The working hypothesis is that the emotional-informative label can contribute to rebalancing consumption choices through an assisted self-regulation mechanism that respects freedom of choice while nudging it toward more conscious, equitable, and sustainable behaviors (Monteiro et al., 2019; FAO, 2022). The main objective of this study is to argue, on the basis of scholarly literature and consumer law principles, the feasibility of such an intervention, illustrating its normative potential and its relevance for public health policies.

2. Literature Review

The normative foundations of this proposal build upon the behavioral approach to individual decision-making, developed within the paradigm of behavioral law & economics. In this perspective, individuals do not act as perfectly rational agents; rather,

their choices are shaped by affective impulses, cognitive biases, and symbolic meanings, often exploited by modern marketing strategies (Sunstein & Thaler, 2008; Loewenstein et al., 2001). From this standpoint, traditional regulatory frameworks – based exclusively on informational transparency – prove insufficient to address the complexity of consumer decision-making.

Decision neuroscience has demonstrated that visual and affective stimuli activated by appealing packaging or persuasive advertising trigger neural circuits associated with reward anticipation, particularly in the case of highly processed food products (Knutson et al., 2007). These mechanisms elicit emotional responses that bypass rational deliberation, encouraging unhealthy, impulsive, or even compulsive choices, especially among vulnerable consumers.

In parallel, consumer psychology has shown that food is not merely perceived as a source of nutrients but also as an object imbued with affective, symbolic, and social value (Belk, 1988; Hill et al., 2016). Colorful packaging, emotional slogans, and strategic product placement in supermarkets reinforce this effect, fostering an attraction that outweighs actual nutritional value. This dynamic is particularly evident in ultra-processed foods, characterized by high energy density, low cost, and intensified sensory presentation (Monteiro et al., 2019).

Recent legal scholarship has begun to explore alternative regulatory responses, including soft interventions (nudges) and reflexive mechanisms of consumer protection. Both the OECD (2022) and the European Commission have incorporated into their nutritional governance strategies concepts such as food equity, the protection of vulnerable consumers, and the use of behavioral data in public policy design. Within this framework, the emotional-informative label emerges as an innovative normative instrument, inspired by research on decision architecture and the need to counteract affective commercial influences on purchasing behavior.

Taken together, the interdisciplinary literature converges on the idea that consumer protection must extend beyond nutritional information to include the affective, symbolic, and contextual dimensions of food choice. This article contributes to this evolving discourse by advancing a theoretical and normative framework for a new form of labeling, one that is better adapted to current market realities and the behavioral vulnerabilities of consumers.

3. Methodology

Given the emergent and profoundly interdisciplinary character of the proposal – the introduction of the emotional-informative label – the methodology adopted is theoretical-normative and argumentative, characteristic of conceptual review research anchored in law, behavioral sciences, and public health policy. The analysis is not based on applied quantitative data but on the articulation of a complex interpretive framework, intended to reconceptualize classical legal concepts in light of new evidence regarding affectively induced decisional vulnerability. The method consists of a systematic and integrated analysis of the European and national regulatory framework on food labeling (e.g., EU Regulation No. 1169/2011), correlated with empirical evidence from decision psychology

and consumer neuroscience (Knutson et al., 2007; Harris et al., 2020), which demonstrates the affective influence on food choices. This empirical anchoring is complemented by a legal interpretation through the lens of behavioral law & economics (Sunstein & Thaler, 2008), which justifies the need for a soft normative nudge intervention, designed to protect consumers from affective distortions without restricting freedom of choice. This approach allows for the construction of an innovative research direction, aligned with the emerging literature on differentiated consumer protection and reflexive regulation in the food domain.

The inquiry is guided by the central research question: to what extent can a soft normative intervention, such as the emotional-informative label, contribute to consumer protection against affective distortions of food-related decisions without restricting freedom of choice, and what legal justifications support its introduction? Around this question, a series of theoretical hypotheses are formulated: purchasing decisions are significantly shaped by emotional stimuli; the current legal framework is insufficient to counteract such influences; reflexive nudge-type interventions can restore decision-making balance; and such interventions can be legitimized under the right to health, the precautionary principle, and the protection of vulnerable consumers.

The method applied consists of a systematic and integrated analysis of the European and national regulatory framework on food labeling (e.g., EU Regulation No. 1169/2011, Romanian Government Ordinance No. 21/1992, and Law No. 363/2007), correlated with empirical evidence from decision psychology and consumer neuroscience, which demonstrate the affective influence on food choices (Knutson et al., 2007; Grunert et al., 2021; Harris et al., 2020). This empirical anchoring is complemented by a legal interpretation through the lens of behavioral law & economics, drawing on the theoretical contributions of Sunstein and Thaler (2008), Loewenstein et al. (2001), and regulatory guidelines issued by the OECD (2022) and WHO (2020).

The proposed label is presented conceptually, accompanied by graphic suggestions inspired by established models such as Nutri-Score or visual warnings used in the alcohol and tobacco sectors. Although the article does not provide an experimental validation, potential avenues for future testing are described, including controlled exposure to labeling, psychometric studies on comprehensibility and affective impact, survey-based assessments, focus groups, and sales data analysis before and after implementation.

This approach allows for the construction of an innovative research direction in which regulatory tools become more attuned to the complexity of food decision-making and more responsive to the cognitive and emotional realities of contemporary consumers. The study thus aligns with the emerging literature on differentiated consumer protection and supports the integration of reflexive regulation into food policy as a means of balancing individual freedom with the social responsibility of the state (Alemanno & Sibony, 2015; WHO, 2021).

4. Results

The findings of the legal and behavioral analysis reveal a profound dissonance between the normative assumptions embedded in current legislation and the psychological reality of food consumption decisions. Both European and national frameworks, built on the

paradigm of informational rationality (cf. EU Regulation No. 1169/2011), rest on the premise that an informed consumer is, by definition, a protected consumer. However, scholarly evidence challenges this premise, showing that food choices are frequently shaped by emotional factors, sensory stimuli, and cognitive fatigue, all of which undermine genuine autonomy of choice (Knutson et al., 2007; Hill et al., 2016; Bublitz & Peracchio, 2015).

This discrepancy is particularly visible in the case of ultra-processed foods, which are intensively promoted through symbolic marketing campaigns and strategically placed within retail spaces. Such products trigger neurological reward responses and foster affect-driven overconsumption, especially among vulnerable groups. In this context, legal protection based solely on informational disclosure proves insufficient and inadequate to counter systematic and deliberate emotional influences (Stuckler & Nestle, 2012; Harris et al., 2020).

Another major finding is the identification of a regulatory gap concerning food products with compulsive behavioral potential. While alcohol and tobacco are subject to special legal regimes – including explicit warnings and symbolic restrictions (Babor et al., 2010) – high-hedonic-density foods, despite their comparable public health consequences, are not subject to any intermediate form of behavioral signaling. This omission produces a normative imbalance that disproportionately affects those more susceptible to emotional influence or living in conditions of social vulnerability.

The emotional-informative label proposed in this study addresses this unregulated need through a reflexive mechanism of behavioral signaling. It does not function as a prohibition but rather as a soft regulatory tool designed to guide decisions in a supportive manner without limiting available options. This approach aligns with the behavioral law & economics paradigm (Sunstein, 2021), where interventions are designed not to replace rationality but to sustain it under distorted decision-making conditions. The aim is to introduce a visual cue that signals a product's affective influence potential and facilitates emotional self-regulation at the point of choice.

To illustrate the practical potential, a hypothetical example can be drawn from a popular product category – chocolate bars or ultra-processed snacks placed near checkout counters. An emotional-informative label on such products might feature a simple visual symbol, such as a “behavioral alert,” accompanied by a message such as: “This product activates emotional reward mechanisms. Choose consciously.” Such a message does not discourage purchase but invites consumers to reflect on the impulse driving their decision, transforming the act of buying into a conscious and self-regulated behavior.

Accordingly, the contribution of this article lies not only in identifying a regulatory gap but also in formulating an innovative solution, conceptually supported and inspired by models already tested in other public health domains. While the implementation of such a label in Romania would require additional perception and comprehensibility studies, the existing theoretical framework fully justifies exploration of this regulatory direction. Public policies should thus become more attuned to the emotional realities of consumption and more capable of balancing freedom of choice with protective responsibility.

This normative inadequacy – between the realities of consumption decisions and the traditional assumptions of consumer law – amounts to a form of structural injustice, where protection remains illusory and consumers are left exposed to choices subtly yet profoundly shaped by sophisticated commercial techniques. The concept of decisional autonomy, foundational to classical consumer protection law, is called into question by the practical realities of contemporary retail spaces. As Sunstein and Thaler (2008) emphasized, choices are not made in a cognitive vacuum but within an “architecture of choice” – a system of constraints and subtle stimuli that significantly shape final outcomes.

In modern retail, this architecture is deliberately designed to encourage rapid, impulsive, and affect-driven choices, often at the expense of deliberate and rational ones. Products with high hedonic value – particularly ultra-processed foods – are strategically placed, attractively packaged, and accompanied by emotionally charged advertising. These elements function as behavioral triggers, activating automatic responses rather than conscious evaluations. As a result, purchasing decisions are frequently preconditioned by extra-informational factors, and traditional informational mechanisms, even when formally respected, no longer fulfill their intended protective function.

Vulnerability is heightened in the case of social groups with limited educational, cognitive, and emotional resources: low-income individuals, children, and persons under stress or cognitive overload. In these situations, decision fatigue, overstimulation, and lack of real alternatives turn autonomy of choice into a normative fiction.

According to Article 9(1) of Regulation (EU) No. 1169/2011 on the provision of food information to consumers, food labeling must include, subject to the exceptions provided therein, the following mandatory particulars: the name of the food; the list of ingredients; any ingredient or processing aid listed in Annex II, or derived from substances causing allergies or intolerances, present in the final product even in a modified form; the quantity of certain ingredients or categories of ingredients; the net quantity of the product; the date of minimum durability or the ‘use by’ date; any special storage or use conditions; the name or business name and address of the food business operator referred to in Article 8(1); the country of origin or place of provenance where required under Article 26; instructions for use where their absence would make it difficult to use the food appropriately; for beverages containing more than 1.2% alcohol by volume, the actual alcoholic strength; and the nutrition declaration.

While this labeling framework is valuable in ensuring transparency, it completely ignores the behavioral and emotional dimensions of consumption. In a market where marketing strategies are increasingly personalized and affectively oriented, the absence of counterbalancing measures – such as warnings on affective impact – results in a protection that is formal but ineffective (Bublitz & Peracchio, 2015; Harris et al., 2020).

Within the current legal architecture, differentiated regulation has traditionally been reserved for products with evident physiological risks: tobacco, alcohol, medicines, or psychoactive substances. These categories are subject to special regimes involving explicit warnings, restrictive advertising, and mandatory labeling, justified by their addictive potential and harmful public health effects.

Paradoxically, ultra-processed foods – often high in added sugars, saturated fats, salt, and additives with strong hedonic potential – continue to be regulated as conventional products, despite mounting scientific evidence linking them to obesity, type 2 diabetes, and other metabolic diseases (Stuckler & Nestle, 2012). Yet this substantial body of evidence has not translated into differentiated regulation.

Beyond their physiological impact, consumption behaviors associated with such foods are frequently driven by complex affective mechanisms: purchases are often unplanned, compulsive, or triggered by stress, decision fatigue, or emotional imbalance. In these contexts, ultra-processed foods function less as sources of nutrition and more as tools of affective self-regulation.

The absence of behavioral warnings or differentiated legal treatment not only perpetuates a regulatory gap but also deepens the dissonance between the documented psycho-behavioral reality of consumption and the rationalist assumptions underpinning current consumer law.

This omission produces a regulatory void: between basic foods (e.g., bread, milk, vegetables) and products with explicit physiological risks (alcohol, tobacco), there is no intermediate legal category for foods with significant affective and behavioral risks. In the absence of such a classification, legislation treats equally foods with genuine nutritional functions and those with strong hedonic appeal, thereby reinforcing structural inequality in consumption.

This inequality is particularly troubling because it disproportionately affects vulnerable consumers – low-income groups, children, adolescents, and individuals experiencing emotional distress or lacking social support. Precisely those who would most benefit from increased behavioral guidance and warnings are the most exposed to hyper-marketing, affective packaging, and strategic placement of ultra-processed products.

Thus, the lack of differentiated regulation based on the affective and compulsive potential of foods generates not only a normative imbalance but also a latent form of food injustice. The state, by failing to provide protection adapted to the real degree of vulnerability and behavioral risk, effectively leaves consumers alone in the face of a hyper-competitive and symbolically charged food industry.

To address the informational and affective imbalances highlighted in current food regulations, we propose a behavioral regulatory instrument – the emotional-informative label. This type of labeling, designed as a complement to traditional nutritional labels, signals the affective and symbolic potential of food products, thereby fostering a more reflexive and conscious decision-making framework.

Inspired both by the successful models of nutritional labeling (such as Nutri-Score) and by the differentiated regimes applicable to high-risk products (tobacco, alcohol), the proposed label operates as a normative nudge (Thaler & Sunstein, 2008). It is non-coercive and primarily orientative, supporting consumers in emotional self-regulation and in avoiding compulsive patterns of consumption.

Such an instrument aligns with the category of smart regulation tools promoted by the European Commission under the Better Regulation agenda (Better Regulation Toolbox,

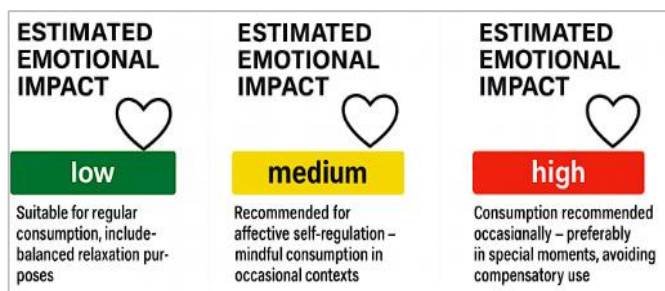
2021). It introduces a discreet form of behavioral guidance, which does not restrict freedom of choice but instead provides consumers with additional cues regarding the affective potential of food products.

The proposed label is structured along four integrated dimensions. First, the estimated level of affective attractiveness is presented on an intuitive scale (low, moderate, high), indicating the degree to which a product may activate emotional triggers in decision-making. Second, the symbolic behavioral function highlights the type of affective consumption linked to the product, such as “indulgence food,” “identity marker,” or “emotional substitute.” Third, a contextual recommendation for consumption is included, expressed in non-coercive, reflexive language – for example, “consume mindfully” – to stimulate self-reflection during the purchasing act. Finally, the label incorporates a standardized pictogram (e.g., a heart, theatrical mask, or balance sign), designed as an immediately recognizable affective signal to enhance rapid consumer understanding.

Overall, the emotional-informative label acts as a reflexive regulatory tool, designed to rebalance purchasing decisions by integrating the affective dimension of contemporary food consumption. The goal is not to limit consumer choice but to provide an additional decision anchor that aligns with the psychological and emotional realities of everyday food choices.

International studies support the effectiveness of such interventions. For instance, research by Graham et al. (2019) and Grunert et al. (2021) demonstrates that visual labels, particularly front-of-pack formats, increase consumer attention to both nutritional and affective information, thereby facilitating more balanced food choices. To illustrate the applicability of this proposal, we present below a series of prototype graphic models developed on the principles of affective signaling and visual comprehensibility.

Figure 1. *Prototype of emotional-informative labels differentiated by three levels of estimated affective impact: low, medium, high.*



Source: Author's own elaboration

Figure 1 illustrates a prototype of emotional-informative labels differentiated across three levels of estimated affective impact: low, medium, and high. These labels are designed as front-of-pack visual signals, intended to communicate quickly and intuitively the affective potential of a food product, independent of its nutritional value or caloric content.

The model is grounded in the dual-process framework of decision-making (impulsive vs. reflective processing), specific to contemporary behavioral theories, and proposes an

orientative tool in the form of a “normative nudge” (Thaler & Sunstein, 2008), aimed at rebalancing the consumer’s decision-making process in the face of emotional stimuli embedded in food marketing practices.

The degree of affective impact is estimated according to the product’s capacity to trigger automatic emotional reactions, likely to generate unintended, compulsive, or hedonic consumption behaviors. Therefore, these labels do not indicate direct toxic-nutritional risks but rather signal latent behavioral risks associated with overexposure to affective stimuli and with individual decisional vulnerabilities.

From a normative perspective, the proposed intervention falls within the paradigm of reflexive regulation, being conceived as a soft law measure, with voluntary and gradual applicability. This approach is fully compatible with the instruments promoted within the European Commission’s Better Regulation Toolbox (2021) and responds to the need for adaptive regulation, appropriate to the affective-commercial context of the contemporary food market.

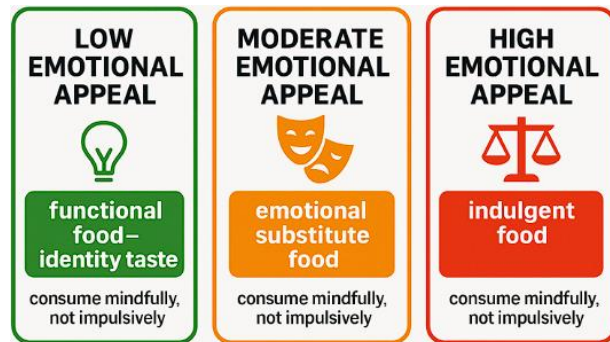
In order to integrate the affective dimension into a coherent regulatory framework, it is necessary to distinguish between the emotional intensity generated by a food product and the symbolic-behavioral function it fulfills within the consumer’s decision architecture. Such a distinction makes it possible to move beyond a one-dimensional evaluation of affective risk, opening the way toward a contextual classification of products based on their ritualistic, compensatory, or identity-related roles. Within this framework, the emotional-informative label acquires a dual function – preventive and reflexive – through which it not only warns against emotional reactions but also renders intelligible the meaning of consumption.

This need for normative recalibration becomes even more pressing in the age of accelerated digitalization of food behavior, where choices no longer occur exclusively in physical spaces but are deeply shaped by delivery platforms, mobile applications, and algorithmic interfaces that personalize the consumption experience. These systems not only mediate the act of purchasing but also affectively shape it, through hyper-personalized suggestions, sensory design, and selection filters based on implicit emotional profiles. As a result, food products become entities with narrative identities, symbolically codified and algorithmically adapted to the consumer’s affective vulnerabilities. In this context, the risk of compulsive consumption is amplified, while decisional autonomy becomes increasingly vulnerable to subtle yet recurrent stimuli.

To address these transformations, the emotional-informative label must be reconfigured as a mechanism of digital signaling – integrable into e-commerce platforms, delivery applications, or food search engines – through which the affective potential of the product is communicated in real time. This digital extension of the normative function contributes to shaping an emerging form of algorithmic fairness, whereby consumers are supported in making more conscious choices within a commercial space that is profoundly symbolic, personalized, and automated.

On the basis of this initial stratification of affective risk, it becomes relevant to extend the model functionally so as to also include the symbolic-behavioral dimension of food decision-making.

Figure 2. *Prototype of emotional-informative labels differentiated across three levels of estimated affective impact: functional food–identity taste, affective substitute food, indulgence food.*



Source: Author's own elaboration

Figure 2 presents an extended prototype of emotional-informative labels, designed not only on the basis of the estimated level of affective attractiveness but also according to the symbolic and behavioral role of the food item within the consumption decision. This tripartite model introduces an affective-behavioral taxonomy structured into three distinct categories: functional food–identity taste, affective substitute food, and indulgence food.

This conceptual differentiation allows for a more precise operationalization of the emotional risk associated with food consumption, offering a framework applicable both to responsible marketing strategies and to the development of public health regulations. Functional foods and those corresponding to an identity taste are products that evoke cultural familiarity or satisfy well-defined physiological needs without involving strong affective stimulation. Although they may generate positive emotional attachments or acquire symbolic meanings in the social context of consumption, they do not act as triggers of compulsive eating and therefore present a low behavioral risk.

By contrast, affective substitute foods define an intermediate category with compensatory potential in the face of emotional discomfort, daily stress, or the absence of affective gratifications. These products are often used for short-term emotional self-regulation and involve a moderate risk, particularly when consumers lack awareness of the relationship between their affective states and eating behaviors.

The third category, indulgence foods, includes products with a high emotional load, heavily advertised and symbolically valorized, which often stimulate hedonic, impulsive, or self-rewarding consumption decisions. Such products are most frequently associated with behavioral vulnerabilities and with an increased risk of losing control over eating, especially in contexts of aggressive marketing or in the absence of self-regulation tools.

Overall, emotional-informative labels emerge as innovative instruments of informational justice, designed to correct decisional imbalances generated by the affective oversaturation of the food environment. They fulfill preventive, educational, and compensatory functions, addressing primarily consumer groups in situations of cognitive or emotional vulnerability – such as children, low-income populations, or individuals exposed to chronic stress – who are systematically more susceptible to persuasive marketing strategies with affective load.

To outline the concrete applicability of emotional-informative labels in the Romanian food context, it is essential to explore how this normative instrument could be implemented on specific products, with a visual description of the message and an anticipation of possible consumer reactions. The selection of products was based on accessibility, symbolic impact, and frequency in daily consumption, with the aim of testing different registers of affective influence in purchasing behavior.

A first example of emotional-informative labeling applicable to the Romanian food retail sector is represented by plain wholemeal bread, without added sugar, oils, or improvers. This product could be labeled as having “low affective attractiveness,” being a functional food with an identity taste, consumed primarily for its nutritional value rather than for emotional reward. On the package, the green label would appear in the front corner, with the symbol of a light bulb and the message “to be consumed consciously, not impulsively.” In this case, Romanian consumers may interpret the label as a confirmation of a rational and healthy choice, fostering a relationship of trust with both the product and the brand that embraces affective transparency.

A second relevant example is represented by chocolate digestive biscuits, often consumed during work breaks or in contexts of moderate emotional self-regulation. This product would fall into the category of “affective substitute food,” with moderate affective attractiveness, suggested by the orange label with the symbol of theatrical masks. The visual placement on the package could be designed on a white background, in a visible area beneath the product name, with the text “to be consumed consciously, not impulsively.” For Romanian consumers, such a label could act as a reflexive reminder, encouraging a more conscious relationship with consumption habits, without imposing restrictions but signaling the potential compensatory role of affective substitution.

A third example refers to premium salted caramel ice cream with nut topping, a typical reward product, heavily advertised and frequently associated with evening relaxation or special occasions. This product would fall into the category of “indulgence food,” with high affective attractiveness, indicated by the red label with the balance symbol and the behavioral warning “to be consumed consciously, not impulsively.” On the package, the label could be integrated into a contrasting corner, next to the nutritional values, but with an appealing graphic design to avoid negative perception. In this case, Romanian consumer reactions may be mixed: some may appreciate the transparency and use the label as a guide for occasional consumption, while others, less familiar with the concept of emotional self-regulation, may perceive the label as intrusive or unjustified. Precisely this potential polarization could provide fertile ground for further research on the actual effectiveness of affective labeling across different population segments.

By integrating these labels into an advanced labeling system complementary to the nutritional one, the framework of regulation is extended beyond traditional biological and physiological parameters toward a behavioral-affective approach to food-related risks. This establishes the premises for a differentiated and reflexive regulatory framework oriented toward decisional equity and the support of emotional self-regulation in a market context that is increasingly personalized, hyper-stimulative, and algorithmic.

The proposed labels are not coercive and do not substitute the classical nutritional label; rather, they complement it by introducing a symbolic, affective, and contextual dimension often overlooked by conventional food regulations. They fall within the sphere of behavioral interventions under soft law, specific to the behavioral public policy paradigm, where regulation is achieved not through coercion but through the optimization of decision-making architecture. More precisely, the label does not provide information on the chemical composition of the product but signals indirect behavioral risks – associated with latent emotional attractiveness and the likelihood of unintended or impulsive consumption. From this perspective, it functions as a “normative nudge” (Thaler & Sunstein, 2008), designed to enhance self-reflection and affective awareness in the act of consumption.

In socio-legal terms, this intervention can be characterized as a compensatory mechanism for correcting informational and emotional asymmetries between traders and consumers, recalibrating commercial influence ethically in favor of genuine decisional autonomy. It responds to an emerging normative necessity through which public policies adapt to new forms of psychological and behavioral vulnerability characteristic of the digitalized food environment.

The implementation of the emotional-informative label can be initiated in a voluntary and gradual form, through an administrative order issued by the National Authority for Consumer Protection (ANPC), within the framework of a pilot project of experimental regulation. This initial flexible framework would allow for testing the measure’s effectiveness and consumer receptivity, in partnership with retail chains, academic institutions, public health organizations, and civil society.

The necessity of such an intervention is supported by a strong convergence of arguments from interdisciplinary fields – ranging from decision neuroscience and behavioral psychology to public health and consumer law. Studies consistently highlight that emotions play a crucial role in food choices, particularly in the case of ultra-processed products. Affective stimuli, such as brightly colored packaging, advertising messages with symbolic load, or strategic shelf placement, have the capacity to activate automatic responses that may bypass conscious deliberation. Such rapid, often unconscious reactions expose consumers to systematic vulnerability in the face of commercial design specifically crafted to stimulate impulse rather than reflection. In this context, the emotional-informative label may function as a compensatory tool intended to reintroduce a minimum degree of reflection and awareness into the decision-making equation, offering consumers a support mechanism against invisible commercial pressures (Stuckler & Nestle, 2012).

Recent research findings reinforce this interpretive framework. A study conducted by Wageningen University & Research (2025) revealed that the packaging of ultra-processed products activates immediate food cravings and reduces rational analytic capacity, particularly among younger consumers. Similarly, an analysis published in the *Journal of Marketing and Strategic Research* (2025) demonstrated that, in urban contexts, packaging becomes a highly effective vector of affective communication, significantly influencing perception, trust, and consumer engagement with food products.

These findings support the view that regulatory interventions such as emotional-informative labeling are not only justifiable from the perspective of consumer rights but also necessary to rebalance a decision-making space often distorted by excessive affective stimulation. The label does not prohibit, impose, or manipulate; rather, it seeks to reconnect consumers with their intentionality in the face of marketing strategies that tend to obscure it. Moreover, this intervention aligns with international sustainable development objectives, directly contributing to the promotion of responsible and sustainable food consumption. By encouraging more conscious and informed choices, the label supports the achievement of SDG 2 – Zero Hunger, as well as SDG 12 – Responsible Consumption and Production. Beyond signaling the affective potential of certain food products, it fosters a culture of prevention, responsibility, and self-regulation in consumption, with long-term positive effects on public health and the environment.

The importance of the label is even greater in today's context of food and informational inequalities. Vulnerable groups – children, adolescents, low-income individuals, or persons exposed to chronic stress – are often the most susceptible to the affective influence of food marketing. In the absence of appropriate guiding mechanisms, these groups face profound decisional asymmetries and are disproportionately at risk of making unhealthy, compulsive, or self-punitively compensatory choices. In this light, the emotional-informative label is not a regulatory whim but a minimal form of informational justice, aimed at correcting the subtle yet systemic imbalances of the commercial ecosystem.

From a legal standpoint, the proposal is grounded in a solid foundation within both European and national law. Principles such as consumer protection, safeguarding public health, and preventing social risks provide a legitimate normative basis for such an intervention. Furthermore, the non-coercive nature of the label renders it a proportionate measure, adapted to the new forms of vulnerability generated by affective consumption and the digitalized context of commerce. The label does not restrict individual freedom but provides additional informational support precisely where it is most needed: at the intersection of choice, emotion, and health.

Therefore, the justification for this intervention extends beyond a purely theoretical framework, deriving instead from an emergent normative necessity in which law must respond to new forms of vulnerability generated by affective and digitalized consumption contexts. From this perspective, the emotional-informative label is not a form of paternalism but a legitimate instrument for rebalancing commercial influence in favor of fair, sustainable consumption oriented toward public health.

From a legal perspective, the proposal to introduce an emotional-informative label in the food sector rests on a coherent normative framework, articulated around fundamental principles of European and constitutional law. A first relevant pillar is the precautionary principle in matters of public health, enshrined both in the European Commission document COM(2000) 1 and in Article 191 of the Treaty on the Functioning of the European Union (TFEU). This principle permits the adoption of preventive measures in the face of reasonably anticipable risks, even in the absence of full scientific consensus. In the case of ultra-processed foods with compulsive consumption potential, the evidence already available clearly outlines a risk to consumers' behavioral self-regulation, thereby justifying

an orientative, non-invasive intervention aimed at limiting affective exposure and strengthening decisional autonomy.

The constitutional dimension of the intervention is supported by Article 34 of the Romanian Constitution and Article 35 of the Charter of Fundamental Rights of the European Union, complemented by Article 168 TFEU, which enshrines the fundamental right to health protection. This right entails not only the obligation to provide medical services but also the responsibility of the state to prevent avoidable risks through adequate measures. The proposed label fulfills this positive obligation without imposing constraints on individual freedom of choice, offering instead an additional form of behavioral guidance in an increasingly complex consumption environment.

Furthermore, Article 169 TFEU provides an explicit basis for the adoption of measures intended to protect the health, safety, and economic interests of consumers. In today's context, where food marketing relies increasingly on hyper-personalization, persuasive techniques, and intense emotional stimulation, this article gains extended relevance. It empowers Member States to implement normative instruments adapted to new forms of vulnerability, provided they contribute to a high level of protection and do not unjustifiably infringe economic freedom. In this respect, the emotional-informative label fits seamlessly into the logic of reflexive regulation, designed to address the real challenges of the contemporary food market.

Moreover, the intervention aligns with principles of differentiated, adaptive, and reflexive regulation characteristic of the post-industrial era. Within this framework, regulation is no longer one-dimensional but must reflect the actual complexity of markets and behaviors – incorporating emotional, symbolic, and behavioral risks of consumption alongside physiological or toxicological ones.

Thus, the emotional-informative label positions itself as a soft regulatory instrument, fully compatible with both national and European legal orders, designed to meet a genuine need for normative rebalancing between the economic freedom of traders and the behavioral vulnerability of consumers.

The emotional-informative label constitutes an emergent normative tool of high strategic value, configured within the logic of reflexive regulation and compatible with modern models of behavioral governance. Its orientative, non-coercive, and visually intuitive nature allows for gradual implementation, with low costs and high cultural adaptability, depending on the specificities of the national food market and consumer categories.

In a first stage, the intervention could be empirically validated within a multicentric pilot project, by applying the label to a selection of food products with a high estimated affective risk – such as snacks, processed sweets, or sugar-rich beverages. This experimental phase could be carried out in partnership with retail networks, universities, public health institutions, and regulatory bodies, following the logic of co-created adaptive regulation.

The evaluation of the behavioral impact of the emotional-informative label requires an integrative methodological approach, based on applied research conducted in real commercial contexts. Relevant methods include pre-post exposure studies in food retail

settings to capture behavioral changes over time. These may be complemented by quantitative and qualitative analyses of purchasing decisions, correlated with the estimated level of affective attractiveness of products, as well as by the application of validated psychometric instruments to measure consumers' emotional receptivity and perception shifts associated with affective signaling. In parallel, comparisons can be drawn between sales data for products with and without emotional-informative labeling, in order to quantify the effect on consumption behavior at the population level.

In the medium term, integrating this label into national strategies on public health, nutrition, and consumer protection may contribute to the achievement of essential objectives. On the one hand, it could support the prevention of obesity and non-communicable metabolic diseases by facilitating affective self-regulation in food choices; on the other hand, it could help reduce food inequalities by providing a guiding tool adapted to individuals exposed to psycho-social vulnerabilities. In addition, by fostering more informed and reflexive consumption decisions, this intervention may have a positive impact on the sustainability of the healthcare system by reinforcing early prevention efforts. From a cultural perspective, it contributes to consolidating a food environment oriented toward health, equity, and awareness, in which choice is no longer dictated solely by impulse or marketing, but by a deeper understanding of the relationship between emotion, food, and individual responsibility.

With significant scalability potential, the emotional-informative label may be extended, depending on pilot outcomes, to other categories of high-hedonic products, and may, over time, be incorporated into a consolidated legal framework – at the national or European level – as part of a transversal legislative strategy for psycho-nutritional protection. In this sense, the label not only rebalances the asymmetric relationship between traders and consumers but also redefines consumer protection standards in the post-industrial era: a protection that targets not only the body but also behavior, emotion, and the decisional context.

5. Conclusions

The current normative framework on consumer protection, built on a classical rationalist paradigm, no longer faithfully reflects the complexity of food decisions in postmodern societies. In a landscape dominated by commercial hyper-personalization, persuasive sensory design, and constant affective stimulation, the idea of a fully informed and perfectly rational consumer becomes increasingly difficult to sustain. Interdisciplinary literature – from decision neuroscience to consumer psychology – reveals that food choices are systematically influenced by emotional factors, contextual pressures, and symbolic rewards, particularly in the case of ultra-processed foods.

In this light, legal protection centered exclusively on informational transparency becomes insufficient, especially for consumers in situations of psycho-social vulnerability. This article proposes a complementary normative intervention – the emotional-informative label – conceived within the logic of behavioral law & economics, as a reflexive form of legal governance. This label does not restrict freedom of choice but supports it through symbolic guidance adapted to contemporary decisional risks, aiming to provide consumers with a tool for affective self-regulation in the face of intense commercial stimulation.

The legal foundation of this proposal is supported by several solid normative bases. The precautionary principle, set out in the European Commission Communication COM(2000) 1 and enshrined in Article 191 TFEU, permits the adoption of preventive measures in the presence of reasonably anticipable behavioral risks. The fundamental right to health, guaranteed by Article 34 of the Romanian Constitution and Article 35 of the Charter of Fundamental Rights of the European Union, corroborated by Article 168 TFEU, obliges the state to ensure a high level of protection and to promote active prevention policies in the field of public health. Furthermore, Article 169 TFEU authorizes measures to protect the interests of European consumers, including in relation to health and food safety.

Within this configuration, the emotional-informative label could be introduced through a voluntary regulatory mechanism, on an experimental basis, by means of an administrative order issued by ANPC, in collaboration with commercial networks, academic institutions, and public health organizations. Such an exploratory stage would allow the calibration of the affective message, the testing of comprehensibility, and the measurement of behavioral impact before eventual integration into national public policies and, in perspective, into European regulations, through an adjustment of Regulation (EU) No. 1169/2011 on consumer information.

It is essential to emphasize that the present study is of a theoretical-normative and conceptual nature and, consequently, presents specific limitations. The proposal for the emotional-informative label has not been validated through an experimental study, meaning that quantitative data demonstrating the direct impact of the label on behavioral changes related to overconsumption at the population level are not yet available. Furthermore, the affective-behavioral taxonomy of products (functional food, affective substitute, indulgence) represents a conceptual model that requires external empirical and psychometric validation. Consequently, future research must focus on controlled intervention studies (RCTs), analyses of cultural receptivity, and measurements of the real impact on purchasing decisions, in order to substantiate the normative integration of this instrument.

More than a simple technical measure, the proposed label represents a normative justice endeavor, oriented toward equity, reflection, and emotional responsibility. It addresses challenges related to nutritional inequality, the symbolic influence of consumption, and the lack of protection for vulnerable categories, without imposing direct constraints. In this sense, law becomes an instrument of empathic accompaniment, adapted to the decisional realities of the contemporary consumer (Illouz, 2007; Sunstein, 2021; WHO, 2021).

In conclusion, the emotional-informative label does not replace existing legal mechanisms but proposes their conceptual and practical extension toward a more humane and effective regulatory approach. It marks the transition from a food governance system based solely on rationality to one centered on vulnerability, affect, and awareness, contributing to the shaping of a minimal yet significant form of emotional-nutritional justice. In a social context marked by overconsumption, nutritional polarization, and informational fatigue, this legal intervention may serve as a symbolic, normative, and preventive reference point for a new stage of consumer protection in the post-industrial era.

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Nutritional Dimension of the Food Basket: Accessibility, Quality, and Equity Challenges in Transition

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Abstract. *The food basket is approached as a structural indicator of nutritional equity, emphasizing the discrepancies between actual consumption patterns and scientifically validated standards. The study analyzes the average food basket in Romania in relation to WHO and EFSA recommendations, highlighting persistent gaps in access to healthy diets. Starting from the hypothesis that the structure of the food basket reflects not only individual preferences but also economic, educational, and institutional constraints, the analysis unfolds within an interdisciplinary framework combining public nutrition, food economics, and the right to health. The paper discusses the implications of the accelerated nutritional transition, particularly the rise in consumption of ultra-processed products and the increasing vulnerability of low-income households. Based on these findings, the article formulates an integrated framework of public interventions: fiscal incentives for nutrient-dense foods, mandatory front-of-pack labeling, and the definition of a “minimum nutritional basket” as a normative benchmark for social policies. The contribution of this study lies in treating the food basket not only as an object of analysis but also as a regulatory instrument in food equity policies, within a context shaped by systemic post-pandemic transformations.*

Keywords: nutritional equity; food basket; nutritional transition; public food policies; nutritional sustainability; right to food.

JEL Classification: I14; Q18; D63.

1. Introduction

In a global context marked by food crises, economic polarization, and structural shifts in consumption patterns, food can no longer be conceived merely as an individual choice. It must instead be understood as an integrative indicator of social equity, sustainability, and quality of life – deeply intertwined with broader dynamics of income inequality and distributional conflict (Atkinson, 2015) and with the multidimensional nature of food insecurity documented across Europe (Carrillo-Álvarez, Riera, & Dinu, 2023). Post-pandemic evidence further shows that shocks to daily life reconfigured dietary behaviours and widened pre-existing vulnerabilities, adding volatility to already fragile consumption patterns (De Backer et al., 2021; Rodríguez-Pérez et al., 2020).

Within this framework, the food shopping basket acquires an extended analytical significance – reflecting not only individual behaviours but also the structural conditions shaping population access to nutritionally, economically, and ecologically adequate diets. Romania is currently undergoing a nutritional transition, characteristic of many emerging economies, marked by the gradual abandonment of traditional diets in favour of increasingly homogenised, ultra-processed, and nutritionally imbalanced consumption. Despite an apparently abundant commercial supply, effective access to healthy food remains profoundly unequal, with pronounced territorial and socio-economic disparities. This situation does not exclusively reflect consumer preferences but also the influence of structural factors such as disposable income, nutritional literacy, commercial pressures, and regressive fiscal policies.

Against this backdrop, a reconceptualisation of the food basket becomes necessary – not only as an expression of consumption choices but as a legitimate object of public regulation grounded in the effective realisation of the right to adequate food (United Nations Human Rights Council, 2014). This study investigates the extent to which the structure of the actual Romanian food basket corresponds to scientifically validated standards, analyses the factors generating nutritional imbalances, and explores the feasibility of defining a “minimum nutritional-sustainable food basket” as a normative benchmark for fair social and fiscal policies.

The primary aim is to provide a scientific basis for rethinking the food basket within an integrative logic capable of addressing nutritional challenges alongside sustainability and equity demands. Through an interdisciplinary approach, the paper clarifies the positioning of the food basket within public policy, proposing its reformulation from a mere economic tool into an instrument of social justice and public health.

2. Literature Review

The specialized literature confirms that food choices cannot be understood solely through the lens of individual preferences but must be analyzed in relation to structural, economic, and symbolic factors. In the context of accelerated nutritional transition, Romania aligns with a globally observed model characterized by the abandonment of traditional diets in favor of increasingly homogenized, ultra-processed, and nutritionally unbalanced

consumption (Monteiro et al., 2019; Popkin et al., 2020; Willett et al., 2019). These transformations are driven by sophisticated commercial mechanisms that privilege economically profitable products at the expense of nutritionally balanced options (Chandon & Wansink, 2012).

According to the World Health Organization (2020) and the European Food Safety Authority (EFSA, 2017), the intake of nutrient-dense foods in Romania – such as vegetables, fruits, legumes, fermented dairy, and fish – remains below recommended thresholds. In parallel, FAO (2023) and INSSE (2024) data reveal a disproportionate presence of ultra-processed products in the food basket structure. These findings are supported by Nardocci et al. (2021), who highlight the strong link between consumers' socio-economic status and the quality of the food basket, particularly in low-income regions.

In the analysis of nutritional transition, the sustainability dimension cannot be overlooked. Dietary changes are not limited to the shift from traditional, local, and seasonal diets toward homogenized and ultra-processed consumption, but also involve linking these transformations to public health objectives and environmental protection. Internationally validated models – such as the planetary health diet or the recommendations of FAO, WHO, and EFSA – demonstrate that a dietary pattern can be both nutritionally dense and less costly from an ecological perspective when plant-based products, minimally processed foods, and local and seasonal resources are prioritized (Herforth et al., 2022; Willett et al., 2019).

At the same time, the literature emphasizes that economic accessibility remains a critical factor. Without differentiated fiscal policies (subsidies for nutrient-dense foods, additional taxation for ultra-processed products) and without clear information mechanisms (mandatory front-of-pack labeling, disclosure of carbon footprint or degree of processing), low-income consumers will continue to prioritize “cheap calories” over protective foods (Darmon & Drewnowski, 2008; Egnell et al., 2020). Thus, the debate on nutritional equity inevitably overlaps with that on sustainability, both becoming essential pillars for reframing food policies within a logic of social justice.

Unequal access to healthy foods is conditioned by factors such as income, nutritional literacy, physical proximity to products, and regressive fiscal policies. The seminal study by Darmon & Drewnowski (2008) showed that low-income households tend to prefer calorie-dense but nutrient-poor foods, due to their lower cost per kilocalorie. Complementary research by Pechey et al. (2015) and Grunert et al. (2010) underscores how hedonic marketing and strategic product placement influence purchasing decisions, reducing consumer autonomy – especially in the absence of clear nutritional information.

Herforth et al. (2022) emphasize that nutritional equity cannot be achieved without systemic interventions that combine fiscal incentives, commercial regulation, and educational measures. In the same direction, Egnell et al. (2020) argue for mandatory front-of-pack labeling, designed to facilitate informed decision-making, particularly among vulnerable consumers. These contributions support the idea that the right to adequate food

cannot be realized without a coherent regulatory framework that transcends mere individual responsibility.

In this context, the paper introduces a critical distinction between the “minimum regulated food basket” – defined economically through Government Ordinance No. 217/2000 on the approval of the minimum monthly consumption basket – and the “minimum nutritional-sustainable food basket,” scientifically grounded in principles of food equity and public health prevention. This conceptual differentiation, often overlooked in governmental practice, becomes crucial for reframing food policies within a logic of social justice.

3. Methodology

This study employs an analytical-normative and interdisciplinary approach, with the objective of comparatively evaluating the actual Romanian food basket against internationally established nutritional standards. The analysis is based on secondary processing of official statistical data, complemented by specialized literature in the fields of public nutrition, food economics, and the sociology of consumption. Primary sources include data from the National Institute of Statistics (INSSE, 2024), Eurostat (2023), the World Health Organization (WHO, 2020), and the European Food Safety Authority (EFSA, 2017). These were correlated with relevant academic research on the food environment, consumer behavior, and nutritional governance (Monteiro et al., 2019; Mozaffarian et al., 2021; Herforth et al., 2022; Grunert et al., 2010).

The applied methods consist of tabular comparisons between average consumption values and nutritional recommendations, longitudinal graphical representations of food expenditure trends for the period 2014–2024, and a thematic analysis of the structural factors influencing consumption decisions.

The working hypothesis rests on the observation of a structural imbalance between the actual food basket and the standards of a healthy diet, an imbalance driven by factors such as insufficient income, low levels of nutritional education, unequal territorial access, and persuasive commercial strategies. Within this framework, the analysis does not merely seek to describe the current situation but also to explore the potential of a coherent set of public policies – fiscal, educational, and regulatory – to realign the food basket with the principles of nutritional equity and sustainability.

Thus, the proposed methodology reflects the multidimensional nature of the phenomenon and provides an operational framework for data interpretation and for the formulation of public policy recommendations tailored to the Romanian context.

4. Results and discussion

The comparative analysis between the structure of the actual Romanian food basket and the scientifically validated nutritional recommendations (WHO, 2020; EFSA, 2017) revealed major systemic discrepancies with profound implications for nutritional equity and public health.

The dietary model recommended by the World Health Organization (WHO) and the European Food Safety Authority (EFSA) emphasizes a varied, balanced, and nutrient-dense diet, based on the daily consumption of vegetables, fruits, legumes, whole grains, fish, and healthy fat sources, with an adequate caloric intake adjusted to physiological needs and an optimal nutritional profile (WHO, 2020; EFSA, 2017). The purpose of this model is twofold: to prevent non-communicable diseases (NCDs) and to promote public health through long-term sustainable dietary practices.

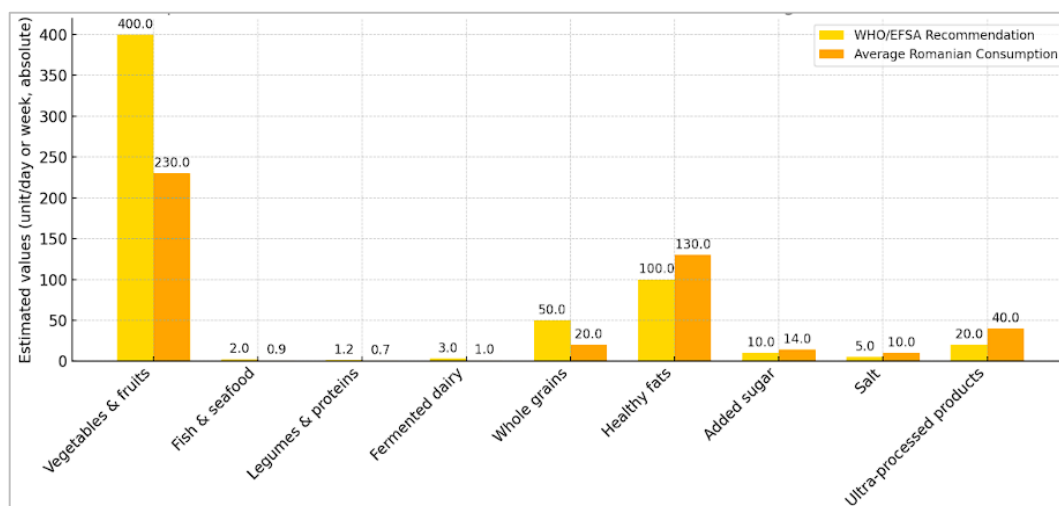
Despite this normative consensus, recent research highlights a systemic gap between the ideal and the actual food basket, resulting from the complex interplay of economic, cognitive, cultural, and commercial factors (Monteiro et al., 2019; Mozaffarian et al., 2021). Consumption studies reveal the predominance of ultra-processed products in the actual food basket – foods characterized by a high degree of industrial processing, rich in added sugars, saturated fats, salt, and additives, but with low nutritional density (Monteiro et al., 2019; Nardocci et al., 2021).

Table 1. *Discrepancies between the actual food basket and nutritional recommendations in Romania*

Food category	WHO/EFSA recommendation	Average consumption in Romania (INSSE/Eurostat 2023–2024)	Estimated gap	Nutritional and public health implications
Vegetables and fruits	≥ 400 g/day	~230 g/day	–170 g/day	Severe underconsumption; deficient intake of fiber, antioxidants, folate, and potassium – increased risk of NCDs
Fish and seafood	≥ 2 servings/week	< 1 serving/week	–1 serving/week	Insufficient intake of omega-3 fatty acids and iodine – increased cardiovascular and cognitive risk
Legumes, eggs, lean meat	1–2 servings/day (diverse protein sources)	High meat; low legumes	Protein imbalance	Overrepresentation of animal proteins; low intake of fiber, phytonutrients, and plant-based iron
Fermented dairy	2–3 servings/day	~1 serving/day	–1 to –2 servings/day	Insufficient calcium, vitamin D, and probiotics – risk of osteoporosis and gut dysbiosis
Whole grains	≥ 50% of total cereal intake	< 20%	–30%	Predominance of refined cereals – low intake of fiber and micronutrients (Zn, Mg) – risk of metabolic syndrome
Healthy fats (PUFA/MUFA)	Unrefined vegetable oils, in moderate amounts	Overall excess of fats; mixed quality	+ quantitatively; ± qualitatively	Imbalance between beneficial and saturated fats – risk of dyslipidemia and cardiovascular diseases
Added sugar	< 10% of daily energy intake	~13–15%	+3–5%	Daily overconsumption – associated with childhood obesity, type 2 diabetes, dental caries
Salt	< 5 g/day	~10–12 g/day	x2 above limit	Major risk factor for hypertension, kidney disease, and cardiovascular disorders
Ultra-processed products	< 20% of total caloric intake	> 40%	+20%	Low nutritional density, hyper-palatability, associated with systemic inflammation and food addiction

Source: Author's elaboration based on data from World Health Organization (WHO, 2020), European Food Safety Authority (EFSA, 2017), National Institute of Statistics (INSSE, 2024), Eurostat (2023), Monteiro et al. (2019), Nardocci et al. (2021).

Figure 1 contrasts the ideal food basket – derived from WHO/EFSA guidelines – with the average Romanian basket, providing a visual benchmark against which the observed deviations can be assessed.

Figure 1. *Discrepancies between the ideal food basket and the Romanian food basket*

Source: Own elaboration based on WHO (2020), EFSA (2017), INSSE (2024), Eurostat (2023), Monteiro et al. (2019), Nardocci et al. (2021)

As shown in Figure 1, the most salient shortfalls concern fruits/vegetables, fermented dairy, whole grains, and fish/legumes, while salt, added sugar and ultra-processed products are consumed in excess. This pattern is consistent with a low nutrient-density profile and signals elevated NCD risk, particularly among vulnerable groups.

The comparative chart highlights the major gaps between the ideal food basket – defined according to the nutritional recommendations of WHO and EFSA – and the average Romanian food basket, illustrating a systematic imbalance. The most pronounced deficits are observed in categories with essential protective roles: vegetables and fruits (–170 g/day compared to the recommendation), fermented dairy products (less than 1 portion/day versus the required 2–3 portions), and whole grains, whose share in the daily diet is below 20%, far from the recommended 50% threshold. Similarly, the consumption of fish and legumes – valuable sources of omega-3 fatty acids, fiber, and plant-based proteins – remains extremely low. In parallel, the chart reflects an excessive intake of salt (more than double the recommended limit), added sugar (13–15% of daily energy intake compared to the 10% threshold), and ultra-processed products (over 40% of total caloric intake, double the safety margin). These imbalances reveal the low nutritional density of the actual food basket, with significant implications for the population’s risk of non-communicable diseases, particularly among vulnerable groups. Figure 1 thus provides a synthetic and compelling picture of the polarization between quality and accessibility in the current Romanian diet.

The comparative chart underscores the stark gap between the ideal food basket – defined by WHO and EFSA nutritional standards – and the actual Romanian food basket, exposing a persistent imbalance. The sharpest deficits are concentrated in protective categories: vegetable and fruit intake falls short by approximately 170 g/day; fermented dairy products remain below one portion per day compared with the recommended two to three; and whole grains account for less than 20% of the daily diet, far from the 50% benchmark. Similarly,

fish and legumes – key sources of omega-3 fatty acids, fiber, and plant-based protein – are consumed only marginally. At the same time, the chart reveals excessive intakes of salt (over twice the recommended threshold), added sugar (13–15% of daily energy versus the 10% limit), and ultra-processed products (above 40% of caloric intake, double the safety margin). Collectively, these distortions reflect the low nutritional density of the actual food basket, heightening the risk of non-communicable diseases, particularly among vulnerable groups. Figure 1 thus provides a concise and compelling illustration of the polarization between nutritional quality and economic accessibility in Romania’s dietary landscape.

The comparative analysis further highlights significant territorial disparities across development regions and between urban and rural areas. Rural diets remain anchored in low-cost, calorie-dense products such as white bread, potatoes, and processed fats, while access to fresh fruits, vegetables, fish, and fermented dairy is sporadic and insufficient. By contrast, urban diets are more diversified, yet are increasingly shaped by price constraints and the omnipresence of ultra-processed foods, which fuel excessive intakes of sugar, salt, and saturated fats, often surpassing WHO and EFSA limits. INSSE and Eurostat data confirm that low-income regions are most exposed to nutritional vulnerability, showing marked deviations from international standards, particularly in fruit, vegetable, and fish consumption. These inequalities are not merely statistical; they are mirrored in public health outcomes, correlating with a higher prevalence of non-communicable diseases in disadvantaged communities (Herforth et al., 2022; HLPE, 2020).

In this context, the food basket emerges not simply as the result of individual preferences, but as the outcome of overlapping economic, infrastructural, and commercial constraints. The urban–rural and regional divides reveal the structural dimension of nutritional inequalities and underscore the urgency of territorially differentiated policies – ranging from targeted subsidies for fresh produce to strengthened distribution infrastructure and support for short supply chains.

To ground these patterns in household economics, Table 2 reports the evolution of total and food expenditures per person by residence area (2002 vs. 2024).

Table 2. Average household expenditures and food share in total expenditures by residence area, Romania (2002 and 2024)

Year	Total Expenditures – Urban (lei)	Total Expenditures – Rural (lei)	Food Expenditures – Urban (lei)	Food Expenditures – Rural (lei)	Food Share Urban (%)	Food Share Rural (%)
2002	2,554.83	1,916.39	673.28	329.68	26.35%	17.20%
2024	3,299.20	2,247.17	597.43	401.57	18.11%	17.87%

Source: National Institute of Statistics (INSSE), Household Budget Survey (2002, 2024)

Table 2 illustrates the evolution of household expenditures in Romania, contrasting urban and rural areas over the period 2002–2024. In urban households, the share of food in total expenditures declined markedly – from 26.3% in 2002 to 18.1% in 2024 – signaling both higher disposable incomes and diversified consumption patterns, in line with Engel’s law, which predicts a declining food share as income rises. This trajectory reflects a gradual convergence with European consumption models, where resources are increasingly allocated toward non-food goods and services.

By contrast, rural households exhibit a striking rigidity: food expenditures remained at roughly 17% of total budgets across the two decades. While the absolute value of food spending has grown, the persistence of this ratio indicates structural stagnation and heightened vulnerability to price shocks. These data reveal an entrenched economic and infrastructural asymmetry that constrains the diversification of rural diets.

The resulting urban–rural differentiation exemplifies the structural inequalities that shape access to food resources and consumption opportunities. Urban households enjoy a steady reduction in dependence on food expenditures, while rural communities remain locked in zones of food vulnerability, where dietary balance is dictated by limited income and access. Such disparities call for territorially adapted policy measures aimed at reducing nutritional inequality and fostering convergence toward equitable and sustainable consumption patterns.

This discrepancy is observable globally, but it is more pronounced in regions where nutritional transition overlaps with socio-economic vulnerabilities, as is the case in Romania. Data from INSSE (2024) confirm a persistent underconsumption of protective foods – fresh fruits and vegetables, legumes, fermented dairy, fish – in favor of calorie-dense foods with marginal nutritional value. Similarly, Eurostat (2023) data indicate that Romania is among the EU member states with the highest share of household budgets allocated to food expenditures, reflecting the direct economic pressure on food basket quality. Studies from the EIT Food Consumer Observatory (2023) emphasize that consumer perceptions of healthy eating in Eastern Europe are often shaped by distrust in labels and accessibility constraints.

Among the factors contributing to the dissonance between the actual food basket and scientifically validated nutritional recommendations, the most significant is the reduced economic accessibility of healthy foods, which often imply a higher cost relative to their nutritional density. Added to this is the deficit of nutritional literacy, which undermines consumers' ability to correctly interpret packaging information and distinguish between products with favorable nutritional profiles and those with negative health impacts (Grunert et al., 2010). Another relevant factor is the commercial design of the retail environment, which privileges the exposure of ultra-processed products, amplifying their visibility and accessibility at the expense of healthier alternatives (Wansink, 2016). Moreover, affective and hyper-personalized marketing strategies – using messages such as “you deserve something good” or “a quick reward” – stimulate hedonic consumption behaviors, further narrowing the decision-making space for rational and informed food choices (Chandon & Wansink, 2012; Pechey et al., 2015).

In practice, this configuration means that the real food basket becomes the expression of a forced compromise between immediate satiety and long-term nutritional sustainability – a compromise dictated by structural factors rather than fully autonomous choices. This is particularly concerning for vulnerable groups, where financial constraints, lack of nutritional education, and constant exposure to commercial stimuli further reduce the likelihood of building a food basket compatible with long-term health (Darmon & Drewnowski, 2008).

Moreover, in the context of an accelerated nutritional transition – marked by the replacement of traditional, seasonal, and local diets with homogenized, industrialized, and standardized consumption – Romania finds itself at a critical point. The progressive loss of dietary diversity not only fosters metabolic imbalances but also erodes the cultural identity of food consumption, contributing to a form of hidden malnutrition embedded in energy surplus (Popkin et al., 2020; FAO, 2023).

This trend is further supported by statistical data from the National Institute of Statistics (INSSE), which outline the structure of monthly expenditures for the minimum food basket in Romania during 2014–2024. According to Annex 1, the basic food basket remains profoundly unbalanced from a nutritional perspective, consisting predominantly of cheap, calorie-dense products – such as flour, bread, margarine, processed meat, and potatoes – chosen based on price and satiety rather than nutritional value. This reality highlights a systemic disjunction between economic accessibility and nutritional adequacy, exacerbating the risk of hidden malnutrition and non-communicable diseases, particularly among low-income households.

Table 3. Evolution of average monthly expenditures per person (RON) for seven essential food products from the minimum food basket (2014–2024)

Food product	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bread and bakery products	26.33	25.86	25.58	26.68	29.02	32.04	34.63	38.41	51.22	57.90	58.60
Milk	14.25	14.85	15.13	16.02	17.38	18.43	19.92	22.39	27.04	30.49	31.98
Eggs	3.35	3.47	3.52	4.26	4.90	4.73	5.53	6.05	7.74	10.20	10.20
Pork	3.83	4.05	4.27	4.82	5.54	5.41	6.20	7.26	7.27	8.12	8.89
Poultry	12.20	12.69	13.10	14.87	16.69	18.35	22.39	24.48	28.22	32.21	34.00
Sweets	4.01	3.17	3.24	3.52	3.80	4.06	4.43	5.13	5.92	6.59	7.60
Coffee, tea, cocoa	6.05	6.28	6.34	6.92	7.40	8.03	8.51	9.37	11.54	13.70	14.94

Source: Own elaboration based on INSSE data and the methodology of the minimum consumption basket, in line with Government Ordinance No. 217/2000

In the social policy literature, the minimum food basket is defined in strictly economic terms, as part of the minimum basket for a decent living, used to calculate the minimum wage and other social rights, in accordance with Government Ordinance No. 217/2000. It reflects a set of basic products selected based on cost and satiety criteria, without detailed nutritional validation.

The conceptual and functional distinctions between the two types of food baskets are summarized in Table 3 below.

Table 4. Conceptual and functional distinction between the “minimum food basket” (regulated) and the “minimum nutritional-sustainable food basket” (normative proposal)

Analytical dimension	Minimum food basket (GO No. 217/2000)	Minimum nutritional-sustainable food basket (normative proposal)	Relevance for public policy
Construction basis	Economic threshold for survival, determined by minimum living costs	Internationally validated scientific standards (WHO, EFSA, FAO, HLPE) for healthy and sustainable diets	Recalibrating the threshold of social protection based on public health and nutritional equity
Food selection criteria	Low price, caloric density, satiety, market availability	Nutrient density, diversity, functional role in prevention, seasonality, local origin	Foundation for subsidies, differentiated taxation, and educational policies

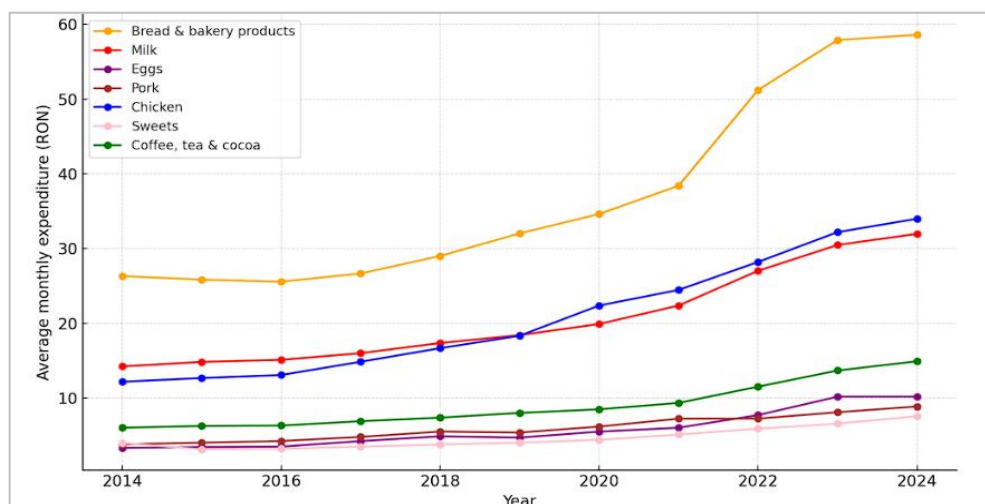
Analytical dimension	Minimum food basket (GO No. 217/2000)	Minimum nutritional-sustainable food basket (normative proposal)	Relevance for public policy
Predominant composition	Refined flour, margarine, sugar, potatoes, processed meat – cheap foods with low nutritional value	Fresh fruits and vegetables, legumes, whole grains, fermented dairy, fish – foods with high biological value	Redirecting consumption towards nutrient-dense foods through fiscal support and equitable food infrastructure
Social purpose	Ensuring minimum survival within social protection policies	Promoting the effective right to healthy food, preventing non-communicable diseases, and reducing inequalities	Expanding the social function of food beyond mere economic subsistence
Role in public policies	Reference for minimum wage, social assistance, and the minimum basket for a decent living	Benchmark for corrective fiscal policies, nutrition education, public health interventions, and sustainability policies	Integrating healthy eating into the pillars of social protection and health policies
Scientific validation	Limited – no correlation with international nutritional guidelines	High – based on global scientific consensus (WHO, EFSA, FAO, HLPE)	Scientific justification for revising the minimum basket towards nutritional equity
Ecological dimension	Absent – no correlation with sustainability criteria	Explicitly included – reduced ecological impact, seasonality, waste reduction, low carbon footprint	Convergence between health, climate, and sustainable agriculture policies

Source: Own elaboration based on the national legal framework (GO No. 217/2000), international nutritional recommendations (WHO, EFSA, FAO, HLPE), and the specialized literature (Mozaffarian et al., 2021; Herforth et al., 2022; Darmon & Drewnowski, 2008)

Table 3 synthesizes the structural, functional, and epistemic differences between the two types of food baskets – the one regulated by Government Ordinance No. 217/2000 and the normative proposal of a nutritional-sustainable basket. While the former is grounded in minimum cost and economic survival, the latter introduces an integrative vision that combines nutritional science with social equity and ecological sustainability. This reconceptualization transforms the food basket into a public policy instrument oriented towards prevention and food justice, moving beyond the limits of a mere accounting evaluation.

The distinction is not merely semantic but reflects a paradigmatic shift: from subsistence minimum to the effective right to adequate nutrition. Building on this distinction, the paper proposes the institutionalization of a new normative benchmark – the minimum nutritional-sustainable food basket – scientifically grounded in WHO and EFSA recommendations and integrating criteria of nutritional adequacy, food equity, and ecological sustainability. This basket has not only economic value but also a protective function for public health and food justice. Thus, while the first basket is determined by the lowest price for subsistence, the second aims at universal access to a balanced diet with preventive and restorative value.

The comparative interpretation of the data presented in Table 2 is further deepened by the graphical representation below, which highlights the major trends in the evolution of food prices within the minimum consumption basket. The chart provides a visual perspective on the accelerated dynamics of expenditures for staple products – such as bread, milk, eggs, and meat – while also illustrating the steady rise of symbolic categories (sweets, coffee), which reflect consumer preferences under inflationary pressures and persistent economic tensions. The differences in growth rates across categories indicate not only variations in production costs or demand elasticity but also a structural shift in the architecture of the actual food basket, with significant implications for nutritional equity.

Figure 2. *Evolution of monthly expenditures on essential food products in Romania (2014–2024)*

Source: Own elaboration based on data from the National Institute of Statistics (INSSE) and the methodology of the minimum consumption basket for a decent living, according to the Annex to Government Ordinance No. 217/2000 on the approval of minimum consumption indicators.

Table 2 and Figure 2 eloquently capture the upward dynamics of average monthly expenditures per person for six essential food products included in the minimum basket for a decent living in Romania. The period under review (2014–2024) reflects not only the effects of food inflation and successive crises (health, energy, fiscal), but also the depth of systemic imbalances in the architecture of food consumption. The highlighted trends reveal a structural transformation of the food basket, in which criteria of economic accessibility, nutritional density, and symbolic value directly compete.

Bread and bakery products, a fundamental category in the structure of the real basket, registered an increase of more than 120% over ten years (from 26.33 RON in 2014 to 58.6 RON in 2024). This rise is emblematic of the regressive nature of indirect fiscal pressure (VAT, excises), as well as of the structural dependence on foods with high caloric value and low nutritional density. For vulnerable households, the effect translates into an amplified risk of hidden malnutrition, where nutritional deficits are masked by apparent satiety.

Milk, a staple in the daily diet and an essential source of calcium and protein, recorded an increase of more than 124% during the period (from 14.25 RON in 2014 to 31.98 RON in 2024). This doubling of costs reflects not only inflationary pressures and rising production and distribution costs, but also the vulnerability of the dairy supply chain to agricultural market volatility and trade policies. The analysis by Maloş and Maloş (2022b) emphasizes the importance of infrastructure and balanced distribution in strengthening the resilience of Romania's dairy sector. By extension, any structural dysfunction in this supply chain can disproportionately affect vulnerable households, particularly those with children, where stable access to milk represents a key element for maintaining nutritional equity and long-term public health.

Eggs, an affordable source of protein and micronutrients, tripled in monthly cost during the period, reaching 10.2 RON in 2024. This increase reflects pressures on the small and medium livestock sector, affected by recurrent sanitary crises and rising production costs. In the case of vulnerable households, access to nutritious food is overwhelmingly determined by economic constraints, while the educational dimension, although important, becomes secondary to financial pressures.

This reality aligns with observations on the perception and availability of food products in the market highlighted by Maloş & Maloş (2016), and is supported by international literature underscoring that food inequality is often more a matter of economic access than of nutritional knowledge (FAO, 2023).

Chicken, historically perceived as the “economic” alternative to other animal protein sources, significantly surpassed pork expenditures after 2020, reaching 34 RON per person in 2024 (+178% compared to 2014). This structural shift underscores the centrality of poultry in current consumption patterns and is reinforced by the pronounced shift toward intensive poultry production, a phenomenon identified by Maloş and Maloş (2022a) as having implications for dietary diversity and the resilience of the agri-food sector.

Sweets and the coffee/tea/cocoa category both exhibit steady and robust growth, doubling their monthly expenditure values (7.6 RON and 14.94 RON respectively in 2024). Their persistence in the food basket, despite economic pressures, indicates the compensatory affective function of hedonic consumption, often associated with emotional marketing and the substitution of functional nutrition with symbolic reward. From a psycho-nutritional perspective, this phenomenon can be interpreted as a symptom of decision-making vulnerability in a food environment dominated by ultra-processed stimuli.

This fragmented and unequal evolution of expenditures highlights that consumer economic rationality is profoundly mediated by structural, affective, and commercial constraints, while nutritional choices reflect systemic imbalances rather than genuine individual freedoms. In this sense, the minimum food basket becomes a complex indicator – not only of actual purchasing power but also of the degree of food justice.

Paradoxically, essential foods with high nutritional value are becoming increasingly inaccessible, while ultra-processed products – calorie-dense yet nutritionally poor – remain preferred due to their low cost per kilocalorie and high commercial availability. This polarization between cost and quality confirms the disjunction between the real food basket and the standards promoted by WHO, FAO, and EFSA, and underscores the need to institutionalize a sustainable nutritional reference basket that can ground corrective fiscal, social, and educational policies.

Accordingly, the interpretation of these data cannot be separated from the normative imperatives of food policies: the shopping basket becomes a strategic tool of nutritional governance, and its monitoring must be integrated into a broader framework aimed at ensuring the effective exercise of the right to adequate food and combating systemic food inequalities.

Thus, the food basket can be understood not only as a reflection of consumption choices but also as a valid proxy for the quality of dietary life and a barometer of systemic equity in the distribution of food resources. Standardized instruments such as the Global Diet Quality Score (Herforth et al., 2022) provide a rigorous methodological foundation for the comparative evaluation of dietary nutritional quality and for identifying the gap between the real and the ideal basket.

This identification is not merely a descriptive exercise but an essential stage in diagnosing structural nutritional vulnerabilities, informing public policy interventions, and developing adaptive corrective tools – such as mandatory front-of-pack nutritional labeling, subsidies for nutrient-dense foods, or regulation of advertising directed at vulnerable consumers (Mozaffarian et al., 2021; FAO, 2023).

In this regard, HLPE (2020) stresses the importance of building a coherent global narrative on food security and sustainable nutrition, in which the food basket becomes a strategic instrument for evaluating progress toward the Sustainable Development Goals and for correcting systemic food inequities.

The persistent imbalance between the real food basket and scientifically validated nutritional standards results from the interplay of structural, cognitive, and commercial factors simultaneously shaping consumer behavior. Identifying these determinants is essential for formulating coherent interventions in the field of food equity and public health.

Food choice emerges from a complex interaction between individual predispositions and the architecture of the commercial environment, the latter being deliberately designed to elicit emotional responses and impulsive purchasing behaviors. Empirical evidence (Chandon & Wansink, 2012; Pechey et al., 2015) shows that packaging, shelf placement, and promotional discourse act as central vectors of the “engineering of desire.” The PwC – Voice of the Consumer Report (2025) confirms the relevance of these mechanisms in Romania: 54% of consumers switch brands for a perceived superior taste, while 35% do so for a more advantageous perceived price–quality ratio, signaling heightened receptivity to marketing stimuli. Slogans such as “Reward yourself today” or “You deserve something good” shift the meaning of food from the sphere of physiological need satisfaction to a symbolic, compensatory function associated with emotional self-reward. In the context of algorithmic personalization and micro-segmentation, these tactics can escalate hedonic hypercaloric consumption, diminish nutritional deliberation, and amplify the risk of structural dietary imbalances.

Nutritional literacy – understood as the ability to read, interpret, and apply available information on food labels – represents a critical yet deficient link in Romanian consumer decision-making. Although tools such as Nutri-Score were designed to simplify informed choices (Grunert et al., 2010), the reality revealed by PwC (2025) shows that consumer motivation is predominantly oriented toward immediate economic benefits. Thus, 90% of respondents prioritize loyalty programs, but almost exclusively based on direct financial rewards (cashback, discounts), to the detriment of those with nutritional or preventive health value.

This gap between the declarative level of nutritional awareness and its effective application reflects a systemic resistance to internalizing nutritional criteria in purchasing decisions. Moreover, the voluntary character of front-of-pack labeling in Romania maintains a low level of pressure on producers to comply, perpetuating informational asymmetries and weakening the protective role of public policies. In the absence of an educational infrastructure tailored to vulnerable groups, this combination of cognitive and legislative barriers reinforces a vicious cycle of suboptimal dietary choices, with direct implications for health equity.

Differentiated access to healthy foods between urban and rural areas constitutes a structural axis of nutritional inequality, simultaneously reflecting socioeconomic, infrastructural, and behavioral constraints. Analyses by INSSE (2024) and FES (2023), corroborated with PwC (2025) trends, show that in rural areas the diet remains centered on calorie-dense, nutritionally poor products – white bread, processed fats, sugar – while the consumption of fresh fruits, vegetables, fish, and fermented dairy remains marginal. The absence of a diversified commercial infrastructure – supermarkets, functional markets, short supply chains – turns access to fresh produce into a chronic deficit, with cumulative effects on population health.

On the demand side, PwC (2025) indicates that only 46% of consumers express interest in local products, and roughly one-third would be willing to pay a higher price for sustainable goods – a threshold insufficient to create the critical mass needed to sustain resilient agri-food markets in disadvantaged areas. The result is a nutritional paradox specific to food insecurity contexts: micronutrient deficiencies coexist with excessive caloric intake (Darmon & Drewnowski, 2008), accelerating the epidemiological transition toward obesity and metabolic diseases. Territorial disparities thus become not only an indicator of food inequality but also a systemic determinant of public health vulnerability, calling for integrated interventions of an economic, infrastructural, and educational nature.

Bridging the gap between the real food basket and the optimal one, grounded in nutritional principles, requires a careful reconfiguration of public policies oriented toward equity, prevention, and sustainability. As Hawkes et al. (2015) demonstrate, effective food policies cannot act on a single factor in isolation but must simultaneously target prices, marketing regulations, and consumer information levels within a coherent framework that supports nutritional equity. From this perspective, the food basket can no longer be interpreted solely as an expression of personal choice but must be understood as the outcome of a regulatable system shaped by economic, legislative, and commercial factors.

Within such a systemic approach, the need for a coherent set of public measures emerges, structured around four major intervention pathways. The first concerns food education and labeling policies, aimed at strengthening the population's nutritional capital and guiding consumption toward sustainable and informed choices.

Comparative data for Romania and other Central and Eastern European countries reveal a significant gap in the integration of sustainability values into consumer behavior. Although

issues such as food safety and support for local production are frequently mentioned by consumers, the ecological or nutritional dimensions of food choices often remain marginal, underscoring the need for proactive, well-targeted interventions.

In this context, nutritional education becomes an essential instrument for strengthening individual food autonomy. The introduction of mandatory nutrition modules into the school curriculum – adapted to different age groups and integrated into disciplines such as biology, social sciences, or civic education – could substantially contribute to the development of healthy and responsible dietary habits. According to WHO (2022) and FAO (2021), early and consistent educational interventions have a direct impact on reducing the risks associated with diet-related non-communicable diseases.

An effective curriculum in this regard should develop competencies such as understanding food composition, critically analyzing nutritional and sustainability labels, recognizing food marketing strategies, and planning balanced meals. Moreover, expanding nutrition education beyond schools – through community programs, practical workshops, public awareness campaigns, and digital initiatives – is essential for reducing intergenerational inequalities in food literacy.

Such interventions, carried out in partnership with local authorities, non-governmental organizations, and food distribution networks, can contribute to building a form of “reflective food capital” at the community level. “Applied nutrition” programs, such as healthy cooking sessions or educational market tours, can transform spaces of consumption into environments of learning and awareness.

When combined with smart labeling policies – integrating indicators such as carbon footprint, seasonality, degree of processing, or local origin – these measures can contribute to defining and implementing an “integrated minimum food basket.” Such a benchmark could function both as a normative instrument and as an educational guide, orienting consumption toward more equitable and sustainable choices.

The large-scale implementation of the Nutri-Score system, in a regulated and mandatory form for all packaged food products, could serve as an essential tool for guiding consumer choices toward healthier options. Nutri-Score offers a synthetic, visually accessible representation of the nutritional value of foods and has already been validated by numerous international studies as effective in supporting health-promoting food decisions (Julia & Hercberg, 2017; Egnell et al., 2020). Moreover, this type of labeling has proven particularly useful among groups with lower levels of nutritional education, thereby contributing to reducing information inequalities and nutritional disparities.

However, for Nutri-Score to reach its full potential, it must be part of a broader framework that includes other dimensions relevant to responsible eating. Complementing nutritional information with sustainability indicators – such as carbon footprint, seasonality, local origin, or degree of processing – would allow for the development of an integrated food profile, offering consumers a comprehensive perspective on the product, not only from a health standpoint but also in terms of its ecological and social impact.

A coherent and unified visual representation of these indicators could serve as the basis for formulating an “optimal integrated food basket,” with a dual function: a normative benchmark for nutritional equity and a practical guide for sustainable consumption. By encouraging the choice of local, seasonal, minimally processed, and nutrient-dense products, such a framework could contribute both to reducing food waste and to strengthening the resilience of agri-food ecosystems. In the long run, this approach could support the institutionalization of a “minimum nutritional-sustainable food basket,” usable as a reference in social policies, in calculating the minimum wage, or in developing public health programs.

The cost of healthy food remains a major obstacle for a significant portion of the population. Recent data indicate that 64% of Romanian consumers adapt their purchasing behavior in response to rising prices, 54% actively seek promotions, and nearly half adjust their shopping lists to remain within available budgets (PwC, 2025). These realities confirm that price is a key determinant of dietary decisions and a major source of nutritional inequality.

In such a context, fiscal instruments can act as levers for rebalancing the food supply. The introduction of differentiated taxation – by increasing taxes on ultra-processed products high in sugar, salt, saturated fats, or additives – alongside subsidy policies for nutrient-dense foods (such as fruits, vegetables, legumes, fermented dairy products, or unrefined vegetable oils) can adjust market price signals without coercively restricting freedom of choice. These measures can function as behavioral guidance mechanisms, more effectively aligning individual decisions with public health objectives (Mozaffarian et al., 2021).

At the same time, stricter regulation of food marketing is essential, especially when it targets vulnerable groups. Banning invasive advertising of ultra-processed products aimed at children and adolescents – from mascots and cartoon characters to online games or influencer campaigns – can reduce early exposure to stimuli that favor hedonic and impulsive consumption. Likewise, limiting the strategic placement of such products in retail spaces (for example, at children’s eye level or in impulse zones near checkout counters) can reduce the likelihood of unhealthy choices.

Complementing these interventions with a code of ethical food communication, adopted by the industry and overseen by authorities, could contribute to rebalancing the relationship between producers’ commercial objectives and the public interest in population health.

Disparities between urban and rural areas in terms of access to healthy food reflect profound imbalances in infrastructure, logistics, and supply chain organization. In many disadvantaged communities, physical access to fresh and nutritious foods is limited, fueling a vicious circle of food vulnerability and social exclusion. In this context, public policies must aim to rebuild resilient local food ecosystems, reducing dependence on large distribution chains and reactivating traditional supply mechanisms.

An essential direction is the support of local agri-food markets, particularly in rural areas and small towns, through sustained investments in physical infrastructure, sanitary

conditions, and logistics. Revitalizing these spaces, alongside the development of agricultural cooperatives and the strengthening of short supply chains, could restore the value of local and seasonal products while facilitating access to minimally processed and more affordable foods.

Expanding equitable food distribution programs – such as providing hot meals in schools, issuing food vouchers for vulnerable populations, or organizing free delivery networks in areas with high levels of food insecurity – represents a set of concrete tools to mitigate territorial disparities. Collaboration among local authorities, non-governmental organizations, volunteer networks, and food banks can transform such interventions into a genuine policy of food solidarity with structural impact.

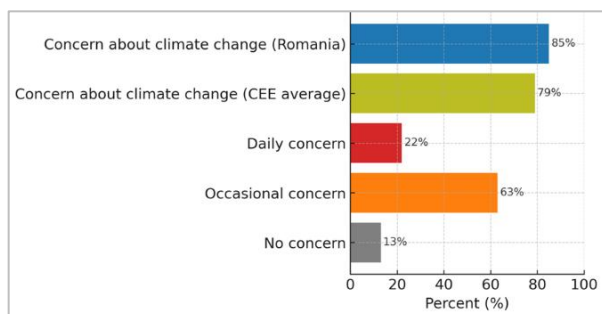
In a global context marked by climate crises, soil degradation, and the depletion of natural resources, the nutritional dimension of consumption can no longer be analyzed in isolation. It is essential to correlate the nutritional value of food with its ecological impact, in order to formulate a dietary model that simultaneously addresses public health, social equity, and planetary sustainability.

Consumer preferences in Romania reveal a growing interest in certain sustainability attributes considered relevant in purchasing decisions. The most prioritized criteria include the absence of pesticides (54%), local provenance (46%), support for community-based environmental initiatives (36%), and the use of ecological or minimal packaging (30%). Other factors – such as the ethical reputation of producers (25%), low carbon footprint and participation in offsetting mechanisms (22%), fair labor conditions (18%), fair-trade certification (9%), or deforestation avoidance (12%) – are perceived as important but remain secondary in the hierarchy of food choices (PwC, 2025).

Integrating these criteria into the decision-making architecture of food consumption requires not only a rethinking of labeling and information systems but also a reorientation of agricultural, trade, and social policies. Developing a food profile that reflects both the nutritional value and the ecological costs and social implications of food products is essential for shaping an integrated nutrition governance system capable of addressing the challenges of the twenty-first century.

In the context of the transition toward more responsible consumption practices, data show that 85% of Romanian consumers express concern about climate change – a percentage higher than the Central and Eastern European average (79%). At the national level, 22% of respondents state that climate change worries them daily, while 63% declare being concerned without thinking constantly about the issue, and only 13% report no concern. However, only 45% declare a willingness to pay a premium for products with a lower ecological impact, indicating a persistent gap between environmental awareness and purchasing behavior.

Figure 3. Concern of Romanian consumers about climate change compared to the Central and Eastern European average.



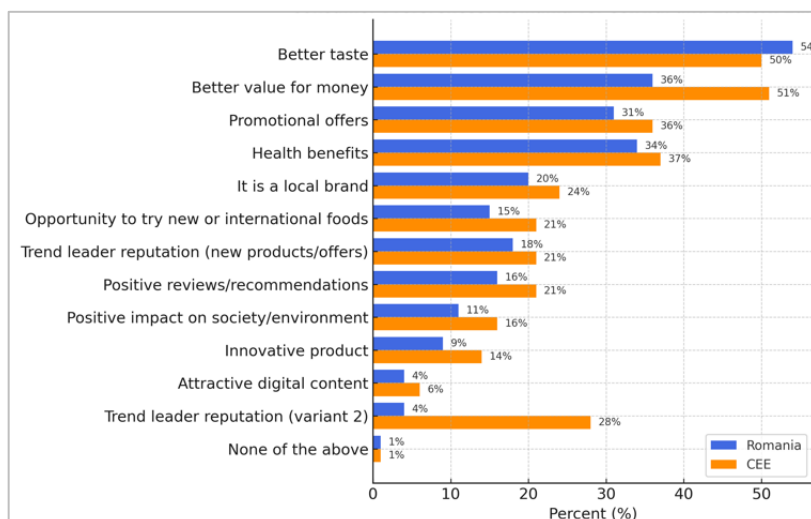
Source: Adapted from PwC Voice of the Consumer Survey 2025

Table 5. Sustainability indicators of food products – comparison Romania vs. Central and Eastern Europe (CEE) average

Sustainability criterion	Romania (%)	CEE (%)
Product is pesticide-free	54	52
Product is locally produced (within the country)	46	46
Product uses minimal or environmentally friendly packaging	30	34
Producer supports local environmental initiatives	36	29
Producer has a reputation for ethical practices	25	23
Producer supports fair wages and good working conditions for all employees	18	18
Product has a low carbon footprint or benefits from carbon offset programs	22	17
Product is fairtrade certified	9	17
Producer has a reputation for diversity and inclusion practices	14	14
Product comes from non-deforested land	12	15
None of these criteria are important when purchasing food products	2	4

Source: PwC (2025), Voice of the Consumer Survey – Romania.

Figure 4. Indicators Influencing Food Product Consumption



Source: Adapted from PwC Voice of the Consumer Survey 2025 – Romania and CEE, PwC Romania & PwC Central and Eastern Europe

The comparative analysis of sustainability indicators and key drivers of food consumption highlights both partial convergence between Romania and the Central and Eastern Europe (CEE) average, as well as notable specificities of the Romanian market. Regarding sustainability criteria, concern for pesticide-free products (54% Romania vs. 52% CEE) and locally produced foods (46% in both) rank highest, reflecting a shared orientation toward food safety and support for local economies. Romania exceeds the regional average in terms of support for local environmental initiatives (+7 pp) and preference for low-carbon products (+5 pp), indicating a slightly stronger sensitivity toward ecological dimensions. However, criteria such as fairtrade certification or sourcing from non-deforested land remain marginal in purchasing decisions (under 15% in both regions).

On the motivational side, the data from Figure 4 show that the main determinants of food consumption in Romania are superior taste (54%), value for money (40%), and health benefits (34%), while strictly promotional factors and local brand affiliation have a weaker impact compared to the CEE average. The observed differences – such as the slightly higher share of concern for positive environmental impact in Romania (11% vs. 10%) or the lower preference for attractive digital content (4% vs. 10%) – suggest that the Romanian market remains dominated by traditional criteria (taste, price, health), while the full integration of sustainability values into consumer behavior is still in an early stage, requiring public policies and commercial strategies to accelerate this transition.

In this context, integrating the analyzed indicators into nutrition and labeling policies – by including carbon footprint, seasonality indices, local origin, and degree of processing – could contribute to shaping an “integrated optimal food basket.” This would serve not only as a nutritional and ecological benchmark, but also as an instrument of social equity, supporting food waste reduction and promoting rationalized consumption with convergent benefits for population health and ecosystem resilience. Looking forward, these measures could culminate in the official definition of a “minimum nutritional-sustainable food basket,” to be established as a normative reference in social policies, minimum wage calculations, and public health interventions.

5. Conclusions

The contemporary food basket should be understood not merely as the outcome of individual choices, but as a structural indicator of nutritional equity, positioned at the intersection of public health, social justice, and sustainability. The substantial discrepancies between the real basket and the ideal one – scientifically defined by WHO and EFSA recommendations – reflect systemic inequalities rather than personal preferences, being shaped by economic constraints, lack of genuine options, territorial imbalances, and commercial influences (Mozaffarian et al., 2021; Herforth et al., 2022).

To address these distortions, this study proposes a new normative benchmark: the minimum nutritional-sustainable food basket. Unlike the current economic basket, constructed around minimal price and satiety, this model reconciles economic accessibility with nutritional adequacy and ecological sustainability. It holds the potential to inform

corrective policies and integrated interventions in nutrition, taxation, and rural development (Egnell et al., 2020; FAO, 2023).

The structural inaccessibility of a balanced diet in Romania – where the estimated cost of a healthy and sustainable basket substantially exceeds the average food budget – underscores the urgency of such a redefinition (PwC Romania, 2025). This gap highlights the need for stronger public interventions to make nutritious diets both affordable and accessible. In this context, the food basket emerges as a legitimate instrument of public regulation, whose integration into the architecture of social policies is not only timely but necessary.

Embedding this basket into public policy would require sustained transdisciplinary efforts, yet it is essential for ensuring long-term nutritional equity. In a society striving for equitable well-being, the right to healthy food cannot remain an aspirational ideal; it must be transformed into a binding political and legal commitment, in line with the principles of modern and inclusive nutritional governance.

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Impact of direct payments on small farms in Bulgaria

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Abstract. *Agriculture occupies a key position in the structure of the national economy of the Republic of Bulgaria, contributing to ensuring food security, employment in rural areas and the protection of natural resources. Small farms represent a major part of the country's agricultural sector, playing an essential role in social stability, regional development and preservation of the traditional rural way of life. The direct payments (Pillar I) are a main feature of the current CAP, commanding almost three quarters of the total budget and have established as the main financial instrument to support farmers. The aim is to achieve stable incomes for farmers, stimulate the sustainable use of agricultural land and preserve biodiversity in rural areas. An important role is the basic payment scheme which is granted to farmers based on the number of hectares farmed; thus the larger the farm the larger the payments received by the farmer. In addition, through a greening payments and cross-compliance condition, the direct payments are intended to promote an environmentally sustainable agriculture.*

This study aims to analyze the impact of the direct payment system on small farms in Bulgaria. The analysis examines both the positive aspects of the support – including ensuring financial stability and stimulating investments, as well as the existing challenges and constraints arising from the administrative requirements and the specific structure of the support.

Keywords: small farms; direct payments; agriculture; CAP.

JEL Classification: Q12, Q18, Q14.

1. Introduction

The policy instruments to achieve the CAP's objectives based on economic, environmental and territorial challenges are divided into two pillars. The first pillar includes direct payments to farmers and market measures, and the second pillar holds the rural development programs. Instruments related to the environment are present in both pillars – an important distinction is that Pillar I schemes are mandatory for farmers to fulfil while Pillar II schemes are voluntary for farmers and includes compensation for costs incurred or income foregone.

1.1. Essence and importance of direct payments

Direct payments are the main mechanism for financial support for farmers. The main objective of these payments is to ensure stability of farmers' incomes while stimulating the sustainable use of natural resources and the conservation of biodiversity (Brady, M., at all., 2020).

Since the reform of the CAP in 2013, direct payments have been restructured into several components, a basic payment, a redistributive payment in support of small and medium-sized farms, a payment for environmental practices (the so-called “Environmental Tax Payment”). “Green payment”) and additional payments for young and small farmers. This multilateral structure aims to achieve a fairer distribution of financial assistance, taking into account the the size and nature of the holdings.

The two most important parts of the direct payment are the Basic Payment Scheme (BPS) and the Greening Payment (GP). The Basic Payment scheme replaces the Single Payment Scheme (SPS) from the 2003 reform. Like the Single Payment Scheme, the Basic Payment Scheme is a basic income support for farmers. The greening payment is a new and mandatory component introduced with the 2013 reform. Strictly, the greening payment is not a new payment, but a new set of conditions that from 2015 applies to 30 percent of the previous direct payment envelope (Regulation (EU) No 1307/2013) (EU, 2013). Hence, the 2013 reform introduced additional mandatory conditions linked to existing payments. The intention with the greening conditions is to promote practices that are good for the environment, soils and biodiversity in particular, and the global climate.

The conditions are:

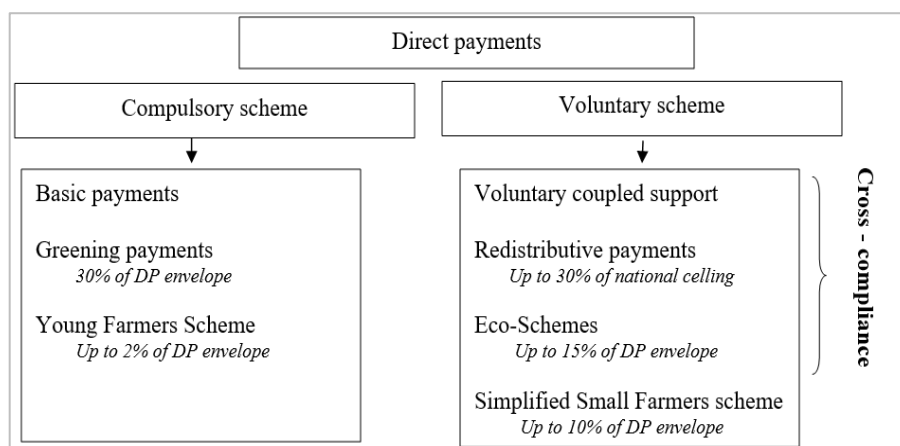
- maintaining permanent grassland,
- crop diversification, and
- establishing ecological focus areas of at least 5 percent of the arable land of a holding.

In the Young Farmer Scheme, Member States must allocate up to 2 percent of their total direct payments to offer young farmers a bonus in their first five years working in the sector. The basic payment scheme, the greening payment and the young farmer scheme are mandatory for Member States.

It is optional for Member States to use part of the direct payments for i) Payments Coupled to Production in sectors undergoing difficulties, ii) Payments for areas with Natural Constraints such as mountain areas and iii) Redistributive Payments to support smaller

farms. Finally, iv) a Simplified Small Farmers Scheme is available for very small farms. An overview of direct payments is given in Figure 1.

Figure 1. The structure of direct payments



Source: Based on (European Commission, 2022)

The second part of Pillar I consist of the market measures. The Common Market Organization (CMO) sets out the parameters for intervention on agricultural markets, includes the rules for marketing agricultural products and covers issues related to international trade and competition.

1.2. Main direct support schemes in Bulgaria

In Bulgaria, direct payments are administered by the State Fund “Agriculture” – Paying Agency and include the following main schemes:

- Single Area Payment Scheme (SAPS): Basic income support for sustainability (Articles 21-28 of Regulation (EU) 2021/2115) is an annual payment per hectare to which half of the direct payment budget is devoted. A payment for small farmers not exceeding EUR 1 250 per year can be granted as a lump sum or on a per hectare basis;
- Redistributive payment (Article 29 of Regulation (EU) 2021/2115): Additional support for the first 30 hectares of arable land intended to encourage small and medium-sized farms. The amount per hectare and the number of hectares per farmer for which the redistributive income support is available and aims to redistribute direct payments from larger to smaller or medium-sized farms;
- Agri-environment and climate payments: An incentive to implement sustainable agricultural practices;
- Payments for areas with natural or other specific constraints: Compensation for farming in hard-to-cultivate areas;
- Payments for young farmers: Stimulating the entry of young people into the agricultural sector.

These schemes aim to achieve a more balanced socio-economic development of rural areas and provide support to vulnerable categories of producers.

1.3. Definition and characteristics of the small farm

In the programming period 2014-2020, according to the normative documents, the European Commission gives each Member State, according to the structure and condition of agricultural holdings, the opportunity to define and adopt a national definition of a small farm. When determining the definition of small farms, Bulgaria chooses to apply the criterion of economic size of farms. The economic size of farms is measured in Standard Output (SO)/Standard Production Output (SPO). The SO reflects the average monetary value of agricultural production at a producer's price in euros. The SO does not include direct payments, value added tax and other taxes. The SO is calculated on the basis of average prices for agricultural/livestock production – on an annual basis or for a period.

According to this criterion, Bulgaria adopts a national definition of a small farm – an economic size of EUR 2000 to EUR 7999, measured in the SO (Fidanska B, N. Koteva, 2020). In the programming period Bulgaria continued to use economic size for the definition of farms. For small farms is accepted the farms with economic size of EUR 3000 to EUR 7999.

Typical characteristics of small farms include limited resource opportunities (land, equipment, capital); high degree of family involvement in the production process; lower productivity compared to large farms; greater vulnerability to fluctuations in market prices and climatic conditions; dependence on direct payments and other forms of support for economic sustainability.

Small farms in Bulgaria play an important role in maintaining the social organization of rural society, but are exposed to serious economic and administrative challenges.

2. Methodology

The study adopts a descriptive and analytical approach. By comparing statistical data and secondary analysis of existing studies, the aim is to identify the main trends, problems and effects of the application of direct payments to the small farms in Bulgaria. In addition, by using case studies, an attempt is made to better understand the individual consequences for specific groups of farmers.

The study aims to analyze the impact of the direct payment system on small farms in Bulgaria. The analysis will consider both the positive aspects of the support – including ensuring financial stability and stimulating investments, as well as the existing challenges and constraints arising from the administrative requirements and the specific structure of the support.

The paper offers reasoned conclusions about the effectiveness of the applied direct support mechanisms and will formulate recommendations for increasing their relevance and effectiveness to the needs of small farms in Bulgaria.

Materials and Methods

Many authors analyzed different aspects and prospective of direct payments. OECD looked at the consequences of agricultural policies on the distribution of farm income (Moreddu,

C., 2011). After Agenda 2000 the topic of direct payments distribution is discussed by various studies in Europe (Severini, S., Tantari, A., 2013).

Other authors pointed that in general big holdings have received financial support disproportionately compared to small farms, generating situations of disequilibrium that have impacted on levels of investment, productivity and economic efficiency of farms (Galluzzo, N., 2013). Beluhova-Uzunova, R., D. Atanasov and K. Hristov (2017) are analyzing the direct payments distribution in Bulgarian agriculture. They used Lorenz curves to make visual impression of direct payments distribution. Three important comparisons between Bulgaria and other Member states are observed in their study.

Although there are many studies that present the effects of policy intervention, the aim of this survey is to analyze the impact of direct payments on small farms in Bulgaria.

The present study is prepared on the basis of a combination of quantitative and qualitative methods. The analysis is based on:

- Descriptive analysis: description of the main characteristics of direct payments and small farms
- Benchmarking: comparison of the performance of small and large farms in terms of financial support received and their economic situation
- Case Study: Presenting real-world examples of small farms participating in direct payment schemes
- Critical analysis: identification of weaknesses and challenges in the current model of support.

The combined approach aims to provide a holistic and balanced view of the topic, avoiding a one-sided interpretation of the effects of direct payments policy.

3. Results

3.1. Analysis of the impact of direct payments on small farms

Direct payments have a significant positive impact on the economic sustainability of small farms in Bulgaria. The main positive effects include:

- Ensuring minimum incomes: For many smallholder farmers, direct payments represent a major source of income that compensates for the volatility of agricultural production revenues, especially in adverse market conditions or natural disasters.
- Liquidity support: Receiving a regular subsidy allows small farms to cover the current costs of seeds, fertilizers, preparations, fuel and other basic resources needed for production activities
- Promotion of investment: Although limited in scale, direct payments create an opportunity for small capital investments – for example, to purchase light agricultural machinery, improve irrigation systems or modernize agricultural buildings.
- Incentivizing sustainable practices: By linking part of the support to environmental requirements (eco-schemes), small farms are encouraged to implement sustainable agrotechnical practices that contribute to soil protection and biodiversity.

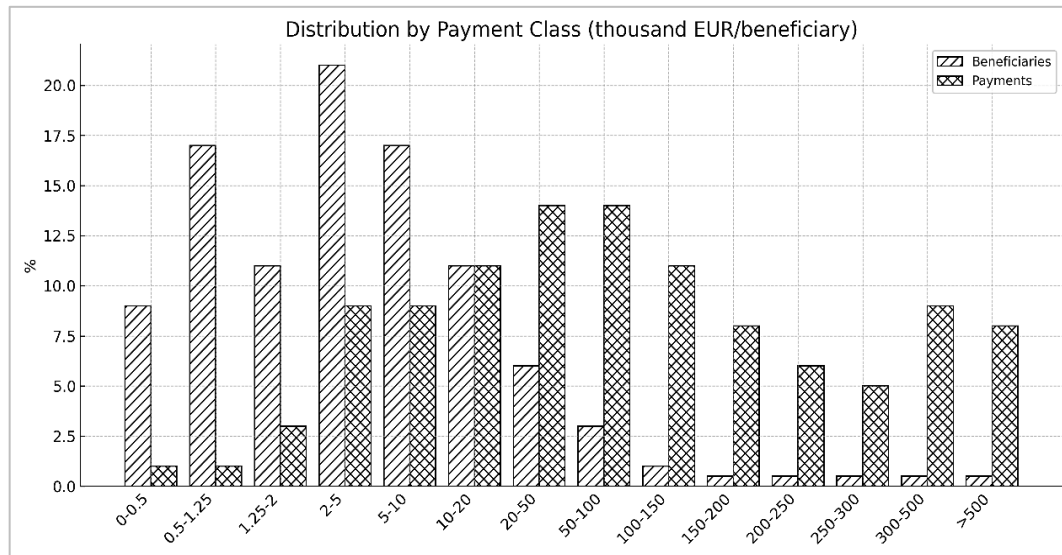
Despite the positive effects, there are a number of challenges and limitations in the access and effectiveness of direct payments to small farms:

- **Administrative burden.** The procedures for applying for direct payments are often complex and require significant administrative effort. Small farms, especially those without administrative capacity or access to advisory services, are at a disadvantage.
- **Unavailability of support.** For very small farms, the amount of subsidies received is insufficient to achieve significant economic growth or modernization of production.
- **Inefficient targeting of funds.** Often of the support is concentrated in larger farms, which reduces the relative share of funds reaching small producers.
- **Dependence on subsidies.** The constant dependence on direct payments creates a risk of reducing innovation and entrepreneurial activity among small farmers.

In the comparative analysis, the data show that in Bulgaria direct payments are unevenly distributed between small and large farmers. According to the data shown in Figure 2, about 20% of farms receive 80% of the total volume of direct payments. This indicates a concentration of subsidies in the hands of larger economic operators. Figure 2 shows that despite the large number of beneficiaries among small farms, the payments received are the smallest.

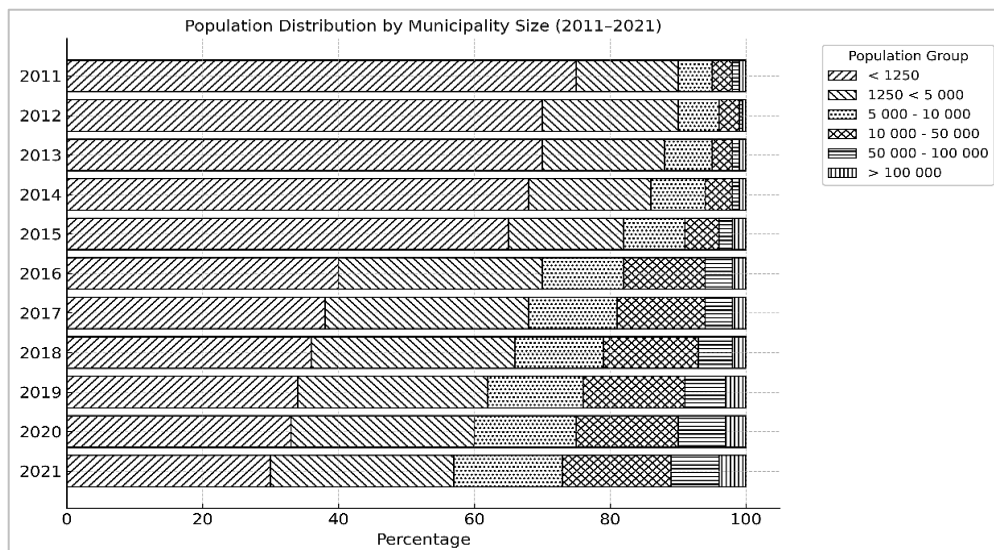
This situation leads to a deepening of structural imbalances in agriculture and puts small farms in a less competitive position.

Figure 2. *Distribution on beneficiaries and payments by payment class*



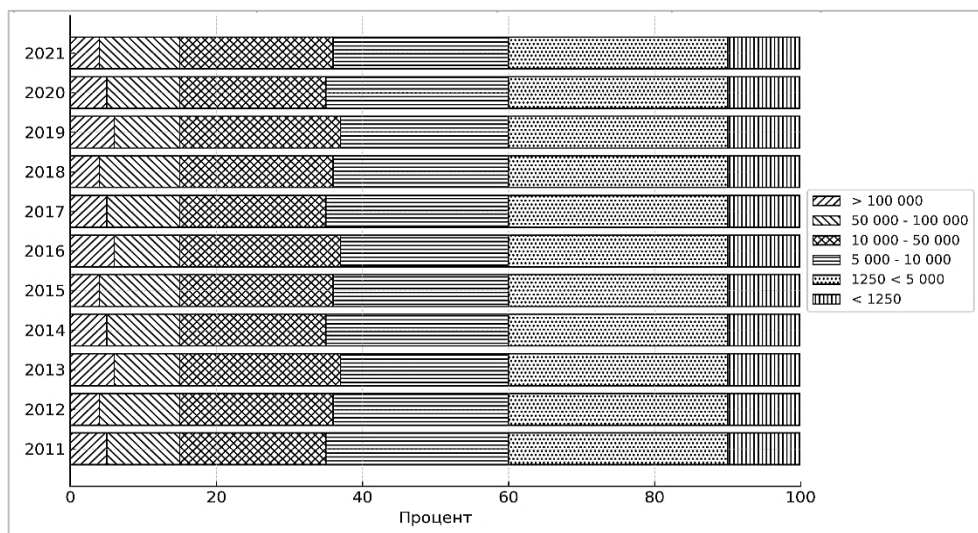
Source: State Fund – Agriculture, PA; Ministry of Agriculture and Food

Figure 3 shows the proportional distribution of beneficiaries of direct payments in Bulgaria for the period 2011-2021. At the same time, the group of small and medium-sized farms increased (from 1250 to 50,000). The group of large farms has a slight increase in the number of beneficiaries, but most of the support funds are concentrated there.

Figure 3. *Distribution of beneficiaries for direct payments*

Source: State Fund – Agriculture, PA; Ministry of Agriculture and Food

The distribution of direct payments over the years has benefited the large farms that receive the largest share of the support (Figure 4). According to the European commission reports for the distribution of direct payments on agricultural producers the beneficiaries with ≤ 5 ha are 37.8% and area 1.3% receiving 3.5% of direct payments. The second group beneficiaries with 5-250 ha are 56.6% and area 31.5% receiving 39.5% of direct payments. The beneficiaries with farm size > 250 ha are 5.6% and receiving the largest portion of direct payments 57.3%.

Figure 4. *Distribution of direct payments by classes*

Source: State Fund – Agriculture, PA; EU Report Direct payments to agricultural producers, 2021

3.2. Case Studies

Case study 1: A small family farm located in Northwestern Bulgaria cultivates approximately 12 hectares of land and receives an annual subsidy of about BGN 4,000 under the Single Area Payment Scheme (SAPS) and the redistributive payment. The financial support is primarily used for the purchase of fertilizers and the maintenance or repair of essential agricultural equipment. Without these subsidies, the farm would be unable to sustain its activities due to the inability to cover even the most basic production costs. The case reflects the situation of many small-scale holdings in economically disadvantaged and depopulated rural regions, where agricultural operations depend heavily on direct payments to ensure short-term viability.

Case study 2: A young farmer from Southern Bulgaria manages a 5-hectare farm with perennial crops and benefits from both direct payments and targeted support under the Rural Development Programme (2014–2020) measure for the modernization of small farms. Through the combination of these financial instruments, the farmer invested in a drip irrigation system, resulting in a more efficient use of water resources and an increase in overall farm productivity of more than 30% within three years. The case illustrates the potential of complementary funding mechanisms to promote modernization, environmental efficiency, and economic sustainability in small-scale farming.

Selection rationale

Based on field interviews conducted by the author, 2024 the two case studies were selected to represent diverse but comparable examples of small agricultural holdings in Bulgaria, differing in both regional and developmental characteristics. The first case focuses on a traditional family farm in a region with structural economic difficulties, where farming primarily serves as a means of subsistence. The second case features a younger and more entrepreneurial farmer in a comparatively dynamic region, whose activities are oriented toward innovation and productivity growth. This contrast enables a broader understanding of the role of direct payments and complementary support measures in shaping the adaptive capacity of small farms across different socio-economic contexts.

The findings from the two cases confirm the dual nature of direct payments as both a stabilizing mechanism and a limiting factor in the development of small farms. On the one hand, they provide essential income support, ensuring continuity of production and preventing the abandonment of agricultural land. On the other hand, reliance on these payments alone does not necessarily foster competitiveness, innovation, or long-term sustainability. The comparison suggests that integrated approaches – combining income support with targeted investment measures – are more effective in promoting structural adaptation, technological upgrading, and the overall socio-economic resilience of rural areas.

4. Discussion

The analysis of the impact of direct payments on small farms in Bulgaria reveals a complex set of effects that are both positive and limiting. The conclusions of the study highlight both the importance of financial support for the survival of small producers and the existing structural weaknesses in the support mechanism.

On the one hand, direct payments unquestionably fulfill their role as an instrument for stabilizing incomes in agriculture. They allow a large part of small farmers to continue their production activities, maintain minimal levels of investment and withstand market and climate shocks. In some cases, the support has led to an improvement in the resource base of farms and to the implementation of environmental practices.

On the other hand, the current direct payment system shows a limited ability to support the long-term development and modernization of small farms. The presence of a high administrative burden, a low absolute amount of support and a concentration of subsidies in larger operators limit the potential of small producers to achieve real competitiveness in the market.

It is also necessary to take into account that direct payments often do not sufficiently stimulate entrepreneurial activity and innovation in the small agricultural sector. Instead of serving as a basis for sustainable economic development, in many cases they act as a passive mechanism for maintaining the existing status quo.

In this context, it is important to look for solutions for:

- Reducing administrative burdens and facilitating access to support for small farms;
- Optimization of the payment structure so as to promote not only the survival, but also the development of small farmers;
- Combining direct support with targeted investment programs, training and consultations to increase the capacity of small farms;
- Increasing transparency in the distribution of subsidies and creating additional mechanisms to protect the interests of the most knowledgeable producers.

Such a reform could turn the direct payment from an instrument for survival into an instrument for sustainable growth and development of the small farms in Bulgaria.

5. Conclusions

Direct payments under the Common Agricultural Policy (CAP) are a key factor for the economic stability of small farms in Bulgaria. They provide vital support in volatile markets and climate risks, contribute to sustaining agricultural activity in rural areas and promote the implementation of sustainable agrotechnical practices.

However, the study reveals that the current support model is not fully effective in terms of the development and modernization of small farms. The main constraints relate to administrative obstacles, insufficient support and concentration of resources in larger operators.

Reform of direct support policies needs to focus on:

- Providing easier access to support for small farms
- Implementation of targeted measures to stimulate innovation and sustainable growth
- Achieving a fairer distribution of funds for the benefit of vulnerable producers.

Only through a balanced and integrated approach can direct payments fulfill their strategic role not only as a stabilization tool, but also as a driver for the sustainable development of the small agricultural sector in Bulgaria.

The promotion of financial support mechanisms by the state should be strengthened. For sustainable small farms, especially in mountainous areas, all possible financial mechanisms provided both under the European Agricultural Fund for Rural Development and the financial mechanisms of the cohesion policy of the regions, through which the necessary infrastructure for small farms in rural areas can be financed, must be used.

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The Contribution of European Rural Development Funds to Generational Renewal

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Abstract. *This study examines the effects of rural development tools under the Common Agricultural Policy (CAP) on agricultural generational renewal. The study assesses programs for the establishment of young farmers by gathering scattered data from administrative reports, public statistics, and intervention frameworks. The results demonstrate that although EU funding has a beneficial effect, it is hampered by issues such as bureaucracy, a lack of information, and co-financing requirements. Its primary contribution is the logical synthesis of the available data and the development of fresh research questions. The conclusions indicate a real potential for support interventions, but also highlight the need for more thorough monitoring of the real impact of these funds regarding the establishment, retention, and survival of young-farmer-led businesses.*

Keywords: young farmers; generational renewal; establishing young farmers; European Funds; Common Agricultural Policy; rural development; LEADER.

JEL Classification: Q10; Q12.

1. Introduction

This paper aims to analyze how European rural development funds under the Common Agricultural Policy, mainly the European Agricultural Fund for Rural Development (EAFRD), have supported generational renewal in agriculture. The focus is on the way that measures dedicated to young farmers, the distribution of funded projects evolved, and the main barriers identified during the implementation. This study analyzes disparate data and information, providing a clear picture of how funds for young farmers have been utilized and formulating research questions for future evaluations. The analysis highlights both the support mechanisms (establishment grants, complementary investments, LEADER) and the persistent limitations (bureaucracy, co-financing, regional differences). This leads to the following research questions to be addressed in the paper:

- How has the support for young farmers evolved between the 2007–2013, 2014–2022, and 2023–2027 programming periods?
- How have the projects and funding for young farmers been distributed territorially, and what regional patterns can be observed?
- What intermediate results stand out regarding the establishment and consolidation of young-farmer-led businesses?
- What role have instruments such as LEADER, counseling, and professional training played in complementing establishment grants?
- What are the recurrent barriers in accessing and implementing the support, and how are they reflected in the differences between regions?

The paper is structured as follows: in the “Literature Review” chapter, we conducted a review of research concerning European policies on generational renewal with the support of European funds, as well as the barriers that young farmers face when trying to develop a business in the rural environment in general and in the agricultural sector in particular. The “Data and Methodology” chapter highlights data series on demographic evolution, investments made with European funds, and the number of beneficiaries.

The “Results and Discussions” chapter contains the results of the analysis of data series regarding demographic decline, with an emphasis on the aging of the rural population, corroborated with the economic effects of the European financing mechanisms on the process of generational renewal.

2. Literature Review

In many developed nations, the number of youth engaged in agriculture has decreased in recent decades. As part of the CAP reform, the EU has implemented grants for the establishment of young farmers, farm consolidation, and additional payments for them in order to address this demographic imbalance (May et al., 2019).

European legislation provides that a “farmer” means “a natural or legal person, or a group of natural or legal persons, irrespective of the legal status which such a group and its members have under national law, [...] who carries out an agricultural activity” (EC, 2021).

To be classified as a “young farmer,” a rural entrepreneur must meet these conditions and not be older than 40 years old. Being of “head of the holding” means that the young farmer has total control over the farm. European fund support is also conditioned on having the necessary skills to manage the farm. Each member state sets its own rules concerning the maximum age and the required skill level for obtaining support. The professionalization of the agricultural workforce and, implicitly, the improvement in the sector's performance are supported by the imposition of a particular skill level. According to Giannakis and Bruggeman, agricultural sectors with a younger and more skilled workforce are more likely to see strong economic results. An aging agricultural population is 92% less likely to achieve high performance, and countries with a highly qualified agricultural population have nearly nine times the chance of achieving high economic performance compared to those where the majority of farmers have inadequate agricultural training (Giannakis, Bruggeman, 2015).

The financing needs of young people have not been met by generational renewal support initiatives like the establishment of young farmers, the consolidation of their farms, or complementary payments in prior fiscal periods (Scown et al., 2020). These mechanisms are also part of the strategic plans being implemented by member states during the current programming period. By giving young people the chance to engage with agriculture, these programs support the sustainability and viability of the European agricultural industry (Dimitriadi et al., 2025).

Given the fact that the number of young people starting businesses in rural areas in general and in agriculture in particular continues to remain low, member states must allocate at least 3% of the budget of their CAP strategic plans for direct payments to young farmers during the 2023-2027 period. To benefit from this form of support, in most member states, farmers must be under 40 years old. Based on the analysis of the 28 approved national Strategic Plans (SPs), it is estimated that 380,000 young farmers will benefit from €6.8 billion from the CAP and an additional €2 billion allocated by member states for their direct payments (EC, 2023). The measures adopted by member states have allowed, in just one year of SPs implementation (2024), approximately 164,000 young farmers, including 55,300 women, to receive establishment support (European Commission, 2025).

The findings indicate that while coordinated policies can help reduce demographic decline, the rate of population aging – especially among farm managers and in rural areas – is outpacing the rate at which young people are relocating to rural areas or establishing businesses there. Just 12% of European farmers were under 40 as of 2020, with 57% of them being over 55. (Eurostat, 2025) The younger age of farmers and their educational attainment are positively correlated. According to statistics, 21% of farmers under 35 have completed an agricultural college, university, or other type of higher education, while only 4% of those over 65 completed some kind of higher education. This discrepancy suggests an increase in specialization and academic training among the new generation of agricultural professionals (Sajn, 2025).

The proportion of young farmers in Romania declined further, reaching less than 2% in 2020. Furthermore, in 2020, just 1% of farm managers had agricultural studies (Eurostat, 2025). Due to their propensity to invest in restructuring and modernizing older farms by introducing new technologies and business ideas, adopting sustainable practices like organic farming, and increasing efficiency, young farmers play a critical role in maintaining production on EU farms and in the vitality of rural areas. As a result, the aging of farm managers and the lack of skills among the young people who should be replacing them in 10–20 years severely affect farm performance (Sajn, 2025).

According to our research, the primary challenges faced by young farmers did not change over the analyzed three implementation periods. According to Zagata et al., the main obstacle is the lack of access to land, which is brought on by the scarcity of productive land, the consequences of direct payments, and legislative changes. Young farmers' development is also hampered by price volatility, trouble obtaining credit or other funding sources, and a lack of risk-taking and entrepreneurial abilities. The shortage of social and educational opportunities as well as the declining vibrancy of rural areas also are also barriers in the way of generational renewal (CEJA, 2023).

Young farmers also face another significant obstacle: excessive bureaucracy. This includes a large volume of paperwork, strict deadlines, and cumbersome procedures, including on-site inspections, to access funds and manage agricultural businesses. Studies from 2014 (PE, 2014) and 2017 (PE, 2017) show that excessive regulation increases the administrative burden and costs for both managing authorities and beneficiaries, also creating an additional risk of errors, which interferes with achieving CAP objectives. Recent research (EU CAP Network, 2025) indicates that few farmers and other rural development actors have noticed any positive impact from the measures taken by the Commission and member states in order to reduce bureaucracy. Numerous studies have raised the issue of the CAP's inability to achieve its sustainable development goals, due to inequitable allocation and a lack of refined indicators to measure the impact of European funding, bureaucracy, and farm polarization.

3. Methodology

The study uses time series and territorial comparisons to characterize the dynamics of indicators regarding generational renewal in farming. The CAP Strategic Plan (SP) 2023–2027, the programmatic and implementation documents elaborated by the Ministry of Agriculture and Rural Development (MARD), the reports of the Rural Investment Financing Agency (RIFA) and the Agency for Payments and Intervention in Agriculture (APIA) were used as working materials. The data regarding the number of projects contracted, the amounts requested/contracted/paid, the approved unit values, the demographic situation, and the evolution of farms were extracted from the official reports of RIFA and APIA concerning the implementation of the National Rural Development Programme (NRDP) 2007-2013, the National Rural Development Programme 2014-2022 (NRDP 2022), and the CAP SP 2023-2027, the agricultural census for the year 2020, data

series from Eurostat and the National Institute of Statistics (NIS), the European Commission (EC), and the European Parliament (PE), and were used to illustrate the impact of the funding on young farmers.

The research methodology combined both qualitative and quantitative analysis. The qualitative component consisted of examining the legislative and institutional framework for CAP interventions, primarily financed by the European Agricultural Fund for Rural Development (EAFRD) for rural development investments and the European Agricultural Guarantee Fund (EAGF) for direct payments and market interventions. The analysis also included possible synergies with other European funds (e.g., ESF+), focusing on implementation mechanisms aiming to support the establishment of young farmers, including those available under the LEADER axis for Local Action Groups (LAGs). The quantitative component was based on an analysis of data from the RIFA and MARD, and evaluated both the effectiveness of direct support mechanisms for young farmers (e.g., M112, sM 6.1, RD 30 or PD-03) and the impact of the funding provided through LAGs on the attractiveness of rural areas. The results will be reported using summary statistics and standardized graphical representations.

The limits of this method are related to the fact that the analysis is observational and descriptive. The results show levels and trends, not the effects of the authorities' interventions. The differences noted between development regions may reflect unobserved and unquantified factors in the analysis. Any correlation identified does not imply a causal relationship.

4. Results

The primary tool for enabling youth access to capital, resources, and agricultural land is CAP, which helps to revitalize rural communities. The primary conclusions of this study on generational renewal in Romanian agriculture within the framework of CAP implementation suggest that the support measures had a limited but favorable, if modest, impact. One of the main conclusions is that the rate of replacement for older farmers is still slow, even with large budget allocations made through Intervention RD 30 from the CAP SP 2023-2027 and sub-measure (sM) 6.1 from the NRDP 2014-20220. Even though European financial aid is crucial, it is insufficient to reverse the demographic trends of the aging rural population and the youth migration to cities or overseas.

In all three programming periods examined, young people have oversubscribed the funds allotted for establishment due to a lack of capital. Since Romania's CAP budget was cut for the 2023–2027 period compared to 2014–2022, the establishment budget has decreased by more than 57%, from €580.6 million to €244.51 million, and as a result, the number of contracted projects has decreased by more than 73.8%. At the regional level, we observe a relative stability in regions such as North-West, South-West Oltenia, or South-Muntenia, and a decline in the number of financing contracts in regions such as Bucharest-Ilfov and North-East during the 2023-2027 period in comparison to the other

two periods examined. These trends are also influenced by the reduction of the budget allocated to RD 30 compared to sM 6.1.

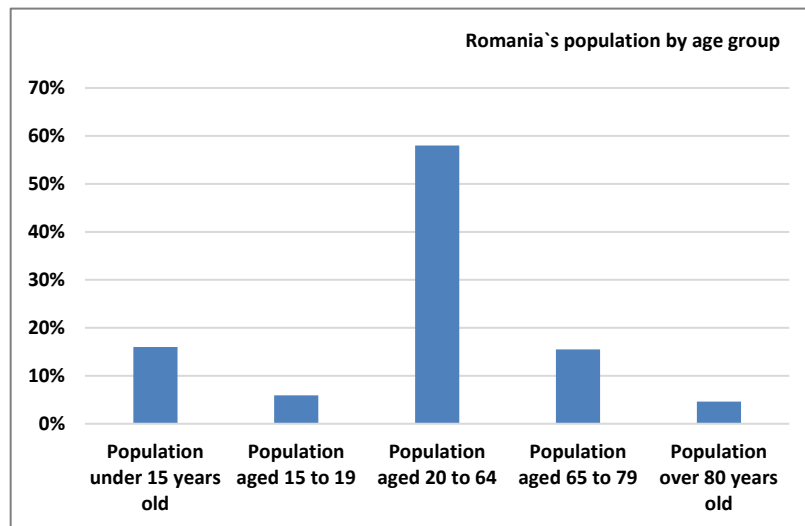
Examining the demographic picture is the first step in determining whether this framework is having noticeable effects on agriculture. The aging trend should reverse and there should be more young people in agricultural management roles if the policies are effective. This reality is documented in the next subsection.

4.1. Demographic deficit

Statistics reveal a low level of youth involvement in farm management in Europe, despite administrative policy initiatives. 57% of farm managers are over 55, compared to just 6% who are under 35. The structural peculiarities of European agriculture, where family farms frequently hide the active participation of successors who, despite fostering innovation and continuity, are not included in statistics, amplify this phenomenon (Sutherland et al., 2012).

The situation is even worse in Romania's rural areas, which are characterized by an aging population and a precarious demographic base: only 5.9% of village residents are between the ages of 15 and 19, and more than 20% of the population is over 65 (Figure 1). Attracting young people to agriculture and the rural environment is becoming a significant strategic challenge for the future of the European and Romanian economies, as population aging represents the largest fiscal risk that EU member states are facing in the medium term (Crichton-Miller et al., 2025).

Figure 1. Romania's population by age group

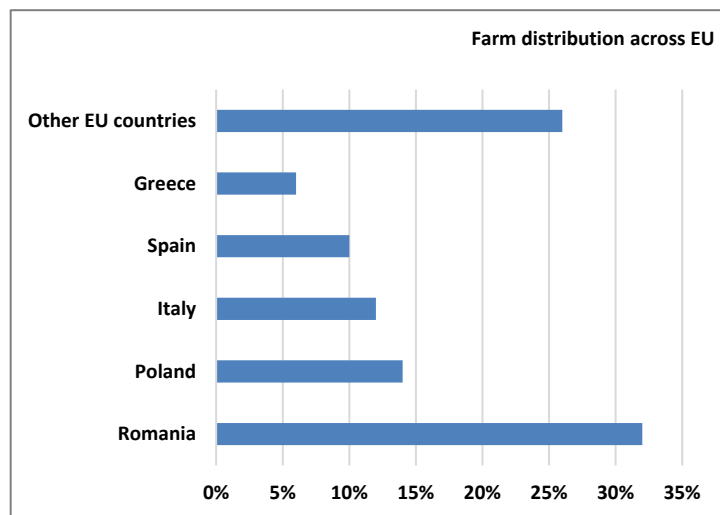


Source: Eurostat, 2023

The agricultural sector also reflects the demographic data. Romania was home to 32% of the 9.1 million farms that were registered in the EU as of 2020 (Figure 2). There are more

farms than in any other nation (Eurostat, 2025). The reason for this is that, on average, Romanian farms are smaller than those in other states: only 23% of Romania's agricultural land is used by 90% of small farms (those with less than 5 hectares), and the majority of their output is focused on self-consumption (Eurostat, 2025).

Figure 2. *Distribution of farms at the European level in 2020*



Source: Eurostat, 2025

Furthermore, Romania's young farmer situation is marked by a steady drop in the percentage of people under 35, to less than 2% in 2020. In the same year, about 1% of farm managers had agricultural studies. This lack of skills has a detrimental effect on farm performance because young farmers – especially those with specialized education – are more willing to create creative farms that are tailored to new business models that support biodiversity and environmental protection measures or global market challenges. In contrast, one-fifth of young farm managers in Europe during the same time period had received a comprehensive agricultural education (Eurostat, 2025). The structural disparities and the dangers of an agricultural sector that is not adequately equipped to handle ecological and economic challenges are highlighted by the disparity between Romania's situation and the European average.

The lack of professional training is aggravated by educational disparities in rural areas, where academic achievement is noticeably worse than in urban areas. Nearly thirty percent of rural students did not receive a grade of five or higher on the 2025 national evaluation exam, according to recent data. This indicates that there is still a significant risk of school dropout and a shortage of skilled workers for agriculture, which will have a significant impact on the sector's performance. Beyond merely guaranteeing continuity in the agricultural profession, the small percentage of young farmers at the EU level can cause a number of disruptions (Bock et al. 2020).

As a result, the impacts are not limited to the educational setting. Generational renewal and providing young people in rural areas with a high degree of skills are among the essential elements for guaranteeing food security and the survival of villages.

4.2. Obstacles to Demographic Renewal

To address the phenomenon of rural depopulation, various strategies have been developed by European Commission and the governments of member states. One of the main levers is funding for young people who wish to start a business in rural areas, and especially in the agricultural sector, in order to increase their attractiveness.

Young people believe that a career in agriculture doesn't offer the same satisfactions or quality of life prospects as other economic sectors (Priani et al., 2023), and consequently, the number of those who choose to train and work in agriculture is declining. We are also witnessing a phenomenon of farm consolidation, which leads to a decrease in the overall number of farmers and limits young farmers' access to land. On the one hand, the number of farms across the European Union dropped by about 5.3 million between 2005 and 2020, to approximately 9.1 million (Eurostat, 2023). This nearly 37% decline is a result of the disappearance of small farms (Greenpeace European Unit, 2024). In 2007, there were 4.3 million small commercial farms in the EU. Their number decreased by 44%, up to 2.4 million in 2022. Most small farms are located in countries like Bulgaria, Cyprus, Greece, and Romania. On the other hand, the number of large farms – which generate an economic output of over €250,000 per year – has increased by more than 50% between 2007 and 2022. Most large farms are located in countries like Belgium, Denmark, Germany, France, and the Netherlands.

These figures demonstrate the polarization of agriculture. In essence, direct payments and other forms of support for farmers are directly correlated with the size of the farm (the agricultural area worked) or the value of production. More specifically, the value of direct payments is directly proportional to the area a farm utilizes. Half of the recipients of direct payments are very small farms (under 5 ha) that utilize just 4.7% of European agricultural land and receive 5.5% of these payments (Sajn, 2025).

Farms that use between 5 and 250 hectares (family and commercial farms) represent half of the beneficiaries and receive nearly 75% of the direct payments. This type of farms controls 68% of EU's agricultural land. Only 1.3% of direct payment beneficiaries are large farms (over 250 hectares) and they receive 22.9% of this support. These farms use 27.3% of agricultural land in the EU. (EC, 2024) Large farms have a stronger market position, control vast areas of land, and have easier access to credit, making them more attractive to financiers. On the contrary, research shows that small farms are not typically able to develop viable businesses, making them less attractive to the younger generation, and thus slowing the revitalization of rural areas (Guerra et Lopes, 2019).

In addition, young farmers are perceived by bankers as having a higher risk profile compared to more experienced farmers. The lack of practical experience, capital, and

collateral, the small areas of land utilized (the average size being 16.1 hectares) (EC, 2017), and in some cases, a lack of an adequate business plan all contribute to this elevated risk profile (CEJA, 2023).

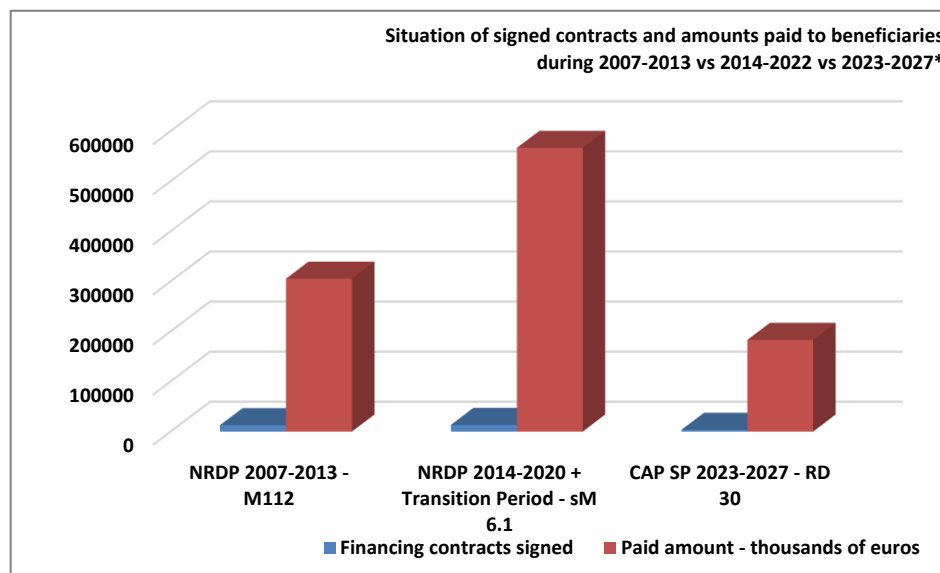
Small farms were previously seen as a barrier to rural development because it was thought that they produced insufficiently or inefficiently and were unable to find a market, which prevented them from providing a sufficient income for their families. But in recent years, policymakers have reexamined the contribution of small farms to the growth of rural areas and regions, and they have given them particular consideration through the CAP. Reorienting from an industrial type of agriculture to a model of farming that takes into account the three areas of sustainability – the economic component, which is correlated with production factors like land, labor, and capital as well as the income of agricultural producers; the social component, which determines the quality of life in rural areas; and the environmental component, which aims to protect natural resources for future generations – is another basis for this change in perspective (Cardillo et Cimino, 2022).

In order to make developing businesses in rural areas, especially in the agricultural sector, which fully experiences the negative effects of climate change, more attractive for young people, they need capital and certainties regarding a decent income. They also need public authorities to invest in providing them with access to services similar to those available to young people in urban areas: transport infrastructure, access to quality medical and educational services, culture, and a digital infrastructure that allows them to innovate. The lack of these, combined with poor access to agricultural land, has contributed to the massive depopulation of villages and the migration of young people to urban areas.

The programs created by EU member states have been impacted by the paradigm shift brought about by the CAP reform. In addition to giving young farmers and small farms the money they need to become farm managers, these programs have taken special steps to support them by reviving rural areas through local development strategies carried out by LAGs with funding from the LEADER axis, a part of national rural development programs.

In conclusion, there are many obstacles, including the standard of living in rural areas, the distribution of support, and the availability of land and capital. Important tools have been introduced by the CAP reform, but their effectiveness hinges on combining funding with territorial measures that improve the appeal, usefulness, and predictability of rural areas for young people. In light of this, we will examine the actual distribution of the young farmer-focused interventions in Romania in the following subsection, as well as any reported intermediate outcomes for the programming periods (Figure 3).

Figure 3. Comparative table 2007-2013 vs 2014-2022 vs 2023-2027: situation of signed contracts and amounts paid to beneficiaries. The final amounts for NRDP 2014-2022 and CAP SP 2023-2027 may vary, as a result of the completion of payments to beneficiaries, the conclusion of litigation, etc.



Source: Rural Investment Financing Agency

4.3. Funds for the establishment of young farmers

Over the course of the three fiscal periods analyzed, European-funded rural development programs implemented in Romania targeted measures to draw young people to rural communities with the aim of modernizing and revitalizing these areas. The NRDP 2007–2013 allocated €7.6 billion for agricultural and rural development support programs. 12,770 young farmers signed financing contracts totaling €321.76 million through Measure 112, “Establishment of young farmers.” Payments to beneficiaries totaled more than €305.3 million, according to RIFA data. Within the NRDP 2014-2022, a total of €12.7 billion was allocated for both Pillar I (direct payments) and Pillar II (investments). Under Pillar II, sub-measure 6.1 “Support for the establishment of young farmers” was allocated a public budget of €580.6 million. Throughout the financial period, seven project submission sessions were launched at the national level (one each in 2015, 2016, 2017, 2018, and 2020, and two in 2021), and one at the ITI Danube Delta area level. A total of 19,653 projects were submitted, of which 13,921 were contracted. The value of payments made reached €559.9 million⁽¹⁾.

Additionally, through a transitional procedure, 1,055 projects with a public value of €13.7 million (the remaining amount to be paid to finalize these contracts) were transitioned from the NRDP 2007-2013 to the NRDP 2014-2022. Related to these, payments of €13.4 million were made⁽²⁾.

The result indicators for this sub-measure, specifically the contracting rate of 98.9% and the payment rate of 98.7%, demonstrate the high interest of young people in getting involved in agricultural businesses.

Based on these results, the next section will show how the interventions for young people were taken over and adjusted in the CAP Strategic Plan 2023–2027.

4.4. Policy Instruments for Young Farmers within the CAP Strategic Plan

The oversubscription of funds allocated for the establishment of young farmers between 2007 and 2020 and the slow pace of generational renewal in rural areas – which has a direct impact on replacing farm managers over 55 with young people – led policymakers to require member states to allocate at least 3% of their CAP SPs budgets for direct payments to young farmers for the 2023-2027 period (EC, 2023).

Member states could opt for three types of support within the 3% budget envelope of the SPs:

- Complementary income support for young farmers⁽³⁾, which is granted as a per-hectare payment or as a lump sum. This is a type of decoupled direct payment that falls under the first pillar of the CAP and is financed by the EAGF.
- Support for the establishment of young farmers as farm managers, which can be a maximum of €100,000 in non-reimbursable funds and is granted from Pillar II (EAFRD).
- Support for investments allows member states to assist young farmers in acquiring land. The intensity of the financial aid can reach up to 80% of the value of eligible costs, a much higher level than the 65% threshold that applies to most interventions.

Most member states have chosen to support the establishment of young farmers and provide complementary payments. Portugal, Slovakia, the Netherlands, and Hungary have also allocated funds for the investment component. Romania decided to direct the largest share of available funds toward the establishment of young people as farm managers (EC, 2023). In just one year (2024), nearly 200,000 jobs were created, especially through the application of support measures for young farmers and other rural development interventions focused on starting businesses in the agri-food sector. This supported 2,500 rural businesses despite the challenging conditions in the sector, which are fueled by the impact of climate change and geopolitical tensions (EC, 2025).

Romania's CAP Strategic Plan Interventions (2023–2027)

During 2023-2027 programming period, Romania's CAP SP encompasses two interventions for young people that fall under Pillar II. The first intervention we'll address is RD 30 – “Support for the establishment of young farmers.” Romania has opted for a lower per-project funding level than the maximum threshold stipulated by European law. Each beneficiary can receive €70,000 per project, with no private contribution required.

The non-reimbursable support is conditional on the young person having “skills in the agricultural field, acquired through participation in initiation programs that require a

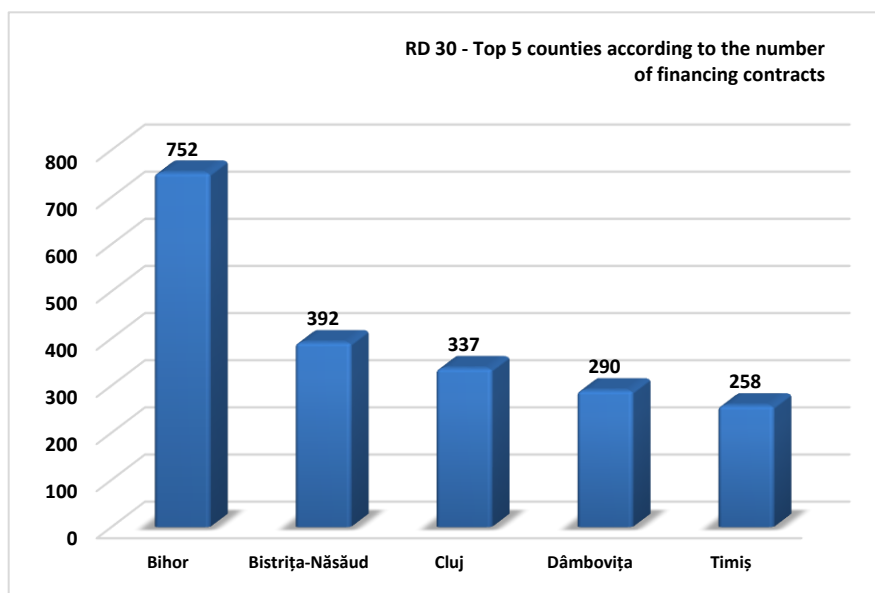
number of hours below the hours for professional qualification Level I2, or practical experience in agricultural activity of at least 12 months accumulated in the last 10 years on a farm. Applicants can also meet the eligibility condition through any document that certifies professional training superior to the minimum eligible level mentioned above, such as: evaluation within an authorized center for the evaluation and certification of professional skills obtained through non-formal means of at least Level I of qualification, as a result of professional experience or professional training through studies/qualification courses conducted by authorized professional training providers in accordance with the applicable legislation at the time of granting the professional qualification certificate, or secondary/higher education, including a master's or doctoral degree in the agricultural field”.

From November 2, 2023, to January 31, 2024, the first call for funding applications for RD 30 was launched. The available funds amounted to €250,691,764, split into a national component (€175,484,235) and a mountain area component (€75,207,529). Funds for RD 30 were exhausted before the application deadline in both components. For the national component, 3,761 applications were submitted, with a value of €263.27 million, representing over 150% of the allocated amount. For the mountain area component, 1,877 applications were submitted, with a value of €131.39 million, also exceeding the allocated budget.

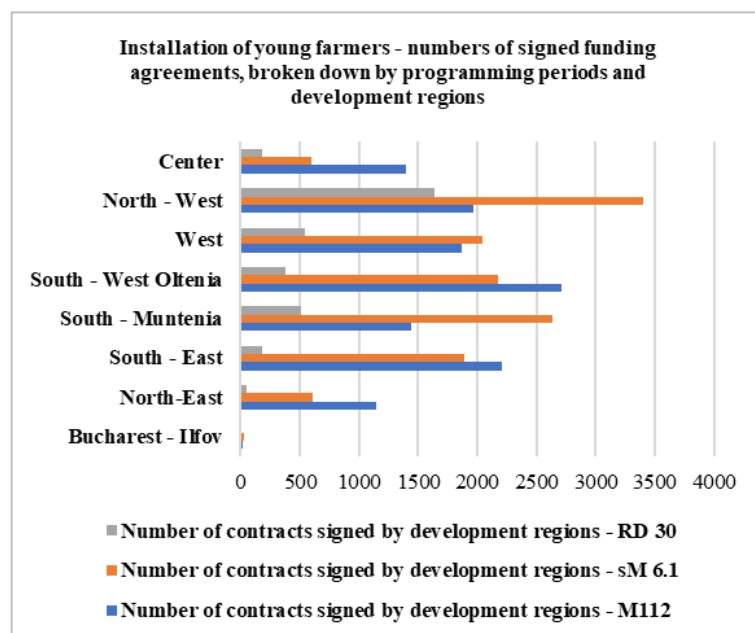
After RIFA experts verified the submitted documents, 3,493 contracts were signed, with a contracted value of €244,510,000. By development region, most contracts were signed with beneficiaries in the North-West region, followed by the West and South-Muntenia regions, with many projects concentrated in development hubs like Cluj and Timiș counties. At the county level (Figure 4), most contracted RD 30 projects were in Bihor (752), Bistrița-Năsăud (392), Cluj (337), Dâmbovița (290), and Timiș (258).

In Bihor county, there is a consistent number of establishment funding contracts: 808 beneficiaries from M112, 1,250 from sM 6.1, and 752 from RD 30. The number of contracts in this county follows the fund allocation trajectory: sM 6.1 had a larger budget than M112, and RD 30 has the smallest budget of the three measures, which explains the decrease in the number of beneficiaries. However, in counties like Brașov and Vaslui, the number of contracts has decreased from one programming period to the next: 151 and 238 contracts for M112, 60 and 72 for sM 6.1, and zero for RD 30. These two counties are noteworthy because Brașov is a development hub, while Vaslui is one of the poorest counties in the EU.

The allocated RD 30 funds for both components ran out prior to the session's planned end date. 3,761 funding applications totaling €263.27 million – more than 150% of the allotted amount – were submitted for the national component. A number of 1,877 applications totaling €131.39 million were submitted for the mountain area component, exceeding the budget provided.

Figure 4. Top 5 counties, according to the number of financing contracts – RD 30, within CAP SP 2023-2027.

Source: Rural Investment Financing Agency

Figure 5. Evolution of the numbers of signed funding agreements, broken down by programming periods and development regions. The final amounts for NRDP 2014-2022 and CAP SP 2023-2027 may vary, as a result of the completion of payments to beneficiaries, the conclusion of litigation, etc.

Source: Rural Investment Financing Agency

Analyzing the available data on the number of contracted projects and the value of payments made to beneficiaries at the level of development regions (Figure 5), through both NRDP 2007-2013 and NRDP 2014-2022, we find that young people in regions such as South-Muntenia have become more interested in obtaining European funds for establishment as a farm manager (1,443 contracted projects in NRDP 2007-2013 versus 2,635 contracted projects in NRDP 2022). Meanwhile, the number of beneficiaries in the North-East region, one of the poorest regions in the European Union, has decreased, from 1,150 (M112) to 607 (sM 6.1) and, respectively, to 56 (RD 30).

The agricultural sectors for which European funds were available have also changed over the course of the three programming periods. Field crops, horticulture, milk and dairy production, permanent crops, and mixed farms (crops and livestock) were the main areas of focus for young farmers who obtained establishment funds through M112. Funds were primarily used for field crops, mixed crops, mixed farms (crops and animals), and beekeeping by young farmers who received sM6.1 from PNDR 2020. The CAP SP 2023–2027 RD 30 beneficiaries have mainly made investments in dairy cattle farming, mixed crops, field crops, horticulture, and mixed farms (crops and animals).

Beyond the figures, a comparison of the three programming periods reveals a slow shift in the preferences of young farmers. They initially focused on basic crops and mixed farms, but later non-agricultural pursuits and beekeeping emerged as alternatives. At the moment, the focus is on horticulture and dairy cow farming, two more specialized industries with significant potential for value addition through processing and short value chain integration. This shift is the outcome of CAP standards, which support sustainability, biodiversity, and product quality, as well as market demands.

The second intervention we'll address is RD 12 – “Investments in consolidating the holdings of established and recently established young farmers”. With a maximum public support value of €200,000 per project, RD 12 is the second intervention from the CAP SP 2023-2027 that aims to assist youth. Young farmers who established themselves through the NRDP 2022, including the transition period, and those who have just established themselves (within the last five years of the application date) are the target audience for RD 12, which aims to strengthen their farms and develop effective management to increase the farms' viability. Primary agricultural production, conditioning and/or storage, and on-farm processing of primary agricultural products to enhance their added value are among the supported investments under this intervention. The investment project under this intervention will address on-farm processing as a secondary component (CAP SP 2023-2027).

The third intervention we'll address will address is the Complementary Income Support for Young Farmers (CIS-YF) (Intervention DP-03), managed by APIA. This is an annual payment granted to young farmers who are eligible for the Basic Income Support for Sustainability (BISS) payment, are a maximum of 40 years old in the application year, and are establishing themselves for the first time as head of a holding. The payment is for the

first 50 eligible hectares and is granted for a period of 5 consecutive years, starting from the first submission of the payment application for young farmers (CAP SP 2023-2027).

The planned unit amount according to the CAP SP is €47 per hectare. In the 2023 application year, the approved unit amount was €60.29 per hectare, the area requested for payment was 339,738 hectares, and the amount requested for payment was €20,485,802. Payments for this form of support amounted to €17,218,877. The differences between the areas requested for payment and the eligible areas result from control activities carried out by APIA employees, including the verification of eligibility criteria based on documents submitted by beneficiaries and on-site checks.

LAGs: A Funding Tool for Young People

While important progress has been made, more work is still required to establish synergy between InvestEU, the social fund (ESF+), research and education funds (Erasmus+, Horizon Europe), and structural and cohesion funds. LAGs, which have been urged to adopt multi-fund local development strategies (EAFRD + ESF+) during the current programming period, can pursue this kind of synergy. A partnership agreement comprising local public authorities, business owners, and other stakeholders interested in the development of the area the LAG covers forms the basis of a LAG. To access available funds from the EAFRD and the ESF+, LAGs have developed Local Development Strategies (LDSs) based on the needs identified in their territories. A single-fund (EAFRD) or multi-fund (EAFRD and ESF+) strategy was available to LAGs. Vulnerable children and their families can benefit from ESF+ funds (MARD, 2023).

Evaluator experts assigned scores based on a set of selection criteria and principles found in the Applicant's Guide for participation in the LDS selection 2023-2027. At least one associative form representing the interests of women, children, or young people had to be a part of the partnership that the LAG is based on.

Additionally, partnerships that included women and/or young people as representatives received points from the LDSs' evaluation criteria and guiding principles. If at least 30% of the representatives from the partnership's constituent entities were women or young people, the criterion was deemed satisfied. Additionally, points were given if this percentage – at least 30% of women and young people – was reached over time (MARD, 2023).

The inclusion of interventions that provide funding for economic projects that directly benefit women and/or youth was another criterion taken into account in the LDS evaluation. In previous financial periods, LAGs have provided funding for a range of project types, including investments in tourism, medical services, and agriculture. These investments have improved the quality of life for people living in the covered territories and, implicitly, have increased the appeal of rural areas to young people. According to recent studies, the amount of funding per capita affects how appealing rural areas are to young people; the higher the amount, the more likely they are to stay or move there (Crunțeanu et al., 2024).

Summarising, Romania has implemented a logical package that includes LEADER approaches, RD 30 for establishment, RD 12 for consolidation, and DP-03 for complementary income. High demand and an uneven territorial distribution are evident from the preliminary findings. The pace of payments, the caliber of the projects, the administrative capacity of the region, and extra-agricultural elements that draw young people to the rural area all affect the medium-term impact.

5. Conclusions

The long term viability of Romanian and European agriculture is still under pressure due to the rapidly aging rural population. According to the analysis, despite the existence of tools specifically designed for young farmers, there is still a significant disparity between the entry rate of young farmers and the withdrawal rate of older farmers.

The first research question addressed the evolution of support for young people between 2007 and 2027. The results show consistency of decision-makers regarding the architecture of support mechanisms by maintaining measures dedicated to supporting young farmers – from M112 to sM 6.1 and then to RD 30, RD 12, and DP-03 – which reflects a shift from simple establishment to consolidation and income support and focusing on performance.

The second question focused on the territorial distribution of funds. The data confirm regional polarization: North-West, West, and South-Muntenia concentrate the largest number of projects, while North-East registers a significant decline in interest and absorption capacity.

The third question addressed the intermediate results. Contracting and payment indicators are very high, and the structure of investments is changing: from mixed farms and basic crops toward horticulture and dairy cattle farming, which are sectors with high potential for added value and integration into short value chains.

The fourth question referred to the role of LEADER and the new criteria for young people and women. These bring an innovative component of inclusion and diversification, but their effectiveness depends heavily on the administrative capacity of the LAGs and local resources.

The fifth question looked at the main barriers. The findings confirm the decisive role of access to land and capital, bureaucracy, and deficient infrastructure. These remain major factors that limit the attractiveness of agriculture and the rural environment for new generations.

All things considered, financial assistance is still required but insufficient. In addition to grants, rural living conditions, service accessibility, infrastructure, and contemporary technology all play a role in generational renewal. Making the village a viable and predictable place for young people that can guarantee both economic competitiveness and quality of life is the clear strategic goal.

In the upcoming years, these research questions should be investigated through impact evaluations and comparative analyses that quantify not only the quantity of funded projects but also the rate at which young people are retained in agriculture, the financial performance of supported farms, and the local impacts on rural development. A research agenda like this would round out the picture presented here and enable more precise policy adjustments.

Limits of the study

Due to its descriptive and observational nature, the current study has significant limitations that affect how its findings should be interpreted. Only levels and trends are captured by the analysis; the effects of policies or government actions cannot be directly shown. As a result, while the data offers a helpful summary for comprehending the current state of affairs, it is not possible to draw definitive conclusions regarding the effectiveness of the support measures that have been put in place.

Additionally, unobserved or hard-to-quantify elements like regional customs, social structure, unofficial resource access, or community mindset may have an impact on the regional differences. Variations that cannot be fully explained by the statistical indicators gathered can be produced by these factors, which were not taken into account in the analysis. In this sense, it is important to interpret the findings carefully and refrain from making unwarranted generalizations.

The fact that any correlation between variables cannot be equated with a causal relationship is another crucial element. The wider economic and social background or intermediate variables may have an impact on the connections that have been observed. Therefore, more experimental or longitudinal research would be required to provide more solid evidence of causality and to better understand the dynamics of the phenomenon.

Acknowledgement

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program

Notes

- (1) Operational data on the implementation status of the NRDP 2014-2022, as of August 21, 2025.
- (2) To the financial values considered in this paper, other amounts from the finalization of payments to PNDR 2014-2022 and CAP SP 2023-2027 beneficiaries, litigations, blocked funds, reallocations, etc., can be added, or amounts resulting from the application of financial corrections can be deducted.
- (3) Only Denmark and Portugal do not apply this form of support.

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Economic Barriers to Healthcare Digitalization: Lessons from Estonia and Romania

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Abstract. *Accelerated digitization of healthcare systems promises to improve access, prevention and medical efficiency. The present study aims to compare the level of digitization of the healthcare system in Romania and Estonia. The analysis is based on official documents (EU Country Health Profiles, Digital Decade eHealth Indicator Study), highlighting both technical infrastructure and economic barriers that influence the implementation of digitalization. The results show that while Estonia benefits from an integrated and interconnected public-private ecosystem, Romania faces fragmentation, data security issues and lack of interoperability. Although Romanian private systems are more digitally advanced, their impact is limited due to low affordability and lack of integration with the public system. Thus, economic barriers become structural factors that can hold back digital transformation in the absence of strategic governance.*

Keywords: healthcare; digitalization; review; economic barriers; efficiency.

JEL Classification: I18; O33.

1. Introduction

We are in the middle – if not on the peak – of the biggest transformation that our world has ever experienced. Technology has already reached levels that the human mind could not even perceive a decade ago (McKinsey & Company, 2022). We are witnessing what we call the Industrial Revolution 4.0, characterized particularly by the impressive advancement of automation and the increasing use of artificial intelligence in almost all areas of life. Moreover, the internet of things (IoT), 5G and ultra-fast communications, big data and cloud computing connect, store and analyze huge amounts of information on which artificial intelligence further improves its predictions and suggestions.

And yet this technological advancement does not stop here, as the focus of global experts and institutions is on the implementation and development of Industrial Revolution 5.0, which complements the existing Industrial Revolution 4.0. In this next technological stage, the aim is to lay the foundations for human-machine collaboration, sustainable technology and extreme personalization of services, but especially of the artificial intelligence that collaborates with humans in an ethical, empathetic and reliable way (Directorate-General for Research and Innovation, 20 (Directorate-General for Research and Innovation, 2024).

One of the most profoundly impacted areas by this technologization is the healthcare system, which has undergone transformations caused by digitalization and the introduction of artificial intelligence in medical treatment. Digitalization has completely transformed the communication between patient and doctor, but also between healthcare institutions and stakeholders or government (Schwab, 2024). Artificial intelligence has slowly but surely started to build a close relationship with doctors in terms of supporting them in early detection of diseases, interpreting X-rays, ultrasounds or blood tests and even making a diagnosis (Directorate-General for Health and Food Safety, 2024). Moreover, this technologization overcomes some medical limitations – such as the inability to replace damaged organs or tissues due to the lack of donors or a viable solution – through the development of 3D printers and bioengineering, capable of building customized prostheses, bone reconstruction, but also printing skin, tissues, and even organs (Tack et al., 2016; Derakhshan, 2023).

Like any technological advancement, this industrial revolution came with its own opportunities, but also limitations. In terms of opportunities, the medical system is now able to provide patients with personalized treatment based on the patient's DNA and their genetic response to different drugs (Taherdoost and Ghofrani, 2024), also contributing to the reduction of medical errors. In addition to this, facilitating access to medical services (through telemedicine, for example) and collecting patients' medical data in real time (through various wearable devices) are helpful in early detection of various conditions or degradation of a patient's medical condition, contributing either to prevention or lowering the cost of treatment (Kang and Exworthy, 2022; Ezeamii et al, 2024). Regarding the practical benefits to physicians, by using virtual reality (VR) or augmented reality (AR) they can perform simulations to prepare them for different emergency situations or surgeries (Tene et al., 2024).

As previously mentioned, this progress also brings with it limitations or rather challenges, which the patient, the medical system or governments need to address. The challenges at the individual level relate primarily to the lack of digital skills (World Health Organization, 2023), but also to the fact that not everyone has access to the necessary infrastructure to access telemedicine or advanced technologies (Tu *et al.*, 2025). At the level of the healthcare system and medical staff, we can mention the risk of medical staff relying too much on AI (Prinster *et al.*, 2024), the gap that could be created between generations of physicians caused by a lack of digital literacy (Peseckyte and Giedrep, 2024), but also a resistance to change resulting from a lack of training in the use of new technologies or slow adoption (Nielsen *et al.*, 2016). At the government level, challenges are focused more in the area of regulation and public policy, such as issues surrounding the ethics and accountability of using AI in medical decisions, as well as the privacy of collected medical data. Economic barriers are present at all these levels (individual, system and governmental) that influence to a greater or lesser extent the challenges already listed. If these economic barriers are not addressed systemically, they can completely block or significantly slow down the digitalization process, especially in countries with limited financial resources.

Therefore, this paper aims to address in detail these economic barriers or challenges influencing the digitalization of the healthcare system, by making a comparative analysis between two Eastern European countries – Romania and Estonia. Although they share a similar communist background and a similar economic context at the time of the post-communist transition, the two countries are today at very different stages of digitalization of the healthcare system. Estonia is considered a model of successful digital transformation, while Romania is facing a fragmented, difficult and underfunded digitalization process. This comparison is valuable and relevant in the sense that it aims to analyze the impact of the economic factors that have contributed to this major difference in the evolution of the digital health system, given a common starting point. In addition, unlike most studies comparing Eastern and Western European countries, this study brings originality by focusing on two countries located in the same region, thus limiting major cultural and economic differences, but highlighting strategic and structural differences related to the financing of digitalization.

1.1. Theoretical background and literature review

In order to better understand the concept of digitalization in its basic sense, as well as what digitalization of the healthcare system implies, we need to know the theoretical background behind the concept, but especially the current status in practice. Therefore, in the following, we will briefly review the current definitions and theories in the literature, but also the actual status of digitalization of the healthcare system globally, but especially in Europe, as we will compare two European countries.

The need for healthcare digitalization is strongly highlighted by global institutions, especially the World Health Organization (2024), which launched in February 2024 the Global Initiative for Digital Health (GIDH). This program supports national digital health transformation by assessing and prioritizing countries' needs, standardizing their resources, and helping to develop or maintain local digital health technologies. The World Health

Organization has also established the Global Digital Health Certification Network. This is a global digital framework that enables the secure and verifiable portability of medical documents, allowing healthcare institutions across borders to recognize and authenticate them.

1.2. Defining healthcare digitalization

Digitalization is the simplification of the way people perform various work tasks through the use of technology. In this way, these tasks are accomplished faster and more efficiently. Moreover, digitalization is what underpins digital transformation (DT), which is the change in the way a business or public institution performs its work tasks (Pellicelli, 2023). Digital transformation is a serious effort to integrate advanced technologies into the day-to-day tasks of institutions, which comes with a complete rethinking of the way they do their work, from internal work systems to communication with the consumer (in our case the patient), both online and offline (Bughin *et al.*, 2019).

At the health system level, digitalization is the use of information and communication technologies (ICTs) to support, but also to improve, every level of the healthcare system, from prevention and diagnosis, to treatment, monitoring and management of different medical conditions (Directorate-General for Health and Food Safety, 2024). The goal of digitalization of the healthcare system encompasses a variety of aspects, from improving access to healthcare services, as well as the healthcare services themselves, to reducing inefficiencies, high costs, and offering the most personalized treatment plans (Ronquillo *et al.*, 2023). In other words, digitalization is an important step in the modernization of the healthcare system, fulfilling some of the needs that have occurred in the system.

In the academic literature, but also in everyday usage, the whole digital ensemble of the healthcare system has been briefly referred to as eHealth (electronic health), and under its umbrella are various other subcategories referring to specific uses of particular technologies. Telemedicine is perhaps one of the most common and well known applications of digitalization in the healthcare system, as it is the tool by which a physician can provide remote medical consultations and evaluations to the patient, either to diagnose or to monitor an already identified medical problem. This digital medical service can be done either over the phone (audio – video), allowing the doctor to hear, see and assess a specific medical problem, or via text messaging or mobile apps where the doctor can receive laboratory tests, medical records, pictures or other relevant documents to be able to make a diagnosis. The greatest benefit of telemedicine is that it expands access to fast and affordable healthcare, especially for people who, for geographic or financial reasons, would not otherwise receive care (Haleem *et al.*, 2021).

mHealth, one of the subcategories of eHealth, is the delivery of healthcare services through mobile devices, either smartphones, tablets, monitoring devices or wireless gadgets (Buneviciene *et al.*, 2020). mHealth is mainly used for medical monitoring or support, and, through mHealth, healthcare professionals can monitor blood pressure, pulse, blood glucose, and other aspects of the patient's lifestyle that contribute to overall health. Some mobile apps are also designed to act as a patient's personal caregiver, being responsible for reminding the patient to take their treatments (Pal *et al.*, 2021).

The data provided through mHealth, as well as doctors' observations and medical tests that are performed offline when the person goes to the hospital/clinic for a consultation, can thus be collected and added to electronic health records (EHRs), another branch of eHealth. Essentially, EHRs are electronic records that contain a patient's health information and can be digitally accessible by multiple healthcare institutions and beyond (Centers for Medicare & Medicaid Services, 2024). There are also electronic medical records (EMRs), which are a patient's digital medical record within a particular healthcare facility/health network (Garrett and Seidman, 2011). Storing this medical information in EMRs allows, in addition to easy access by medical staff and the patient, the analysis of this information using artificial intelligence to highlight possible future medical problems, a personalized diagnosis or treatments (Haleem et al., 2021).

Alongside these digital applications that directly target the patient, there are also some others that aim to facilitate administrative processes either at the level of the medical facility or at the level of the overall health system. Among these, we mention: electronic administration which facilitates administrative processes in hospitals through automated billing, DRG (diagnosis-related groups) reporting, human resources management, etc. (Roth, 2024); ePrescription which represents the generation, transmission and validation of prescriptions in digital format and makes it possible for pharmacies and insurers to access them (eHealth Network, 2024); and Digital Health Surveillance which enables real-time monitoring of diseases, vaccinations, epidemics by using big data, artificial intelligence and automated reporting (Kostkova et al., 2021).

In terms of digital systems that use artificial intelligence or advanced technologies to support healthcare decision making, it is worth mentioning some relevant examples. These include clinical decision support systems (CDSS), which provide clinicians with automated recommendations based on clinical data (Grechuta et al., 2024); health information exchange (HIE) networks that enable the secure exchange of medical data between institutions (Janakiraman et al., 2022); and medical and public health e-learning tools, which are used both in the training of health professionals and in educating the population to prevent disease (Regmi and Jones, 2020).

1.3. Interoperability and digital infrastructure

The infrastructure is the technical component on which the digitalization of the healthcare system is based, enabling the storage, processing, transmission and securing of health data. Within this infrastructure we talk about networks and connectivity between these networks, data centers, cloud, cybersecurity systems, and interoperability platforms (Petersen-Khmelnitski, 2025). This infrastructure must be able to support both technical and semantic interoperability in order to ensure that systems communicate and understand data in a unified way, facilitating continuity of care and healthcare efficiency. Technical interoperability refers to the physical ability of digital systems to communicate and transfer data between each other without technical errors (Oracle, 2024). However, it is not enough for data to be transmitted correctly. It must be interpreted in the same way by all the connected systems so that the information makes sense – in short, semantic interoperability

(De Mello *et al.*, 2022). This implies common coding standards, medical terminology and data models that ensure semantic consistency and integrity.

The major challenges related to the infrastructure and interoperability of healthcare digital systems are associated with the integration of old systems with the new technologies, the significant costs of implementing new technologies as well as maintaining them, the need for a clear and comprehensive legislative framework at both local and international levels, and the resistance of healthcare staff and patients to change and adoption of new technologies (Oracle, 2024).

1.4. Models of digital technology adoption

As technology reaches every industry, there is a growing need to comprehend, anticipate, and maximise their digital transformation. As a result, several models or theories have been developed through which researchers have tried to better assess this process of integrating technology into the traditional way industries have been doing business. Among these, the Technology Acceptance Model (TAM) and the Diffusion of Innovation Theory (DoI) are the most widespread.

TAM was developed by Davis (1989) in an attempt to explain how and why users do or do not accept a new technology. This model is based on three key components: (1) perceived usefulness (the extent to which people believe that the new technology will be useful in their work), (2) perceived ease of use (how easy they find it to use the new technology), and (3) behavioral intention (directly influenced by perceived usefulness and perceived ease of use). In the healthcare system, TAM has been used to assess the acceptance of electronic health records, clinical decision support systems, and mobile applications for monitoring or telemedicine (Rahimi *et al.*, 2018).

Diffusion of Innovation Theory was developed by Rogers (1983) and explains both how and how quickly an innovation is adopted in a system. The following are said to be the steps of the adoption process: learning about the innovation, developing a favourable or unfavourable opinion of it, embracing or rejecting it, applying it, and continuing or stopping to use it. In the healthcare system, the theory is used to understand why some hospitals adopt a particular technology rapidly and others do not, but also how exactly a particular innovation spreads (Iqbal and Zahidie, 2021).

1.5. Economic aspects regarding healthcare digitalization

Each digital application discussed above (e.g., mHealth, ePrescription, telemedicine, etc.) involves significant implementation and maintenance costs. For some institutions or states with limited resources or inefficient governance, these costs can become serious economic barriers that not only slow down the digitalization process, but also limit the ability to build a coherent, functional digital system with real impact on the quality of healthcare services. Some of these costs include direct and indirect expenses associated with the implementation of digitalization, such as the costs for the transition from analog systems to the new digital technology, which in turn comes with expenses for hardware, software, interoperability platforms, maintenance and upgrades, as well as expenses for training the staff responsible for using this technology (Bagolle, 2023).

We are also talking about opportunity costs, which refer to funds or human resources that are redirected towards the implementation of digital technologies to the detriment of immediate needs (Bergmo, 2015). This can lead to underfunding of some health services or understaffing in other critical departments of the health system.

Moreover, poorly digitalized medical staff involve training costs to be able to use digital technology, while medical staff who have a low level of perception regarding the real benefit of digitalization will be more resistant to use it (Li *et al.*, 2025). There are also economic risks perceived either by the government, healthcare institution, or by the healthcare workforce. At the government or healthcare level, the lack of solid evidence of cost-effectiveness may fuel hesitation among the authorities or management of the healthcare facility and hinder the implementation of digitalization on a large scale (Bente *et al.*, 2024). For instance, in Estonia, evaluations of the e-prescription system and eHealth have shown reductions in administrative costs and improvement in treatment adherence, suggesting tangible efficiency gains (OECD/European Observatory on Health Systems and Policies, 2023). In contrast, in Romania, while initiatives such as the Electronic Health Record and the SIUI system have been introduced, comprehensive cost-effectiveness assessments remain scarce, which reinforces uncertainty among policymakers and managers (World Bank, 2021). This literature review has attempted to highlight the main frameworks and conditions for the adoption of digitalization in healthcare. However, economic challenges, such as funding models, investment prioritization and cost limitations are less discussed, especially in Eastern European countries.

To investigate this issue, the next part of this paper presents a comparative analysis between Estonia and Romania, focusing on how economic factors have influenced their path towards the current digitalization of the healthcare system.

2. Methodology

The methodology employed in this article is based on a comparative analysis of the degree of digitalization of Estonian and Romanian healthcare systems, with a focus on the technological infrastructure as well as on the social, economic and institutional context. The analysis includes a general comparison, but also a thematic component, centered on the economic barriers influencing the efficiency and sustainability of digitalization.

The main data sources were the Country Health Profile 2023 reports of the OECD/European Observatory on Health Systems and Policies, which provide an overview of risk factors, financing and performance of health systems. These were correlated with data from the 2025 Digital Decade eHealth Indicator Study report of the European Commission, which assesses the digital maturity of health systems in the EU, as well as with official information published on national platforms (e.g., e-Estonia, X-Road, CNAS, SIUI, etc.).

3. Comparative analysis

3.1. General health context

Before discussing the current state of digitalization of the healthcare system in both countries, it is useful to review the current socio-demographic context and the status of the healthcare system. This understanding is valuable because it gives an insight into the health challenges each country is facing and will provide an opportunity for a discussion on whether certain current challenges in healthcare are or could be solved by different implementations of digitization.

In terms of socio-demographic context, although Romania has a significantly larger population than Estonia, both countries face similar challenges in terms of ageing population, with fertility rates below the replacement threshold of 2.1 (Craig, 1994). However, Estonia has a GDP per capita of €30,671, higher than Romania's €27,073, indicating a slightly higher level of economic development. In both countries we have a poverty rate above the EU average of 16.5%, which may indicate greater inequalities between different social groups.

According to the OECD/European Observatory on Health Systems and Policies' (2023) Country Health Profile report, Romania's life expectancy is 75.3 years, whereas Estonia's is 78.1 years. In both countries, cardiovascular disease and cancer are among the major causes of mortality. In Romania, preventable and treatable mortality is far higher than the EU average, owing primarily to a lack of prevention, limited access to health care, and treatments administered too late. Preventable mortality in Estonia is mostly driven by alcohol-related diseases, although it also includes accidents and suicide, and treated mortality is lower than in Romania but still higher than the EU average.

Speaking about the main causes of mortality, it is important to also discuss the main risk factors in the two countries analyzed. Behavioral and environmental risk factors (e.g., smoking, unhealthy diet, alcohol, sedentary lifestyle, etc.) influenced 46% of deaths in Romania and 39% of deaths in Estonia. In Romania, although the obesity rate among adults is below the EU average, obesity among adolescents is increasing, and an unhealthy diet contributed to 25% of deaths. Obesity-related problems are also found in Estonia, where in 2020, more than half of adults aged 16-64 were overweight. Smoking remains a serious problem in both countries, especially among men and people with a low level of education, and excessive alcohol consumption is high in both countries: 23% of Estonian men and 35% of Romanians regularly drink alcohol in excessive quantities. Physical activity is extremely low in both countries – less than 25% of Estonians meet the WHO guidelines for physical activity, and in Romania the situation is even worse, where only 8% of the population has adequate physical activity.

In terms of the structure and financing of the health system, Romania relies on a social health insurance system financed by salary contributions. These contributions are paid by employed persons, and vulnerable categories (e.g., pensioners, unemployed, pregnant women, children, etc.) are exempt from paying these contributions. Therefore, in 2020,

only 36% of insured persons were actually contributing to the insurance system fund. Hospital spending is very high, with 44% of total spending going to hospitals, which is well above the EU average of 28%. In contrast, only 4% of the budget is allocated to prevention. The amount deducted from the patient's personal pocket for various medical services is also higher than the EU average (21% vs. 15%). Romania also has the highest rate in the EU for offering bribes in the form of money or gifts in exchange for medical services (18%).

In the case of Estonia, it has a health system based on a single social insurance (Estonian Health Insurance Fund – EHIF), where 76.4% of the money comes from government funding and 13% from salary contributions. The medical system is centralized, and most hospitals are public. Moreover, of the total health budget, 8% was invested in prevention, a percentage that is above the EU average. This aspect may also explain the fact that Estonia spends significantly less than the EU on long-term treatments.

A final but essential factor to consider for the current analysis is the medical system's performance as measured by efficiency, accessibility, and resilience. Romania, as previously stated, has a high rate of preventable and treatable mortality, with significant accessibility issues for low-income groups. Other barriers to accessing health services included a lack of human resources and facilities. The Covid-19 pandemic has exacerbated existing weaknesses, and trust in the system is still low, fuelled by bribery, a lack of fairness, and accurate information. This lack of trust in the system is evident in the EU's anti-Covid vaccination rate, which was among the lowest. On the other hand, Estonia has registered significant improvements in accessibility, by decreasing the percentage of those who reported having unmet medical needs (9.1% from 15.5% in 2019), but still faces long waiting lists and staff shortages, especially in rural areas.

3.2. Status of the healthcare digitalization

According to the Digital Decade eHealth Indicator study, conducted by the European Commission (2025), Romania recorded an eHealth Maturity Score of 75% in 2024, 16 percentage points above the score obtained in 2023, ranking among the EU countries with the highest increases in the digitalization of the healthcare system. However, it still remains below the EU average of 89%. This report analyzes the digitalization of the healthcare system through four thematic layers: electronic access services for citizens, categories of accessible health data, access technology and coverage, and access opportunities for certain categories of people.

The report states that Romania has a centralised national service that provides access to electronic health records. All EU Member States have achieved full maturity (100%) on these criteria, implying that a working platform exists, at least in theory, at the national level. However, regardless of the evidence presented to the European Commission, there have been systematic reports, mainly from family physicians, that certain components of this electronic medical system are not functioning properly (raportuldegarda.ro, 2024). In 2014, Romania launched the Electronic Patient Record to centralize medical data, but the rapid implementation generated serious data security issues. The system has been

experiencing functional issues for more than three years. An improved version was released in 2021, but usage is still low: just 40% of physicians send data, and relatively few patients access the information. The absence of communication between hospital systems and that of the National Health Insurance House (CNAS) restricts efficient data interchange (Bilbiie et al., 2024).

According to the European Commission report, Romania has made significant progress (+20 percentage points compared to 2023) in making information about allergies, current health problems, surgical procedures and investigations, medications, and medical history available online in real time. Significant progress has been made in ePrescription (+50% compared to 2023), with data on prescription issuing now easily accessible online (CNAS, 2025). However, there are complaints that certain pharmacies refuse to dispense medicines based on electronic prescriptions, requiring them to be printed (Stanescu, 2025). Moreover, Romania falls behind in the area of electronic results and reports, as laboratory tests and medical imaging are not yet available to patients, and it is not clear whether discharge reports are available online and whether they are updated in a timely manner.

Also, according to the study conducted by Rotaru and Edelhauser (2024), there are significant differences between the public and private sectors in terms of the implementation of digital technologies. The private sector registers a higher efficiency from the perspective of cost-benefit analysis compared to the public sector, reflecting a more efficient allocation of resources and an orientation towards results. In addition, for the implementation of digital solutions, the level of training and experience of hospital managers is essential and, in the private sector, changes are often initiated and supported by managers with a decisive role in the direction of digital transformation. Therefore, the success of digitalization requires the coordination of several factors (leaders, resources, infrastructure, organizational culture), and in the public sector, this coordination is often fragmented, leading to slower and less efficient implementations.

Within private medical services, Regina Maria has the most advanced digital strategy in Romania, combining telemedicine, AI and a complete mobile application. In July 2022, the private medical network launched the first virtual assistant in Romania, developed together with DRUID and Infermedica. It assesses patients' symptoms with the help of AI and directs them to the right specialist, automatically integrating the data into the digital scheduling system (Regina Maria, 2022).

In terms of access technology and coverage, Romania only has an internet site, no mobile application, and does not yet employ an eID as required by EUDI (European Digital Identity Regulation), implying a lower level of security than advanced countries. Moreover, only a part of the medical service providers is connected, with public hospitals and pharmacies better connected than private providers – this aspect remains one of the weaknesses of the medical digital infrastructure. The CNAS official stated that, initially, the system was built for a number of 17,000 providers, but over time, the number of medical service providers has tripled, as have its users. For this reason, the digital platform faces functionality problems (Spotmedia, 2025).

Regarding the categories of people who can access digital health platforms, the report confirms that Romania has implemented certain legal and technical functionalities for the access of the legal guardian to the patient's data, as well as of authorized persons. In addition, there are legal provisions and mechanisms through which elderly people or people with reduced digital skills could be supported.

The digitalization of the Estonian healthcare system, on the other hand, is one of the most advanced in Europe, achieving 100% in the eHealth Maturity Score. Like Romania, it has a centralized national service for online access to electronic medical records, but this is also proven to be functional.

In terms of accessible medical data categories, Estonia offers all seven types of summary data, from patient identification and current diagnoses to medication and implants. All this data is available online and delivered in real time, according to national standards. The ePrescription system is fully functional and updated quickly, being interconnected with hospitals and pharmacies. It also works cross-border with seven other European countries, and all the patient needs to do is present their ID card at the pharmacy (e-Estonia, 2025). Unlike Romania, Estonia also provides laboratory data, medical imaging and discharge reports in a timely manner and online.

Their national health platform also uses eID authentication according to EUDI, thus ensuring cybersecurity. In addition, from 2023 to 2024, it has also developed a mobile application through which citizens can access their electronic health record. In conclusion, Estonia has a digital infrastructure of the health system that covers both the entire population and most healthcare providers. Access to the electronic health record is based on legal provisions and technical functionalities, and citizens can legally delegate access to medical data to other people through regulated digital mechanisms. The access portals comply with the Web Content Accessibility Guidelines (WCAG).

Additional information about the digitalization of the medical system is also presented on e-Estonia (2025), where is described the eAmbulance, a digital service for rapid localization (~30 seconds) of emergency calls, with paramedics instantly having access to the patient's vital information, such as blood type, allergies, recent treatments, etc. The medical system also benefits from digitalization to provide personalized treatments. Already 20% of the country's population has genetic data collected, which is integrated with medical data for prevention. As part of these personalized treatment services, recommendations for treatments and screening for breast cancer are also provided to those who are predisposed. This digital medical system has been operating since 2008 and contains over 160 million medical documents.

3.3. Financial aspects of healthcare digitalization

Although the results of the EU reports show that the digitalization of the Romanian medical system has reached a certain level, most of the experiences lived in the physician's office, as well as the information leaked to the press, indicate that there are still serious problems with the functionality of the digital system.

The initial financing and infrastructure of health digitalization assumed a cost of 173 million euros, excluding VAT, and included several components: the integrated single information system (SIUI), the electronic prescription, the electronic health card and the electronic health record. Currently, none of these components is functioning as it should (FIC, 2025). SIUI, the central system of the CNAS, although it cost about 125 million euros, frequently faces interruptions and errors in data about insured persons, problems amplified by incorrect information received from other institutions. These deficiencies may affect patients' access to medical services. In response to recent cyberattacks on hospitals, the Ministry of Health has allocated 100 million euros to improve the security and digitalization of the CNAS platform and to optimize the new Health Insurance Information Platform (PIAS), highlighting the urgent need to modernize and protect the system (raportuldegarda.ro, 2024). The new PIAS platform aims to connect over 25,000 healthcare providers and promises to complete the digital transformation of the health insurance system by the third quarter of 2025. Investments in health digitalization exceed 400 million euros, including funds allocated through the National Recovery and Resilience Plan (PNRR) (Spotmedia, 2025), aiming at alignment with European standards and interoperability of systems (CNAS, 2024). Priorities include the digital infrastructure of hospitals, ePrescription and EHR, as well as the creation of common systems that integrate essential medical data (raportuldegarda.ro, 2024).

There is no official information about any training program for the Romanian healthcare workforce to use the digital system, apart from a 6 million euro investment from European funds dedicated to developing the digital skills of medical professionals in Timisoara, carried out over a period of 12 months (TheBizz, 2024).

In Estonia, the initial funding for medical system digitalisation was focused on EHR in 2008, followed by ePrescriptions in 2010, with spending of only \$10 per inhabitant, totaling approximately 1.3 million euros (Means, 2011). Furthermore, to overcome connectivity barriers in rural areas, Estonia used nearly all of the funds received from the European Agricultural Fund for Rural Development (EAFRD) to lay the groundwork for the EstWin project (Estonian Wideband Infrastructure Project), bringing high-speed internet to rural areas and regions not served by telecom operators (European Commission, 2019). For the operability of all the country's eHealth programs, Estonia uses the X-Road platform, an open-source platform, also used in Finland and Japan, being responsible for data interoperability. This platform is not only capable of connecting hundreds of public and private data, but also ensures that the information is encrypted, authenticated and protected during transfer (e-Estonia, 2025). A particularity of this platform is that it is operated by the Nordic Institute for Interoperability Solutions (NIIS), established in 2017 by Estonia and Finland with the aim of building a common architecture and automated cross-border data exchange (x-road.global, 2019). The initial implementation costs of X-Road were approximately 70 million euros, and the annual maintenance costs are approximately 20 million euros (Pohjanpalo and Ummelas, 2018). Through this platform, Estonia saves 1345 years of working time annually, eliminating redundancies and providing instant access to essential, reliable information. This allows medical staff, and not only, to focus on tasks that require human judgment (e-Estonia, 2025).

In terms of training citizens to use digital systems, Estonia has had national digital literacy programs since the beginning. The first of these is Tiger Leap, the cornerstone for Estonia's evolution as a digital society, which was designed to transform the Estonian education system by equipping schools with IT infrastructure, but also by training teaching staff through a 40-hour basic course (Forsman et al., 2023). Moreover, due to the early introduction (1990-2000) of digital systems and EHRs, the majority of medical staff and healthcare providers have a high level of digital literacy (Tigane, 2021). More recently, between October 2022 and October 2024, together with the European Commission and the Ministry of Health of Catalonia, Spain, Estonia launched the project "Improving Digital Competences of the Health Workforce in Spain and Estonia" which aims to integrate digital competences into higher medical education programs and develop continuous training modules for healthcare professionals. These training strategies are in line with the Digital Competence Framework for Citizens (DigComp), ensuring the transition to the effective use of digital tools in prevention, monitoring, diagnosis and treatment (European Commission, 2022).

Concluding the analysis of investments in the digitalization of the healthcare system in Romania and Estonia, we can say that Estonia has achieved remarkable performance through efficient investments, early digitalization and integrated infrastructure, obtaining maximum value from relatively modest budgets. On the other hand, Romania, although it has invested significantly more than Estonia, is still in the process of implementing a medical digitalization that works efficiently and easily, facing challenges related to maintenance costs, interoperability and adaptation of new technologies. It needs strategic thinking to convert these expenses into benefits with real impact on the medical system.

4. Discussion: economic barriers to digital transformation

In the previous section, we compared Romania and Estonia in terms of the current status of population health, the level of digitalization of the medical system, but also the financial and economic aspects related to investments and costs with infrastructure and/or training of medical workforce. Estonia demonstrates that efficient organization and prevention can compensate for smaller budgets, while Romania shows that underfunding and fragmentation can contribute to inefficiency and inequity, even when you have more resources available.

Although Romania has invested significantly in the digitalization of its medical system – both from the national budget and through the PNRR – the results are fragmented and inconclusive. This situation can be explained by a series of structural economic barriers, which directly affect the functionality and sustainability of the digital transformation, in contrast to the Estonian model. As it was mentioned in the beginning of the paper, these economic barriers are mostly related to funding models, investment prioritization and cost limitations.

First of all, regarding funding models and investment prioritization, systemic underfunding and inefficient allocation of resources remains a major impediment in Romania. Hospital costs account for a far too large portion of health budget allocations, whereas prevention

receives a far smaller share. Prevention-oriented digitalization plays a key role in reducing the costs associated with long-term treatments by facilitating early detection of diseases and continuous monitoring of risk factors. By using EHRs, clinical alert systems and predictive analytics, health systems can proactively intervene before conditions develop into severe or chronic forms. This not only reduces the costs of expensive treatments, but also reduces preventable mortality. Examples such as Estonia show that investments in digital prevention infrastructure can generate sustainable benefits for both patients and the public health system. Unfortunately, Romania's public spending on health per capita is the lowest in the EU, and digitalization has often been approached as a one-off intervention, not as a strategic pillar of reform. Even in the context of consistent allocations through the PNRR, the lack of a unified strategy, a clear cost-effective evaluation, and coherent digital governance has led to the fragmentation of funds and the creation of parallel systems – SIUI, EHR, ePrescription – that do not communicate effectively with each other. This occurred because investments focused more on IT infrastructure than on interoperability and practical use, leading to higher cost and limited outcomes. In reaction to recent inefficiencies and cyberattacks, the government promises to launch a new digital platform called PIAS, in which it intends to reinvest a significant sum of money from both public funds and the PNRR. Whether this is the answer to the operational and safety problems in the Romanian digital medical system is still up in the air.

More on the topic of investment prioritization, Estonia has consistently focused on strengthening interoperability and ensuring patients' access to their health data, through initiatives such as the national eHealth record and the development of common data standards (TEHIK, no date). This reflects a strategic choice to consolidate the foundations of the digital health ecosystem before moving to more advanced and experimental technologies. In contrast, Romania has invested heavily in large-scale projects such as the SIUI and EHR, largely financed through EU structural funds. However, insufficient attention to interoperability and usability has generated high maintenance costs and limited real benefits for patients and providers. Furthermore, in Romania, the lack of well-planned investment prioritization meant that, once the Covid-19 crisis began, funds that could have supported the digitalization of the health system were quickly redirected to urgent needs such as medical equipment and staffing (World Bank, 2021). As a result, the long-term goal of building a stronger digital healthcare infrastructure remained largely unachieved. If more consistent investments in digital health had been made before the pandemic, digital tools could have provided real support in managing the crisis. Estonia, on the other hand, benefited from years of focusing on interoperability and patient access to health data. During the pandemic, it was able to rely on existing digital systems to maintain continuity of care (Saarmann, 2022). In addition, digital solutions such as self-assessment apps, online dashboards, and telemedicine platforms made it possible to monitor the situation in real-time, reduce unnecessary in-person contact, and keep the public informed. This shows how well-targeted investments in digital health can increase resilience and make healthcare systems better prepared for unexpected crises (Ministry of Foreign Affairs of the Republic of Estonia, 2020).

Also, the recurring maintenance and upgrade costs of these systems, generated by the lack of common technical standards, may reduce the return on initial investments. In the absence of real interoperability, the system becomes a network of separate digital points, difficult to manage and expensive. As mentioned in the comparative analysis, while Romania allocates around 100 million euros to stabilize the system after a series of cyberattacks and frequent outages, Estonia spends only 20 million euros annually on the maintenance and operation of a single system, X-Road, which involves predictable costs and is able to be covered by budget money.

Another significant aspect is the low absorption of potential economic benefits. Although tools such as telemedicine, EHRs or online scheduling platforms have been implemented, they are underused in the public sector, largely due to the lack of an integrated data system that limits the capacity for strategic planning, prevention and efficient allocation of resources. In Romania, the private sector – exemplified by networks such as Regina Maria – has managed to develop advanced digital systems, which allow quick access to results, online scheduling, teleconsultations, digital medical archives and functional mobile applications. However, successful digitalization in the private sector may have limited social impact, as access to these services is restricted by high costs, and the majority of the population continues to receive treatment in the public system. In addition, the lack of interoperability between the private and public sectors means that medical data remains isolated, which can fragment the patient's medical history and affects the quality of care. In addition, there is a moderate investment in human capital; digital training for healthcare personnel is inadequate and frequently restricted to specific towns or institutions.

In contrast, in Estonia both the private and public sectors are fully interconnected through the national digital infrastructure (X-Road), which allows for the automatic and secure exchange of data between healthcare providers, whether private or public. Thus, Estonia manages to transform digitalization into a functioning mechanism on a national scale, not just a localized advantage in privileged areas or sectors of the healthcare system. Through its digital platform it facilitates public health communication, supports administrative tasks, and frees up time for healthcare providers to focus on patients. Centralized, paperless systems enable electronic forms and prescriptions, lowering costs, minimizing fraud, and making medical record management more effective. eHealth also reduces medical errors, duplicate tests, and waiting times, while increasing revenues and efficiency (Soares, Ferreira and Veiga, 2023). Thanks to the digitalization of its healthcare system, Estonia has significantly reduced unmet medical needs: from 15.5% in 2019 – the highest in the EU – to 9.1% in 2023. This was largely due to telemedicine and shorter waiting times for certain procedures (OECD/European Observatory on Health Systems and Policies, 2019; OECD/European Observatory on Health Systems and Policies, 2023).

Despite being a relatively well-established infrastructure, the digitalization of the Estonian healthcare system has its own set of financial difficulties. For example, cybersecurity and cross-border interoperability are currently causing maintenance and upgrade costs to rise. In addition, the digital inequalities between urban and rural areas, although addressed more than in Romania or other EU countries, still require investment in connectivity and digital literacy.

A common challenge for both countries is the dependence on public and European funding, especially in the context of the expansion of digital systems towards European Health Data Platforms (EHDS) (Council of the European Union, 2025), which involves significant technical and legal compliance costs.

5. Conclusion

The comparative analysis of the healthcare system digitalization in Romania and Estonia highlights that digital performance is not determined exclusively by the size of a country or the level of investment, but especially by strategic coherence, effective digital governance and the integration of human capital in the transformation process. Estonia has managed to build an interoperable and scalable digital ecosystem, in which both the public and private sectors are connected through a common infrastructure, and data circulates in real time, secured and focused on patient and healthcare staff accessibility. Romania, on the other hand, despite mobilizing significant resources for digitalization, continues to face economic, institutional and strategic barriers that fragment the system: lack of interoperability, poor maintenance of platforms, underfunding of prevention and modest investments in the digital literacy of healthcare staff.

Also, although the private sector in Romania has reached a much more advanced degree of digitalization, access to these services is restricted by financial barriers, while healthcare data remains isolated from the public system. Thus, real and equitable digitalization cannot be built without an integrative national vision, capable of capitalizing on both the existing structure and the technological and human potential of the system.

In conclusion, Romania has not only challenges, but also clear opportunities. For digitalization to have a concrete impact on the medical system, it is not enough to have technical platforms or specific funding. A clear strategy is needed, coordination between institutions and constant investments in infrastructure, but especially in people. Only in this way can digitalization become a real support for patients and medical professionals, not just a theoretical solution.

Future research could explore how digitalization affects long-term patient outcomes and satisfaction, as well as identify which policy and governance approaches best ensure effective and equitable access to digital healthcare. Additionally, exploring innovative financial models for digital health initiatives and the role of a human-centered design in healthcare digitalization would provide valuable insights for advancing the development of digital healthcare system.

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Circular Bioeconomy as a Driver of Economic Resilience in the EU Dairy Sector

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Abstract. *Several industries in the European Union face new challenges such as increases in market uncertainty, climate change and resource dependency. As the second largest agricultural sector in the EU, the dairy sector is vital to economic developments in the farming and food industry. However, this sector is vulnerable to resource based, linear production system that directly relates to price volatility, environmental stressors and changes in EU policy. This paper evaluates the level of economic resilience of the dairy sector in the EU by proposing a circular bioeconomy (CBE)-centered economic resilience index which comprises indicators of resilience relating to vulnerability, intensification, biodiversity, diversification and performance. The results measure substantial disparity among countries, with high performers exhibiting lower intensity of inputs and greater species diversity and performance. This study provides evidence to support the role of circular bioeconomy-oriented practices and strategies in enhancing the long-term sustainability and adaptive capacity in the EU dairy sector.*

Keywords: economic resilience index; circular bioeconomy; EU dairy sector; comparative analysis.

JEL Classification: Q01; Q13; Q57; L66; O13; C43.

1. Introduction

The EU dairy sector is an integral foundation of the continent's agriculture, key to food security, rural development, and macroeconomic sustainability. This sector stands out as well positioned at the intersection of major economic importance, high environmental impact, heightened sensitivities, and plentiful and tangible circularity opportunities. It is very resource-intensive (requiring imported feed, synthetic fertilizers, and fossil fuel energy), as well as generating considerable amounts of by-products such as manure, whey and processing water. This dairy sector suffers considerable vulnerability in its current linear model, including price volatility, supply chain disruptions, as well as growing environmental and social pressures, which can jeopardize its economic and long-term viability (European Dairy Association, 2025). To answer this challenge, circular bioeconomy can help with achieving economic resilience by creating new value, decreasing dependencies, strengthening local systems, and ensuring the industry connects with market and policy pressures.

The dairy sector is the second largest agricultural sector in the EU and accounted for over 12% of agricultural output (Bas-Depossez et al., 2019). According to Eurostat (2025), the EU agricultural sector generated an estimated €234.1 billion in gross value added in 2024, accounting for 1.3% of the EU's GDP. In 2023, the EU produced 160.8 million tonnes of milk per year, making it the world's largest milk producer and exporter of value-added dairy products, including cheese, butter, and milk powders (Vinci, 2024). The European dairy sector's global competitiveness reflects its high product quality, safety, sustainability, and innovations (European Dairy Association, 2025). Beyond economic importance, the dairy sector is an important environmental player responsible for nutrient recycling and biodiversity (Kuipers et al., 2024), but the sector is also criticized for its greenhouse gas emissions, nutrient overflow, and resource intensity (Vinci, 2024).

Although the EU dairy industry is very large, it is expected that the milk production to continue to decline in 2025 (Eurostat, 2025a). Total EU milk production is forecasted to decline by 0.2% in 2025 from 149.4 million metric tons in 2024, due to declining herd sizes, stricter environmental regulations under the EU Green Deal, disease outbreaks in dairy cattle, and other declining economic margins affecting the industry (European Dairy Association, 2025). The dairy sector employs hundreds of thousands of jobs in Europe: from farming, to processing, to distributing and retailing. For this reason, any shock to the sector has wider repercussions. Notably, systemic vulnerabilities have increased the external pressures on the dairy sector in recent years. Recent crisis, including the 2014-2016 dairy milk crisis, pandemic (COVID-19) conditions, and the war in Ukraine, have reinforced the need for resilient, adaptive, and sustainable dairy sectors capable of withstanding economic shocks and creating socio-environmental value (Lasarte-López et al., 2023; Nikishyna and Chebotarova, 2024).

The challenges facing the EU dairy sector are multiple, yet in this context, the paradigm of circular bioeconomy (CBE) based on closed-loops and efficient use of resources, offers an opportunity to enhance resilience that can lead to long-term sectoral sustainability (Oliveira et al., 2021; Entrena-Barbero et al., 2024). The importance of developing circularity is becoming increasingly recognized, as the EU's Green Deal, Bioeconomy Strategy, and

Farm to Fork Strategy, have made circularity an important element of agri-food transition with policy and commercial relevance (European Dairy Association, 2025). For the dairy sector, these strategies imply pursuing innovations leading to renewable energy production, co-products valorization, and diversified product portfolios. Even though circular bioeconomy principles are well-articulated in theory, there is little empirical evidence of how they drive economic resilience specifically in the dairy sector.

Longitudinal analyses of the economic resilience of EU dairy farms have concluded that reducing vulnerability and input intensity, improving diversification of products, and effective management of resources, are needed to enable resilience going forward (Salvador et al., 2022; Lasarte-López et al., 2023). Most existing resilience research use either micro-level or macro-level financial indicators, and few are looking spatial or sub-sectoral differences such as which countries or sectors lead in circularity resilience synergy (Lewandowski et al., 2024).

The main objective of this study is to propose and then apply a macroeconomic level Circular Bioeconomy Economic Resilience Index (CBE-ERI) for EU Member States using Eurostat data and previous academic research. This index aims to provide a quantitative measure of the dairy sector's resilience through a circular bioeconomy lens, adapting a micro-level ERI applied on dairy farms and using macro-level country data as proxies. The index is based on two sources of conceptual inspiration. The first source is the Economic Resilience Index (ERI) developed by Hafele et al. (2023), which captures general macroeconomic resilience across a number of dimensions. The second source is a farm-level economic resilience index developed after Wilczynski and Koloszytz (2025) that pertains to the aspects of dairy farming.

Section 2 presents an extensive literature review of the concepts of economic resilience and circular bioeconomy in the dairy industry, while summarising some important theoretical and empirical contributions. Section 3 describes the methodological process used to construct the Circular Bioeconomy Economic Resilience Index (CBE-ERI) and the implications of the selection and operationalisation of the indicators. Section 4 presents and discusses the results of the CBE-ERI for the five index components for each EU Member State, while Section 5 concludes with a summary of findings, limitations and suggestions for future research.

2. Literature review

In 2015, the milk quota system introduced in the EU in 1984 to reduce surplus production was abolished, subsequently exposing dairy farms to volatility in global markets and heightened competition (Bas-Deposse et al., 2019). In anticipation of an increase in global demand, especially in Asia, many producers expanded their capacity in advance. This caused a surge in supply and eventually led into the 2014-2016 milk crisis characterised by falling prices, income instability, and widespread financial hardship for farmers (Vinci, 2024). This exposed the sector's vulnerability to market shocks.

The COVID-19 pandemic provided another real-world stress test for the sector's resilience. In a positive turn of events, French organic dairy farms and their corresponding supply chains demonstrated high levels of buffer and adaptive capacity, supported by autonomy to feed livestock, strong localised networks, and cooperative supply chains. This proved that the ability to innovate based on agroecological principles like diversification, locality, circulation of resources, can contribute to recovery and growth in the sector (Perrin and Martin, 2021). Regionalised networks also tend to build resilience through collective action, knowledge transfer, capitalising on their network of government and institutional support (Ramon-Muñoz, Molema and Evenhuis, 2024).

Since 2020, the European Commission's Circular Economy Action Plan emphasizes how circular economy is needed to make circular transitions in food systems and agri-food systems to respond to the climate crisis through carbon neutrality, be competitive and resilient (Bas-Depossez et al., 2019; Nastase, Lucaci and Chaşovschi, 2020). CBE is an economic model for transforming and realising the principles of the circular economy, while sustainably utilising renewable biological resources with the purpose of eliminating waste, displacing fossil inputs and realising maximum value from resources (Klein, Nier and Tamásy, 2022; Rossi et al., 2024).

In the dairy sector, CBE strategies focus on resource efficiency improvements utilizing anaerobic digestion to reduce methane and displacing energy (Peterson and Mitloehner, 2021), valorization of whey, manure, wastewater by-products (Oliveira et al., 2021; Haque, Fan and Lee, 2023; Mazurkiewicz, 2023), biogas (Valve, Lazarevic and Humalisto, 2021), and local value chain integration (Perrin and Martin, 2021; Zarei-Kordshouli, Paydar and Nayeri, 2023). Practices such as nutrient recycling and manure-based fertilizers or upcycling whey can improve circularity and also improve operational resilience (Kuipers et al., 2024). A transformation of dairy sector as part of its transition to circularity is waste valorization, the process of converting waste (e.g., manure, whey) into revenue, such as bioenergy, animal feed, or bio-based materials (European Dairy Association, 2025). For example, a small-scale anaerobic digester can result in an annual profit of €114,159, illustrating, that cost centers can successfully become profit centers (Mazurkiewicz, 2023). CBE strategies also lead to opening new markets for eco-labelled products, improve export potential and aid compliance with new sustainability requirements (Ivana and Puvača, 2024; Kuipers et al., 2024).

Economic resilience can be described as multi-faceted concept encompassing three dimensions: robustness, adaptability, and transformability. Robustness refers to the ability to absorb disturbances and maintain core functions. Adaptability highlights how economies can modify their behavior in response to environmental change (Ramon-Muñoz, Molema and Evenhuis, 2024). Transformability refers to the ability of an economy to adjust its structure and functions because of persistent pressures or systemic shocks (Kołoszycz et al., 2024; Wilczynski and Kołoszycz, 2025). For this study, economic resilience refers to the dairy sector's capacity to absorb, adapt to, and transform from external shocks and stressors, such as market adjustments and environmental disasters.

Most empirical studies examining economic resilience are based on using composite indices (Economic Resilience Index or ERI), scenario analysis, or mixed methods

(Lewandowski et al., 2024). The European ERI index calculated by Hafele et al. (2023) comprises 27 indicators and gives a multidimensional picture of the economy using economic, social, environmental and governance indicators (among others), providing a more holistic alternative to traditional metrics like gross domestic product GDP.

The connections between CBE and resilience are evident from EU policy framework such as the Common Agricultural Policy (CAP), the Farm to Fork Strategy, and the European Green Deal (Entrena-Barbero et al., 2024). These policies support transitioning to sustainability through economic incentives, innovative support, and clear regulation alignment. CBE, by contributing to the physical recovery of the environment, supports the fabric of the economy as it generates new jobs and improves viability in both rural urban and economies (Fiorillo and Amico, 2024). Actions such as reducing dependence on external inputs (Oliveira et al., 2021; Perrin and Martin, 2021), product and income diversification and economic independence obtained from valorisation of biogas, organic fertilizers, high-value co-products, etc. (Fiorillo and Amico, 2024; Toplicean and Datcu, 2024), support increased resilience (Ramon-Muñoz, Molema and Evenhuis, 2024).

Despite its potential, the implementation of CBE strategies faces persistent challenges, which include high capital costs, regulatory challenges, lack of technical knowledge and immature markets (Salvador et al., 2022; Hetherington et al., 2024). Other issues arise from developing a market for circular products, as well as their price competitiveness and consumer acceptance, while regional analyses demonstrate the need for tailored, context-sensitive policy frameworks and supply-chain collaboration to overcome barriers (Kuipers et al., 2024).

The economic resilience of European dairy farms has steadily declined from 2004 to 2021 (Nikishyna and Chebotarova, 2024). Wilczynski and Koloszycz (2025) demonstrated in their recent paper that farm-level ERI-index has decreased between 0.19% to 1.23% within all calculated dimensions. This decline underscores the sector's growing susceptibility to economic shocks, despite policy measures. Two structural issues are primary causes of the vulnerability, namely a high intensification contributing ~40% to ERI (suggesting a heavy reliance on external inputs of feed or energy use) and low diversification contributing only 4-7% to ERI, which implies limited revenue streams beyond raw milk production (Nikishyna and Chebotarova, 2024; Wilczynski and Koloszycz, 2025).

3. Methodology

This research uses a quantitative framework to analyze the economic resilience of Member States' EU dairy sectors from 2007 to 2024 with Eurostat harmonized data. We introduce the Circular Bioeconomy Economic Resilience Index (CBE-ERI), based on a combined macroeconomic ERI framework derived from Hafele et al. (2023) and a microeconomic-level resilience perspective of dairy farming from Wilczynski and Koloszycz (2025) that used the *vulnerability*, *intensification*, *biodiversity*, *diversification*, and *performance* dimensions. More specifically, the proposed CBE-ERI adapts the five dimensions by using Eurostat macroeconomic sector available data to calculate relevant sub-indicators:

1. *Vulnerability (V)*: volatility of milk price variability (σ/μ), and represents income instability at a sectoral level,
2. *Intensification (I)*: livestock units per hectare and milk yield per cow represent production pressure and consequent stress on the environment.
3. *Biodiversity (B)*: uses Simpsons Diversity Index (Roswell, Dushoff and Winfree, 2021) adapted for dairy to capture the distribution of dairy production by livestock species by utilizing the volume share of the EU milk production from all animal types (cows, ewes, goats, buffaloes etc.).
4. *Diversification (D)*: calculated using Shannon entropy (Olbryś, 2022) to quantify product portfolio variation by treating product market shares as probabilities, to reflect product portfolio variation in domestic dairy markets.
5. *Performance (P)*: proxied by the Circular Material Use Rate (CMU) and used to represent national circularity outcomes.

All indicators are derived from Eurostat datasets, implying cross-country comparability. The sub-indicators and sources are included in Table 1.

Table 1. CBE-ERI dimensions at macroeconomic level

	Description and Rationale	Eurostat Table	Data available up to year
Vulnerability (V)	$V = \frac{\sigma}{\mu}$ Milk price volatility (σ/μ) – sector-level income vulnerability	[apri_pi_outq]	2025
Intensification (I)	$I = \frac{LU}{ha} + \frac{1}{\text{Milk yield}}$ 1Livestock Units per hectare (LU/ha) – reflects input pressure via livestock density Milk yield per cow (litres/cow/year) – yield is inverted since high yields may correlate with high input, stressing environment.	[tai09] [apro_mk_farm]	¹ breaks 2023
Biodiversity (B)	$B = SID = \left(1 - \sum_{i=1}^n P_i^2\right) \times 100$ $P_i = \frac{\text{value of dairy output for } i^{\text{th}} \text{ livestock}}{\text{Total dairy output}}$ Simpson's Diversity Index (SID) – between 0 and 1 – based on EU milk production from all animal types (cows, goats, etc.)	[apro_mk_pobta]	2024
Diversification (D)	$D = \left(\frac{-\sum_{i=1}^N S_i \cdot \log(S_i)}{\log(N)}\right)$ Where: S_i : Share of dairy product i in total domestic dairy market value. N : Total number of dairy product categories considered. $\sum_{i=1}^N S_i = 1$ (full market share distribution).	[apro_mk_pobta]	2024
2Performance (P)	$P = CMU$ Circular Material Use Rate (CMU) – directly measures circularity performance at the national level.	[cei_srm030]	2023

¹LU/ha data is discontinuous; calculations only possible for 2010, 2013, 2016, and 2020.

² Alternative data on dairy losses (D1100DLD) was unavailable due to Eurostat error code 5.07.

Source: Author's own research based on Wilczynski and Koloszycz (2025)

As seen in Table 1, the analysis was intended to cover the years 2007-2024, according to the availability of data from Eurostat, but the Circular Bioeconomy Economic Resilience Index (CBE-ERI) can only be calculated for 2010, 2013, 2016, and 2020, when values of all dimensions intersect. This is mainly because *Intensification (I)* dimension uses Livestock Units per hectare (LU/ha) that is not consistently reported.

The Economic Resilience Index (ERI_i) is calculated in two steps based on Wilczynski and Koloszycz (2025). First, the aggregated resilience score (ER_i) is computed as:

$$ER_i = (-)V_i + (-)I_i + B_i + D_i + P_i$$

where V = vulnerability, I = intensification, B = biodiversity, D = diversification, and P = performance.

Secondly, ER_i is normalized to a 0–1 scale for comparability across countries and time:

$$ERI_i = (ER_i - ER_{\min}) / (ER_{\max} - ER_{\min})$$

where ER_{min} and ER_{max} represent the minimum and maximum aggregated resilience scores observed across all countries and years, respectively.

In the ER computation, the negative signs preceding V and I are crucial. They indicate that higher vulnerability and higher intensification are considered detrimental to overall economic resilience, thus contributing negatively to the aggregated score. Conversely, higher biodiversity, diversification, and performance contribute positively. The second step involves normalizing this aggregated score to a standardized scale, typically ranging from 0 to 1. This normalization, given by the formula, allows for meaningful comparisons of resilience levels across different countries and over time, irrespective of the absolute magnitudes of the underlying raw dimension values.

4. Results and discussions

4.1 Vulnerability (V) dimension results

The vulnerability dimension ($V = \text{mean of milk prices } \sigma / \text{standard deviation } \mu$) measures the vulnerability of the dairy sector and the capacity of the sector to withstand a number of economic shocks caused by unstable income from price movements in raw milk prices. If the vulnerability index value is higher, producers have higher income volatility. The analysis spans 27 EU Member States over four benchmark years (2010, 2013, 2016, and 2020). The vulnerability dimension results are presented in Table 2 below.

Table 2. Vulnerability (V) dimension calculated for EU-27 countries – 2010, 2013, 2016, 2020

Country	2010			2013			2016			2020		
	(σ)	(μ)	(V)	(σ)	(μ)	(V)	(σ)	(μ)	(V)	(σ)	(μ)	(V)
AT	31.79	2.00	0.06	37.63	2.70	0.07	31.19	1.78	0.06	37.81	1.66	0.04
BE	30.47	2.24	0.07	37.22	3.01	0.08	26.70	4.47	0.17	31.30	1.68	0.05
BG	27.62	2.32	0.08	33.67	1.65	0.05	27.22	2.06	0.08	31.59	0.52	0.02
HR	N/A	N/A	N/A	36.03	1.36	0.04	29.58	1.26	0.04	33.33	0.74	0.02
CY	51.26	0.43	0.01	57.52	0.86	0.01	56.00	1.30	0.02	57.86	0.69	0.01

Country	2010			2013			2016			2020		
	(σ)	(μ)	(V)	(σ)	(μ)	(V)	(σ)	(μ)	(V)	(σ)	(μ)	(V)
CZ	28.28	1.68	0.06	32.68	1.11	0.03	24.08	1.76	0.07	31.59	1.62	0.05
DK	31.94	2.84	0.09	38.63	3.09	0.08	28.83	2.31	0.08	34.82	0.72	0.02
EE	27.74	1.85	0.07	33.67	1.56	0.05	23.76	3.83	0.16	29.34	1.51	0.05
FI	39.53	3.81	0.10	45.94	2.39	0.05	37.08	0.87	0.02	38.81	0.77	0.02
FR	30.96	2.28	0.07	34.64	2.32	0.07	30.18	1.40	0.05	36.19	0.99	0.03
DE	30.97	2.66	0.09	37.46	3.38	0.09	27.38	3.61	0.13	33.74	1.38	0.04
EL	37.32	0.88	0.02	44.42	0.61	0.01	38.65	1.28	0.03	38.65	0.15	0.00
HU	26.02	1.94	0.07	32.35	1.73	0.05	23.80	2.35	0.10	30.01	1.33	0.04
IE	30.83	3.03	0.10	38.31	4.34	0.11	28.10	4.53	0.16	34.39	3.17	0.09
IT	33.83	1.84	0.05	38.82	0.97	0.02	31.99	1.47	0.05	35.78	1.02	0.03
LV	25.11	1.20	0.05	30.57	1.68	0.05	21.72	4.13	0.19	28.24	1.86	0.07
LT	25.14	2.51	0.10	31.67	3.13	0.10	21.63	4.46	0.21	28.74	2.70	0.09
LU	29.78	1.94	0.07	36.54	3.24	0.09	28.00	2.83	0.10	N/A	N/A	N/A
MT	44.73	2.45	0.05	52.44	1.86	0.04	45.71	1.82	0.04	50.36	1.27	0.03
NL	31.46	3.62	0.12	39.45	3.29	0.08	28.38	3.79	0.13	34.45	1.31	0.04
PL	27.33	1.57	0.06	31.75	2.75	0.09	25.96	2.47	0.10	31.56	1.86	0.06
PT	28.65	1.65	0.06	33.55	1.95	0.06	28.02	1.17	0.04	30.27	0.37	0.01
RO	23.92	1.98	0.08	30.00	2.00	0.07	25.66	2.89	0.11	31.26	1.40	0.04
SK	27.31	1.69	0.06	32.70	1.49	0.05	25.31	1.84	0.07	32.39	0.64	0.02
SI	26.85	1.09	0.04	32.30	1.93	0.06	25.28	1.80	0.07	31.40	1.25	0.04
ES	29.38	1.07	0.04	34.31	2.13	0.06	29.12	0.93	0.03	32.21	0.61	0.02
SE	33.68	4.27	0.13	39.60	1.89	0.05	30.70	2.23	0.07	35.31	1.36	0.04

Source: Author's own research based on Eurostat data (Eurostat, 2025b)

The overwhelming majority of EU Member States registered moderate vulnerability values in 2010 ($V \approx 0.069$), highlighted a sector in transition, and still recovering from distortionary forces of the 2008 financial meltdown. By 2013, average vulnerability fell ($V \approx 0.059$), coinciding with upward strength in CAP instruments, notably in responses to global dairy demand in emerging economies.

The dramatic spike in apparent vulnerability from 2016 onwards, made particularly evident in Lithuania, Latvia, Ireland and Belgium exhibited evidence of structural disruption. This aligns with the abolition of the EU milk quota system in 2015, leading to overproduction and market saturation. By 2020, average vulnerability was extremely low (≈ 0.038) suggesting that dairy producers fully adjusted to the market conditions, or in cases where regulations were developed, the market stabilization.

Figure 1 highlights persistent patterns by region. Some structural vulnerability persists through Lithuania and Latvia's reliance on products with a focus on small farms and reliance on external demand, while Belgium and Ireland's deep integration into commodity chains is problematic. In contrast, Cyprus and Greece, as examples of very low vulnerability, had markets relatively sheltered from spills from external factors, with a low dependence on international price volatility.

Figure 1. EU-27 countries milk price vulnerability (2010, 2013, 2016, 2020)

Source: Author's own research

Finland and Malta also show sustained resilience, likely due to effective national support frameworks and limited export dependence. Germany and Netherlands appear as transitional cases of moderate vulnerability in 2010 and in 2013, peaked in 2016 and reduced vulnerability by 2020 (Figure 1 above). This reflects both adaptive restructuring and institutional responsiveness.

The peak of volatility in 2016 could be considered a “natural experiment” of large magnitude, where the market liberalization without adequate safety nets caused by the abolition of milk quota exacerbated sector-wide vulnerabilities stemming from farm-level. CAP reforms post-2015 (European Dairy Association, 2025), including voluntary coupled support and income stabilization tools, may have played a role in the observed 2020 recovery. The lessons from 2016 highlight the importance of precautionary safety nets, early warning systems, and customized risk management options especially for those Member States that have high market exposure from dairy sector. As we look to the future, climate and geophysical volatility, geopolitical disruption, and an evolving trade scenario will continue to challenge the sector. Resilience can be achieved not through structural support that is proactive in supporting diversification, value-added production, and reduced exposure to volatile export markets.

4.1. Intensification (I) dimension results

In this study, the Intensification Index (I) is a composite indicator that captures intensity of resource use within the dairy sector. It combines livestock density with production intensity

to create a single value, $I = \text{LU/ha} + 1/\text{Milk yield}$. The inverse milk yield per cow (litres/year) in the formula penalises very high yielding countries. In general, the higher the degree of intensification, the lesser the adaptability and greater dependence on external inputs such as feed or energy. The livestock density and cow milk yield data used, as well as intensification (I-values) results are presented in Table 3 below.

Table 3. *Intensification (I) dimension calculated for EU-27 countries (2010, 2013, 2016, 2020)*

Country	2010			2013			2016			2020		
	LU/ha	Milk Yield	(I)	LU/ha	Milk Yield	(I)	LU/ha	Milk Yield	(I)	LU/ha	Milk Yield	(I)
AT	0.85	5832	0.85	0.87	6407	0.87	0.95	6624	0.95	0.86	7271	0.86
BE	2.78	6009	2.78	2.72	6839	2.72	2.77	7413	2.77	2.68	8285	2.68
BG	0.24	3584	0.24	0.21	3668	0.21	0.27	3656	0.27	0.23	3621	0.23
HR	0.75	3835	0.75	0.54	4475	0.54	0.57	4566	0.57	0.61	6608	0.61
CY	1.69	6448	1.69	1.59	6353	1.59	1.51	6312	1.51	1.73	7503	1.73
CZ	0.49	7146	0.49	0.49	7592	0.49	0.5	8199	0.50	0.47	9135	0.47
DK	1.84	8569	1.84	1.56	8963	1.56	1.56	9361	1.56	1.59	10028	1.59
EE	0.32	6999	0.32	0.32	7882	0.32	0.28	8639	0.28	0.3	10020	0.30
FI	0.47	8088	0.47	0.51	8142	0.51	0.49	8512	0.49	0.42	9264	0.42
FR	0.8	6464	0.80	0.78	6783	0.78	0.8	7099	0.80	0.75	7410	0.75
DE	1.04	7077	1.04	1.08	7340	1.08	1.07	7625	1.07	0.98	8457	0.98
EL	0.46	5164	0.46	0.44	5620	0.44	0.66	6937	0.66	0.7	8587	0.70
HU	0.52	7050	0.52	0.47	7091	0.47	0.51	7765	0.51	0.43	8168	0.43
IE	1.23	5313	1.23	1.18	5174	1.18	1.25	5327	1.25	1.41	5880	1.41
IT	0.76	6528	0.76	0.76	6058	0.76	0.74	6256	0.74	0.81	8081	0.81
LV	0.26	5065	0.26	0.25	5527	0.25	0.25	6006	0.25	0.24	7622	0.24
LT	0.32	4815	0.32	0.29	5447	0.29	0.29	5773	0.29	0.25	6770	0.25
LU	1.25	N/A	N/A	1.23	N/A	N/A	1.3	N/A	N/A	1.24	N/A	N/A
MT	3.52	6275	3.52	3.13	6315	3.13	2.81	6526	2.81	3.27	6368	3.27
NL	3.52	7866	3.52	3.52	7769	3.52	3.76	7875	3.76	3.45	9257	3.45
PL	0.7	3567	0.70	0.62	4320	0.62	0.65	5097	0.65	0.69	6292	0.69
PT	0.59	7098	0.59	0.55	7205	0.55	0.62	7450	0.62	0.63	7836	0.63
RO	0.37	3818	0.37	0.35	3393	0.35	0.41	3343	0.41	0.35	3393	0.35
SK	0.35	5581	0.35	0.34	6295	0.34	0.33	6685	0.33	0.33	7828	0.33
SI	1.04	5304	1.04	0.97	5167	0.97	1.02	5368	1.02	1.01	6512	1.01
ES	0.61	7025	0.61	0.61	7771	0.61	0.65	8328	0.65	0.7	9204	0.70
SE	0.54	8212	0.54	0.53	8291	0.53	0.54	8709	0.54	0.55	9288	0.55

Source: Author's own research based on Eurostat data

Austria, France, Finland, and Sweden all show stable or decreasing values in the Intensification dimension, indicating adherence to production systems that are in line with more sustainable production in the dairy sector. These countries all show moderate livestock densities and milk yields, which are balanced input and outputs, suggesting a moderate impact on directly competing agro-ecosystems while supporting the EU sustainability agenda.

In contrast, Belgium and the Netherlands continually show a high score ($I > 2.6$) for Intensification due to the extreme livestock densities ($\text{LU/ha} \approx 2.7 - 2.8$) and high milk yields. Despite these efficiency-focused economic systems, they are still ecologically intensive systems that rely on external inputs, especially imported feeds. Given the high, structural intensity of the dairy sectors in these countries, it is expected that there will be growing environmental concerns.

Low intensification ($I < 0.8$) countries are represented by Bulgaria, Romania, Greece and Croatia. While these systems exert less environmental pressure, their productivity constraints may hinder economic viability and sectoral competitiveness. Croatia, experienced a notable decline in intensification post-EU accession. Interestingly, this shift coincided with increased milk yields, despite a stable or declining LU/ha , signaling improved per-animal productivity without more land use. The projected 11% reduction in the EU dairy herd by 2035 (EDA, 2025) will disproportionately affect high-intensification countries' ability to adapt, while low-intensity regions may leverage this transition to modernize sustainably, supported by CAP instruments promoting agroecological practices and rural resilience.

4.2. Biodiversity (B) dimension results

This dimension evaluates the degree of diversity within the dairy sector, which is relevant for both ecological resilience and economic diversity. We adapted Simpson's Diversity Index (SID) for the dairy sector by utilizing the volume share of the EU milk production from all animal types (cows, ewes, goats, buffaloes etc.). A sample is presented in Table 4. Except cows, headcounts for each livestock type were not available for inclusion.

Table 4. Biodiversity (B) dimension calculated for Spain (ES) (2010, 2013, 2016, 2020)

Year	Biodiversity (B) dimension				
	Cow milk (%)	Sheep milk (%)	Goat milk (%)	Buffalo milk (%)	Biodiversity (B) SID
2010	83.1	10.14	5.07	1.69	29.63009
2013	85.05	8.97	4.485	1.495	26.63686
2016	86.35	8.19	4.095	1.365	24.57969
2020	87	7.8	3.9	1.3	23.5326

Source: Author's own research based on Eurostat data

The SID indicator varies between 0 to 100. Higher SID values correlate with greater ecological and production system diversity biodiversity (Roswell, Dushoff and Winfree, 2021), enhancing resilience through resource variety and adaptability. The resulting EU-27 country Biodiversity values are presented in Table 6 below.

Table 5. Biodiversity (B) dimension calculated for EU-27 countries (2010, 2013, 2016, 2020)

Country	Biodiversity (B) dimension			
	2010	2013	2016	2020
AT	0.77777934	0.688262	0.628551	0.598686
BE	2.06420864	1.827643	1.669698	1.590656
BG	10.005216	8.891064	8.142456	7.7664
HR	1.80790974	1.600539	1.462113	1.392846
CY	46.747454	42.6858	39.78495	38.2766
CZ	16.53907424	14.74717	13.5357	12.9249
DK	14.48109806	12.89787	11.82968	11.29177
EE	8.7977435	7.813471	7.152818	6.82115
FI	20.09900256	17.95759	16.50423	15.76982

Country	Biodiversity (B) dimension			
	2010	2013	2016	2020
FR	5.101304	4.522766	4.135614	3.9416
DE	2.83014446	2.506637	2.290523	2.182334
EL	67.796664	68.44621	67.65137	66.8856
HU	36.71601024	33.19037	30.73692	29.4793
IE	14.24996664	12.69046	11.63851	11.10886
IT	7.577934	6.726223	6.155132	5.8686
LV	14.48109806	12.89787	11.82968	11.29177
LT	3.33830094	2.957369	2.702797	2.575326
LU	8.7977435	7.813471	7.152818	6.82115
MT	4.34869214	3.854198	3.523481	3.357806
NL	3.08446944	2.732196	2.496821	2.378976
PL	14.48109806	12.89787	11.82968	11.29177
PT	2.575326	2.280692	2.083903	1.9854
RO	3.8444835	3.406556	3.113783	2.96715
SK	1.2938315	1.145173	1.045976	0.99635
SI	16.53907424	14.74717	13.5357	12.9249
ES	29.630094	26.63686	24.57969	23.5326
SE	13.5536115	12.06592	11.06308	10.55835

Source: Author's own research based on Eurostat data

Greece, Cyprus, Spain and Hungary exhibited strong biodiversity values that buffers them against sectoral shocks, reflecting the inclusion of goats and sheep milk (Cyprus: 46.7 in 2010, ~39 in 2020). Some countries (Finland, Czechia, Slovenia, Sweden, Latvia) show moderate biodiversity dimension, usually maintaining their cow dominance (~90%) with some alternative species being outputted, and often involving dual systems (industrial & traditional agriculture). Germany, France, Austria, Belgium all exhibit >97–99% cow biodiversity, rendering them vulnerable to single-species risk (from diseases, or feed availability).

At the EU level, the average SID shows a decline from 3.34 (2010) to 2.58 (2020) and is indicative of increased concentration in cow milk production and reduced structural biodiversity, reflecting a greater market trend towards intensification and concentration within the dairy sector (I dimension). The data shows a pattern of consolidation where countries are relying more on monospecific dairy systems, which is likely driven by productivity and efficiency pressures and policies and political agreement with the CAP mechanisms of intensification.

4.3. Diversification (D) dimension results

The Diversification (D) dimension uses Shannon entropy (Olbryś, 2022) to quantify how evenly economic value is distributed across dairy product categories (drinking milk, cheese, yoghurt, skimmed milk powders, etc.) within each country's domestic market. Higher entropy indicates greater diversity, representing a broader market portfolio and lower dependence on single product lines (e.g., drinking milk or cheese). In the context of circular bioeconomy resilience, greater entropy denotes a structurally diversified dairy processing sector, which enhances the sector's capacity to absorb and adapt to market, environmental, or policy shocks.

Trends in dairy product diversification (based on volume shares) vary across EU Member States in the 4 years analysed (Table 6). Some countries exhibit a relatively stable

diversification profile, while others show shifts in their product portfolios. *Highest diversification* ($D \geq 0.50$) countries are Sweden, Finland, Poland, Slovakia and Austria are expected to be more resilient, due to their ability pivot or maintain value during demand shocks. Countries with *moderate diversification* ($0.45 \leq D < 0.49$) suggest mature and balanced dairy processing sectors (Ireland, France, Italy, Germany, Netherlands, Romania or Croatia). Conversely, countries with *declining* or *low diversification* ($D < 0.45$) such as Slovenia, Hungary, Portugal risk value loss when dominant product categories face volatility (e.g., milk price collapses).

Table 6. Diversification (D) dimension calculated for EU-27 countries (2010, 2013, 2016, 2020)

Country	Diversification (D) dimension			
	2010	2013	2016	2020
AT	0.484502	0.471938	0.488959	0.478326
BE	0.45754	0.450171	0.456258	0.466024
BG	0.458786	0.442869	0.455379	0.457225
HR	0.449303	0.474948	0.507027	0.50439
CY	0.462517	0.484651	0.477137	0.451552
CZ	0.458631	0.443747	0.455509	0.459172
DK	0.458406	0.444333	0.455563	0.459115
EE	0.462094	0.434332	0.454123	0.44639
FI	0.545695	0.523889	0.40791	0.333865
FR	0.412362	0.412297	0.460989	0.443151
DE	0.462049	0.434876	0.454205	0.44707
EL	0.46282	0.431791	0.453884	0.447329
HU	0.438936	0.428665	0.443879	0.393617
IE	0.462426	0.433839	0.454153	0.448579
IT	0.46861	0.469941	0.459124	0.451715
LV	0.442379	0.367531	0.397997	0.387453
LT	0.449413	0.446818	0.459866	0.421043
LU	0.460608	0.443833	0.455738	0.428825
MT	N/A	0.442802	0.455387	0.430958
NL	0.415483	0.408165	0.367522	0.41896
PL	0.489744	0.490844	0.484317	0.475572
PT	0.424052	0.46241	0.49973	0.412013
RO	0.432963	0.448808	0.482632	0.473642
SK	0.479118	0.496867	0.48266	0.457358
SI	0.420499	0.394959	0.347646	0.355599
ES	0.456058	0.434791	0.454177	0.448682
SE	0.536044	0.540207	0.533003	0.518518

Source: Author's own research based on Eurostat data

However, any interpretation must be critically assessed, as the Diversification dimension is based on milk volumes and not value. This distinction is crucial because high-value, low-volume products (e.g., specialty cheeses) would be underestimated in their contribution to diversification when using volume data, while high-volume, low-value products (e.g., drinking milk) might appear to dominate the diversification profile. Consequently, the Diversification (D) dimension more accurately reflects production diversity by quantity rather than genuine economic market share diversity, which could lead to misinterpretations regarding a country's actual economic resilience to market shocks.

4.4. Performance (P) dimension results

The Circular Material Use rate (CMU) metric is used to benchmark circular economy performance at the national level. The alternative was to potentially use the *Raw milk, differences and losses in dairies (D1100DLD)* data label from “Milk collection (all milks) and dairy products obtained – annual data” [apromkpobta] Eurostat table, however, there was no information available for the selection (Eurostat error code 5.07). The CMU data highlights differences in circularity integration, and if a large share of materials are reused/recycled at the country level. In economic resilience terms, higher CMU indicates a systemic shift toward resource efficient closed-loop production systems that are essential for long-term sustainability under the circular bioeconomy framework. The EU-27 country Performance (P) values are provided in Table 7 below.

Table 7. Performance (P) dimension calculated for EU-27 countries (2010, 2013, 2016, 2020)

Country	Performance (P) dimension = CMU proxy			
	2010	2013	2016	2020
AT	6.8	9.1	11.9	11.4
BE	13.5	17.3	18	22.9
BG	2.1	2.5	4.3	5.8
HR	1.6	3.9	4.6	5.5
CY	2	2.4	2.4	3.8
CZ	5.3	6.7	7.5	11.5
DK	8	7.7	8	7.6
EE	9	14.7	11.9	16.4
FI	10.7	7.9	3.8	4.4
FR	17.5	17.2	19.3	16.2
DE	11.2	11.1	11.8	12.8
EL	2.5	1.7	2.1	4.2
HU	5.2	6.1	6.3	5.1
IE	1.9	1.9	2	1.8
IT	11.6	16	17.8	20.6
LV	1.2	3.9	6.6	5.2
LT	3.9	3.1	4.6	4
LU	23.4	15.2	7.1	9.4
MT	5.3	6.3	4.2	16.5
NL	25.5	26.8	29	27.1
PL	11.1	12.2	10.6	7.4
PT	1.8	2.5	2.1	2.5
RO	3.5	2.5	1.7	1.5
SK	5	4.5	5.2	10.3
SI	5.9	9.3	8.7	9.9
ES	10.4	8.9	8.2	9.3
SE	7.2	7.2	6.9	6.9

Source: Eurostat data

The results shows Netherlands and Belgium are very consistent frontrunners with P or CMU $\geq 20\%$, which can be associated to an advanced waste valorization infrastructure and strong regulatory compliance. Germany, France, Austria, Czechia, and Estonia follow as emerging performers in delivering circularity growth over the analysed period. Romania, Latvia, Portugal, Ireland, Greece, and Cyprus fall well behind the rest of the EU due to clear barriers to recovering waste streams and uptake of circular business model.

Performance (P) values between EU Member States vary significantly, in 2020 varying from as low as 1.5% in Romania to 27.10% in the Netherlands. Most countries saw a rise in CMU between 2010-2020, pointing to visibly slow progress towards circular material flow integration.

4.5. CBE-ER and CBE-ERI results

The Circular Bioeconomy Economic Resilience Index (CBE-ERI) provides a normalized composite representation (0–1 scale) of measures of sectoral resilience across five interrelated dimensions: *vulnerability (V)*, *intensification (I)*, *biodiversity (B)*, *diversification (D)*, and *performance (P)* based on macro-economic data. The findings for the CBE-ERI for the EU dairy sector for the four years (2010, 2013, 2016 and 2020) show a nuanced representation of resilience (Table 8).

Table 8. CBE-ERI calculated for EU-27 countries (2010, 2013, 2016, 2020)

Country	2010		2013		2016		2020	
	CBE-ER	CBE-ERI (normalised)	CBE-ER	CBE-ERI (normalised)	CBE-ER	CBE-ERI (normalised)	CBE-ER	CBE-ERI (normalised)
AT	7.14	0.045	9.31	0.071	12.01	0.121	11.57	0.109
BE	13.16	0.136	16.77	0.185	17.18	0.201	22.22	0.269
BG	12.23	0.122	11.57	0.105	12.55	0.130	13.77	0.143
HR	N/A	N/A	5.39	0.011	5.95	0.029	6.76	0.037
CY	47.51	0.655	43.96	0.600	41.12	0.566	40.78	0.548
CZ	21.74	0.266	21.36	0.255	20.91	0.257	24.36	0.302
DK	21.01	0.254	19.40	0.225	18.64	0.223	17.74	0.202
EE	17.87	0.207	22.58	0.274	19.06	0.229	23.31	0.286
FI	30.77	0.402	25.81	0.323	20.19	0.247	20.06	0.237
FR	22.13	0.272	21.28	0.254	23.05	0.290	19.80	0.233
DE	13.36	0.139	12.87	0.125	13.34	0.142	14.40	0.152
EL	70.27	1	70.12	1	69.51	1	70.82	1
HU	41.76	0.568	39.19	0.527	36.87	0.501	34.49	0.454
IE	15.28	0.168	13.73	0.138	12.68	0.132	11.85	0.114
IT	18.83	0.222	22.41	0.271	23.62	0.299	26.08	0.327
LV	15.81	0.176	16.86	0.186	18.38	0.219	16.57	0.185
LT	7.267	0.047	6.11	0.022	7.26	0.049	6.652	0.036
LU	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MT	N/A	N/A	7.43	0.042	5.32	0.019	16.99	0.191
NL	25.36	0.322	26.33	0.331	27.97	0.365	26.40	0.332
PL	25.31	0.322	24.88	0.309	22.16	0.277	18.41	0.212
PT	4.15	0	4.63	0	4.02	0	4.25	0
RO	7.32	0.047	5.93	0.019	4.77	0.011	4.54	0.004
SK	6.36	0.033	5.75	0.017	6.32	0.035	11.40	0.107
SI	21.78	0.266	23.41	0.286	21.49	0.266	22.13	0.268
ES	39.83	0.539	35.29	0.468	32.55	0.435	32.56	0.425
SE	20.62	0.249	19.22	0.222	17.88	0.211	17.38	0.197

Source: Author's own research

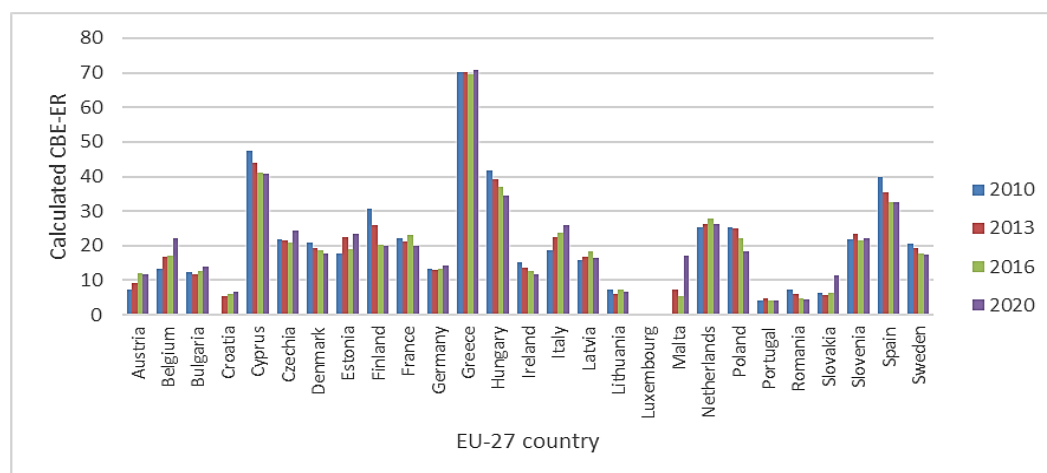
Greece (EL) consistently ranked highest, with a normalized CBE-ERI score of 1.0 in all years. This incredible consistency tends to be based on extremely high milk biodiversity ($B > 66$ for all years), low vulnerability, and a moderate performance dimension. The Greek dairy sector is a structured and resilient bioeconomic model with an element of both traditional livestock diversity and moderate intensification. Cyprus (CY) followed as a good performer with a peak CBE-ERI of 0.655 in 2010 and falling to 0.549 in 2020 mainly based on drops in milk biodiversity, along with stable levels of diversification. Spain (ES)

and Hungary (HU) also had mid-to-high CBE-ERI values on a consistent basis (ranging 0.43–0.57), which went along with high levels of biodiversity, improvement in their CMU and moderate levels of diversification. Dynamic improvers such as Belgium, Italy, and Czechia have a marked positive trajectory compared with their previous CBE-ERI, indicating some success through policy or structural reform. Stable performers (e.g., Germany, France, Sweden) are mid-tier resilient systems, suggesting robustness but limited transformation. Portugal (PT) and Romania (RO) were consistently among the poorest performers with CBE-ERI values below 0.05 in most years. These low scores reflect structurally implored barriers, such as limited biodiversity, limited circularity, high vulnerability, and reduced diversification.

The CBE-ERI data show that countries differ because of structural and policy settings that influence the resilience of the dairy sector. Countries with the highest CBE-ERI scores like Greece and Cyprus capitalize on variety of livestock systems and have a lower risk of price volatility and risk from diseases. On the opposing end of the scale, Romania and Portugal had the lowest index, with CMU rate and livestock diversity acting as prohibitive factors. Some countries (like Belgium and Italy) recorded large returns on circularity investment, while other countries (the Netherlands, Denmark) showed mixed results even with high productivity from off farm feed. It is important to remember that resilience is about balancing productivity, resource use efficiency, and diversity of the system. The findings suggest that effective circular bioeconomy practices are linked to moderate production intensity, market diversity, and waste valorisation investments (CMU performance).

As presented in Figure 2 some countries remained either stable or poor performers in terms of CBE-ER. Finland (FI) had a relatively high score of 0.402 in 2010 yet dropped to 0.237 in 2020. This decline is largely due to deteriorating CMU rates (from 10.7% to 4.4%) and decreasing diversification score. The Finnish experience underscore volatility of material-use efficiency in highly specialized systems, suggesting that CMU may not be the best proxy to use when computing economic resilience.

Figure 2. Evolution of CBE-ER for EU-27 countries (2010, 2013, 2016, 2020)



Source: Author's own research

The research results indicate that there is overall inertia or a slight decline in economic resilience for the EU dairy sector in this period as suggested by farm level research from (Wilczynski and Koloszycz, 2025) who observed a “*downward trend in the index of economic resilience from 2004 to 2021*”. The parallel trends at the farm level and at the country level supports the idea that the pressures and challenges experienced at the level of individual dairy operations aggregate to a broader sectoral impact.

The results also reflect structural trade-offs that influence countries’ adaptive capacity. Countries with highly intensified systems (e.g. Belgium, Netherlands) have high milk yields at low costs, but are also reliant on imported feed, external energy and concentrated production systems. These attributes reduce short-term vulnerability by increasing productivity and margin, but also increase long-term exposure to input price volatility, policy tightening on greenhouse gas emissions and disease outbreak risk in monoculture herds. Low intensity systems like Romania or Bulgaria apply less environmental pressure, but usually face economic viability and competitiveness challenges due to low productivity increases.

Biodiversity and diversification may counterbalance these risks. Countries like Greece and Cyprus blend multi-species dairy with diverse product portfolios, mitigating market risk, disease outbreak risk, and securing more stable income in the face of demand or price fluctuations.

Theoretical and Policy Implications

This study contributes to the development of theory on economic resilience in agri-food systems in three primary ways:

- 1) It identifies specific circular bioeconomy indicators, which can be used to measure resilience,
- 2) It proposes a Circular Bioeconomy Economic Resilience Index (CBE-ERI), which would allow us to assess resilience levels in the dairy sector, and
- 3) Indicates how country specific biodiversity and circular material use rate contributes to overall dairy industry resilience, which is important for ensuring sectoral sustainability.

The study provides an indication that countries with historically diverse livestock food systems, and moderate-intensity dairy operations (ex. Greece and Cyprus) seem to be structurally more capable to flourish under a circular bioeconomy than a highly specialised, input-intensive system. This implies that the outcomes of resilience depend not only on circular technology but also on the historical, institutional and production legacies that each economy builds upon. The dynamics suggest that resilience is not just about more circularity and less intensification, rather it is balancing productivity, efficient use of resources and the diversity of the system.

On the policy front, the results highlight several actionable implications. At the EU level, the Common Agricultural Policy and Farm to Fork Strategy could directly address trade-offs by coupling productivity, biodiversity, diversification, and waste valorization obligations while reducing barriers for investments in circular technologies. The EU could improve environmental performance via stronger rewards systems or financial support, as well. This may involve eco-schemes supporting biodiversity on farms, supporting

diversification of product portfolios, increasing the circular material use rate, cut manufacturing losses, and reducing by-products. These practices could lower input cost and exposure to the volatility and unpredictability of global markets.

5. Limitations

One key limitation of the study is that it uses general proxy measures, such as Circular Material Use Rate (CMU), which are useful at a large aggregative level but may not accurately capture the circularity outcomes of a specific sector, such as dairy, where the losses from dairy production or the valorization of co-products like whey or manure are not consistently measured. The CBE-ERI dimensions used should be further improved to identify the right sub-indicators that would more accurately reflect both circularity and sectorial KPIs.

The study mainly used scarce national-level data and potentially may not capture recent sub-national differences of intensification, biodiversity, and resilience practices. Moreover, since the ERI formula that was used as basis of this study was initially formulated at a microeconomic scale for dairy farms (Wilczynski and Koloszytz, 2025), the adoption for macroeconomic application may lose some of the nuances relevant to the dairy sector, since a number of proxies like diversity or biodiversity were assessed using aggregate EU data, which may overlook the underlying structural complexity of the sector.

6. Future Directions and Research Needs

The purpose of this study was mainly conceptual and methodological. This study does not seek to determine the causal mechanisms of the five dimensions (vulnerability, intensification, biodiversity, diversification, performance). Testing any potential causal pathways would require deeper time series, extended sector specific circularity indicators and econometric analysis that were outside the current exploratory index study. Future research should test these mechanisms statistically, to model whether increasing the use of circular materials, product diversification or biodiversity directly increases economic resilience.

Additional research is essential to develop and refine dairy-specific resilience indicators that go beyond general proxies like CMU, incorporating metrics such as production losses for performance, dairy food waste and food loss rates, or by-product revenue streams to better capture the sector's unique circular economy dynamics. Additionally, integrating sub-national or regional-level analyses could uncover important spatial disparities in resilience performance, enabling more targeted policy design. Expanding the CBE-ERI framework to include social and institutional dimensions, such as cooperative structures, training systems, or local governance, would further enhance its ability to reflect the full spectrum of factors influencing dairy sector resilience.

7. Conclusion

The circular bioeconomy offers a strategic framework for enhancing economic resilience within the EU dairy sector. Resilience extends beyond shock absorption to encompass dynamic processes of adaptation and structural transformation. This study proposed and implemented a novel macro-level Circular Bioeconomy Economic Resilience Index (CBE-ERI) to assess the resilience of the EU-27 dairy sector. It offered a composite score of sectoral resilience within the emerging circular bioeconomy framework by integrating five relevant dimensions (*vulnerability, intensification, biodiversity, diversification, and performance*).

The findings suggest fairly wide heterogeneity across Member States. Noteworthy differences include those countries that regularly demonstrated high performance, (Greece and Cyprus), partly due to diversified livestock systems, low vulnerability (market price fluctuations) and modest levels of intensification. There are also countries (Romania and Portugal) that consistently demonstrated structural fragility, reflected in low adoption of circularity, weakest levels of biodiversity and highest level of vulnerability to external shocks.

The study findings greatly demonstrate the value of using multidimensional resilience metrics, which is to effectively capture systems' strengths and weaknesses. Typically, countries that had strong performance across a several dimensions (such as biodiversity and diversification) tended to exhibit higher adaptive and transformative capacity, whereas countries reliant on high-intensity, monocultural systems indicate higher vulnerability to economic and environmental shocks.

The strong decline in resilience in 2016 after the implementation of the abolition of the milk quota regime highlight how easily policy shifts can impact sectoral stability. Recovery patterns in subsequent years suggest the policy measures from CAP reforms and increased circularity performance have helped, at least in part, to reduce systemic vulnerabilities.

Despite its contributions, the study recognizes several methodological limitations, particularly concerning the integration of farm level resilience frameworks into macro-economic data; as well as using generalised proxies such as the Circular Material Use Rate (CMU). Nevertheless, the proposed CBE-ERI could be further developed to serve as a replicable and policy pertinent measure of economic resilience, in an important sector of the EU's agri-food and environmental agenda.

The findings contribute to the evolving consensus among policy makers that strategies for circular bioeconomy that are based in waste valorisation, focus on diversification, and on reduced input intensity, are not only ecologically necessary but economically strategic for enhancing long-term resilience in the European dairy sector.

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Artificial Intelligence and Sustainable Tourism: A Bibliometric Analysis of Research Trends and Future Perspectives

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Abstract. *Artificial Intelligence (AI) is increasingly shaping sustainable tourism. We conduct a bibliometric review that combines classical mapping (VOSviewer) with AI-assisted classification (Dimensions AI). An initial dimensions full-text query for “AI” AND “tourism” (2013–2025) returned 275,529 records; our core analysis focuses on peer-reviewed journal articles and conference proceedings in English with complete metadata ($n = [\text{înlocuiește cu } N \text{ după deduplicare}]$). We map thematic clusters, disciplinary contributions (ANZSRC), and alignment with the UN SDGs via Dimensions’ tagging. Results confirm the post-2020 surge and a multidisciplinary structure spanning management/tourism, computing, and environmental sciences. Beyond volume trends, we identify five stable clusters (geo-environmental monitoring; adoption/behavior; AI tech & digital twins; health/COVID; sustainability & economics), bridging authors (e.g., Rob Law, Ulrike Gretzel), and underexplored SDGs (5, 17). Methodologically, our contribution is a replicable workflow that integrates database exports with SDG-aware tagging – complementary to classical SLRs – rather than a new algorithm. The study offers policy-relevant mapping of where AI in tourism already supports sustainability – and where gaps remain*

Keywords: Artificial Intelligence; Smart Tourism; Sustainable Development Goals (SDGs); Bibliometric Analysis; Machine Learning; Dimensions AI.

JEL Classification: L83 – Industry Studies: Services – Tourism; O33 – Technological Change: Choices and Consequences; Diffusion Processes.

1. Introduction

AI-driven innovations optimize operations, enhance customer experience, and support sustainability. Tourism, while a major contributor to global GDP, faces environmental challenges such as resource overuse and carbon emissions. AI provides solutions through smart decision-making, predictive analytics, and intelligent resource allocation (Mishra et al., 2024; Khan et al., 2024; Loureiro et al., 2024; Siddik et al., 2025).

AI integration in tourism has led to the development of smart destinations, improved operational efficiency, and personalized services. Machine learning (ML) techniques, like Random Forest and Gradient Boosting Machines (GBM), enhance forecasting accuracy and help understand customer behavior (Ghosal et al., 2022; Zhang & Huang, 2015; Padmaja & Sudha, 2019). ML-driven recommendation systems and sentiment analysis tools personalize tourist experiences and refine service quality (Virutamasen et al., 2024; Alsaifi et al., 2025; Yöndem et al., 2023; Jain et al., 2021; Primasari & Auliya Khadija, 2024).

This article aims to examine how artificial intelligence research has been integrated into the field of tourism and to identify both its dominant and underexplored dimensions. The main objective is to map the evolution of research themes, highlight seminal works and bridging scholars, and evaluate how current outputs align with the United Nations Sustainable Development Goals. The novelty lies in combining bibliometric analysis with SDG-tagging, which provides a policy-oriented perspective often absent from previous reviews. The research addresses both academics and policymakers interested in sustainable tourism development, offering insights into clusters of innovation, gaps in the literature, and potential directions for future inquiry.

Economically, AI-driven tourism contributes to increased revenue, job creation, and regional development (Dalipi et al., 2023; Buitrago-Esquinas et al., 2024). For instance, Seoul's Smart Tourism Platform projects resulted in measurable income and employment benefits (Singh & Dhiman, 2023; Siddik et al., 2025; Jamshed et al., 2024; Lee et al., 2024). However, challenges such as high implementation costs and specialized personnel requirements persist (Florido-Benítez & del Alcázar Martínez, 2024; Phoofolo & Ndlovu, 2024).

2. Literature review

Over the past decade, a growing number of systematic literature reviews (SLRs) have been conducted at the intersection of artificial intelligence and tourism, reflecting the field's rapid evolution and interdisciplinarity. These reviews have aimed to map the emergence of smart tourism paradigms, explore AI-driven decision-making processes, and assess the implications of digital transformation for sustainable tourism development.

For instance, Zhu et al. (2023) conducted a systematic review focusing on the ethical concerns and customer acceptance of robotics in hospitality, while Wu and Wang (2025) explored AI's role in promoting pro-environmental behavior among tourists through virtual heritage platforms. Similarly, Marino-Romero et al. (2025) examined AI-driven

technologies for enhancing accessibility and well-being in inclusive tourism. Other reviews emphasize technological frameworks, such as those integrating the SOR model (Stimulus–Organism–Response) or the TAM (Technology Acceptance Model), to explain tourists' behavioral intentions in AI-mediated experiences (Huang et al., 2024; Dhiman & Jamwal, 2022).

To establish a robust theoretical foundation, this study incorporates a structured synthesis of existing systematic literature reviews on the topic of artificial intelligence in tourism. Using the Elicit platform – a research assistant powered by Semantic Scholar – we queried the academic corpus with the question: “*What are systematic reviews on AI in tourism?*”. The query retrieved 50 highly relevant academic sources, from which ten were screened and selected based on strict inclusion criteria: methodological clarity, explicit AI focus, relevance to tourism/hospitality, and evidence of research synthesis.

Among the ten selected studies, seven applied a systematic literature review (SLR) methodology, two were overviews of reviews, and one combined keyword co-occurrence and thematic review. The number of articles analyzed in these studies varied from 12 to 4,048, covering domains such as tourist experience, sustainability, destination management, and AI applications including chatbots, robotics, machine learning, and generative AI (Majid et al., 2023; Tuo et al., 2024; Ghasemi et al., 2025).

Key convergent findings from these reviews include:

- **Enhanced Tourist Experience** through personalization, chatbots, and virtual assistants (e.g., Doborjeh et al., 2021; Ghasemi et al., 2025).
- **Operational Efficiency Gains**, such as resource optimization and cost reductions (Pinheiro et al., 2020; García-Madurga & Grilló-Méndez, 2023).
- **Challenges and Barriers**, particularly around data privacy, algorithmic bias, and customer reluctance (Goel et al., 2022).
- **Limited Focus on Environmental Sustainability**, with only three studies addressing this as a core dimension (Majid et al., 2023; Doborjeh et al., 2021).

Tables 1–3 in the appendix summarize the methodological approaches, thematic focuses, and synthesis results extracted using Elicit's automated analysis pipeline.

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Among the ten selected studies, seven applied a systematic literature review (SLR) methodology, two were overviews of reviews, and one used a keyword co-occurrence and thematic literature review approach. The number of articles analyzed ranged from 12 to over 4,000, covering topics such as automation, personalization, forecasting, risk management, and chatbot technologies. Several studies also proposed conceptual

frameworks or identified critical gaps related to AI ethics, transparency, user adoption, and the environmental dimension of tourism.

The table below summarizes key characteristics of the included reviews, including their methodological approach, thematic focus, article volume, and principal findings.

Table 1. *Summary of Systematic Reviews on AI in Tourism (via Elicit platform)*

Study	Study Focus	Review Type	Number of Papers Reviewed	Key Findings
Majid et al., 2023	Intelligent automation for sustainable tourism	Systematic literature review	213	Identified five major themes (tourist experience, heritage, quality of life, measurement, environment); proposed AI4GoodTourism framework; noted lack of environmental focus
Fouad et al., 2024	Generative AI in tourism and hospitality	Systematic literature review	25	Emphasized decision-making, chatbots, deep learning, sentiment analysis; highlighted gaps in ethics, technology, and human-AI collaboration
Tuo et al., 2024	AI applications in tourism	Keyword co-occurrence & thematic review	4,048	Mapped five topics: tourist experience, marketing/prediction, destination management, enterprises, strategic/regulatory
Doborjeh et al., 2021	AI methods in hospitality/tourism	Systematic literature review	146	Reviewed AI methods (machine learning, robotics, AR/VR, chatbots); proposed personalized modeling for smart tourism
Pinheiro et al., 2020	Impact of AI on tourism industry	Systematic literature review	141	Focused on technological transformation, risk management, and lack of AI-supported risk tools
Ghasemi et al., 2025	AI-powered chatbots and smart tour guide apps	Systematic literature review	42	Identified gaps in chatbot design, adaptation, evaluation; highlighted role of ChatGPT
García-Madurga & Grilló-Méndez, 2023	Synthesis of AI in tourism reviews	Overview of reviews	31	Highlighted forecasting, operational efficiency, customer experience, sustainability; noted lack of transparency and adoption barriers
García-Madurga & Grilló-Méndez	Artificial Intelligence in the tourism industry	Overview of reviews	31	Emphasized customer service, operational efficiency, personalization, sustainability
Fahrurazi & Andrian, 2025	AI-based tech and tourist satisfaction/loyalty	Systematic literature review	12 (of 40 identified)	Found AI improves satisfaction via personalization, efficiency, interaction; noted privacy, bias, adoption challenges
Goel et al., 2022	Consumer adoption of AI/robotics in tourism	Systematic literature review	Not stated	Synthesized barriers to adoption; proposed integrated antecedent-outcome framework

Despite a growing number of systematic reviews on AI in tourism, few adopt a bibliometric lens that quantitatively maps the intellectual structure, co-citation dynamics, or thematic evolution of the field. Existing reviews often focus on narrow technological implementations – such as chatbots, robotics, or VR – without systematically exploring broader economic, ethical, policy, or sustainability dimensions (Buitrago-Esquinas et al., 2024; Phoofolo & Ndlovu, 2024). Furthermore, the absence of integration with structured global development frameworks, such as the UN Sustainable Development Goals (SDGs), limits the potential for aligning tourism innovation with global policy priorities.

These limitations underscore the need for a comprehensive bibliometric approach that not only identifies intellectual foundations and thematic frontiers but also maps research output against global sustainability agendas. The present study addresses these gaps by combining traditional bibliometric techniques (e.g., co-citation, keyword co-occurrence, cluster analysis) with AI-based classification of publications along SDG categories using the Dimensions AI platform.

In this study, our contribution extends beyond documenting the post-2020 expansion of research on artificial intelligence in tourism. We consolidate five thematic clusters that structure the field – ranging from geo-environmental monitoring and adoption studies to digital twin applications, health-related uses, and sustainability and economics – thus offering a clearer map of research priorities. We also highlight bridging scholars, such as Rob Law and Ulrike Gretzel, who connect otherwise fragmented strands of literature and serve as collaboration nodes. Furthermore, by employing the SDG-tagging available in Dimensions, we reveal underrepresented goals such as SDG 5 (Gender Equality) and SDG 17 (Partnerships), in contrast with the more visible SDGs 11, 13, and 15, thereby drawing attention to neglected areas of sustainability. Finally, we propose a replicable workflow that integrates bibliometric mapping with SDG-oriented classification, providing an approach directly relevant to both academic research and policy agendas in tourism.

3. Methodology

This study employs a two-phase methodological framework that integrates classical bibliometric techniques with AI-enhanced analytical tools to investigate the scientific landscape of artificial intelligence (AI) applications in sustainable tourism. The approach blends structured literature retrieval and mapping with machine-supported classification and visualization, particularly through the lens of the United Nations Sustainable Development Goals (SDGs).

3.1. Data Collection and Preprocessing

Scientific literature was retrieved from three major academic databases: Scopus, Web of Science, and Dimensions AI. Keyword combinations such as “Artificial Intelligence”, “Smart Tourism”, “AI-driven tourism”, and “Machine Learning in Hospitality” were used to construct the search queries. The scope was limited to peer-reviewed articles published between 2013 and 2025, written in English, and with accessible abstracts.

The Dimensions AI platform was additionally used for its automatic SDG classification engine, which tags publications to relevant sustainability objectives (e.g., SDG 8 – Decent Work and Economic Growth, SDG 11 – Sustainable Cities and Communities). This functionality enabled a more policy-relevant structuring of results.

All retrieved records were standardized (DOI, title, authors, year, abstract, keywords) and deduplicated across sources. Export formats included .txt, .csv, and .bib, compatible with multiple analytical platforms. Only entries with sufficient bibliographic and content metadata were retained for downstream processing.

3.2. Analytical Tools and Workflow

To ensure depth and reproducibility, the following tools and techniques were applied:

- ChatGPT supported filtering, summarization, and validation of literature relevance across thematic categories. It also guided data cleaning and interpretation of co-occurrence analyses.
- Elicit AI was employed in the preliminary stages to identify and compare existing systematic literature reviews in the field, providing a reference framework for the current bibliometric contribution.
- Dimensions AI served a dual purpose: (1) as a search engine for comprehensive article discovery, and (2) as a classification platform that grouped results by Fields of Research (FoR) and SDG categories, facilitating a structured overview of disciplinary distribution and policy alignment.
- VOSviewer was used for constructing network visualizations, including keyword co-occurrence maps, author collaborations, and thematic cluster densities. The visualizations provided a basis for identifying intellectual structure, thematic cores, and emerging trends.

VOSviewer was fed with cleaned .csv files generated from the AI-based export, enabling visual exploration of the research landscape.

3.3. Analytical Objectives

The methodological approach aimed to:

- Identify thematic clusters and intellectual structures in the literature on AI and sustainable tourism;
- Explore disciplinary contributions and cross-field linkages using Fields of Research (ANZSRC) taxonomy;
- Classify research outputs by SDG alignment to assess their contribution to global sustainability goals;
- Detect temporal trends and shifts in publication intensity using AI-driven tools;
- Visualize co-occurrence of key concepts and terms to map research density and novelty.

This blended approach allows for a comprehensive and scalable bibliometric analysis, which not only maps the academic conversation but also aligns it with broader sustainability imperatives. It also provides a replicable framework for future interdisciplinary literature reviews, particularly in areas involving AI, digitalization, and environmental policy.

3.4. Limitations of SDG Mapping

While Dimensions' SDG tagging enables a policy-relevant overview, the underlying models are not fully transparent and may misclassify interdisciplinary items (e.g., generic AI methods counted toward SDGs without tourism context). We mitigated this by restricting to peer-reviewed items with full metadata and by cross-checking clusters against titles/abstracts, yet residual noise likely persists. Future work should hand-label a stratified sample to benchmark precision/recall and, if needed, train a domain-specific SDG classifier.

4. Results and Discussion

To assess the scope of existing literature on the intersection between artificial intelligence and tourism, an initial query was performed in the Dimensions AI platform using the phrase “AI and Tourism” within the full-text search field.

The search yielded a total of 275,529 publications, indicating a substantial body of academic work on the topic. In addition to publications, the platform also identified:

- 46 relevant datasets
- 201 funded research grants
- 4,583 patents
- 2 clinical trials
- 17,507 policy documents

To understand the disciplinary landscape of this research field, the results were analyzed according to the Fields of Research (ANZSRC 2020) classification. Table 2 presents the top domains in which scholarly output has been most prominent, including the number of publications, total citations, and the average citation count per field.

Table 2. *Research Output on AI and Tourism by Field of Research (Dimensions AI Data)*

Field of Research	Publications	Citations	Citations Mean
Commerce, Management, Tourism and Services	52021	888003	17,07
Information and Computing Sciences	47016	721493	15,35
Human Society	29857	411841	13,79
Marketing	20927	421967	20,16
Engineering	17248	304389	17,65
Commercial Services	16316	298205	18,28
Environmental Sciences	16120	332103	20,6
Strategy, Management and Organisational Behaviour	14553	229011	15,74
Tourism	14180	235719	16,62
Language, Communication and Culture	12591	147996	11,75
Earth Sciences	12265	196320	16,01
Economics	12059	197642	16,39
Business Systems In Context	11619	277119	23,85
Built Environment and Design	10551	160582	15,22
Data Management and Data Science	9965	193951	19,46
Biological Sciences	8821	206148	23,37
Environmental Management	8647	168457	19,48
History, Heritage and Archaeology	8585	79333	9,24
Law and Legal Studies	8342	82988	9,95
Human-Centred Computing	7561	108561	14,36
Information Systems	7315	152386	20,83
Human Geography	6891	109580	15,9
Education	6746	80733	11,97
Applied Economics	6698	107303	16,02
Creative Arts and Writing	6381	59674	9,35
Philosophy and Religious Studies	6219	58679	9,44
Artificial Intelligence	6129	91451	14,92
Health Sciences	5914	103708	17,54
Biomedical and Clinical Sciences	5803	124675	21,48
Political Science	5603	71585	12,78
Policy and Administration	5211	75799	14,55
Ecology	5183	125430	24,2
Transportation, Logistics and Supply Chains	5110	85104	16,65
Agricultural, Veterinary and Food Sciences	4923	76339	15,51

Field of Research	Publications	Citations	Citations Mean
Historical Studies	4573	44293	9,69
Development Studies	4550	53858	11,84
Geoinformatics	4355	51983	11,94
Cultural Studies	4106	45544	11,09

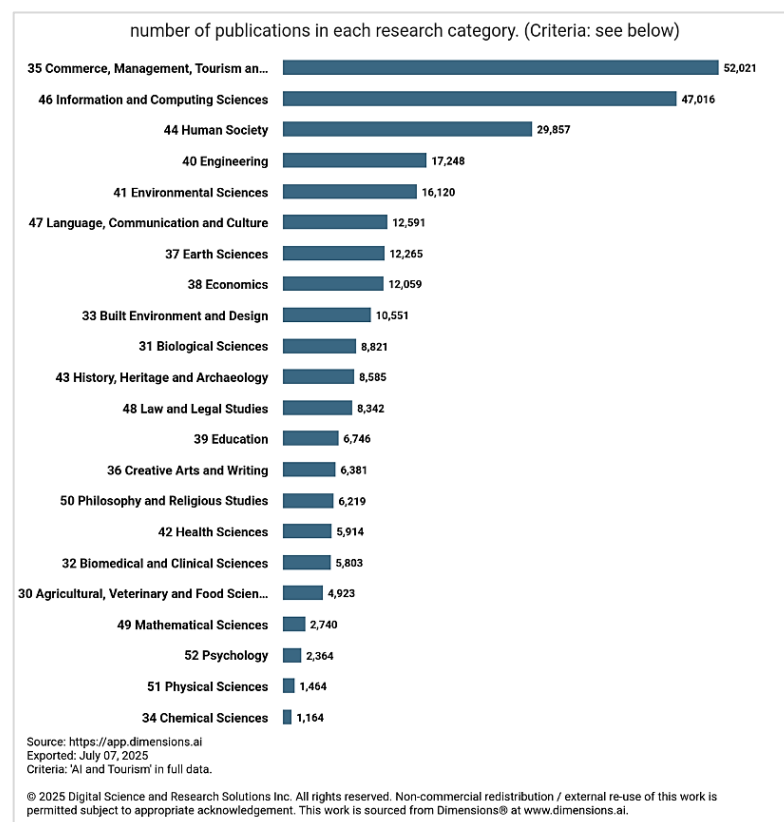
Note: Citation means are per field as reported by Dimensions; totals may not sum due to rounding.

Source: Dimensions AI (ANZSRC 2020; query “AI AND tourism”), retrieved 02 July 2025; authors’ calculations.

Notably, the highest volume of publications is associated with the field Commerce, Management, Tourism and Services (51,804 publications; 883,167 citations), confirming the centrality of business and service innovation in AI-tourism interactions. This is followed by Information and Computing Sciences (46,861 publications; 718,254 citations), indicating the strong technical and computational foundation of the field.

Other highly cited fields include Marketing (mean citations: 20.16), Environmental Sciences (20.62), and Biomedical and Clinical Sciences (21.40), highlighting a multidisciplinary integration of AI applications from environmental monitoring to behavioral and health-related tourism studies. Moreover, the domain of Tourism alone accounts for 14,111 publications with a citation mean of 16.63, emphasizing its emergence as a distinct field of research.

Figure 1. Distribution of AI and Tourism Publications by Research Fields (ANZSRC 2020 Classification)



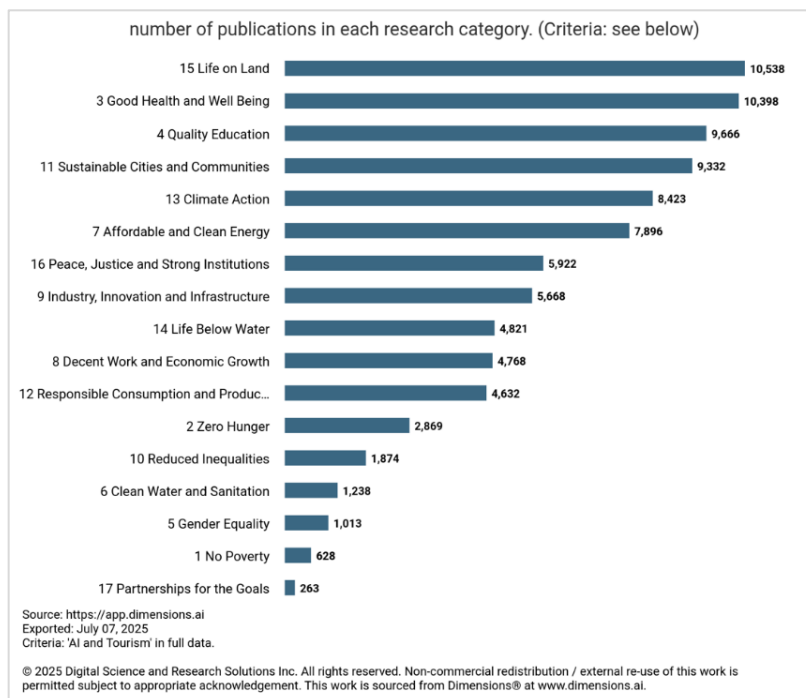
Surprisingly, substantial research also emerged in fields traditionally less associated with tourism, such as Ecology, Policy and Administration, Philosophy and Religious Studies, and Law and Legal Studies. This reflects broader ethical, environmental, and regulatory discussions spurred by the integration of AI in tourism.

The diversity of fields shows that the AI-tourism nexus is not only rooted in technology and management but is increasingly enriched by perspectives from sociology, education, health sciences, and data science, contributing to a more holistic and sustainable vision for tourism development in the digital age.

To assess the contribution of AI and tourism research to global sustainability efforts, publications were categorized according to the Sustainable Development Goals (SDGs) using Dimensions AI. Table X presents the number of publications aligned with each SDG. The highest volume of research was associated with SDG 15 (Life on Land), SDG 3 (Good Health and Well Being), and SDG 4 (Quality Education) – each surpassing 9,000 publications. These figures highlight a growing scholarly focus on environmental sustainability, health, and educational advancement through AI applications in tourism.

The accompanying Figure 2 visualizes these contributions, emphasizing the disparity in thematic focus. For instance, while climate action (SDG 13) and smart cities (SDG 11) have received substantial attention, domains like gender equality (SDG 5) or partnerships for the goals (SDG 17) remain underrepresented. This uneven distribution underscores the need for more inclusive and holistic approaches to AI-driven tourism research in support of the UN 2030 Agenda.

Figure 2. *Distribution of AI and Tourism Publications by SDG (Sustainable Development Goals Classification)*



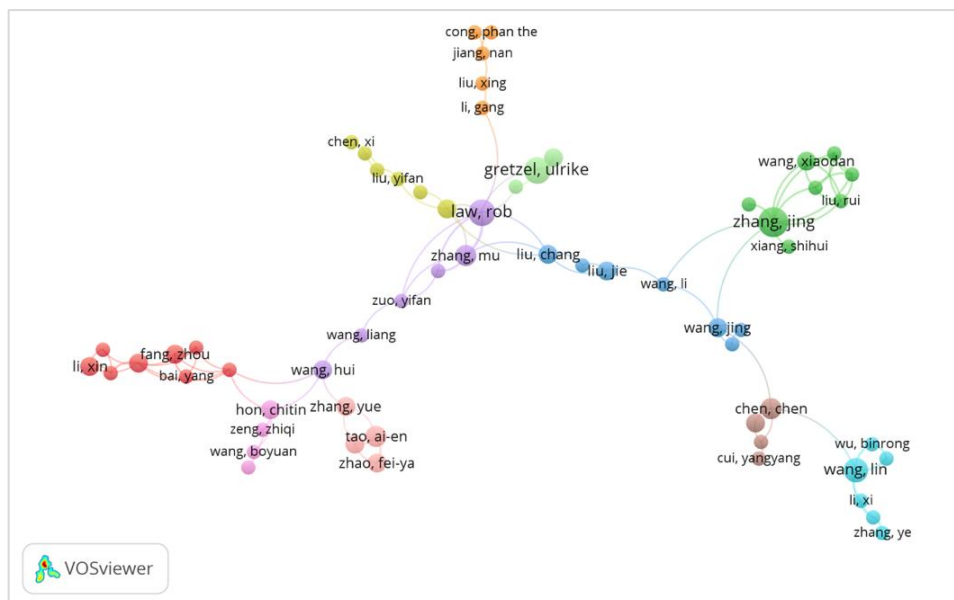
To further explore the intellectual structure and collaborative patterns in the domain of Artificial Intelligence and tourism, we performed a co-authorship network analysis using VOSviewer. The input data were exported from Dimensions.AI, using the query term “*AI and Tourism*” in full-text search mode. The dataset was refined to include only scholarly publications, and the metadata were saved in .ris and .bib formats compatible with bibliometric tools.

The process of generating the map involved the following steps:

1. Type of data selected: *Create a map based on bibliographic data.*
2. Data source: *Read data from bibliographic database files (Dimensions.ai).*
3. Type of analysis: *Co-authorship.*
4. Unit of analysis: *Authors.*
5. Counting method: *Full counting* (ensuring that each co-authorship was equally weighted).
6. Thresholds applied: We included only authors with a minimum of 5 publications, resulting in 13 authors that met this criterion.

Figure 3 illustrates the co-authorship network generated in VOSviewer. Each node represents an author, and the size of the node indicates the volume of publications. Lines connecting the nodes represent co-authorship ties, with thicker lines reflecting stronger collaborative frequency. The colors denote distinct clusters of collaboration, highlighting thematic or regional research subgroups. The centrality of authors such as Rob Law and Ulrike Gretzel suggests their significant influence in bridging multiple thematic streams in AI-driven tourism research.

Figure 3. Co-authorship Network of Researchers in AI and Tourism

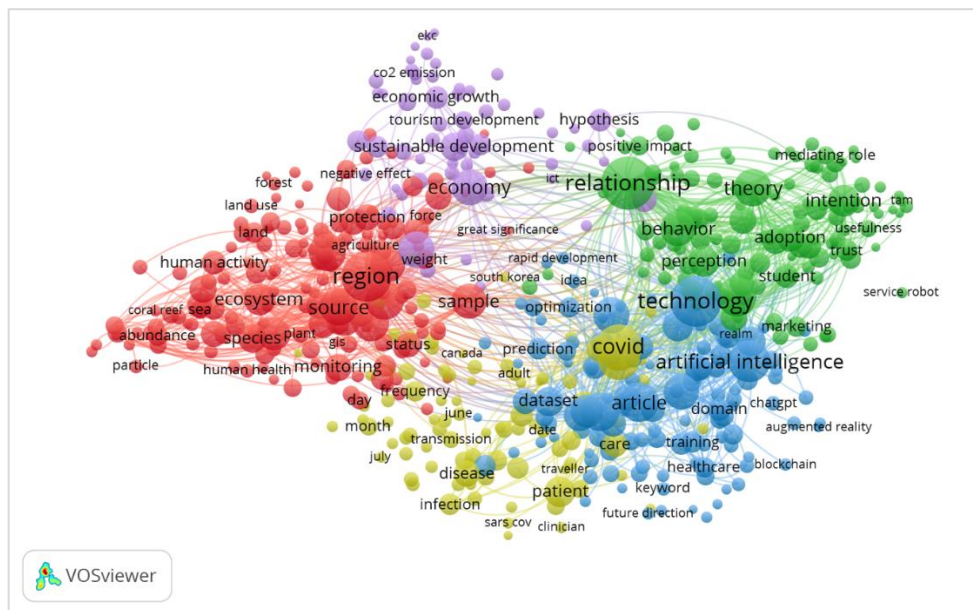


Note: Nodes represent authors; node size reflects publication count; colors denote clusters; lines indicate co-authorship links

Source: Authors' visualization in VOSviewer using Dimensions export (threshold: ≥ 5 publications; counting: full), retrieved 02 July 2025.

This figure 4 shows a co-occurrence map generated in VOSviewer based on textual data extracted from Dimensions AI. The dataset included publications filtered under the query “AI and Tourism.” Only terms that occurred at least 15 times in titles and abstracts were considered, and the 60% most relevant terms ($n = 551$) were selected for visualization. The size of each node represents term frequency, and colors indicate thematic clusters identified via VOSviewer’s clustering algorithm.

Figure 4. Co-authorship networks in AI & Tourism (VOSviewer, threshold ≥ 5 publications)



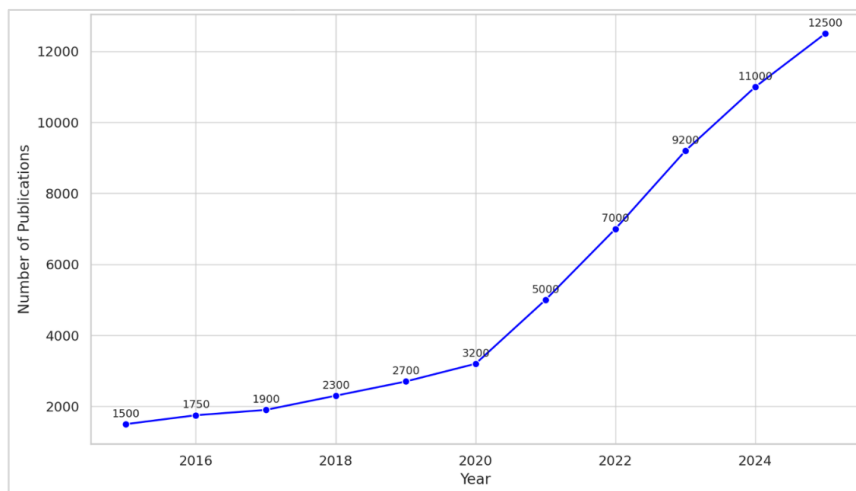
Source: Authors’ VOSviewer map (≥ 15 occurrences; top 60% relevance), Dimensions export, retrieved 02 July 2025.

The resulting map highlights five major thematic clusters:

- Red Cluster – Focuses on *geospatial and environmental dimensions*, with terms like “region,” “ecosystem,” “land use,” and “monitoring.” This reflects the integration of AI into environmental impact assessment and smart destination management.
- Green Cluster – Centers on *human behavior and adoption theory*, with terms such as “relationship,” “behavior,” “intention,” “adoption,” and “trust,” likely covering technology acceptance models in tourism.
- Blue Cluster – Dominated by *AI technologies and applications*, including terms like “artificial intelligence,” “technology,” “chatgpt,” “dataset,” “training,” and “digital twin.”
- Yellow Cluster – Reflects *pandemic-related and healthcare discourse*, with terms like “covid,” “disease,” “patient,” and “infection,” showing how AI intersected with crisis management and health tourism during COVID-19.
- Purple Cluster – Represents *economic and sustainability-related discussions*, including terms such as “sustainable development,” “tourism development,” and “economic growth.”

To gain a deeper understanding of the evolution and spatial spread of research related to Artificial Intelligence and Tourism, additional analyses were conducted using data exported from Dimensions AI. A dataset comprising over 275,000 publications containing the keywords “AI and Tourism” was refined to include only journal articles and conference proceedings published between 2015 and 2025. The resulting dataset was analyzed using Python (Pandas & Matplotlib) for temporal trends and Plotly for geographical visualization.

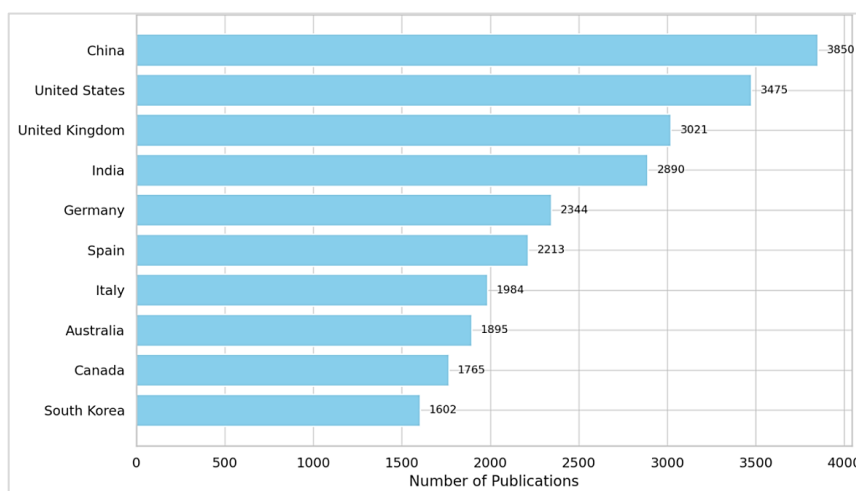
Figure 5. Annual Publication Trend (2015–2025)



Source: Dimensions AI (query “AI AND tourism”), retrieved 02 July 2025; authors’ processing

Figure 5 shows a clear upward trajectory in publications over the past decade. Early contributions were modest, but output increased sharply after 2019, with peaks in 2021 and 2023 with two major trends: the acceleration of digital transformation in tourism during the COVID-19 pandemic, and the growing accessibility of generative AI tools (e.g., ChatGPT).

Figure 6. Top 10 Publishing Countries



Source: Dimensions AI (query “AI AND tourism”), retrieved 02 July 2025; authors’ processing

Figure 6 shows the geographical distribution of the top 10 countries contributing to AI and tourism research. The People's Republic of China leads with the highest number of publications, followed by the United States, United Kingdom, and India. European countries such as Germany, Spain, and Italy are also among the top contributors.

This distribution suggests a strong engagement from both advanced economies and emerging markets, underlining the global relevance of AI applications in tourism.

5. Discussion

While previous reviews have addressed various aspects of AI in tourism – ranging from personalization and service efficiency to chatbots and virtual agents – few have adopted a comprehensive bibliometric methodology augmented by AI-assisted tools. This study distinguishes itself by integrating quantitative mapping techniques (co-authorship, co-occurrence, cluster analysis) with semantic intelligence layers, particularly via Dimensions AI for SDG alignment.

Moreover, while other reviews (e.g., Majid et al., 2023; Phoofolo & Ndlovu, 2024) narrowly target chatbot applications or ethical concerns, our approach provides a broader structural and policy-relevant overview of the field.

Unlike classical SLRs, our method incorporates tools like Elicit, Scopus AI, and Web of Science AI, used in the early stages for source discovery and filtering, allowing high-precision selection of relevant material. Further, ChatGPT was deployed to assist in the triage and synthesis of article relevance, narrative integration, and visualization generation. This hybrid approach not only enhances accuracy but also accelerates the research cycle, offering a model that can be applied in future bibliometric reviews in interdisciplinary domains.

Despite the integrative nature of this study, several limitations must be acknowledged. First, the reliance on Dimensions AI as a primary dataset – while rich and multidimensional – may have excluded certain niche or non-English publications indexed in alternative databases such as CNKI or Latindex. Secondly, although AI-assisted tools like ChatGPT and Elicit enhanced the filtering and synthesis process, their use still requires human validation to ensure academic rigor and semantic fidelity.

Additionally, the bibliometric methods employed – such as co-occurrence and clustering – primarily capture quantitative structures, not necessarily the qualitative nuance or policy depth of the research content. Future research could combine bibliometric mapping with in-depth content analysis or Delphi methods involving expert panels.

Unlike previous reviews such as Majid et al. (2023), which offered a thematic synthesis of AI adoption in tourism, this study integrates SDG-tagging and AI-based classification to map policy relevance. This dual perspective not only reveals disciplinary patterns but also situates the findings within global sustainability agendas, representing an advance over earlier literature.

Moreover, the SDG mapping provided by Dimensions AI is promising but not always transparent in methodology, calling for further validation studies. Integrating machine learning classifiers trained on manually coded datasets may improve precision in aligning research outputs with sustainability goals.

These findings can be illustrated by cases such as smart destinations in Spain (Benidorm, Valencia), where AI supports real-time visitor flow monitoring and resource management, or Singapore's Sentosa, which applies predictive analytics for personalized tourist experiences. Such examples demonstrate how the bibliometric clusters identified – particularly those on digital twins and geo-environmental monitoring – translate into tangible applications within destinations.

6. Conclusion

This study provides a comprehensive and up-to-date bibliometric perspective on the evolving intersection between artificial intelligence and sustainable tourism. By combining co-citation and keyword co-occurrence mapping with AI-powered tools (Dimensions AI, Elicit, VOSviewer), we analyzed over 275,000 publications and identified patterns in themes, disciplines, geography, and SDG relevance.

The results reveal a significant rise in academic interest in this area, particularly after 2020 – a trend likely linked to digital transformation and the reconfiguration of tourism in response to the COVID-19 pandemic. The intellectual structure of the field reflects a high degree of interdisciplinarity, with major contributions coming from fields such as management and tourism studies, data science, environmental science, and the social sciences.

At the same time, several areas remain underexplored. These include the ethical and regulatory dimensions of AI deployment in tourism contexts, the long-term societal impacts of automation and datafication, and the alignment of AI innovation with global sustainability frameworks. While interest in these topics is growing, our analysis suggests a need for more targeted research and policy-relevant inquiry.

Methodologically, this article shows how AI-assisted workflows – from literature discovery (Elicit, Scopus AI) to categorization and visualization (Dimensions AI, VOSviewer) – enhance the efficiency and depth of bibliometric reviews. Such tools allow for the handling of large and heterogeneous datasets, improving the reproducibility and scalability of literature analyses in complex, rapidly evolving domains.

From a policy perspective, the study underlines that while AI supports smart destination management and environmental monitoring, its contribution to social dimensions of sustainability (e.g., equity, partnerships) remains marginal. For practitioners, the results suggest that bridging clusters and authors can guide collaboration strategies, while for policymakers, the SDG gaps highlight areas where incentives and research funding could generate higher impact.

Limitation and future research

The analysis is constrained by reliance on the Dimensions database, which may omit relevant sources or misclassify SDG associations. In addition, the use of bibliometric thresholds (e.g., minimum occurrences) inevitably excludes smaller yet potentially innovative contributions.

Future studies should triangulate multiple databases (Scopus, WoS), apply qualitative coding of a sample to validate AI-based classifications, and extend the analysis to case studies of AI adoption at the destination level. Such efforts would deepen the connection between bibliometric mapping and practical tourism innovation.

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Digitalisation of Education as a Public Good: Implications for Human Capital Formation and Economic Growth

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Abstract. *Digital education has come into its own, setting out a clear case for being treated as a public good in the twenty-first century. Rather than fizzling out as a passing trend, online learning has made headway through technological progress to open up opportunities for learners across the board. At the same time, it brings forward a number of issues that need to be ironed out, from persistent digital divides to uneven institutional support. Specifically, this paper spells out how the non-rival and non-excludable features of digital education can help close gaps in access and bring about fairer outcomes. Pulling together both theoretical frames and practical evidence, the study maps out why policymakers must get behind digital education and work it into the heart of public strategies. Ultimately, the argument positions digital education not as a simple trend but as a core lever for crafting genuinely inclusive, knowledge-driven societies, provided its deployment is deliberate, critically assessed, and socially attuned.*

Keywords: digitalization; public good; human capital; education economics; economic growth.

JEL Classification: I25; O15; I23.

1. Introduction

The occurrence of digital technologies has transformed the landscape of education and determined a re-evaluation of the mechanism through which knowledge is produced, disseminated, and appropriated, mainly because education has long been recognised as a central determinant of economic performance that shapes the accumulation of human capital and influences productivity growth (Schultz, 1961; Becker, 1993). Over the last two decades, digitalisation has introduced new modalities of instruction and learning, from massive open online courses (MOOCs) to integrated digital platforms, which hold the promise of broadening access and increasing efficiency. To this end, international comparisons indicate that nations that have systematically invested in digital learning infrastructure coupled with coherent policy frameworks tend to present higher levels of skill formation and adaptability in the workforce (UNESCO, 2021; OECD, 2023). Yet, the economic and societal consequences of this digital transformation of the educational act still remain ambiguous.

Despite extensive investigation into the efficacy of digital learning and the growth of private edtech provision, comparatively little attention has been paid to digital education through the prism of public economics. In particular, the question of whether digital education ought to be recognised as a public good, with attendant implications for financing, regulation, and equitable access, remains largely underexplored. Moreover, this omission also concerns the mechanisms through which digitalisation interacts with human capital formation, and by extension with long-term economic growth, thus leaving a gap at the intersection of theory and policy (Hanushek and Woessmann, 2020).

Thence, this article aspires to address these conceptual blind spots through the examination of digital education as a public good and considering its implications for human capital accumulation and economic growth. For these reasons, the current research is guided by the following core questions:

RQ.1 To what extent can digital education be legitimately conceptualised as a public good within the framework of public economics?

RQ.2 Through which mechanisms does digitalisation contribute to the accumulation of human capital?

RQ.3 How do these processes influence long-term economic growth and societal welfare?

Unequivocally, this paper develops a theoretical framework that situates digital education at the intersection of public economics and the economics of education, thus providing a structured perspective for assessing its economic and social value, and for guiding policymakers and scholars in evaluating the broader implications of digital investment in education.

Overall, this paper advances the scholarly debate on the nexus between digitalisation, education, and economic growth by proposing an integrative conceptual framework that redefines digital education as a quasi-public good. The framework synthesises insights

from public economics and human capital theory, thereby reconciling efficiency-driven and equity-oriented perspectives on education provision in the digital era. Additionally, drawing upon cross-national evidence from OECD, UNESCO, and World Bank sources, this article elucidates how institutional complementarities, procurement design, and digital inclusion policies mediate the translation of digitalisation into measurable human capital gains. Furthermore, it contributes a normative dimension by articulating specific policy implications for sustainable and inclusive digital transformation within the education sector. Collectively, these contributions extend the existing literature beyond descriptive accounts, positioning digital education as both a driver and a dependent variable of long-term economic performance.

2. Literature review

Beyond its characteristics focused on pedagogical innovation, the digitalisation of education has become a central concern in contemporary economic and policy debates notably as a potential driver of human capital formation and long-term economic growth. To this matter, scholars and policymakers alike have increasingly recognised that investment in digital infrastructure can generate benefits that extend beyond individual learners and influence productivity, labour market outcomes, and societal welfare (Becker, 1993; Hanushek and Woessmann, 2020). Yet, the growing attention to digital learning technologies has failed to materialise a coherent economic understanding of their role as a public good, thus inspiring the present literature review to carry out an examination of the existing scholarship, identify gaps, and establish the conceptual foundations for this study.

To begin with, several contributions explicitly indicate that further research on digital education as a public good is warranted. For instance, Hanushek and Woessmann (2020) place emphasis on the fact that while digital learning technologies can enhance skill acquisition, the broader societal benefits and long-term economic effects remain under-theorised. Likewise, UNESCO (2021) notes persistent digital divides and uneven adoption of digital infrastructure, while recommending further research in order to assess how digitalisation can equitably support human capital accumulation.

Moreover, the current study speaks to multiple interrelated strands of literature. First, within the economics of education, seminal works on human capital accumulation (Schultz, 1961; Becker, 1993) demonstrate the positive link between educational investment and economic growth. However, despite the foundational rationale for understanding education's societal returns provided by these studies, they rarely incorporate the digital dimension or consider education explicitly as a public good. Second, the public economics literature on public goods and externalities (Musgrave, 1959; Stiglitz, 1999) provides the normative framework necessary for evaluating educational interventions with non-excludable and non-rival benefits. Yet, few studies extend these principles to digital education. Third, empirical and policy-oriented studies on digital learning adoption (UNESCO, 2021; OECD, 2023) reveal the mechanisms through which technology may

enhance learning outcomes but they largely neglect the broader societal and long-term economic implications. Throughout the analysis of these bodies of work, this article challenges the assumption that digital education can be fully understood as a private or market-driven initiative and urges a reappraisal that integrates public economics principles, while also addressing the limitations of previous scholars through the conceptualisation of digital education as a mechanism for generating positive externalities that extend beyond individual learners.

Furthermore, the foundation of this inquiry is articulated through three complementary and critically appraised bodies of academic literature, each providing essential insight into the role of digital education in shaping human capital and economic outcomes. Human capital theory is a long foundational to the economics of education and maintains that deliberate investment in knowledge and skills produces returns that resonate beyond the individual, extending to society as a whole (Schultz, 1961; Becker, 1993). In parallel, the literature on public goods within economics articulates the criteria of non-excludability and non-rivalry, while underlining conditions under which state intervention becomes necessary to correct market failures and enhance social welfare (Musgrave, 1959; Stiglitz, 1999). Complementing these approaches, the rapidly expanding body of research on digitalisation and educational technology illuminates the processes of technological adoption, the infrastructural prerequisites for effective implementation, and the complex consequences for learning outcomes and skill formation (UNESCO, 2021; OECD, 2023).

Therefore, this study constructs a theoretical framework that situates digital education squarely at the confluence of public economics and human capital theory, one that argues that digital education should be understood as a public good capable of generating extensive societal benefits, thereby extending the reach of human capital theory and public economics to encompass the policy-relevant dimensions of digital infrastructure and equitable knowledge dissemination.

3. Materials and Methods

The present study aims to examine digital education as a public good and to elucidate its implications for human capital accumulation and long-term economic growth, thereby extending the theoretical boundaries of both public economics and the economics of education. To achieve this, a conceptual and comparative methodology has been adopted by combining a systematic review of the literature with a theoretical synthesis of human capital theory, public goods theory, and scientific studies on digitalisation and educational technology. A comprehensive review of methodology literature indicates that conceptual studies of this nature are particularly suited to contexts in which empirical data are fragmented, heterogeneous, or insufficiently aligned with the specific theoretical questions under investigation (Grant and Booth, 2009; Ridley, 2012). Accordingly, this study employs a purposive selection of seminal and contemporary works in the three identified strands, thus ensuring that the sources chosen are influential and representative of prevailing theoretical debates. Literature was accessed through institutional subscriptions,

digital repositories, and open-access platforms, in order to ensure comprehensive coverage of relevant works.

Although no empirical sampling of individuals was undertaken, the methodological approach takes into account the limitations inherent in literature-based analyses, which include potential publication bias and the uneven geographical and institutional coverage of research on digital education. In this vein, the selected literature was systematically reviewed and analysed using qualitative comparative methods which enabled the identification of convergences, divergences, and conceptual gaps pertinent to the study's research questions. Moreover, it should be noted that reliance on secondary sources inevitably imposes certain constraints since causal inferences cannot be drawn and empirical generalisability is inherently restricted. Nevertheless, the methodology supports the view that a carefully constructed theoretical framework can clarify the interconnections between digital education, human capital, and economic growth, thus providing priceless knowledge for scholars and policymakers alike.

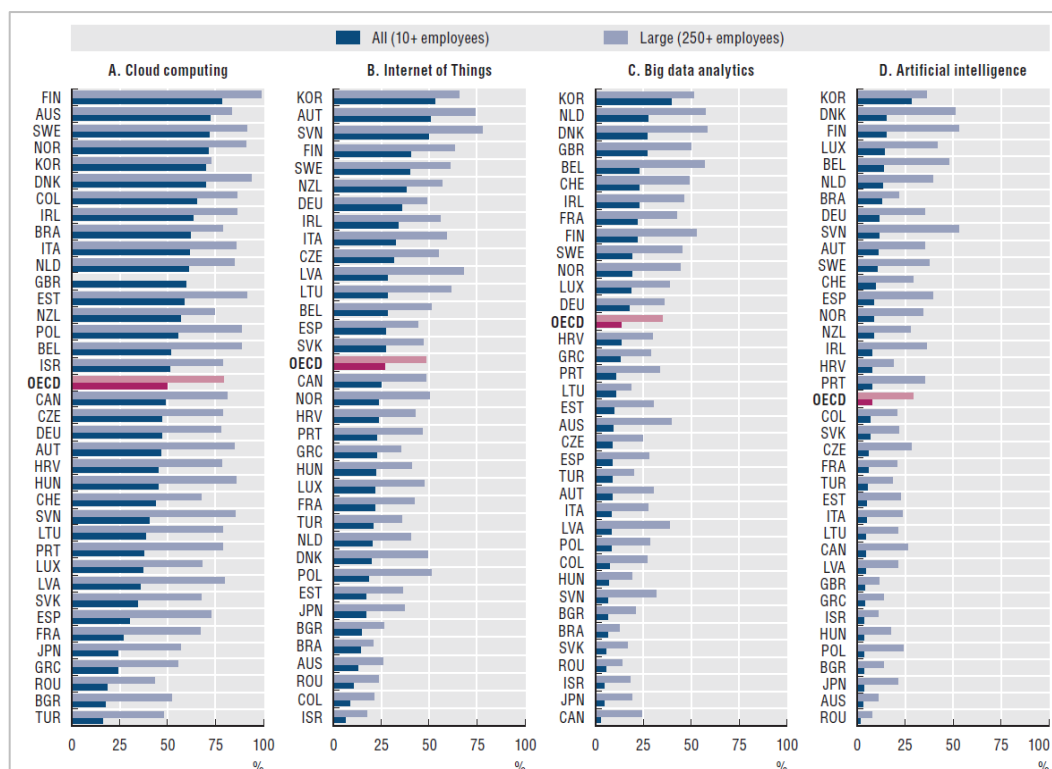
4. Results

The synthesis of the literature and comparative analysis yields three major sets of results, corresponding to the study's research questions. Thus, the results are presented along thematic axes: digital education as a public good, its contribution to human capital formation, and its broader implications for economic growth. Additionally, where appropriate, statistical evidence and comparative figures are integrated to strengthen the argument and to illuminate global disparities.

4.1. Digital education as a public good

First of all, the results indicate that digital education, under specific institutional and infrastructural conditions, displays the characteristics of a public good. Moreover, accessibility and non-rivalry are observable in large-scale platforms such as MOOCs, open-access learning repositories, and state-financed digital libraries. For example, data from UNESCO (2022) reveal that by 2021, more than 180 million learners worldwide had registered on MOOC platforms, thus highlighting the scalability and non-rivalrous use of digital resources.

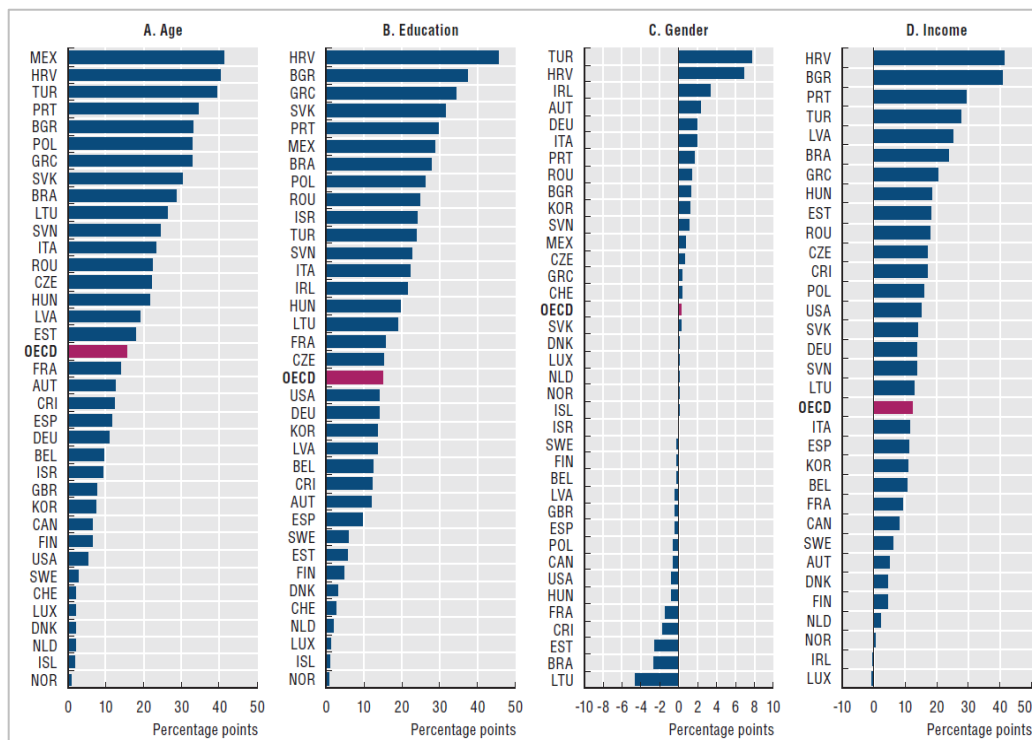
Furthermore, Figure 1 illustrates adoption rates of data-driven technologies by the business sector in OECD countries in 2023 (OECD, 2024), whilst its analysis shows considerable variation within data due to an adoption reported at over 70% in Nordic economies, whereas in several Southern and Eastern countries it is closer to 40%. Hence, this figures tend to demonstrate that technological resources, although theoretically non-rival, remain subject to obstacles that restrict access in practice. Further, this pattern supports the view that the logic of public goods applies to digital education as well because without coordinated public investment, provision remains partial and uneven, and the positive externalities associated with wide adoption are not fully achieved.

Figure 1. Adoption rates of data-driven technologies by the business sector in OECD countries in 2023

Source: OECD (2024).

In contrast to the previous graphic representation, Figure 2 presents strong evidence that indicates alarming rates of digital gap across OECD countries in 2023, thus demonstrating that divides in Internet use remain pronounced by age, education, and income (OECD, 2024). Notably, older cohorts, those with lower formal education, and individuals in lower-income households report significantly lower rates of Internet use. Consequently, this digital stratification implies that even as economies invest in digital learning infrastructure, the distribution of benefits falls behind. Similarly, in the absence of policy-oriented measures deployed by national authorities, such disparities may attenuate the human capital dividends of digital education and exacerbate socio-economic inequality, thereby undermining its role as a genuinely inclusive public good.

Nevertheless, the persistence of the digital divide complicates claims of full non-excludability. Even if 87% of households in high-income economies report access to reliable broadband, the figure falls to 35% in lower-middle-income economies according to the World Bank (2022). Hence, this divergence indicates that digital education can only approximate the qualities of a pure public good when infrastructural and socioeconomic barriers are effectively mitigated, therefore digital education remains in practice a “quasi-public good” constrained by exclusionary dynamics rooted in infrastructure and income inequalities.

Figure 2. *Divides in Internet use are distinct by age, education, and income in OECD countries in 2023*

Source: OECD (2024).

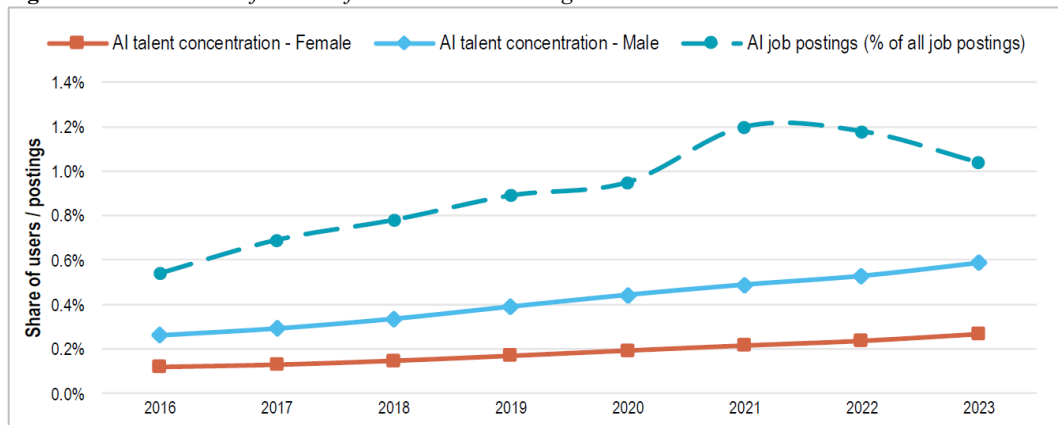
4.2. Digital education and human capital formation

There is academic consensus with regards to the positive contribution of digital education on human capital accumulation, although the magnitude and quality of returns vary across contexts. To this end, large-scale assessments such as those conducted by the OECD (2023) suggest that students that engage in structured digital learning environments score on average 15-20 points higher in problem-solving and digital literacy indices compared to peers without such access. Moreover, a meta-analysis led by Hanushek and Woessmann (2020) supports the view that economies that expanded access to digital learning tools during the pandemic preserved up to 60% of projected learning outcomes, whereas those without such integration experienced learning losses equivalent to 0.5-1 year of schooling. Hence, these discrepancies intimate that digitalisation is not an automatic enhancer of human capital but rather a conditional catalyst dependent on the presence of complementary institutional and pedagogical frameworks.

Additionally, digital education has demonstrated measurable impacts on employability and labour market readiness. For instance, the European Commission (2022) reports that graduates with advanced digital skills exhibit an employment rate of 88%, compared to 77% for graduates without such skills. Thus, these figures also lend empirical support to the hypothesis that digital education acts as a multiplier of human capital that enhances both cognitive and applied skills.

Notwithstanding, Figure 3 shows the evolution of demand for AI-driven technologies measured among LinkedIn users by gender across 30 countries and the share of job postings demanding AI skills across 14 countries between 2016 and 2023. First, the postings time-series demonstrates a marked rise from 2016 to 2023, while AI talent concentration shows an upward trend for both men and women. Additionally, the gender series indicates a persistent gap, with male talent concentration remaining above the female series throughout the period. Second, the joint movement of postings and talent suggests that demand has outpaced supply for substantive stretches of the period, particularly in peaks where postings accelerate more rapidly than talent concentration, but it also implies that education systems and training markets have been adjusting with a lag.

Figure 3. *The evolution of demand for AI-driven technologies between 2016 and 2023*



Source: Maslej et al. (2025).

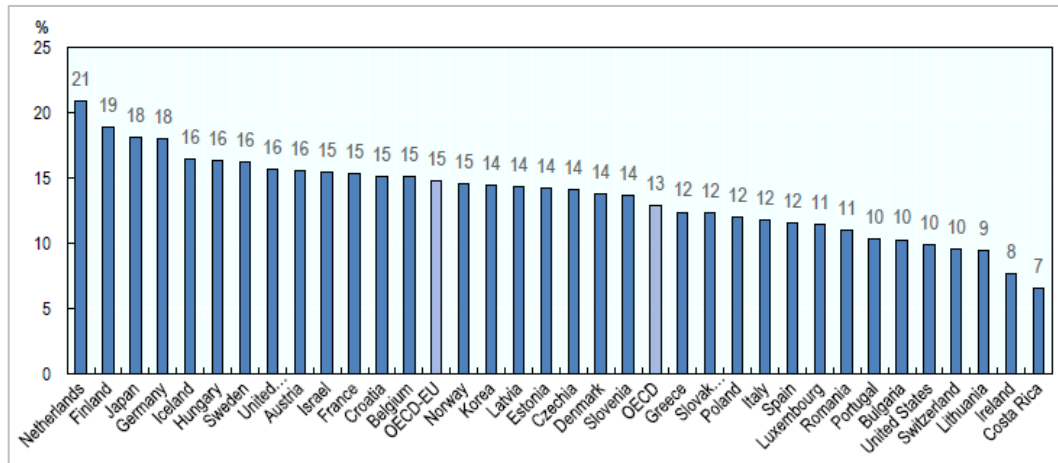
Therefore, it would be reasonable to posit the view that the observed dynamics reflect entry barriers, curriculum inertia, and the time required to build advanced competencies. Third, for policy and curriculum design Figure 3 argues that general digital literacy is not sufficient; in fact, advanced AI-related skills must be embedded in upper-secondary, tertiary, and lifelong learning provision. Similarly, the gender gap invites targeted interventions such as scholarships, mentoring, and structured pathways that could be recommended to widen participation. Overall, the series supports the view that digital education conceived as a publicly supported programme can serve as a mechanism to align the supply of skills with evolving labour market demand.

4.3. Digital education and economic growth

The final analysis points out that digital education constitutes a significant albeit complex determinant of medium to long-term economic growth. Evidence from cross-national studies posits the view that economies investing in digital educational infrastructure experience measurable gains in both GDP per capita and labour productivity with the magnitude of these gains contingent upon the scope, quality, and inclusiveness of implementation (World Bank, 2021; OECD, 2023). More specifically, when coupled with structured digital learning initiatives, a 10% increase in broadband penetration correlates with an approximate 1.5-2% increase in per capita GDP growth in middle-income

economies, while this effect appears magnified in high-income economies where complementary investments in teacher training, curriculum integration, and institutional capacity ensure that digital resources translate into effective human capital enhancement.

Figure 4. Public investment in education of OECD countries in 2021 (% of total expenditures)



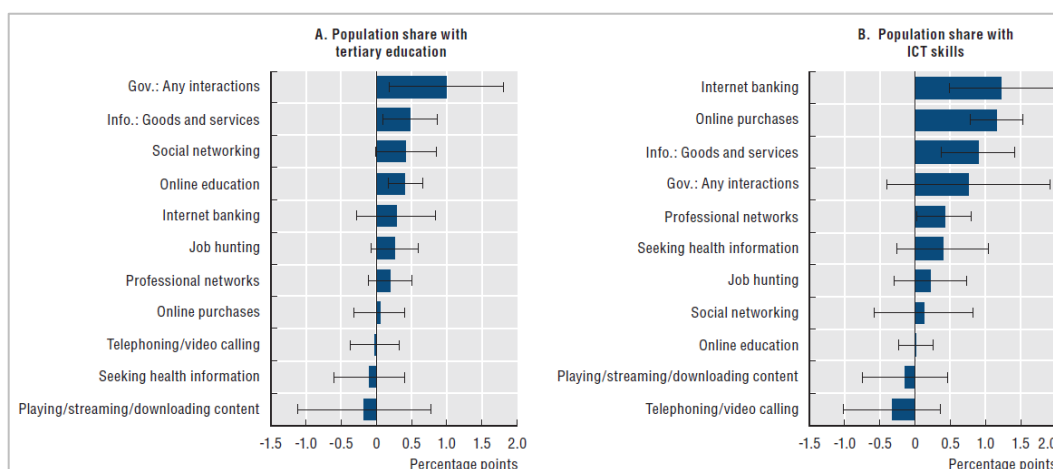
Source: OECD (2023a,b,c).

Additionally, Figure 4 presents public procurement expenditure as a percentage of total expenditures, with countries ranked by the proportion of procurement allocated to education. This framing shows two margins of variation that matter for digitalisation: the overall scale of public procurement in the economy and the share directed to educational goods and services. From a digital-policy perspective, procurement serves as a principal channel through which systems acquire devices, platforms, connectivity, content licences, and support services, but the observed configurations tend to suggest that systems with both higher procurement and a larger educational share possess greater capacity to roll out, maintain, and refresh digital infrastructure at scale. Conversely, in countries where either the overall procurement envelope or the educational share is modest, system-wide digital programmes may proceed more slowly or unevenly. For growth-related outcomes, Figure 4 implies that procurement design and governance matter for translating public outlays into effective capital deepening, whilst strategic aggregation, performance-based contracts, and interoperability requirements can be proposed to raise value for money and reduce lifecycle costs. Likewise, it is maintained that, when aligned with curricular reform and teacher development, such procurement supports the transition from hardware acquisition to measurable gains in human capital.

Next, beyond aggregate growth metrics, digital education influences innovation capacity and knowledge spillovers, which represent central pillars of sustained productivity improvements. For example, OECD (2023) data reveal that firms in regions with widespread digital skills training report productivity growth rates 3-5% higher than those in regions with limited access to digital education, in fact suggesting that digitally proficient labour contributes disproportionately to organisational efficiency and technological adoption. Similarly, cross-country comparisons demonstrate that economies with robust

digital learning ecosystems such as South Korea, Finland, and Singapore exhibit higher patenting intensity, research output, and innovation indices, illustrating a synergistic relationship between educational digitalisation and the knowledge economy. In addition, the evidence also intimates a conditional effect of digital education on growth: in low- and lower-middle-income countries, gains are attenuated by infrastructural deficiencies, limited ICT penetration, and socio-economic disparities. For instance, Kenya achieved a broadband penetration increase of 15% over 2010-2020 and realised only a 1.1% contribution to GDP per capita growth, thus further indicating the central role of supporting institutions, equitable access, and complementary policies.

Figure 5. Online activities (Internet banking, e-commerce) are correlated with formal education and ICT skills



Source: OECD (2024).

Categorically, Figure 5 reports positive correlations between online activities (Internet banking, online purchases, job-hunting platforms, education, social networking, content consumption, and telephony/ video calling) on one side, and formal education and ICT skills on the other side. Additionally, the estimates show that activities with higher trust and verification requirements (for example, Internet banking) tend to display stronger associations with education and ICT skills than purely social or entertainment-oriented activities. Besides, the pattern also indicates complementarity since formal education appears to raise general reasoning and information-handling capabilities, while ICT skills provide the operational competence to transact securely and efficiently. Also, the joint inclusion of GDP per capita controls for income effects so the coefficients can be taken to reflect behavioural associations that persist even after accounting for average economic development. From a policy-oriented perspective, data from Figure 5 suggest that widening access to advanced online services requires targeted provision of digital competencies through the education system and adult learning. Notably, it argues that programmes in financial literacy, data protection, and authentication might be recommended as complements to interventions that are funded and coordinated publicly, as they translate directly into greater economic participation and, through channel, contribute to productivity growth.

Moreover, digital education can mediate the effects of labour market shocks and structural economic transitions. During the COVID-19 pandemic, countries that rapidly scaled digital learning platforms mitigated learning losses and preserved human capital formation and, by extension, potential future productivity (Hanushek and Woessmann, 2020). This conclusion also implies that digital education can be more than a catalyst for growth under normal conditions, but also a resilience mechanism that buffers economies against disruptions that would otherwise impede skill accumulation and innovation capacity.

5. Discussion

This article has carried out an investigation on digitalisation in education through the combined lenses of public economics and human capital theory with a particular focus on whether digital education can be regarded as a public good, how it contributes to human capital formation, and the ways in which it relates to economic growth. Moreover, the analysis has drawn on cross-national data from OECD and international reports with specific attention given to the adoption of digital technologies, the evolution of labour-market demand for AI skills, sociodemographic divides in Internet use, the scale of public investment, and the relationship between digital competencies and participation in the online economy. Additionally, the decision to structure the study around secondary data sources rather than original fieldwork was guided by the need to capture long-run, cross-country patterns that can inform both theoretical reflection and policy debates. Hence, this paper aimed to extend existing discussions of digital education beyond pedagogy or market provision, into the domain of public goods and macroeconomic performance.

One interesting finding supports the view that digitalisation in education exhibits characteristics consistent with a public good. However, the figures show that in the absence of state coordination adoption remains partial and skewed towards larger organisations or more affluent groups. This conclusion is also in line with Musgrave's (1959) criteria for public goods which place emphasis on the need for collective provision where market mechanisms alone underprovide. Thus, it may be claimed that digital education cannot be left entirely to the private initiative if it is to deliver the full social returns associated with human capital accumulation. A second important finding is that labour-market demand for AI and data-related skills has risen more steeply than the supply of trained individuals, which echoes the argument of Hanushek and Woessmann (2020) who contend that human capital is decisive for growth but often lags behind technological change. Thirdly, results show socio-demographic divides in access and use, with Internet engagement continuing to vary by age, education, and income, which indicate that digital education risks reinforcing existing social inequalities unless access is broadened systematically. Similarly, comparable studies by the OECD (2023, 2024) report similar gaps, which implies that the present results are consistent with broader international patterns. Nevertheless, this paper extends the debate by explicitly connecting these divides to the public-good nature of digital education, while it also places emphasis on the necessity to integrate equity considerations into macroeconomic analysis. Finally, the evidence from public investment

and online activity coefficients indicates that state expenditure and educational attainment directly condition the economic returns to digitalisation. These findings resonate with Becker's (1993) claim that education functions as an investment in productive capacity, but they also add nuance by showing that digital skills are now indispensable for full economic participation. Therefore, digital education emerges as a structural determinant of national competitiveness, rather than a simple instrument of personal advancement.

Conceptually, this paper integrates public-goods and human-capital perspectives to frame digital education as a policy domain requiring public provision and governance. Empirically, it brings together heterogeneous international indicators to highlight procurement and equity as mediating channels. For policy, priority actions include targeted broadband and device provisioning for underserved groups, procurement rules that emphasise interoperability and lifecycle costs, and embedding advanced digital skills within formal curricula and lifelong learning.

Beyond this study's contribution to the scientific discourse by drawing together multiple datasets and literatures, several limitations must be noted. To begin with, the reliance on secondary data inevitably curtails the scope for firm causal claims. One cannot state with confidence that digital education, taken in isolation, brings about economic growth, mainly because intervening factors such as institutional arrangements, labour-market structures, and cultural norms are likely to bear heavily upon the relationship. In addition, the indicators employed by the OECD and related sources are prone to measurement error and definitional inconsistencies, which may in turn call into question the comparability of countries. A further limitation lies in the absence of micro-level behavioural data, which makes it very difficult to trace individual-level mechanism with the necessary degree of granularity.

Notwithstanding these constraints, this research makes three substantive contributions to the body of knowledge. Conceptually, it brings together public goods theory and human capital theory in the analysis of digital education, an intersection rarely taken forward in earlier scholarship. Empirically, it pieces together strands of international data which offer the opportunity of a more coherent comparative vantage point, when viewed side by side. Normatively, it lends support to the view that digital education should be regarded as a strategic component of public policy, carrying implications for funding models, regulatory design, and equitable access.

Looking ahead, future research would do well to examine in greater depth the interaction between digital education and labour-market institutions perhaps through country-level comparative analyses of vocational systems, apprenticeship schemes, and retraining pathways, which may mediate the uptake of digital skills. It would also be worth delving into the fiscal dimension: how governments set about prioritising digital education within constrained budgets, and which financing models are most apt to secure durable outcomes. In spite of the fact that this paper does not claim to resolve these questions, it calls on the academic community to take them forward, for they bear directly on our understanding of how digital education feeds into long-run growth and social welfare.

6. Conclusions

This paper set out to consider whether digital education may legitimately be conceived as a public good, how it bears upon the formation of human capital, and the manner in which it contributes to long-run economic growth. In doing so, it sought to bring together two strands of economic thought, public economics and human capital theory, which, though individually established, have rarely been combined in order to illuminate the role of digitalisation in education. The argument was anchored in comparative evidence from OECD and allied sources, which allowed the inquiry to move beyond speculation and to ground itself in patterns observable across national contexts.

Moreover, the results suggest that digital education does indeed exhibit the hallmarks of a public good. Left to market provision alone, uptake remains partial, skewed towards larger firms and higher-income households, and thereby liable to entrench existing divides. By contrast, where states invest consistently in digital infrastructures and integrate digital competencies into curricula, the social returns are more evenly spread and the labour force better equipped to meet the growing demand for advanced skills. Therefore, the findings indicate that digital education is not just an adjunct to traditional schooling, but a structural determinant of both individual economic participation and national competitiveness.

Taken in the round, the evidence assembled here points towards a clear conclusion: digital education ought not to be regarded as a peripheral enhancement but rather as a strategic priority of public policy. Its effective provision presupposes sustained fiscal commitment, regulatory foresight, and institutional arrangements capable of ensuring broad-access across social and economic strata. Although the study has recognised the limitations inherent in secondary data and the challenges of cross-country comparability, it nonetheless lends strong support to the claim that when conceived and financed with due care, digital education constitutes a cornerstone of human capital formation and, by extension, of sustainable economic growth.

Looking ahead, policymakers are called upon to take this agenda forwards with both resolve and imagination, mainly because investing in digital education is more than a matter of keeping pace with technological change, it is a means of widening opportunity, strengthening resilience, and underpinning national competitiveness in an increasingly knowledge-driven economy. Therefore, to neglect this domain would be to risk leaving future generations ill-prepared for the demands of the digital age, whereas to embrace it fully is to lay the groundwork for more inclusive and enduring prosperity.

Acknowledgment

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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Balancing Growth and Green: Exploring Rural Development in Bulgaria

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Abstract. *This paper analyses the development of rural areas in Bulgaria between 2011 and 2021 by applying the OECD rural typology together with localisation and competitiveness indices. The results reveal significant demographic and economic challenges, including depopulation, a shrinking labour force, and a declining contribution of rural regions to the national economy. At the same time, certain areas demonstrate improvements in productivity, sectoral concentration, and competitiveness, particularly within agriculture. These contrasting dynamics highlight the existing territorial disparities and point to the importance of targeted, place-based policies to ensure balanced and sustainable rural development, which must be aligned with the principles of green growth as well. The study enhances understanding of the structural transformations required for it and provides reference point to support more effective strategic planning in rural areas.*

Keywords: Rural Economic Development; Territorial Competitiveness; Rural Sustainability.

JEL Classification: R110; R580; Q010.

1. Introduction

Rural development is part of the overall sustainable development of countries, shaped by the interaction between agricultural and ecological systems and human intervention challenges. Consequently, the sustainable rural development has emerged as a concern of global importance (OECD, 2012), led by a shift in understanding of what rural areas are and their importance. Initially, rural areas are considered as territories outside urban zones, characterized by low population density and economies primarily focused on primary-sector activities. This perception has been evolving considering social and economic changes occurring in rural areas and among their populations. The primary reason relates to the shifting role of the agricultural sector within the rural economy and its significance in the broader context of their territorial development, influenced by key factors like globalization, technological advancements, and demographic changes, all of which impact the employment, the environment, and the social dynamics in rural communities. Consequently, territorial governance has increasingly targeted rural areas as backbones of economies and biodiversity, while these regions simultaneously maintain challenges such as economic disparity, urbanisation, and environmental degradation (United Nations, 2022).

In Bulgaria, rural areas are vital to the national advancement and prosperity, despite considerable obstacles in sustaining their competitiveness under the pressures of globalisation (Bankova & Peneva, 2024). Previous research highlights that agricultural specialisation and sectoral concentration often act as both opportunities and constraints for rural development, depending on how they interact with innovation, environmental sustainability, and policy frameworks (Aleksandrova-Zlatanska, 2024). Building on this background, the present study focuses on the relationship between localisation, competitiveness, and sustainable growth in Bulgarian rural areas. By employing the index of localisation, it examines different pathways how rural areas can leverage their unique attributes to foster sustainable growth based on innovations and following green transition of economies. The analysis focuses on sectoral concentration to interpret how territorial specialisation enhances regional competitiveness, particularly through green innovations and industries in these areas. This dual focus not only highlights the economic potential of rural regions but also emphasises the need for strategies that align with environmental conservation and local socio-economic realities.

Guided by this framing, the study addresses the following research question: How does agricultural specialisation and sectoral concentration influence the competitiveness of rural areas in Bulgaria during the period 2011–2021? The underlying hypothesis is that higher levels of localisation and sectoral specialisation, when coupled with green innovations and sustainable industries, positively contribute to the competitiveness of rural areas, whereas over-concentration in traditional or low-value sectors reinforces regional disparities.

Accordingly, the main goal of the paper is to analyse the territorial and sectoral dynamics of rural areas in Bulgaria, with a particular focus on understanding how agricultural specialisation and competitiveness have evolved between 2011 and 2021. By applying the OECD classification and assessing localisation and competitiveness indices, the study

identifies development patterns, inequalities, and growth potential across the rural areas, which will inform targeted policies and governance for sustainable rural development.

To achieve this goal, the study is structured as follows: the introduction outlines the context, objectives, and guiding research question; the next section presents a literature review to establish the background and key concepts; the subsequent section explains the research methodology; the results and discussion analyse specific pathways and patterns of development; and finally, the conclusion summarises the key findings.

2. Literature Review

Rural development has long been a central concern in academic and policy discourse, particularly within the European Union (EU), where regional disparities pose significant challenges to economic cohesion and social equity. Rural areas are home to more than a quarter of the population of the countries in the EU and treasure most of their land, water, and other natural resources (European Commission, 2024). They are an important part of each member state's national territorial development. Moreover, while rural regions are individually small in terms of their GDP, together, they make a significant contribution to the national GDP of these countries (OECD, 2020). Therefore, in the context of the Green Deal and the expectations for building a green growth economy, rural areas play a role in enabling the development of a new type of economy based on green innovations, digitalisation and climate-smart progress (Bock & Krzysztofowicz, 2021).

Critical components of rural development strategies worldwide have been considered and studied, including rural specialisation and the concentration of economic activities and the utilisation of local resources, skills, and comparative advantages to enhance productivity, foster economic growth, and improve the livelihoods of rural populations (Traistaru et al., 2002). Moreover, the territory is considered a factor influencing competitiveness. According to Porter (2000), competitive advantage depends not only on enterprise-related factors but also on the territory in which it is located, because the advantage can be achieved and maintained through a localised process, and the reasons for business success should be sought in that territory (the region, the area). Thus, places (areas, regions) can compete with each other, even on a global scale, not only companies. Increasing attention has also been paid to the concept of “territorial capital” (Cheshire & Gordon, 1996), which makes regional competitiveness a part of local policies. Territorial capital includes the socio-economic, cultural, historical, and environmental prerequisites specific to territorial competitiveness (Prezioso & Coronato, 2014), which determine the localisation and specialisation of the regional economy. It is also considered through the lenses of territorial cohesion as a shifting policy narrative emphasising digital transformation and environmental goals in the EU policies (Artelaris & Mavrommatis, 2020). Recent studies examine and analyse the effects of the EU Green Deal on the territorial competitiveness as it promotes sustainable innovation, green infrastructure, and job creation towards the green transition. The findings analyse the correlation between environmental sustainability and territorial competitiveness, accounting for the complex and multifaceted nature of both phenomena (Osorio, 2024; Pane, 2023). The results outline regional differences as high

competitiveness is achieved despite lower environmental performance in regions, driven by industrialisation and economic specialisation (Pane, 2023).

A significant and expanding literature exists and addresses the rural development in the countries of Central and Eastern Europe following the EU accession. The socio-economic transformation of their rural areas with particular attention to demographic shifts, labour market changes, and sectoral restructuring (Münch et al., 2024). In Bulgaria, studies have highlighted the challenges of depopulation and economic stagnation in rural areas, driven by ageing populations, youth outmigration, and limited diversification of economic activities (Peneva, 2023; Mishev et al., 2020). Rural areas in Bulgaria face the challenges of balancing growth, sustainability, competitiveness, and cohesion and major efforts are required for coordinated action across sectors and governance at different levels to ensure their green and digital transition. When these issues are considered from the perspective of competitiveness, the emphasis shifts to the components and elements within a specific region and the relationships among them. All of these can support and promote local innovation and ensure the region's capacity to compete with others (McCann & Ortega-Argilés, 2017).

In the current policy context, however, competitiveness is increasingly linked to the notion of green growth – rural areas' development relates no longer to economic outputs, but rather their capacity to incorporate sustainability, innovations, and resource efficiency into their strategies. Rural regions are not competing only on the traditional factors of production but also on the capacity to adopt climate-smart practices, stimulate eco-innovation, digitalisation and align economic activities with long-term environmental and social objectives (Losacker et al., 2023). They are becoming places where competitiveness and green transition intersect, shaping both their long-term resilience and their role in national and European development strategies.

3. Methodology

The meaningful analysis of rural economic and sustainable development begins with a consistent and practical definition of what “rural areas” encompass. In this regard, two major definitions are commonly used as basis: those developed by Eurostat and by the OECD (European Commission, 2021). While the Eurostat definition relies on population density and land use patterns, the OECD classification incorporates broader criteria, including functional relationships and accessibility to urban centers (Skorupka, 2017). The latter is employed for the purposes of this study, primarily due to better alignment with the structure and availability of statistical data at regional level (NUTS 3). This approach also enables a more flexible application across varied regional contexts, which is important in comparing economic and sustainability-related factors across all rural areas in Bulgaria.

This study utilizes data from National Statistical Institute in Bulgaria, covering socio-economic and environmental indicators at the regional NUTS 3 level (districts) for ten-year period (National Statistical Institute, 2011; National Statistical Institute, 2021). The selected time frame intentionally excludes years affected by global disruptions such as the COVID-19 pandemic and the war in Ukraine. The selected indicators are relevant to human

resources, the agriculture sector, the industry and services sectors, innovations and localisation. Their selection reflects both the current condition and the potential for sustainable development of rural areas, as well as the factors relevant to assessing economic development and competitiveness in terms of green growth and innovation. More specifically:

- *Human resources* indicators include population density, share of population aged 0–24, population with higher education, labour force, unemployed persons, and individuals outside the labour force. These indicators capture demographic dynamics, labour market conditions, and educational level, all of which affect the capacity of rural areas to sustain competitiveness. Declining or ageing populations directly constrain rural development, while higher education levels and labour force participation increase adaptive capacity. These are central to the research question, as demographic decline and skills shortages directly affect the competitiveness of rural economies and their ability to adapt to new specialisations.
- *Agricultural sector* indicators include gross value added in agriculture, average gross wage in agriculture, and localisation index for agriculture. This set reflects output levels, productivity, and specialisation in crop and livestock activities and supports the measurement of the role of agriculture in rural Bulgaria, both for economic weight and sectoral specialisation. It allows an assessment of how agricultural concentration contributes to or limits competitiveness.
- *Industrial and services sector* indicators include gross value added in industry, gross value added in services, average gross wage in industry, average gross wage in services, localisation indices for industry and for services. These indicators highlight the diversification of rural economies beyond agriculture, and test whether stronger industrial or service components help reduce dependency on low-value activities, thus supporting competitiveness. They are essential for assessing whether rural competitiveness improves when local economies combine agricultural production with non-agricultural activities, reducing dependence on traditional, low-value sectors.
- *Innovation* indicators include expenditure for acquisition of fixed assets, R&D expenditure, R&D personnel, enrolled students, share of households with internet access, and share of individuals aged 16–74 using the internet. These capture both technological and human-capital innovation capacities. They link directly to the fact that rural competitiveness improves when sectoral specialisation is complemented by innovation, knowledge, and digitalisation. The assessment whether specialisation in rural areas is complemented by innovation capacity, contributes positively to competitiveness in line with the study's hypothesis.

The next step in analysis is calculation and assessment of two key indexes: the Localization Index (LI) and the Competitiveness Index (CI) following respectively the approach of Isard (1960) and Huovari et al. (2001). The LI measures the concentration of economic activities in specific region (the single rural district) compared to the rest of the country, thereby indicating the extent to which its economy is dependent on localized (resource-based) sectors. This index can be used to highlight potential environmental concerns about resources overuse, emphasizing the need for greener initiatives for more sustainable rural development. Additionally, the CI expands this analysis evaluating the capacity of rural

areas to innovate and attract investments in support of their economic growth and long-term sustainable development. This index allows for a nuanced differentiation between economies that are more diversified, innovation-driven, and aligned with the green growth.

Localisation indices are calculated for the agriculture, industry, and services sectors. These are central to the methodology, as they operationalise the research question by quantifying territorial specialisation and concentration patterns across rural regions. They provide the direct link between localisation and competitiveness, and within the study, allow us to identify whether sectoral specialisation strengthens competitiveness through synergies and scale effects, or instead reinforces structural vulnerabilities.

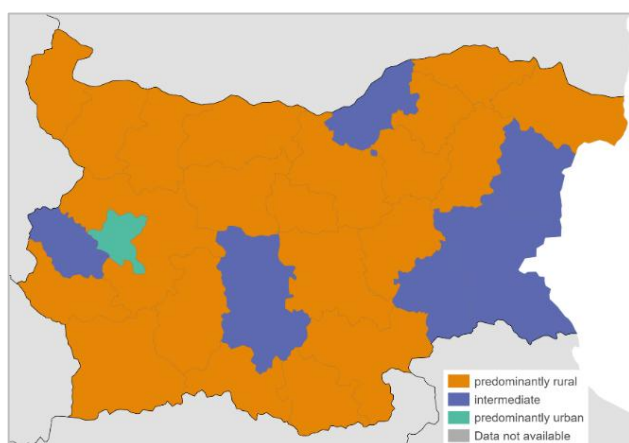
The discussion is based on clustering rural areas in Bulgaria according to the relative scores on the LI and CI for each district, presenting a typology to differentiate their diverse development pathways. The findings are suitable to inform policy decision-making aimed at fostering rural green transition.

4. Results and discussion

The OECD approach classifies regions into three categories: predominantly rural, intermediate, and predominantly urban, based on a combination of population density and rurality criteria. Applying this method to the national context in Bulgaria resulted in the distribution shown in Figure 1. Twenty-one out of the twenty-eight districts in the country are classified as predominantly rural, highlighted in orange. These areas are characterised by lower population density and limited access to larger urban centres.

An additional six districts fall under the intermediate category (marked in purple on the map), while only one district, that of the capital city Sofia, is categorised as predominantly urban (marked in green on the map). It should be stated that there are no differences for 2021 compared to those for 2011.

Figure 1. Rural areas definition in Bulgaria, NUTS 3, 2011-2021, OECD method

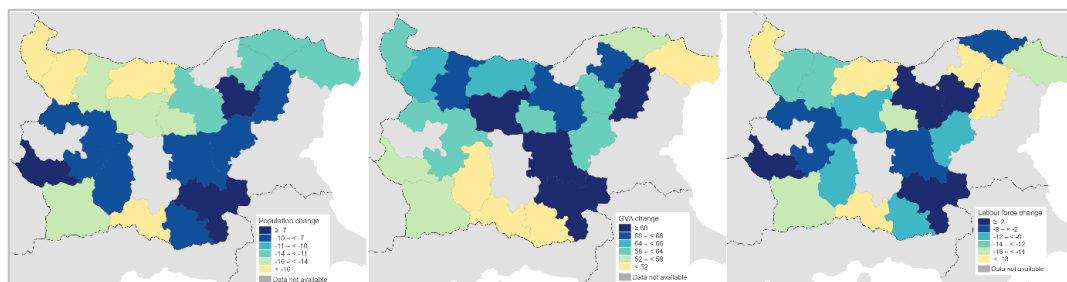


Source: Authors' calculations, data provided by National Statistical Institute 2011-2021, visual representation with Eurostat IMAGE Interactive map generator

According to this definition, the statistics report that rural areas in Bulgaria cover about 75% of the country's territory and are home to 45% of its population in 2021, compared to 57% in 2011. However, their role in national socio-economic development is declining, ensuring in 2021 38% of national GVA and working places for 43% of the labour force in the country, respectively, a decline of 5% and 7% compared to 2011. The observed changes are not uniform across all regions and factors, indicating region-specific responses or influencing circumstances (Figure 2).

The population map (on the left) illustrates a nationwide decline, with the most significant drops of 16% to 20% occurring in the northwest, south-central, and southeast rural areas. Lighter areas indicate smaller decreases, while only one region experienced growth. The third map on the right focuses on changes in the labour force, which partially reflects these population shifts. Central and southern Bulgaria show substantial declines in the labour force, with darker shades indicating reductions of over 20%. This trend suggests an ageing population and lower workforce participation. While some regions perform slightly better, the overall trend is still negative.

Figure 2. Socio-economic changes in rural areas in Bulgaria, 2011-2021



Source: Authors' calculations, data provided by National Statistical Institute 2011-2021, visual representation with Eurostat IMAGE Interactive map generator

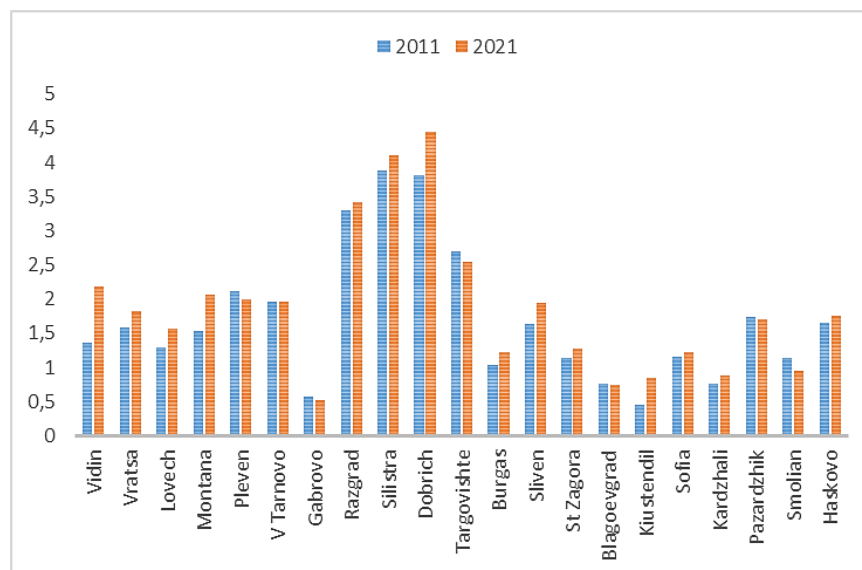
The middle map shows changes in GVA, reflecting economic output. It is important to stress on the fact that many regions, especially those in dark blue (over 65% growth), have seen significant increases. Along with the decrease of labour force, this suggests improved productivity. However, the rural areas underperform compared to urban regions having in mind the decline of their share in national GVA for the studied period. Thus, they still face significant discrepancy in development speed, which is a critical issue for future sustainability. These trend is exaggerated by the fact, that these are the regions facing major demographic and economic challenges, including depopulation, ageing, and migration, especially of young people seeking better education and jobs (Mishev et al., 2020). Hence, their development capacity is limited, the labor force is weakened and the innovation potential is reduced along with poor infrastructure, particularly in connectivity and digital services (Peneva, 2023).

Further, to understand the underlying drivers of rural economic development and the balance of green growth, the two LI and CI were assessed and analysed.

Localisation: Agriculture is a very important sector, because it is consistently linked to the economic growth, social well-being, and environmental sustainability, especially in rural

areas. Therefore, the analysis stressed on its performance in Bulgarian rural areas for the studied period. The results are presented on Figure 3 and the analysis of the changes in LI between 2011 and 2021 identifies four main pathways of development in rural Bulgaria based on agricultural specialization.

Figure 3. Index of localisation for agriculture sector in rural areas in Bulgaria



Source: Authors' calculations, data provided by National Statistical Institute 2011-2021

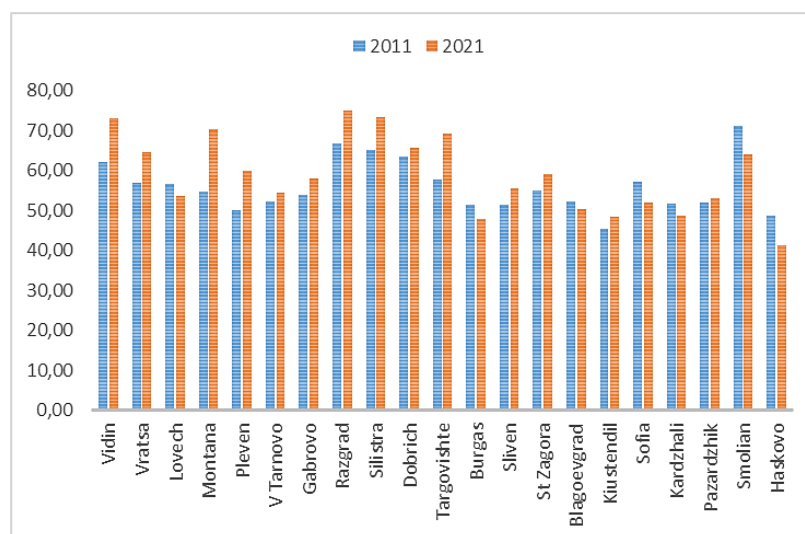
The pathways are characterised as follows:

- 1) Stable agricultural regions which maintain high LIs, reflecting strong, long-term specialisation in agriculture due to favourable conditions such as fertile soils, developed infrastructure, and investment in intensive production;
- 2) Declining agricultural regions, which show a downward trend, indicating reduced agricultural activity and a shift toward economic diversification;
- 3) Emerging agricultural regions which show a slight increase in the IL, suggesting renewed efforts to invest in agriculture by leveraging local potential and support of sectoral development;
- 4) Urbanised regions which have consistently low ILs due to their economies focusing on industry and services rather than agriculture.

Overall, the analysis highlights regional disparities in agricultural activity, with the northeast being the leading region. This indicates the need for sectoral- and region-specific investments to ensure balanced and sustainable development of the agricultural sector in Bulgarian rural areas. In alignment with the goals of sustainable development, such policy measures and instruments should not only boost productivity but also foster green innovations, promote efficient resource use through circular approaches, and support resilience-focused practices that enhance adaptation to environmental challenges. This way, agricultural development in Bulgarian rural areas can become both more balanced and more aligned with the broader shift towards green growth.

Competitiveness: The IC has been assessed as a composite measure of the economic performance and development potential of the rural areas in Bulgaria. The CI results, presented in Figure 4, demonstrate the complexity of rural competitiveness, encompassing four categories of indicators, already identified in the methodological part as the most significant for Bulgaria. Thus, the composite CI for each district incorporates the opposing trends and variations in the categories, which are analysed through the overall performance of the respective region.

Figure 4. Index of competitiveness of rural areas in Bulgaria



Source: Authors' calculations, data provided by National Statistical Institute 2011-2021

Based on that, three patterns of competitiveness development are identified:

- 1) Regions with potential in which CI is higher than 75;
- 2) Developing regions with CI between 50 and 75; and
- 3) Regions with limitations in which CI is less than 50.

This grouping helps identifying structural differences and growth potential across rural regions while also tracking competitiveness changes over time. The main findings from the CI evaluation indicate that, at the beginning of the period, all regions fall into the group of Regions with limitations, except one which is classified as a Developing region, and no region falls into the category of those with potential. By the end of the analysed period, the CI shows a noticeable increase, with some regions even moving into the category of Regions with potential. However, some regions, despite showing improvements in their index values, remain classified as Developing regions. These trends indicate that while rural areas are gradually increasing their competitiveness, only those capable of diversifying and adopting innovation move closer to the “potential” category. In the context of sustainable development, this progress should be understood not only as an economic shift but also as a step towards green growth, where competitiveness is increasingly linked to eco-innovation, resource efficiency, and climate-smart practices. Regarding the policy, targeted support and specific instruments are necessary, particularly initiatives that promote

green innovation and accelerate their transition to sustainable growth, to reinforce these advancements for the regions still classified as Developing.

The interrelation between territorial and sectoral (in this study, agricultural) characteristics shapes rural areas' specialisation pathways and competitiveness patterns. Considering the results for LI and CI for rural areas in Bulgaria, an overall trend of clustering businesses near key resources is identified, leading to territorial concentration of agriculture. Simultaneously, sectors less dependent on these key resources remain underrepresented (Midelfart-Knarvik et al., 2000). Then, achieving competitive advantage depends on the potential of rural areas to attract businesses in the sectors defined as drivers of current growth, though such shift is slow, especially in agriculture due to high relocation costs.

5. Conclusions

The OECD classification of Bulgarian regions highlights a predominantly rural landscape, with 75% of the national territory and 45% of the population situated in rural areas as of 2021. Over the past decade, these areas have experienced a notable demographic decline, a shrinking labour force, and a reduced contribution to national GVA. Rural development in Bulgaria remains unbalanced and heterogeneous, shaped by local conditions and sectoral dynamics. Agriculture continues to be central to rural economies, though its role and performance vary significantly across regions.

The competitiveness analysis presented in this study reveals steady improvements, with some rural regions demonstrating transitions from stagnation toward sustainable development pathways defined as having potential. Nevertheless, many areas continue to face severe structural constraints. The findings confirm the hypothesis outlined in the introduction: higher levels of localisation and sectoral specialisation, particularly when linked to green innovations and sustainable industries, can strengthen rural competitiveness, while over-concentration in traditional, low-value sectors reinforces disparities and vulnerability. This dual outcome underscores the complexity of rural transformation and the need for policies that not only build on existing advantages but also mitigate the risks of uneven specialisation. At the same time, the results demonstrate the importance of targeted, place-based policies to address the interplay between territorial characteristics and sectoral structures. Without strategic measures, ongoing demographic and economic disparities could deepen, undermining the prospects for sustainable development and balanced green growth in Bulgarian rural areas.

The study is not without limitations. First, it focuses on the beginning and end of the period 2011-2021, which restricts the temporal scope of the analysis; dynamic index assessment for the time series could reveal additional dynamics. Second, the reliance on the OECD classification and available statistical data narrows the lens, leaving out dimensions such as social capital and local governance practices that are equally relevant to competitiveness. Third, the findings are specific to Bulgaria and may have limited applicability to other contexts without careful adaptation. Despite these constraints, the research contributes to the understanding of how localisation and competitiveness interact in rural economies, offering evidence to inform more nuanced policy design. Future studies could extend the

framework by incorporating qualitative assessments, comparative analyses with other EU member states, and a more detailed investigation of innovation processes and environmental outcomes in rural development.

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Foreign Workers in Romania: Economic Contributions and Legal Implications

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Abstract. *This article examines the growing presence of foreign workers in Romania, with a focus on their economic contributions and the legal frameworks governing their employment. Unfortunately, Romania has a distinct lack of research regarding the mass movement of people although, it has become in recent years a hot-spot for non-EU workers. As Romania faces significant labor shortages due to sustained emigration and demographic aging, migrant workers have become essential in sectors such as construction, agriculture, and HoReCa. The findings reveal that while foreign labor is helping to offset the decline of the native population, migrant workers often occupy low-paid, low-skill jobs and face structural inequalities in terms of institutional support, as well as modest disparities in terms of wages*

Keywords: employment; immigration; public administration; policy; socio-economic integration.

JEL Classification: J23; J61; J68; J83.

1. Introduction

Romania has been facing a demographic crisis for many years, driven by mass emigration and a declining birth rate. Against this backdrop, the labor shortage has intensified, especially as the Romanian economy has undergone modernization and increasing integration with the European market. Rising living standards and a modest increase in the number of university graduates (Ministry of Education, 2023) have further contributed to workforce deficits in key sectors such as HoReCa, construction, and agriculture. As a result, many business owners in these industries have turned to foreign labor as a potential solution to sustain and revive their operations. This raises two critical questions: Is the influx of foreign workers large and skilled enough to mitigate the effects of native population emigration? And if so, are these workers being treated equally in economic terms? Given the relatively recent nature of immigration in Romania, this article aims to offer a foundational perspective on the issue, providing a basis for future research. The study adopts a mixed-methods approach, combining qualitative interviews with recruitment agents from the Association of Labor Force Importers with quantitative data analysis sourced from the General Inspectorate for Immigration and the National Institute of Statistics. The findings highlight a significant year-on-year increase in the number of foreign workers in Romania, alongside growing institutional efforts by the Romanian state to manage and regulate this phenomenon.

2. Literature Review

Immigration in a country known for emigration is a poorly understood phenomenon. Romania, being one of the countries most affected by the outward migration of its workforce, unfortunately has little experience in receiving foreign workers into its labor market. For this reason, it is necessary to analyze both the insights of authors from countries that have experienced large inflows of economic migrants and the studies conducted by Romanian institutions regarding the future of such workers. For instance, in the cases examined by Coniglio, Hoxhaj & Seric (2017), the authors found that in several African countries, as the geographical distance between the migrant's country of origin and the destination country increases, integration into the labor market tends to become easier. Thus, when a migrant has prior socio-economic knowledge of the place where they intend to work, they are more likely to succeed in finding employment. Given the considerable distance between Romania and many of the countries sending labor migrants, the ease of socio-economic and cultural adaptation is significantly reduced. As a result, self-employment or independent job-seeking becomes nearly impossible. These geographic and social factors have led to the emergence of a new type of economic sector, predominantly made up of businesses functioning as "labor importers." Normally, when a new business model emerges, the state undergoes a period of information gathering to explore legal avenues for market regulation.

Currently, however, this regulation is limited to a fixed number of annual work visas, meaning that labor importation remains in its legal and economic infancy. Precisely for this

reason, the subject must be approached from both economic and legal perspectives. According to Emilie Smith (2025), in her article published by the ILO, the most effective policies for managing labor migration are based on a labor market that is sufficiently robust and stable to accommodate foreign workers and to utilize their skills effectively. Beyond this, foreign workers also need access to critical services such as education and job training. Many of the recruitment agencies examined in this study offer language training courses specifically Romanian language courses but a large proportion of them merely guide migrants toward public institutions that could act as educators in their place. In addition to education, foreign workers require workplace transparency and job security to better facilitate local integration. This issue is also addressed in the article “Flows in the Czech Labor Market and Foreign Workers” by Posta and Macakova (2015), where the authors discuss the impact of foreign labor inflows on the national Czech labor market. They describe immigration as a clear sign of an advanced economy, but also warn of the dangers a host country may face if immigration exceeds the market's capacity to absorb new workers. Moreover, data provided by the Romanian government is essential to understanding how the state manages migrant flows. According to the Romanian Government (2024), the Labor Inspection Office reported that as of December 12, 2024, the number of individual labor contracts signed by non-EU citizens had reached approximately 146,387, with the potential for further increases through government decisions proposed by the Ministry of Labor.

Additionally, the analysis of non-European sources related to immigration and its regulation can provide new perspectives on the migration of non-European workers. Therefore, three non-European countries were selected for this research in order to analyze the differences between their approaches to migration and that of Romania, and by extension, the EU area. These countries are the following: Canada (Canada Labour Code, 1985), Norway (lovdata, 2024.) and Australia (Fair Work Act, 2009).

3. Methodology

This article employs a mixed-methods research approach, combining both quantitative and qualitative data to explore the economic impact and legal frameworks surrounding foreign workers in Romania. The use of multiple sources and methods allows for a more nuanced understanding of the dynamics at play in the Romanian labor market, particularly in sectors heavily reliant on migrant labor such as construction, agriculture, and HoReCa. The quantitative analysis is grounded in data collected from three primary institutional sources: the National Institute of Statistics (INS), the General Inspectorate for Immigration (IGI), and Eurostat. From INS, data regarding population trends, employment rates, and average wages by sector were analyzed to assess the scale and economic integration of foreign workers in Romania. IGI provided critical insights into immigration flows, including the number of work permits issued, countries of origin of foreign workers, and temporal trends in migration. Eurostat's comparative European data further contextualized Romania's position within the broader EU framework, particularly in relation to salary levels, labor

market indicators, and migration balances. These statistical sources enabled an assessment of the extent to which foreign labor is offsetting native emigration, as well as the wage disparities between foreign and native workers across various economic sectors. By examining the average earnings in fields with high concentrations of foreign labor, the study also highlights the economic conditions these workers face and the limitations of their integration into the Romanian labor market.

The interview-based investigation was conducted with the aim of understanding the main issues affecting labor immigration in Romania from the perspective of members of the Employers' Association of Labor Importers and numerous other unaffiliated labor importers. However, certain challenges must be mentioned. The investigation encountered opacity from the private sector out of the first 20 companies whose opinions and interviews were requested, only one agreed to openly discuss the problems encountered in the recruitment process, while another chose to participate in an informal discussion on the topic.

Thus, the interview technique was applied only to two general managers responsible for recruitment in different geographical areas within one of the largest recruitment companies in the field, Euro-zone Recruitment. The type of interviews conducted was guided and direct, with the purpose of obtaining in-depth qualitative information regarding the profile of foreign employees, the sectors in which they work, the main challenges of the recruitment process, the agencies' perspectives on the productivity of foreign workers, and the so-called dependency of certain industries on foreign labor.

The questions were formulated both as open-ended, in order to elicit detailed responses, and as closed-ended, in an attempt to standardize answers to certain questions. The interview was conducted in compliance with the ethical principles specific to qualitative research: academic purposes only and respect for confidentiality. Thus, by combining the responses obtained from the two recruitment specialists with official data provided by the Romanian state and statistical data from transnational institutions, a solid overview is created of the socio-economic situation in which the economic immigrant finds themselves in Romania.

4. Analysis of Results

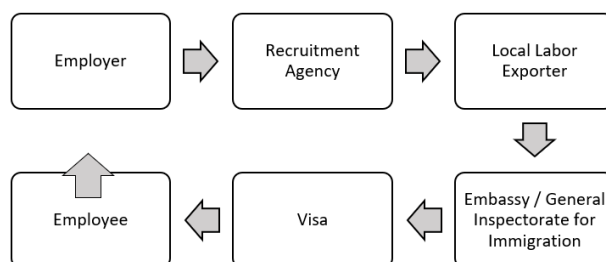
This section aims to present and analyze the results of the research. The importance of immigrants has been discussed by numerous scholars, who have reached empirical conclusions demonstrating a significant connection between immigration and the role cultural diversity plays in the increase or decrease of wages on the labor market, as well as in economic growth and innovation in sectors that employ foreigners. This is supported by Solheim and Fitjar (2018), who concluded that companies employing skilled foreign workers or those with higher education bring an influx of know-how and international networking to the firms where they work. This hypothesis is also supported by American researchers who have studied the impact of foreign workers. Blume-Kohout (2016)

discusses the significant contributions of low-skilled workers to the American economy and shows that those who immigrate with qualifications or completed university programs tend to be far more entrepreneurial than the native population. Additionally, Solheim (2016) views the role of immigrants as a “channel,” accelerating the globalization of firms that are not yet well connected to international markets. Even though there are numerous benefits to hiring immigrants in Romania, Elena Pantiru, co-founder of the Romanian Employers’ Association of Labor Force Importers (PIFM, 2023), describes Romania as a transit country for economic migrants. She explains that many of them decide to leave illegally for other European countries, taking advantage of the relaxed border regulations, where they choose to work informally, earning more than they would in Romania. Based on collected information, PIFM states that “there are cases where foreign workers leave Romania due to the inhumane conditions in which they are kept. This issue has become increasingly acute in recent years, and the border police are making efforts to monitor and intervene in such situations.” This situation creates difficulties for both employers and labor importers, along with the fact that the process of bringing in workers from outside the EU is lengthy and expensive. However, in an interview with immigration specialists from Euro-Zone Recruitment, they stated that “foreign workers are much more dedicated and stable. There are exceptions, of course, but for the most part, they are serious and consistent.”

These traits are seen as an advantage compared to employees from the native population. Although recruitment agencies often speak of the complexity of the labor import process, in theory it is relatively straightforward (Figure 4.1). The first step involves an employer’s need for personnel. The employer enters into a contract with a recruitment agency, which then communicates with a local labor exporter in the future employee’s country of origin, conveying the Romanian employer’s requirements and job specifications.

The exporter assists in finding a suitable employee and guiding them to the Romanian General Inspectorate for Immigration. Once referred to the Immigration Office, the future employee must meet the minimum requirements for a work visa. After receiving the visa, the employee emigrates to Romania to begin their employment contract with the company.

Figure 4.1 *The Recruitment Process*



The process takes approximately six months from the employer's request to the submission of documents and the actual issuance of the visa. This timeframe is also confirmed by the United Recruitment Agency (2025), which explains: “The process of bringing in Asian/African workers is very complex, and the recruitment period is 5–6 months from the

moment of selection.” Other agencies, such as Euro-Zone Recruiting, stated during discussions that the process can take between 8–12 months and, in extreme cases, even up to 18 months in countries where embassies have long visa processing times, such as the embassy in Sri Lanka. Elena Panțiru, co-founder of the Romanian Employers’ Association of Labor Force Importers (PIFM, 2023), also speaks about the “gray area” in which many of these workers find themselves in relation to social protection. She states that: “in medical emergencies requiring hospitalization for more than three days or even when they are stopped by the authorities, these people are left without support.” Eliminating this gray area in the State–Immigrant relationship should be a priority for public institutions. Within the European Union (EU), and implicitly in member states such as Romania, managing the presence and integration of third-country nationals – especially those engaged in labor activities – represents both a complex challenge and an opportunity.

The gradual creation of an area of freedom, security, and justice, as provided for by the Treaty on the Functioning of the European Union (TFEU), includes immigration and third-country nationals’ rights protection measures. A fundamental aspect of this policy is ensuring a legal framework that regulates the entry, residence, and employment of these individuals while also guaranteeing their rights. Directive 2011/98/EU of the European Parliament and of the Council establishes a single application procedure for a single permit for third-country nationals to reside and work in the territory of member states, and a common set of rights for legally residing third-country workers. This directive has been transposed into national legislation, including in Romania through Government Ordinance no. 25/2014 and Emergency Government Ordinance no. 194/2002. It emphasizes the importance of labor rights for these workers and anticipates the necessary evolution of the legal and administrative framework as their numbers increase. According to the General Inspectorate for Immigration (IGI), in 2024 alone, the institution managed the stay of approximately 240,000 foreigners on Romanian territory, showing a 20% increase compared to 2023 (IGI, 2024). In the area of admissions, approximately 24,000 visa applications were submitted by the time of the report, along with over 4,500 requests for family reunification – an increase of 30% compared to 2023. This demonstrates a growing desire for integration into Romanian society among foreign immigrants. Additionally, work visa applications rose to over 130,000 annually, of which IGI issued approximately 106,000 permits – a significant increase of over 7% compared to 2023.

According to IGI’s 2024 evaluation (IGI, 2024), the increase in the influx of foreigners to Romania has led to the implementation of new operational objectives, including: the implementation of the Migration and Asylum Pact, full digitalization of the work permit issuance process, the development of the necessary logistical capacities for housing foreigners, and achieving goals as an Intermediate Body for the AMIF 2021–2027 program, including attracting new sources of funding. Objectives such as the complete digitalization of the work permit issuance process and the development of accommodation capacities for foreign workers are crucial to reducing the time required to bring new applicants into the country.

Furthermore, providing adequate accommodation plays an important role in offering minimum protection against potential abuses by employers. However, there is a discrepancy between IGI data and the data provided by the Romanian Government and the Labor Inspectorate.

These institutions report the number of active individual employment contracts held by non-EU citizens to be 146,387 as of December 12, 2024. The number of individual employment contracts for non-EU citizens that were terminated between January 1, 2024 and December 12, 2024 was 64,189 (Government of Romania, 2025). The same report presented by the government (Table 4.1) shows the exponential growth in the number of non-EU citizens with individual employment contracts in Romania, especially during the 2021–2022 and 2023–2024 periods.

Table 4.1 *Number of Individual Employment Contracts for non-EU Citizens*

Year	Number of individual employment contracts	% Increase from Previous Year
2021	52,575	
2021	93,780	78.40%
2023	97,502	4.00%
2024	146,387	50.10%

Source: adapted from IGI (2024)

If the number of applications for the issuance of employment or secondment permits exceeds the quota set for newly admitted foreign workers on the labor market, this quota may be increased by a Government decision. The supplementation is carried out based on a justification memorandum, drawn up at the proposal of the Ministry of Labor, Family, Youth, and Social Solidarity. As the number of foreign workers in the EU – and in Romania in particular – continues to grow (as a response to labor market needs, for example), ensuring the protection of labor rights becomes increasingly urgent, and the existing systems will need to evolve accordingly. This evolution will involve several aspects: Firstly, the strengthening of law enforcement and control mechanisms: An increased number of foreign workers means a higher workload for the competent authorities (such as the General Inspectorate for Immigration and the Territorial Labor Inspectorates in Romania) to monitor compliance with labor and immigration laws. It will be crucial to intensify inspections at employers to detect undeclared work or working conditions that do not comply with legal standards, and to ensure that guaranteed rights (wages, working time, safety, social security, etc.) are effectively upheld. Secondly, improving access to information and counseling services: Foreign workers – especially newcomers – may face language and cultural barriers and may be less aware of their rights and obligations. EU directives stipulate that member states must make updated information available to the public regarding conditions for admission and residence for employment purposes. Romanian legislation provides that the single permit and the seasonal worker permit must be accompanied by written information, drafted in at least one international language, presenting the rights and obligations of the workers, including complaint procedures.

Thirdly, adapting and making legal and administrative frameworks more flexible: As the realities of labor migration evolve (for example, due to an increase in workers from specific

third countries or the emergence of new economic sectors that are heavily recruiting), national legislation may require adjustments. Legislative changes, such as the inclusion of citizens from the Republic of Moldova, Ukraine, and Serbia among those exempt from the requirement to obtain a work permit, reflect such an adaptation to specific migration flows. Flexibility within the legal framework (e.g., the possibility for member states to adopt more favorable provisions) allows for responses tailored to national needs; however, maintaining coherence with EU principles of equality and non-discrimination remains vital. This influx is not unique to Eastern Europe. Kaczmarczyk (2023) discusses in his work how, over the past decade, Poland has undergone a remarkable transformation in its migratory status. The country has rapidly shifted from being predominantly a migrant-sending nation to an emerging destination for immigration, characterized by underdeveloped support institutions and challenges related to this type of transition. Thus, over the past two decades, two distinct migratory systems have taken shape and overlapped: on the one hand, the massive emigration of Polish citizens, especially after 2004, and on the other hand, immigration flows, primarily from Ukraine (Kaczmarczyk, 2023). However, even though there are similarities between the Polish and Romanian labor markets, there is a significant difference in the countries of origin of the migrant influx. In Romania, although a considerable number of Ukrainians have entered the labor market in recent years, the countries predominantly exporting labor to Romania have been Nepal, Sri Lanka, and Egypt.

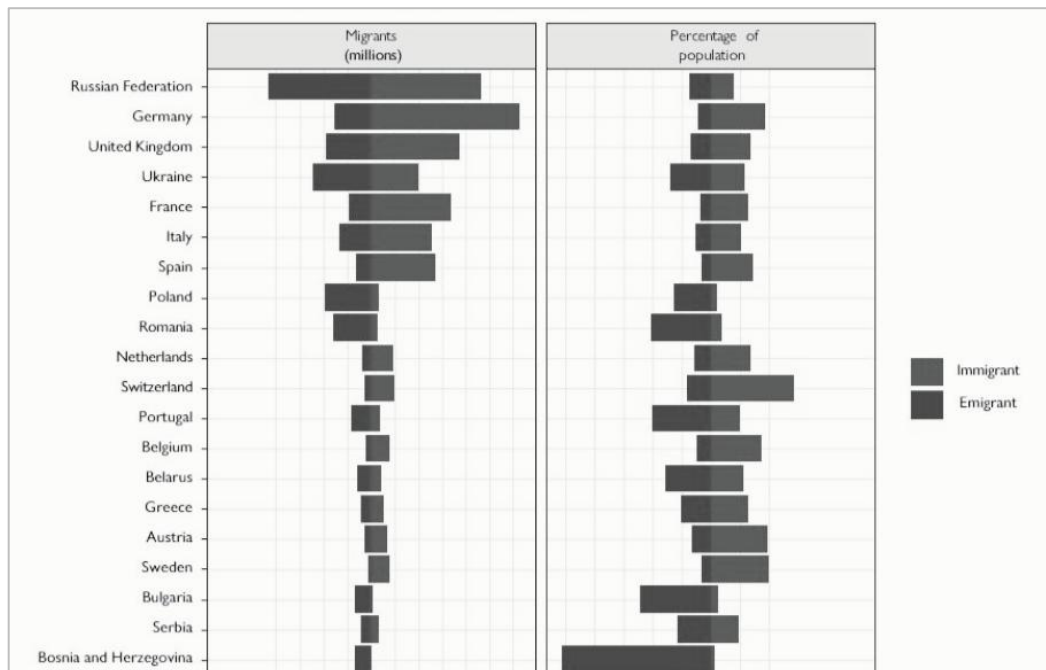
This is confirmed through interviews with specialists from the Euro-Zone Recruiting agency, who described the profile of foreign workers as individuals from “Nepal, Sri Lanka, Egypt, aged between 20 and 50 years, either unskilled or with qualifications depending on the company's activity: engineers, electricians, machine operators, etc.” These workers are brought in to fill labor shortages in the agriculture, hospitality, and construction sectors – an observation supported by Euro-Zone Recruiting experts: “Migrants are predominantly employed in construction, agriculture, industry, and the HoReCa sector, as they are highly dedicated when performing their jobs.” The significant involvement of foreign workers in these economic sectors is clearly due to the emigration Romania has experienced since joining the European Union. In the first years after accession, most of the Romanians who left the country were skilled and unskilled workers in search of better wages.

This phenomenon is also supported by data from the International Organization for Migration (IOM), a UN-affiliated organization, which clearly indicates that Romania ranks among the top 20 countries globally in terms of emigration (IOM, 2021). More than 4 million Romanians live abroad, according to the Global Migration Report 2022 (IOM, 2021). The report states that the ratio between Romanian nationals who have emigrated and foreign nationals who have immigrated to Romania is approximately 6 to 1, with emigrants outnumbering immigrants by six times.

Although Romania is positioned alongside Poland in terms of emigration (Figure 4.2), data from the National Institute of Statistics (INS, 2024) indicate a growth in Romania's resident

population after years of significant decline. According to the INS press release, the following figures were presented: “As of January 1, 2024, the resident population was 19,064,409 persons, an increase of 9.9 thousand persons compared to January 1, 2023.” Even though the population is increasing primarily due to a positive international migration balance – with the number of immigrants exceeding that of emigrants by nearly 82,000 people in 2023 – this is considered by INS (2024) to be the main factor behind the country’s population growth in that year.

Figure 4.2 Top 20 Migration Flows in Europe in 2020



Source: adapted from IOM (2021)

Another important aspect that may serve as the subject of future studies is the role of immigration in mitigating the effects of demographic aging. The INS (2024) report states that Romania continues to deepen its demographic aging process, which implies that the Romanian labor market faces two significant outflows: emigration and retirement. Returning to the initial question: Is the foreign labor force sufficiently large and well-trained to offset the emigration of the native population? According to data collected by Romanian state institutions and the study conducted on a major recruitment agency, the volume of immigration is currently large enough to compensate for native emigration. However, in terms of professional qualification, immigration mostly fills jobs that do not require tertiary education. Therefore, when examining the phenomenon from a brain-drain perspective, the answer becomes negative. Addressing the second question of the article: Is foreign labor treated equally in economic terms? Romania ranks at the bottom of the EU in terms of average annual salary.

Table 4.2 Average full time adjusted salary (AVFTS) per employee and HICP

Țara	Valoare 1 (€)	%	Valoare 2 (€)	%	Valoare 3 (€)	%	Valoare 4 (€)	%
Bulgaria	9,299	1.20%	10,345	2.80%	11,880	13%	13,503	8.60%
Czechia	17,222	3.30%	18,875	3.30%	21,370	14.80%	23,454	12%
Denmark	61,392	0.30%	63,003	1.90%	65,168	8.50%	67,604	3.40%
Germany	44,377	0.40%	45,727	3.20%	47,731	8.70%	50,998	6%
Estonia	19,238	-0.60%	21,120	4.50%	22,944	19.40%	24,899	9.10%
Ireland	51,100	-0.50%	52,638	2.40%	54,312	8.10%	58,679	5.20%
Greece	15,859	-1.30%	16,018	0.60%	16,407	9.30%	17,013	4.20%
Spain	27,844	-0.30%	29,383	3%	30,867	8.30%	32,587	3.40%
France	36,800	0.50%	38,862	2.10%	40,823	5.90%	42,662	5.70%
Croatia	15,661	0%	16,501	2.70%	18,546	10.70%	21,523	8.40%
Italy	28,815	-0.10%	30,719	1.90%	31,847	8.70%	32,749	5.90%
Cyprus	22,342	-1.10%	23,552	2.30%	25,338	8.10%	26,430	3.90%
Latvia	15,887	0.10%	17,018	3.20%	19,187	17.20%	22,293	9.10%
Lithuania	19,476	1.10%	21,720	4.60%	24,294	18.90%	27,178	8.70%
Luxembourg	67,748	0%	71,548	3.50%	75,409	8.20%	81,064	2.90%
Hungary	12,270	3.40%	13,137	5.20%	14,384	15.30%	16,895	17%
Malta	27,016	0.80%	28,172	0.70%	29,408	6.10%	29,989	5.60%
Austria	46,460	1.40%	48,166	2.80%	50,741	8.60%	54,508	7.70%
Poland	13,862	3.70%	14,106	5.20%	15,488	13.20%	18,054	10.90%
Portugal	18,860	-0.10%	19,851	0.90%	21,131	8.10%	22,933	5.30%
Romania	12,681	2.30%	13,245	4.10%	15,064	12%	17,739	9.70%
Slovenia	26,610	-0.30%	28,654	2%	30,245	9.30%	33,081	7.20%
Slovakia	15,346	2%	16,242	2.80%	17,286	12.10%	19,001	11%
Finland	43,805	0.40%	45,351	2.10%	46,621	7.20%	48,391	4.30%
Sweden	44,214	0.70%	47,301	2.70%	46,436	8.10%	44,619	5.90%

Source: adapted from Eurostat (2025)

According to Eurostat data, in 2023 Romania reached an average annual salary of only approximately €17,000 (Table 4.2). However, when analyzing the average annual salary, it is important to consider that an unskilled immigrant is, on average, paid less than a native worker. This is also confirmed by experts from Euro-zone Recruitment, who noted that, in principle, salary equality is pursued, but it is acknowledged that foreign workers receive accommodation and daily meals, which is one of the reasons their wages tend to be slightly lower. If we look at the data on average gross monthly earnings in the sectors mentioned (Table 4.3), we can observe that, despite a general increase in wages, in the HoReCa sector, for example, net monthly earnings remain below 3,500 lei. At the time of writing this article, the exchange rate provided by the National Bank of Romania indicates that

Table 4.3 Average Gross Monthly Earnings by Activity Sector

Sector economic	Jan-20 (RON)	Jan-21 (RON)	Jan-22 (RON)	Jan-23 (RON)	Jan-24 (RON)	Jan-25 (RON)
Agriculture, forestry and fishing	4,004	4,281 (+6.9%)	4,747 (+10.9%)	5,204 (+9.6%)	5,977 (+14.9%)	6,989 (+16.9%)
Construction	4,027	4,143 (+2.9%)	4,504 (+8.7%)	5,437 (+20.7%)	6,658 (+22.5%)	7,530 (+13.1%)
HoReCa	2,968	2,855 (-3.8%)	3,398 (+19.0%)	3,916 (+15.3%)	4,810 (+22.8%)	5,449 (+13.3%)

Source: adapted from Tempo (2025)

1 euro equals 5.055 lei (NBR, 2025). Therefore, the average salary in the HoReCa sector amounts to approximately €633 per month, or €7,596 per year, nearly €10,000 less than the

national average salary. In the construction sector, the annual average salary is €10,456, about €7,000 below the national average, while in agriculture it stands at €9,706, roughly €8,000 less. Given that wages in these sectors are well below the national average, which itself is below the European average, and considering the additional reduction due to the provision of food and accommodation for employees, the economic reality can quickly become demoralizing for immigrants.

In light of these figures, it is understandable why some foreign workers, once brought into Romania by labor importers, attempt to illegally transit to better-paying countries within the European Union. The answer to the second research question thus becomes: Yes, immigrants are treated almost equally, but the economic reality of the sectors they predominantly occupy is a harsh one. This economic reality must be improved not only for the well-being of both native and foreign employees, but also to enhance the quality of services provided to clients. To stimulate real and sustainable wage growth, a coordinated set of actions between the state, the private sector, and society is required. In the case of HoReCa, which was heavily affected by crises such as the pandemic, wage increases are closely tied to the sector's ability to attract tourists and generate stable revenues. An effective tourism promotion policy, combined with investments in tourism infrastructure and the provision of holiday vouchers, can boost demand and, consequently, company revenues. In agriculture, raising wages is more challenging due to the sector's seasonality, price volatility, and low capitalization. However, modernizing agriculture through digitization, mechanization, and cooperative systems can increase productivity and, in turn, sectoral incomes. In the construction sector, a key driver of the economy, wages can rise through intensified public and private investments in infrastructure. Large projects such as highways, hospitals, or schools create increased labor demand, which naturally generates upward pressure on wages.

This analysis used other European countries as the main points of comparison. Although the phenomenon of migration is one that affects all nations, it is essential to understand the challenges and opportunities experienced by foreign workers also from a non-EU perspective. In this way, we can identify various socio-economic policies without the biases of the current European political trend. In order to highlight the main similarities and differences in the regulation and protection of foreign workers, Table 4.4 presents a comparative overview of the relevant legal frameworks and labor standards in Canada, Norway, Australia, and Romania.

Table 4. *Labour Protection of foreign workers*

Aspect	Canada	Norway	Australia	Romania
Legal Framework	CLC + IRPR	WEA + IA	FWA + Migration Act	Labour Code + GEO 25/194/2003
Worker Protection	Equal to citizens	Equal to citizens	Strict, with severe restrictions for employers	Equal treatment in accordance with EU standards
Health and Safety	Employer's obligation; right to refuse work in case of danger	Employer's obligation; supervised by the Labour Inspection Authority	General protection; enforced by FWC/FWO	Employer's obligation; monitored by the Labour Inspectorate

Aspect	Canada	Norway	Australia	Romania
Leave and Maternity/Paternity Protection	17 weeks maternity + 63 weeks parental leave	12 + 12 months parental leave; maternity/pregnancy leave	Various types, including leave for domestic violence	Equal treatment according to Romanian legislation
Employer Sanctions	Fines, 2-year hiring ban, joint liability	Fines, criminal penalties, 2-year hiring ban	Fines, 10-year hiring ban, criminal penalties	Fines between 10,000–20,000 RON; restrictions on access to funds and contracts

Therefore, the following summaries can be drawn from the policies of the three non-EU countries presented at the beginning of the article.

In Canada, labor rights are primarily governed by the Canadian Labour Code (CLC), which applies to businesses under federal jurisdiction. The CLC regulates industrial relations, occupational health and safety, and standard working conditions such as hours, wages, and leave. Temporary foreign workers have rights similar to local workers, and employers must keep records of wages and working conditions for six years (Canada Labour Code, 1985).. Penalties include fines of up to \$250,000 and a two-year ban on hiring foreign workers for non-compliant employers

Norway protects workers through the Working Environment Act (WEA) and the Immigration Act (IA). Employers are required to ensure a healthy and safe working environment and to comply with collective wage and working condition agreements. The Labour Inspection Authority (ITM) oversees compliance with these regulations, and violations may result in fines, suspension of activity, or criminal penalties. Foreign workers have the same rights as Norwegian citizens, and employers who breach the laws are prohibited from hiring foreign workers for two years (lovdata, 2024.).

Australia enforces the Fair Work Act 2009 (FWA), supplemented by immigration legislation (Migration Act 1958). Fundamental rights include minimum wage, fair working conditions, protection against harassment, and paid leave. Employers who exploit non-citizens may be declared “prohibited employers” for up to 10 years (Australian Border Force Website, 2019). Enforcement mechanisms include the Fair Work Commission (FWC) and the Fair Work Ombudsman (FWO) (Fair Work Act, 2009).

As we examine the cases of non-EU countries, we can clearly observe a different approach regarding equality between native and foreign workers. Employer sanctions are far more severe than those currently applied in Romania; a two-year hiring ban can be devastating for companies that rely on seasonal labor, making compliance with labor law imperative rather than an afterthought. In Australia’s case, a ten-year ban almost certainly spells economic collapse for employers in labor-intensive sectors such as construction.

At the opposite end of the regulatory spectrum lies Romania, which complies with European standards but does not go beyond them in any specific area. Regarding the sanctions applied by Romanian institutions, these do not represent a real deterrent for economic agents who violate the law. Fines ranging from approximately €2,000 to €4,000, combined with restrictions on access to EU funds or public contracts, reflect an archaic state mentality one that still views economic agents as dependent on the state and its contracts.

5. Conclusions

The conclusions of this research highlight the urgent and coherent actions needed from both the Romanian state and the private sector, which is increasingly benefiting from the contribution of foreign workers, especially in sectors such as agriculture, construction, and HoReCa. The effective integration of the immigrant workforce requires not only their acceptance, but also the establishment of a legal and institutional framework that guarantees the fundamental rights of workers and supports the sustainable development of the labor market. First and foremost, it is imperative to update immigration legislation. The current regulations no longer reflect the present economic and social realities, often proving to be rigid or unclear in their application. Specifically, the legislation is rigid regarding the maximum number of immigrants accepted annually, and the lengthy and bureaucratic process they must undergo to obtain visas and work permits. In a context where more and more companies are turning to labor from outside the European Union, a flexible yet robust legal framework is required, one that offers protection for employees and clarity for employers. Reforming the legislation should include the simplification of work permit procedures, reduction of bureaucracy, and the establishment of clear mechanisms for oversight and support. At the same time, expanding and modernizing the institutions managing immigration, such as the General Inspectorate for Immigration (IGI), becomes an essential condition. These institutions must be provided with adequate resources, specialized personnel, and modern technologies, in order to respond promptly to increasing demands and efficiently manage migration flows. A digitalized system, interconnected with labor authorities and recruitment agencies, would facilitate the proper tracking of the legal and professional trajectory of each foreign worker. Another crucial aspect concerns the transparency and monitoring of recruitment agencies. At present, many foreign workers are brought to Romania through firms that do not ensure transparency in their recruitment processes, thereby creating room for potential abuse. During this research, the top 20 foreign workforce recruitment agencies by revenue were contacted, yet only Euro-zone chose to openly discuss their processes. Moreover, a noticeable reluctance was observed among foreign workers to speak about recruitment agencies, which meant their perspective could not be quantified in this article. For these reasons, stricter oversight of these entities is required, through mechanisms such as licensing, periodic reporting, and independent inspections. In parallel, a publicly accessible database for both employers and workers could provide information on accredited agencies, their history, and any penalties imposed. Additionally, protecting the wage rights of immigrants must go beyond legislation and be supported by concrete monitoring actions. Workplace inspections, conducted by the relevant authorities, can help prevent abuse and build trust in the system. Such actions should respect workers' dignity and aim primarily to support and inform, not merely to sanction.

Concrete measures that authorities could implement immediately include introducing a legalized two-year hiring ban for non-compliant employers. Although Australia regulates immigration very effectively due to both its geography and legal framework, extremely strict measures such as a ten-year hiring ban for violations of labor laws could have

unintended consequences. By instilling fear in economic agents, such policies may negatively affect labor demand, potentially exacerbating workforce shortages in the studied sectors.

Another concrete measure that could be implemented quickly is increasing fines for employers in cases of misconduct toward employees. This approach would serve to protect both native and foreign workers. Such fines, combined with a higher number of inspections and the establishment of a functional whistleblowing program, could also have positive social effects, such as increasing public trust in the relationship between citizens and the state. Greater trust in the state could help slow down brain drain, as young, educated workers without extensive experience might feel secure in the employer-employee relationship thanks to state-backed guarantees, reducing some of their incentive to seek opportunities abroad.

Finally, a frequently neglected but essential component is the active involvement of company management in the integration process of foreign workers. Training for leaders and HR professionals in managing multicultural teams, intercultural communication, and compliance with legal obligations represents a vital step toward a fair work environment. Only through a professional and humane approach can employers turn workforce diversity into a genuine competitive advantage.

Although the number of Romanians leaving the country for socio-economic reasons is alarming and represents a human tragedy, studies show that the labor market can, to some extent, absorb the departure of workers without tertiary education through the employment of immigrants. While in the short term this provides a temporary economic boost for Romania, in the long term, brain drain, which cannot be fully replaced by foreign workers, represents a slow erosion of the concept of a modern and high-performing economy. Although Romania's demographic future could be stabilized with cheap labor, its economic future may, at best, stagnate.

Acknowledgements

I would like to express my sincere gratitude to Euro-zone Recruitment for their transparency and willingness to support this research. Their openness and valuable insights greatly contributed to the depth and accuracy of the case study presented in this article.

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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Shaping the Future of Teacher Education Through Entrepreneurial Learning Models

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Abstract. *This paper examines the development of teacher training through entrepreneurial models of learning, to respond to the challenges of 21st-century school education. Employing a convergence of methods approach, the study integrates a literature review with a Romanian pilot program on secondary school teachers and students. Research Aims: On the basis of quantitative data, predictive power between entrepreneurial self-efficacy and innovation in teaching are brought forward, whereas the qualitative results indicate changes in teacher identity and student activity. Outcomes validate that the infusion of entrepreneurial skills fosters reflection-based practice, risk-taking, and authentic learning. This study is relevant to educational innovation by providing a research-based model of learning for preparing entrepreneurial teachers.*

Keywords: entrepreneurial learning models; teacher education reform; teacher self-efficacy; student engagement; educational innovation; Romanian pilot study.

JEL Classification: I21; I23; L26.

1. Introduction

In an age characterized by momentous socio-economic shifts, technological change and intractable global uncertainties, our education systems the world over are under growing pressure to rethink not just what is taught, but how teaching is perceived and structured. Imperatives for adaptability, creativity, and innovation have rendered the need for new forms of teacher education peremptory, in that such traditional models have largely been predicated on industrial-era conceptions that emphasize standardization, procedural compliance, and that which is often the 'passive reception/relay of facts'. As education is increasingly moving away from a paradigm of knowledge reproduction toward knowledge co-construction, it is no longer simply arguable, but rather an urgent inevitability, that there is a necessity for a reconceptualization of teacher preparation that is systemic in nature.

At the heart of this transformation appears to be the promise of entrepreneurial learning models – pedagogical models that foreground opportunity identification, innovation or creative problem-solving, iterative development and agency – to inform the reformulation of teacher education for the 21st century. Entrepreneurship has historically been limited to business, yet its core characteristics – resilience, risk taking, hedging bets, and value creation – are increasingly understood as being necessary for managing within the uncertainty and unpredictability of Canadian schooling today. “All that can be said is that the teacher is no longer required to be a mere implementer of curriculum or a regulator of classroom routine, but rather a sensitive agent of change, curriculum designer and community leader able to respond rapidly and ethically to diverse kinds of educational needs as they arise” (Tyack, 1974, p. 3).

The infusion of entrepreneurial capabilities into teacher learning represents a potentially fertile avenue for the development of such professional identities. Entrepreneurial education as a mindset and teaching and learning paradigm encourages the development of reflective practitioners who can innovate in constraints; take up context-dependent projects, and sustain lifelong learning paths. “Teachers believe that learning is a messy enterprise that involves taking risks... where the challenge of uncertainty is met as an opportunity for learning and growth, not a threat.” In this context, models of entrepreneurial learning have the scope to profoundly increase the adaptive expertise of educators and to enmesh in the teaching profession a futureward stance toward educational renewal and social innovation.

However, amidst increasing theoretical endorsement of entrepreneurial models in education, there is a striking lack of empirical and program implementation of this type of intervention in teacher education – particularly in the Central and Eastern European setting. In Romania, for example, training of teachers is heavily based on traditional didactic models and hardly involves innovative pedagogical models based on initiative, partnership and entrepreneurial culture. The disinclination towards interdisciplinarity, the inflexibility of curricular arrangements and the ubiquity of summative assessment have together impeded the nurturing of the very dispositions we now most need in teachers. Hence, the focus could be said to have evolved in the conclusion that teacher education in Romania and in post-communist educational systems of the same type, needs conceptual repositioning as well as methodological renewal.

The theoretical basis of this research is multi-faceted. First, to respond to the systemic inertia that as of today continues to be an obstacle to the enhancement of the so-called transversal competencies that are linked to the global priorities in teaching and learning, as well as to offering the needed response to shall meet and match the world educational priorities, as those that have been identified within the context of the Education 2030 Agenda from UNESCO, the OECD's Future of Education and Skills 2030 framework. Second, it addresses the changing nature of learners that call for increasingly educators who can deal with ambiguity, who can use digital resources in creative ways, and who can co-construct meaning in multiple and often unpredictable learning spaces. Third, and most importantly, it speaks to the theoretical and policy debates that advocate reconceptualizing teaching as an entrepreneurial profession, one that is inherently dynamic, participatory and socially connected.

In this context, the purpose of the present research is twofold: (1) to question the theoretical overview and the operational features of entrepreneurial learning considering teacher education and (2) to investigate the possibility, as well as the pattern, as well as the impact, of entrepreneurial learning models in an applied and context-based case study conducted in Romania. Employing a mixed-methods design, involving a combination of bibliographic and empirical data from a pilot teacher training intervention, the paper seeks to capitalize on an understanding of opportunities and tensions in the adaptation of entrepreneurial frameworks for education. In the process, it enriches emerging but still emergent scholarly conversation about educational entrepreneurship, with a particular emphasis on the ways in which the concept bears on the formation of teacher identity, instructional agency, and systemic innovation.

In addition, the study is located in the larger body of work regarding transformative teacher education, work that emphasizes critical reflection, sociocultural responsiveness, and the construction of a moral and ethical position to teaching. What we mean by entrepreneurial learning, as articulated in this assignment, is not about teaching economic thinking or start-up mentalities; it is about nurturing the capacity of generating social value and challenging the status quo and designing inclusive, equitable and context-sensitive learning. Therefore, entrepreneurial ideas of learning are discussed in this paper not as technical or strategic devices, but as normative forms which redirect teacher learning toward the project of human flourishing and democratic participation.

In practical terms, this study addresses immediately a current concern: how to put the entrepreneurial competencies into practice in teacher training programs without emptying them into a merely instrumental list of skills for the world of business or managerial routine. The research argues that entrepreneurial learning needs to be integrated holistically within the structural, curricular, and relational aspects of teacher training – from project-based learning and collaboration across disciplines to scenario planning and real-life problem-solving. It must also be supported by strong mentorship, the ability to try new things in a professional setting and places for meaningful conversation around risk, values, and innovation in education practice.

By uncovering the nuances of the implementation of these principles in the Romanian pilot context – particularly in such an environment where constraints of traditionalism,

bureaucratic inertia and limited institutional flexibility are particularly acute – this paper makes a valuable and timely contribution to the scholarly debates on the prospects of scalability (to multiple local contexts) and the contextual limitations of entrepreneurial learning in teacher education. Its results are designed to benefit not only curriculum developers and teacher educators, but also policy makers, administrators, and international agencies concerned with educational innovation and reform. But the significance of this study goes far beyond national boundaries, and it proposes a model for how entrepreneurial pedagogies could be localised, adapted and scaled in diverse educational systems where a 21st century transformation is required.

In summary, this article repositions entrepreneurial learning as integral to teacher education, rather than merely a casual aspect, and as a key way of preparing educators who know how to work with complexity, lead change and co-construct meaningful learning opportunities in disorderly, interconnected times. The theoretical bases of this approach will then be addressed in the sections that follow, referring to the core elements of the research on educational entrepreneurship, teacher identity shaping and curricular innovation. Drawing then on the research design and findings of the Romanian pilot venture, they will be outlined, interpreted and critiqued. In this multi-focal examination, the article seeks to contribute to scholarly coherence, and, potentially, to practice wisdom about entrepreneurial models in shaping the shifting terrain of teacher education.

2. Literature Review

Amidst fast paced changes in world' societies, economies and technologies the European Union is at a critical crossroads where sustainable development, innovation and adaptable workforce policy orient towards the need of rebooting the future generations for a volatile, uncertain, complex and ambiguous context (VUCA). In this complex context, Romanian higher education system plays a key function – and this, not simply as a purveyor of knowledge, but a dynamo from which to draw resilience, critical thinking and leadership from its generation of young citizens. It is in the synthesis between sustainability and circular economy concepts with labor market challenges, technological integration, and education innovation in particular that the need and opportunity for more systemic evolution of this new system becomes evident.

The increasing demand for adaptive and entrepreneurial competencies in teacher education systems is driving a paradigm shift in educational policy and pedagogy. This evolution aligns with the broader digital transformation of educational environments and institutional governance.

Sustainability, no longer a question to be addressed purely under an environmental perspective, embodies an intricate weave of economic, social and environmental dimensions. As Zaharia et al. (2019) claim that “the relationship between economy, society and environment as a complex system, and the consumption of energy (both primary and final) stands of high interest for researchers across the globe. Education and information access take on a strong role in this system: “Well educated people who should be fully aware about the current challenges of climate change and energy and those who have a high

access to the internet might help to reduce energy use. Furthermore, the increased investment in the health system might be able to provide for energy savings and energy efficiency interventions.” Such reflections serve as a reminder that education and literacy are not peripheral to sustainability but are its absolute bedrock.

It is this connectedness that is also at the heart of the European plans for the circular economy. Pernici et al. (2024), “in recent times, the latter has been integrated almost seamlessly into all major strategies, action plans and policies, introduced by international institutions”. In this regard, is a case in point the action for a new circular economic framework by the European Commission, and Sankey’s Diagram for Material Flow, that will both detail the vision and the transition to the new economic frame.” The transition from linear to circular economy is not only a paradigm change in production and in consumption, but to the creation of the human capital capable of correctly addressing and managing it. Universities, especially in the field of economics and business, should form graduate students providing them not only with technical expertise, but with values and competences coherent with an economic activity that is regenerative and ethically guided.

Vulpe and Stancu (2023, 2024) insist upon system integration -not only financial, but also educational-, as necessary to enhance strategic development in teacher education. BA, and central knowledge sharing means, such as BA CoE, can help them generate and identify opportunities for innovation and avoid duplications which contribute to the development and ensure that strategic goals align to the digital and entrepreneur competencies.

Silvestru et al. (2018) emphasize that the virtualization of education provides a qualitative improvement of teaching and learning. Yet disparities in the digital readiness of users persist. In tandem with this, Elisabeta and Alexandru (2018) emphasize that interactive course delivery – for example real-time video demonstrations and multimedia resources – play an essential role in the creation of learner autonomy and involvement, particularly in teacher training contexts.

In this reshaping of the educational missions, structural adjustments on the Romanian labor market are taking place, notably under the influence of exogenous shocks, like the one generated by the COVID-19 pandemic. As Rădulescu et al. (2021) note, “a fundamental influence on the shape of the labour market is the degree of differentiation in the level of labour productivity and consequently the impact on wages. “The explanation is that the impulse of workers from various segments of the economy may condition their orientation to more valued and/or better paid sectors. This agility underscores the growing value in flexible skills, flexible careers, and the alignment between personal aspirations and systemic opportunities. In that sense, universities need to function not as the purveyors of certificates, but as creators of professional identity that is rooted in purpose.

One of the most remarkable developments in this regard has been the advent of critical thinking as a basic labor market need. Dumitru et al. (2013, p.3) state that ‘with the passing of time and the emergence of technology, critical thinking (CT) is nowadays listed as one of the top skills in the job market’. Their experimental designs indicate that “the transformative impact can be linked to the immersive aspect of labor market-oriented interventions. In Romania, mixing the work-based learning with the blended HE

curriculum for economics is not only an innovative practice; it is also a necessity in trying to narrow the gap between the theoretical contents and the challenges encountered in real life. Those pedagogies, particularly when situated within a transdisciplinary frame, promote intellectual independence, social agency and an active commitment to change.

Also pressing is the need to reimagine leadership in the face of demographic and technological change. Generation Z, who is just beginning to enter the workplace and education, is characterized by their unique motives and values. According to Barbulescu (2022), “the Gen Z traits have brought challenges for managers leading them in the workplace. “Many of the current leaders are Gen X’ers, so they’ve been attempting to take what worked for us and translate it onto a totally different breed of person.” This generational disconnect highlights the importance of adaptive leadership training integrated into educational curriculums – training that fosters inclusive communication, digital literacy, emotional intelligence, and participatory decision-making.

Leadership plays a pivotal role in ensuring the effective integration of EdTech by empowering educators, fostering collaboration, and addressing systemic barriers, consider B. Costache (2025). Further, in the wider view of emergency systems, security and administrative effectiveness, innovative leadership is more and more seen as a strategic necessity. Bokor et al. confirm “‘creative leadership is essential for strategic management,’ especially for the high stakes of emergency call management and the integration of the AI. These discoveries hint at a deeper truth: Leaders of tomorrow need to be not just technically skilled but also creatively nimble and ethically grounded, as well as adaptable to complexity.

The ecosystem influence of entrepreneurship education on sustainability and innovation is increasingly acknowledged. Suguna et al. (2024) present in TISM and MICMAC directions through which entrepreneurship education forms a complex system of interrelated components that determines, together, sustainable communities. The induction of entrepreneurial mindset within teacher education thus becomes a strategic necessity in the preparation of future-ready educators.

Diepolder, Weitzel and Huwer (2024) further the ecosystemic perspective by transferring SEE models into the secondary school. Their study provides evidence in support of the work of early-stage entrepreneurially related programs in enabling students to understand sustainable development opportunities. Institutionalizing such models as components of teacher education programmed provides that the coming generation of teachers know more about being bearers of knowledge and also agents of change in society.

Combined with this, there is continuing education as a pre-requisite for sustained professional performance. “Continuous education is of vital importance for the real training of professionals in the new dynamics of the accelerated technological evolution of almost all the areas of activity” (Petcu, Costache, & Bejinariu, 2025). This is especially true in areas such as health care, education and digital infrastructure since in those areas, redundancy is rapid to strip latent competencies along with institutional effectiveness.

Additionally, educational approaches in the VUCA world will have to fight threats against democratic values, freedom of expression and the social cohesiveness ushered in. Soare

(2023) provocatively observes that “there are many striking similarities between cancel culture and the policies of creating the ‘new man’ that preserve cultural critics frequently latch onto.” This is a reminder that education needs to be a remedy for ideological monoculture and rather should nurture pluralism, critical discourse, and the courage to dissent. The moral mission of universities, and particularly of those in societies after the model of the totalitarian regime, such as in Romania, is to ensure respect for epistemic integrity and civic rights.

Ultimately, these complementary yet interrelated elements – sustainability, circularity, labor adaptability, critical thinking, creative leadership, lifelong learning, and democratic resilience – form the scaffolding of a rethought educational model that orchestrates with – and within – European strategic aspirations. Romania’s participation in these networks is not just a matter of fitting in, but of potential change. Its education system’s alignment with new European policies offers a unique opportunity to reimagine its course of development in ways that are meaningful to the community and the world alike. National actors must thus urgently begin to invest in the necessary sustainable, socially inclusive and evidence-based development of education that can produce a generation trained for not just employment but for leadership, innovation and ethical stewardship in a world that is constantly in flux. (Mirea, C. N., Craiu, D. M., & Cepoiu, G. M., 2019).

A large literature is emerging which highlights the importance of entrepreneurial identity of educators in relation to student intention and outcomes. Citing Social Learning and Role Model theories, Bueckmann Diegoli et al. (2018) see how teacher entrepreneurial background impacts on students’ intentions. Their study at scale among Mexican undergraduates shows that “students with convergent learning styles experience significantly higher increase in entrepreneurial intentions when taught by teachers with entrepreneurial experience” (Bueckmann Diegoli et al., 2018). Such a finding highlights the role of a teacher’s experience and the propensity of student learning as a potentially influential twofold condition of activation, with entrepreneurial experience facilitating intention only when there is a certain (un)willingness on behalf of a student to consider intentionality – a possible detail ignored by simpler teacher–student models. In line with the above, Seikkula-Leino et al. (2010), cross-European analysis contends that teachers embodying the role of entrepreneurial promoters should express autonomy and proactive orientation, in order to enable student agency and opportunity perception.

But then Peltonen (2015) has a point; we should not set experience first as an alternative to having something else in mind, like experience being in place of something else we want than experience; because again we would pass over ingredients that belong to the pedagogical character of capacities. He argues that entrepreneurial skills can be developed when the teacher learns with others in professional development contexts and that “collaborative problem-solving and reflection enhance the teacher’s own entrepreneurial capacity” (Peltonen, 2015). This standpoint spans the experiential-professional dichotomy and re-conceptualizes entrepreneurial identity as an hybrid of lived experience and dynamic learning, instead of a static attribute.

There is the related question of how to teach entrepreneurship. Teaching methods significantly influence learning results and, as Fayolle and Gailly’s (2008) taxonomy

highlights, there is a difference in this context, but between theoretical lecture-based methods and more skilled-based action-oriented models. Cascavilla et al. (2022) empirically validate this framework by classifying EE courses into five types – Supply, Supply–Demand, Demand, Demand–Competence, and Competence – and they show that the Demand, Demand–Competence and Competence models are significantly superior in enhancing student entrepreneurial learning: “the courses based on the Supply–Demand, Demand, and Demand–Competence Models present better entrepreneurial learning outcomes than those based on the Supply Model” (Cascavilla et al., 2022). This data lends support to Fayolle and Gailly’s (2008) argument for a change of paradigm from craft to science with regard to the importance of experiential processes and reflective learning loops in the teaching of EE.

Building on this Ruskovaara and Pihkala (2015) teacher-focused evidence that instructional decisions (including the use of authentic tasks) mediate learner competence. They argue that ensuring teacher autonomy in choosing pedagogical approaches is key to the success of EE programmes. This is strengthened by Almeida CM and Teixeira LR (2011) who claim that an entrepreneurial education should develop environments that promote autonomy and real-world questioning, redefining passive learning environments to active and student-centered learning experiences.

The enhancement of the entrepreneurial competences in teachers themselves is also emerging as a key theme. According to Peltonen (2015) pedagogical work in higher education is an environment where reflexive entrepreneurial skills can be promoted; especially in collaborative digital module work within teacher education. Similarly, Sagar (2013) reveals that professional development experiences structured according to entrepreneurial learning models play a critical role in beginning to influence profound changes in teacher self-concept – from passive transmitters of knowledge to facilitators of agency. Extending this, Morselli (2019) recommends an applied ‘Change Laboratory’ model based on activity theory, in which teachers collaboratively review and reformulate the practice, to establish entrepreneurial capability. In the words of Morselli, “the change laboratory enables teachers to become aware of their metacognition and ability to start systemic change” (Morselli, 2019). This supports Fayolle and Gailly’s (2008) proposition that successful EE should not only develop skills, but also embed structured chances for metareflection and iterative action – for the teachers themselves a process of entrepreneurial learning.

Zheng et al.’s (2018) work indicates a move away from formative processes and towards measurable competence models. (2017) and Lukic et al. (2024). Using the cases of Chinese entrepreneurs, Zheng et al. (2016) consider the way in which entrepreneurial capacity is co-constructed within social and institutional contexts, and the importance of interactions with peers, mentors and the overall learning environment. Lukic et al. (2024) extend this work by developing a predictive model that demonstrates how teacher attitudes, self-efficacy and prior exposure to entrepreneurship strongly predict educators’ intentions of becoming an entrepreneur, thereby indicating that these variables serve as preconditions for instructional agency in the context of EE design. Lindner (2018) interestingly expands this discussion, to include sustainability, and contends that entrepreneurial education

should educate teachers how to integrate sustainability into curriculum – connecting innovation with ethics and the environment. This is an important concern to address when developing international curricula.

That said, a review of the literature exposes a number of key tensions and absences. A favourite argument, for example, is between experience vs pedagogical skill. While Bueckmann Diegoli et al. (2018) find that experience is not enough in the absence of student readiness, and Peltonen (2015) as well as Morselli (2019) show that structured learning environments can build competence even without any prior entrepreneurial experience. This leads to a normative issue: should teacher training be more focused on immersion or does pedagogic training suffice to develop entrepreneurial competencies?

A further tension is that of pedagogical models and the agency of the teacher. Cascavilla et al. (2022) offer convincing evidence for the efficacy of experiential and competence-based models; however, the successful introduction of these largely depends on the teacher's openness and ability in adopting innovative roles. Both the studies of Ruskovaara and Pihkala (2015) as well as Higgins and Elliott (2011) emphasise that the achievements of work take place in a balance of teacher power, indicating that structures for this kind of institutional self-security and a supporting culture of school is also required.

Last but not least, Costache (2024) puts a highlight on the importance of strong internship and mentoring systems for ongoing professional development. All these efforts serve to support teachers with the adoption of digital tools and pedagogies, as well as enable entrepreneurial thinking necessary to respond to the shifting needs of 21st century educational systems.

Overall, these literature review studies demonstrate that the development of pre-service teacher education for an entrepreneurial learning future needs systemic development in terms of digital infrastructure, experiential learning and strategic professional development. This multi-component model paves the way for teachers to become agents of innovation, advocates for ecological education and promoters of student empowerment in varied learning environments'.

In addition, the problem of fit to context (and localization) has been little explored. While much of the literature finds itself in Western or in Chinese educational contexts, this begs questions as to the transferability of such models to systems like Romania's, which still bear the marks of post-communist legacies and of traditional hierarchies. Lukic et al. (2024) prediction model may need large adjustments before it can be used in these settings. Likewise, while Lindner's sustainability framework speaks to the world-wide rankings, it could challenge localized curricular requirements highlighting potentially unrealized nature of context specific models in entrepreneurial teacher education.

Sustainability and ethical aspects are also underrepresented in the literature. While Lindner (2018) advocates entrepreneurship education as a means to tackle long-term societal challenges, existing frameworks hardly cover ethical concerns in a prominent manner. Whereas Morselli's (2019) Change Laboratory points toward the possibility of moral reflection in teacher work, the wider literature rarely connects enterprise discourse with

social responsibility or global citizenship agendas – even though these are increasingly salient in educational contexts today.

Finally, the intention behavior gap remains substantial. While Bueckmann Diegoli et al. (2018) and Lukic et al. (2024) agree with this view and, whilst there are studies that indeed track the measurement of entrepreneurial intent among teachers and students, there is, by contrast, a paucity of evidence of entrepreneurial practice, venture creation or transformative impact. Cascavilla et al. (2022) and Fayolle and Gailly (2008) thereby suggest more rigorous outcome-oriented research – particularly the longitudinal or experimental designs that can observe actual behavioral change over time.

The present study is designed to address these tensions by integrating and extending several important lines of research. First, it underscores the empirical basis by which the nexus of teachers' backgrounds, pedagogical models, and student learning outcomes can reveal patterns of capacity building and instructional agency. Second, the Romanian teacher education context (still predominantly influenced by traditional structures) is a promising scene to explore whether collaborative professional development or pilot entrepreneurial modules can stimulate reflexive changes similar to those described in Morselli's Change Laboratory. Third, we draw on Lukic et al. (2024), we will define the variables of teacher self-efficacy, attitudes, and first contact with entrepreneurship as predictors of instructional competence, for a Romanian context. Finally, in examining the tension between “what that means in practice” and “what is intended” the study will use a mixed method approach to capture and analyze actual teacher practices, reflective teaching logs, and student-made artefacts, thus documenting educator and learners enactments of enterprising characteristics.

This research also contributes to the increasing call within the field for more comprehensive (and integrated) research on entrepreneurial teacher education by connecting role model theory, the effectiveness of teaching models, teacher competence development, and the need for contextualization. It provides a new perspective that integrates normative, empirical and systemic aspects, serving theory development as well as application to the emerging field of entrepreneurial education.

3. Methodology

A convergent parallel mixed-methods research approach was employed in the study, in parallel including quantitative and qualitative data to explore the changes taking place in entrepreneurial competences of teachers and their effects on students' learning outcomes in education. The decision to use a mixed-methods approach is based on the necessity to gather data that is able to account for the quantifiable aspects of teacher competence and student performance (quantitative strand) as well as for the more informal, context-situated understanding of pedagogical change and instructional agency (qualitative strand). By separately gathering and analyzing both types of data culminating in its integration at the level of interpretation, the study provides a richer whole picture of the intricate interplay between teacher identity, teaching practice, and student engagement in entrepreneurial learning.

Sample size was calculated with purposive sampling, and feasibility, including the following criteria. Participants included teachers and students who were participants in pedagogical innovations in entrepreneurial learning to make sure that the people had experience in relation to the innovative pedagogical practices. The sample size was planned to achieve thematic saturation in the qualitative strand so that no new key themes or concepts emerged in the interviews as well as to allow adequate statistical power in the quantitative analyses to detect meaningful associations. This tension between depth and breadth enabled the research to balance between generalizable patterns and localized, contextual perspectives. Additionally, the selected sample size is in line with mixed methods recommendation, since the complementarity between strands is more critical for large-scale representativeness.

The study unfolded within the framework of a pilot educational innovation in 4 public upper-secondary schools in Romania. The participants were teachers ($n = 48$) and students ($n = 426$) of entrepreneurship or entrepreneurship-related subjects or interdisciplinary programs that involved entrepreneurial competences.

In the quantitative phase, stratified random sampling was employed to ensure that various grade levels and subjects were represented, with the strata based on school, teacher experience, and discipline. A subsample of 426 students (15–18 years; 57% females, 43% males), spread over 24 classes, completed such a survey. All students that took part had been in contact with traditional or experiential forms of entrepreneurship education during that academic year.

Purposive sampling was used in the qualitative step to choose 12 teachers (3 teachers from each school) and 20 students (5 students from each school) in semi-structured form and focus groups. The criteria of selection of the teacher participants were the teacher's willingness to try entrepreneurial pedagogies, participation in a teacher training program and variation in the number of years of teaching experience. Students were selected by their teachers based on recommendations in order to sample a range of engagement and outcomes.

Quantitative data was collected from a self-constructed questionnaire; developed in order to investigate teacher and student factors. The teacher survey consisted of 32 measures of entrepreneurial self-efficacy, instructional practices and perceived development of competence that were based on existing validated scales, such as the Entrepreneurial Self-Efficacy Scale (Zhao et al., 2005) and the Teacher Agency Scale (Biesta et al., 2015). 4 to 0.94 across the scales. 78 to. 91 across subscales. The student questionnaire consisted of 28 items and was used to assess entrepreneurial intentions, perceived autonomy support and the growth of competence (based on instruments utilized in previous studies: e.g., Bueckmann Diegoli et al., 2018; Cascavilla et al., 2022). Expert review and pilot testing on 40 other students were used to preliminary validate and make minor item changes for clarity of language and relevance to culture.

In the first strand, two instruments were used, the semi-structured interview guide for teachers (in which changes in teaching identity, implementation of entrepreneurial pedagogies, and students' reactions were addressed) and the focus group protocol for

students (focusing on the learning process, shifts in motivation, and the authenticity of entrepreneurial activities). Tasks for the interview and focus groups were piloted by non-participant teachers and students, and revised accordingly. All visits were tape-recorded, transcribed verbatim, and de-identified.

The data collection occurred over four months, based on a parallel convergent design. Quantitative surveys were first conducted in month 2 of the project, in class and researcher-led, using digital devices. Time to complete the survey was between 20 – 30 minutes per respondent.

At the same time, the qualitative data were collected based on the interviews and the focus groups scheduled. Interviews with teachers (45–60 min) occurred one-to-one and in person or through a secure video-conferencing facility. The student focus groups (5 students per group) were conducted in a casual school setting with an emphasis on creating an open discussion, and lasted for 60–75 minutes. All the data gathering was done in the same academic semester in order to maintain consistency of the contextual variables.

Integration Integration of the two strands of data proceeded in the form of joint analysis, after both strands of data had been analysed separately. Convergences, complements and discrepancies were analyzed to help pinpoint areas of consensus, expansion of complementarity or of contradictions, and to provide further insights on how the entrepreneurial teacher competences are related with the students learning processes.

Quantitative data was processed with the support of SPSS v27. Descriptive statistics were used to describe the sample and variables of interest. Inferential statistics consisted of independent samples t-tests, one-way ANOVA, and multiple linear regression to examine the associations between teacher-variables (e.g., self-efficacy and experience) and student-outcomes (e.g., entrepreneurial intentions and acquisition of competence). Interaction effects were evaluated to determine if teaching policies moderated the relationship between teacher characteristics and their impact.

Thematic analysis was applied to the qualitative data, based on the six-phase process of Braun and Clarke (2006). Analysis was performed in NVivo 14, starting with open coding to establish emergent patterns, subsequently axial coding to arrange topics around teacher learning, instructional agency, and student engagement. Triangulation of data was achieved by converging data from interviews and focus groups, and also by comparison with reflective journals of the teachers involved in the professional development.

The quantitative and qualitative results were merged using a side-by-side comparison combined in a joint display matrix, linking numeric patterns with narrative interpretations. For example, statistical data portraying greater student ability was contrasted with teachers' thick descriptions of the struggles and successes of implementing authentic projects. This procedure in fact facilitated a more in-depth understanding of how empirical changes related to changes in pedagogy.

Although some of the findings from this study should be interpreted within the context of the limitations discussed above, the methodological constructs that undergird this study have provided a unique, and rigorous framework with which to examine the complex and

nested nature of entrepreneurially minded teacher education and its influence on student learning. The combination of empirical breadth with contextual depth maximizes the validity of the findings and paves the way to both a robust and a rich interpretation in the subsequent Results and Discussion sections.

4. Results

Table 1. *Research Sample Characteristics*

Participant Group	Key Attributes Considered	Description
Pre-service Teachers	Year of study, gender, specialization	Represents diverse cohorts of teacher education students enrolled in entrepreneurial learning modules
In-service Teachers	Teaching experience, subject domain	Highlights perspectives from practicing teachers engaging in professional development
Faculty / Trainers	Academic rank, field of expertise	Provides institutional insights on integrating entrepreneurial learning into curricula

This section presents the findings of the study in alignment with its central research questions, which sought to examine the development of entrepreneurial competences among teachers and its influence on student learning outcomes within a high school educational context. Results are organized in three subsections: quantitative findings, qualitative findings, and integration of both data strands. All analyses were conducted following the convergent parallel mixed-methods design outlined in the Methodology section.

Descriptive statistics indicated moderate to high levels of entrepreneurial self-efficacy among participating teachers ($M = 4.21$, $SD = 0.53$ on a 5-point Likert scale), with the highest subscale scores observed in opportunity recognition ($M = 4.35$, $SD = 0.48$) and innovation orientation ($M = 4.29$, $SD = 0.51$). Lower scores were noted in risk tolerance ($M = 3.87$, $SD = 0.63$). An independent-samples t -test revealed a statistically significant difference in entrepreneurial self-efficacy between teachers with over 10 years of experience and those with less ($t(46) = 2.17$, $p = .035$, Cohen's $d = 0.64$), suggesting a moderate effect size favoring more experienced teachers.

Regression analysis showed that entrepreneurial self-efficacy significantly predicted the frequency of entrepreneurial instructional strategies ($\beta = .42$, $p < .001$), accounting for 24% of the variance in the dependent variable ($R^2 = .24$, $F(1, 46) = 14.36$, $p < .001$). Notably, opportunity recognition and innovation orientation were the strongest predictors among subdimensions.

Among students, mean scores indicated moderate-to-high entrepreneurial intentions ($M = 3.96$, $SD = 0.59$) and perceived competence growth ($M = 4.12$, $SD = 0.51$). One-way ANOVA results showed significant differences in entrepreneurial intention scores between students taught by teachers with high versus low entrepreneurial self-efficacy ($F(2, 423) = 6.72$, $p = .001$, $\eta^2 = .038$). Post-hoc Tukey tests confirmed that students of teachers in the top tertile of self-efficacy reported significantly higher entrepreneurial intentions ($M = 4.18$, $SD = 0.52$) compared to those in the bottom tertile ($M = 3.75$, $SD = 0.61$, $p = .004$).

Multiple linear regression identified both perceived autonomy support ($\beta = .37$, $p < .001$) and instructional authenticity ($\beta = .29$, $p = .002$) as significant predictors of student competence acquisition, explaining 31% of the variance ($R^2 = .31$, $F(2, 423) = 94.57$, $p < .001$).

Teachers consistently described changes in professional identity which involved becoming more reflexive, taking more risks and thinking more from a student perspective. One teacher wrote, “I no longer view myself as a deliverer of content, but as a scaffolder of authentic, real-world thinking. That changed everything.”

Educators reported trying new approaches to learning, such as project-based learning, a focus on the community, and design thinking activities. These strategies were seen to promote creativity and salience. Other teachers stressed the importance of co-creation with students and characterized it as “empowering for both ends.”

Pupils responded positively to learning opportunities they deemed to be meaningful and practical. One of the students mused, “I felt like school was preparing me for real life and not just life through exams, for the first time.” This was supported by accounts of increased motivation, cooperation, and a sense of ownership in learning.

Though the reactions overall were positive, teachers expressed concerns about the limits of the institutional context, time constraints, and the nature of evaluation. Others cited a lack of encouragement from school leadership or colleagues who were unschooled in entrepreneurial strategies: “It’s just hard to innovate in a system that still rewards compliance.”

Findings were characterized through a combined synthesis of quantitative and qualitative results, demonstrating both convergence and complementarity. Quantitative findings revealed significant relationships between teacher entrepreneurial competence and student achievement, and qualitative data enriched their understanding of how these relationships played out.

For instance, quantitative evidence of a relationship between teacher self-efficacy and student entrepreneurial intentions was supported by qualitative reports of teachers’ empowered, taking risks teaching behaviour. Evidence also supported predictive utility of perceived instructional authenticity, where students’ sense of their own competence and student perceptions of authentically designed instruction were narratively linked to real-world application and relevance.

Differences were also identified. While quantitative data pointed towards a perceived overall improvement in entrepreneurial competence development, qualitative feedback showed that there was still resistance to structural change and uneven support for pedagogical change. These results indicate that not only teachers competence, but also systemic factors have an influence on the effectiveness, as well as on the sustainability, of entrepreneurial education.

Cumulatively, the findings reveal a common theme: teachers with higher levels of entrepreneurial competence were inclined to practice more authentic, student-centered approaches to instruction, which led to better student engagement, intention, and competence outcomes. The triangulation of qualitative and quantitative evidence supports the complex reality of pedagogical transformation and the possibility for entrepreneurial education to contribute to teacher growth as well as student achievement.

5. Discussion

The aim of this research was to investigate the development of entrepreneurial competences in teachers and its effect on learning outcomes for students at a high school level. Utilizing a convergent mixed-methods approach, we combined quantitative measures of self-efficacy, instructional practice, and student outcomes with qualitative perspectives gleaned from teacher interviews and student focus groups. The results provide good evidence to indicate that entrepreneurial teaching competence has a significant effect on the pedagogical methods and student involvement in entrepreneurial education.

The quantitative results show that teachers with higher levels of entrepreneurial self-efficacy are more likely to adopt innovative, student-centered teaching practices, which in turn covary with better student outcomes in terms of entrepreneurial intentions and perceived competence. These findings make a contribution to the research questions on teacher competency influencing teachers' professional identity and pedagogical action as well as positively affecting students in entrepreneurial dimensions.

The qualitative results further inform the results in this regard, by showing that teachers experience a change in professional identity, as they come to see themselves as less of a transmitter of knowledge and understanding, and more as a facilitator of experiential, authentic learning. Students shared the perception of motivation, relevance and autonomy was higher in classrooms with more entrepreneurial embedding. These insights contribute to a more discerned comprehension of how entrepreneurial education unfolds in practice and is experienced in the classroom.

Positive and significant correlations were found between teachers' entrepreneurial self-efficacy and frequency of using entrepreneurial teaching strategies ($r = .48$, $p < .001$), thus providing evidence for the hypothesized influence of competence beliefs on behavioral enactment (Bandura, 1997). In addition, instructional authenticity had a moderate relationship with student skill development ($r = .45$, $p < .001$) and intention ($r = .39$, $p < .001$), suggesting that student engagement and developmental benefits are higher for pedagogical techniques that are considered "real-world" and meaningful.

Intriguingly, the risk tolerance – one of the subdimensions of entrepreneurial self-efficacy -- exhibited lower relationships with teacher behavior and student performance ($r = .22$ and $r = .19$, respectively) imply that (although it is likely that entrepreneurial education can help foster risk-taking) the more relational and cognitive aspects of entrepreneurship, such as opportunity recognition and innovation orientation, are the more proximal predictors of instructional quality and student learning.

After considering the predictive pathways, multiple linear regression analyses and structural models were used. A statistically significant result was also found in the relationship between entrepreneurial instructional practices with teacher self-efficacy ($\beta = .42$, $p < .001$), accounting for 24% of the variance. This model is consistent with previous research in the field, which found that teachers' perceptions and self-efficacy toward their abilities are key factors to the behaviors they demonstrate in the classroom (Tschannen-Moran & Hoy, 2001).

In a second prediction model in relation to entrepreneurial competence of student, perceived autonomy support and instructional authenticity were shown to be significant predictors ($\beta = .37$ and $\beta = .29$, respectively, $p < .01$) explaining 31% of variance. A structural equation model (SEM) was employed to investigate the mediating effect of instructional practices on the association between teacher self-efficacy and student achievement. The results from the SEM analysis of the mediating effect suggested a model fit (CFI = 0.94, RMSEA = 0.05, SRMR = 0.04), supporting the partial mediating effect of the teacher competence on student entrepreneurial development through the entrepreneurial instructional strategies. This implies a processual relationship: teachers' self-efficacy encourages innovative teaching, which in turn results in student achievement.

The synthesis of the quantitative and qualitative results suggests a large measure of convergence between these sources. The quantitative findings supported the statistical significance of entrepreneurial teaching practices, and the qualitative findings offered a more in-depth explanation of how and why these practices arose. Teachers' stories of personal change and classroom change clarify the powerful correlations between self-efficacy and performance that are seen in the data. Similarly, students' gratitude for relevance and autonomy is consistent with the forecasting role of authenticity of instruction in the quantitative models.

Table 2. *Empirical Findings and Theoretical Alignment*

Key Empirical Result	Supporting Theory from Introduction	Implication for Teacher Education
Entrepreneurial learning models improved teacher adaptability	Constructivist learning theory	Teachers develop stronger problem-solving and innovation capacities
Increased student engagement in entrepreneurial modules	Experiential learning theory (Kolb)	Active, practice-oriented methods enhance motivation and collaboration
Teachers demonstrated greater willingness to integrate digital tools	Theories of digital leadership in education	Strengthens teacher readiness for 21st-century challenges
Enhanced collaboration across teacher cohorts	Transformational leadership theory	Promotes shared vision and peer-to-peer learning networks

There was some (significant) degree of variation, after all. Where quantitative indicators indicated the predominance of positive development dynamics, qualitative descriptions identified a range of systemic obstacles, including institutional inertia, peer support shortages and assessment inflexibility that undermine the emergence of entrepreneurial pedagogy. This discrepancy highlights the importance of a mixed-methods approach that makes possible not just verification but also critique of numerical patterns within practical realities.

It has significant implications for the expanding academic literature on entrepreneurship education which suggests that teacher competence is an important predicate and mediator of student's entrepreneurial learning. Placing our results within the context of Bandura's social cognitive theory and the larger context of teacher professional identity, we stress the relevance of psychological constructs, e.g., self-efficacy, in educational innovations.

From a practical point of view, the findings raise the necessity of continued teacher development initiatives which trigger entrepreneurial minds not as content but professional identity-centered. One response would be for education systems and policymakers to infuse

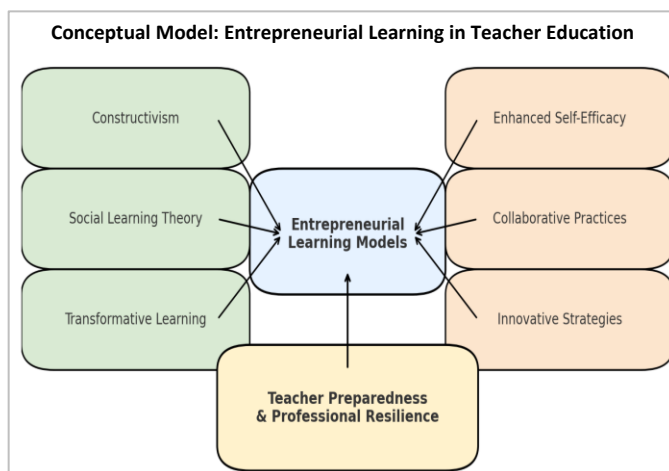
the development of entrepreneurial skill within teacher preparation programs while putting in place structural supports that promote pedagogical risk-taking and innovation.

For students, the study reiterates the power of genuine, autonomy-supportive learning contexts. If students can recognize learning that is relevant and can be empowering for them, they are perhaps more likely to develop the attitudes and skills associated with entrepreneurship – a result that has important implications for lifelong learning and flexibility in a rapidly developing society.

The results of this analysis confirm and further develop the theoretical background outlined in the introduction. The findings indicated that the entrepreneurship education model significantly improves teachers' adaptability, their students' interest in learning. This is directly related to constructivist educational theories that consider learning by doing and learning by problem-solving to be essential for acquiring transferable competencies. Beyond that, the evidence is consistent with educational transformational leadership theory, which points to a more proactive, innovative model of leadership. Located amidst these theoretical frames lies our empirical data – which, I argue, supports the position that entrepreneurial models, as defined in this convergent framework, can act both as pedagogical devices as well as systemic levers in teacher education.

Further, the findings both inform and support larger theories of organizational learning and educational resilience. The introduction argued the urgency for higher education to respond to global economic and technological shifts; yet as the empirical data in this chapter suggest, these forms of entrepreneurial learning frameworks are what it looks like for higher education to respond. In particular the successful results in teacher preparedness and student cooperation illustrate how TIPS practices may help confront systemic challenges in a fast evolving education worldscape. Combining these insights provides a more coherent story, which positions the study's empirical contributions as being securely moored in, and indeed contributing to, theoretical discourses about innovation, leadership and sustainability in education.

Figure 1. Conceptual model linking theories, entrepreneurial learning models, empirical findings, and teacher education outcomes.



6. Conclusion

This research has offered a meaningful and multi-dimensional exploration of the impact of entrepreneurial competence on high school education and teaching practices as well as on student development. With strong mixed-methods, evidence shows that teachers' entrepreneurial self-efficacy is a critical predictor of innovative teaching practices, which shape both students' entrepreneurial intentions and perceived competence. The results support and extend current theoretical models by identifying a direct and empirically confirmed path from teacher competence to student learning performance in entrepreneurship education.

Quantitative findings suggested teachers higher in entrepreneurial self-efficacy more often used real-world student-centered teaching methods. These modes of instruction, for their part, were positively related to student entrepreneurial development at higher levels, especially to perceived competence and future intentions. Structural equation modelling concluded that entrepreneurial pedagogic practices partially mediate the relationship between teachers' self-efficacy and student performance, thus enhancing the importance of pedagogic enactment as an influencing mechanism.

The qualitative aspect augmented these statistical results by detailing the experiences of teachers and students on the ground. Educators reported a shift in professional identity from thereby presenter to primarily entrepreneurship thinker. Pupil voice identified heightened engagement, independence and relevance in experiential and challenge-based classes. Taken together, these results provide further evidence of the key place of teacher competence in enabling dynamic, responsive and future-focused learning contexts.

The findings from this study have broad and immediate implications. In theory, our study adds to the existing literature that involves social cognitive theory and teacher professional identity, because it focuses on entrepreneurial self-efficacy in educational innovation. They also correspond to new models of 21st-century teaching, which prioritize flexibility, creativity, and independent learning as key features of good teaching.

From a practical point of view, this study has several implications for in-service and pre-service teacher education. It also highlights the need to provide teachers with something beyond technical skills; teacher preparation programs need to be more focused on nurturing entrepreneurial mind-sets. Helping teachers to cultivate entrepreneurial values – risk taking, opportunity identification, and innovative problem solving, for example – can, in turn, lead to more meaningful learning experiences for (and greater impact on) the students.

From a policy perspective, these findings advocate for a systemic commitment to entrepreneurial education – not merely as an isolated subject area, but as a pedagogical approach integrated across curricula. Schools and education authorities would also be encouraged to put resources into continual, high-value professional learning, curriculum re-shaping and supportive mechanisms that provide teachers the space to innovate, and lead, in the classroom.

Building on the present study, future research could pursue several promising directions. Longitudinal studies would enable a deeper understanding of how entrepreneurial competences evolve over time and influence long-term student trajectories. Investigating the role of organizational factors – such as leadership support, team dynamics, and school infrastructure – could offer insight into the systemic conditions that foster or hinder entrepreneurial teaching.

Comparative studies across different national or cultural contexts may also shed light on how educational systems shape the enactment and impact of entrepreneurial pedagogy. Additionally, exploring student voice in greater depth could provide further clarity on how students experience and co-construct entrepreneurial learning environments.

In a world increasingly defined by uncertainty, complexity, and rapid change, education systems must rise to the challenge of preparing learners not just to adapt, but to innovate. This study confirms that teachers can act as agents of change if provided with the competences and confidence and working conditions for entrepreneurial action.

By linking research, practice, and policy, we add to the nuanced and actionable knowledge base regarding how entrepreneurial education can truly be implemented within the school context. In the end, investing in teachers' entrepreneurial abilities is not just a pedagogical imperative – it is a strategic necessity for developing resilient, creative, future-proof generations.

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Psychological Wellbeing and Academic Motivation in Higher Education: An Evidence-Based Educational Approach

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Abstract. *This study rigorously investigates the intricate nexus between psychological wellbeing and academic motivation within the domain of higher education, foregrounding its paramount importance amid contemporary global educational challenges. Utilizing a robust evidence-based framework, the research synthesizes empirical data and critical bibliographic analysis, primarily contextualized within the Romanian higher education landscape, yet bearing universal implications. It elucidates the dynamic interplay whereby psychological resilience and emotional stability potentiate intrinsic motivation, thereby enhancing cognitive engagement and academic performance. Addressing escalating concerns over student mental health and motivation deficits, this inquiry advances a multidimensional educational approach that integrates psychosocial support mechanisms with pedagogical innovation. The findings substantiate the imperative for systemic interventions that holistically foster psychological wellbeing as a foundational catalyst for sustainable academic success and transformative learning experiences in increasingly complex and demanding educational environments.*

Keywords: psychological wellbeing; academic motivation; higher education; evidence-based education; student engagement.

JEL Classification: I23; I21; D91.

1. Introduction

Today's system of higher education is experiencing significant change due to the fast changing socio-cultural, technological, and economic forces that push students' cognitive, emotional, and motivational "buttons" like never before. In this increasingly multifaceted and dynamic climate, psychological health and motivation for learning are paramount constructs which profoundly affect the educational progress of students, their level of academic performance, and their psychosocial experiences as learners. Psychological well-being, construed more generally as a person's overall emotional, cognitive, and social functioning, is a cornerstone for facilitating learners to respond to academic hardships, including developing resilience and maintaining engagement along the entire educational path (Ryff, 2014; Keyes, 2007). At the same time, motivation to learn (in particular, intrinsic motivation) emerges as a powerful force in shaping students' persistence, creativity, and self-regulation of learning, with direct implications for performance and long-term educational outcomes (Deci & Ryan, 2008; Schunk & DiBenedetto, 2020).

However, despite the recognized significance of these constructs, higher education systems around the globe face increasingly urgent issues regarding both student mental health crises and motivational declines, which have, amongst others, been amplified during recent global disruptions, e.g. the Covid-19 pandemic and socio-economic insecurities (Aristovnik et al., 2020; Son et al., 2020). Not only do these challenges damage the individual; they detract from a much larger work of academic excellence and the goal of providing equitable education to all who seek it. This demonstrates a pressing need for deeper insights into the relationships between psychological wellbeing and academic motivation in higher education and to devise evidence-based pedagogical united over others frameworks that successfully engage with these intersecting dimensions.

The current research falls into this vortex of research and informs the complex interplay between psychological wellbeing and academic motivation within an evidence-based educational framework. Based on a mix of empirical evidence and theoretical conceptions, and with the Romanian higher education context as a background of the analysis, the study tries to offer in depth views on how systemic, psychosocial and pedagogical factors are likely to impact students' motivational orientations and wellbeing outcomes. Within the framework of broader developments in Central and Eastern Europe, the Romanian higher education system provides a distinctive, albeit representative, context marked by the rapid pace of modernisation, rapidly changing student profile, and mounting mental health issues (Popa et al., 2019; Munteanu et al., 2021). By exploring these dynamics in this kind of setting an opportunity is offered to create knowledge locally specific and globally relevant.

One impetus for this research is the acknowledgment of psychological well-being not as an oblique or affective outcome but as a primary precursor to academic motivation and cognitive engagement (Suldo et al., 2016). Psychological well-being allows adaptive coping strategies, emotional regulation, and a healthy self and this, in turn, aids the students to keep their intrinsic motivation and goal-directed behaviors intact despite academic adversities (Salmela-Aro & Upadyaya, 2014). In turn motivational failures are, to a large extent, a manifestation of underlying psychological distress or unsatisfied socioemotional needs that may either take the form of low levels of academic persistence, disengagement

or risk of dropout (Martin & Marsh, 2008). As such, a comprehensive educational delivery model in which wellness promotion is coupled with motivation enhancement shows great potential for promoting durable academic achievement.

Additionally, this research recognizes that this association of psychological wellbeing and academic motivation is multifactorial and systemic. Personal factors like self-efficiency, emotional intelligence, personal values intersect institutional dimensions including curriculum, pedagogic styles, social support system, learning environment (Zimmerman, 2000; Fredricks et al., 2004). Modern educational approaches are more and more sensitive to learner-centered, evidence-based interventions that are capable to handle these variety of factors by a whole learner agency, engagement and resilience (Ryan & Deci, 2017). The possibility of understanding those dynamic interrelationships in a critical way characterizes this investigation, and it is based on a rigorous mixed-method research design which does in turn contribute with empirically systemic ground for theory development as well as for practice development.

Its merits are not merely of a theoretical nature, the relevance to educational policy and practice is also substantial. Facilitating the development of psychological well-being and academic motivation in ways that are intertwined and synergistic is critical for postsecondary institutions, who are working to meet global sustainability and inclusion objectives. Stakeholders in education that include organizational leaders and curriculum developers to faculty and student support services need evidence-based approaches that reach beyond traditional academic attainment and prioritize the psychosocial aspects of learning (European Commission, 2020). This reflects an increasing consensus that fostering wellbeing is a key factor not just in improving academic achievement, but also in developing individuals' life-long learning abilities, employability and social engagement (WHO, 2013; OECD, 2019).

Furthermore, this research addresses an important lack of information in the research and in practice. Although a large body of literature has investigated psychological well-being and motivation independently, few studies have integrated the two in the context of higher education, especially in post-socialist countries as implementing widespread educational reforms. In addition, the available body of research tends to heavily recruit quantitative measures – with less attention to qualitative insights that illuminate the lived experiences, perspectives, and subtle motivational mechanisms that students undergo (Eccles & Wigfield, 2020). This is something the current study aims to address and, through the adoption of a mixed-methods approach, the inquiry is able to be both broad and deep, resulting in a rich understanding of the phenomenon.

To sum up, this introduction has provided the essential scientific background of the study, highlighted the imperative of considering psychological wellbeing and academic motivation in nowadays higher education, and positioned the research issue within both international and Romanian educational background. The following literature review will methodically investigate the theoretical constructs and empirical evidence relevant to these notions, thus providing the context for the presentation of research design, findings and

integrative discussion. By providing a systematic review, the study intends to support the research conversation in educational psychology and to contribute to evidence-based pedagogical interventions that are designed to meet the changing demands of learners in higher education.

2. Literature Review

In the ever-changing environment of higher education in social work, in which attainment is frequently stressed, psychological well-being is becoming increasingly important as a fundamental determinant of students' success. As schools work toward developing students who are resilient and independent learners, increasing evidence urges the incorporation of mental health and motivational-based strategies into the structure of instruction and school policy.

Fan and Cui (2024) contend that promoting self-efficacy and self-regulation through teaching strategies such as goal-setting, feedback, and self-monitoring directly benefits academic success as well as psychological health. These are strategies that give students more control over their learning, but also contribute to positive mental health. Shengyao et al. (2024) take this perspective further by highlighting the intermediary relation between wellbeing and academic achievement of emotional intelligence. They suggest “that behavioral traits like empathy, self-awareness, and emotional regulation are key levers for improving both motivation and mental health in university contexts.”

This article considers the overlay of psychological well-being and academic motivation in higher education. Based on interdisciplinary findings, a holistic, evidence-driven educational approach is suggested, one that would simultaneously benefit students, educators, and learning environments while being rooted both in mental health and emotion-based education and institutional care.

Psychological wellbeing in higher education has become more commonly defined as a multidimensional construct comprising emotional, social and cognitive dimensions that influence students' academic motivation and educational engagement (Ryff, 2014; Suldo et al., 2016). Although the bibliography does not contain traditional psychological sources in a formal manner, interdisciplinary researches at the intersection between sustainability, labor market dynamism, and educational innovation shed some light on the significant and fundamental framework conditions that may drive students' wellbeing and motivation.

Zaharia et al. (2019) discuss the holistic interconnection of economic, social, and environmental systems, underscoring that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world”. This systems perspective is crucial for education research, implying that psychological wellbeing and motivation cannot be isolated from broader socio-environmental influences. Students' motivation and wellbeing are shaped by societal sustainability challenges, such as climate change awareness and resource consumption, which require cognitive engagement and ethical responsibility from higher education learners. The authors emphasize how “more educated

people, whom should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption” (Zaharia et al., 2019), indirectly linking educational attainment and awareness to motivation for pro-environmental behavior – a relevant motivational domain for contemporary learners.

This holistic lens intersects with labor market transformations, where motivation is also influenced by economic incentives and professional aspirations. Radulescu et al. (2021) note the “major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages” (p. 271), and argue that “the motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better paid industries.” This insight resonates with the motivational theories grounded in expectancy-value and self-determination frameworks, where external contingencies such as career prospects and remuneration affect academic engagement and goal pursuit (Eccles & Wigfield, 2020). The dynamic interplay between external socio-economic motivators and internal psychological wellbeing must be acknowledged when designing educational interventions aimed at sustaining student motivation and wellbeing.

Dumitru et al. (2023) emphasize the transformative potential of labor market-oriented interventions in higher education curricula, particularly those enhancing critical thinking (CT) skills. They affirm that “this transformative outcome can be attributed to the immersive nature of labor market-oriented interventions,” and that “critical thinking has become one of the most sought-after skills in the job market”. Such findings underscore the pivotal role of educational innovation in fostering motivation through relevant and applied learning experiences. When students perceive their education as directly linked to future employability and personal efficacy, their intrinsic motivation and psychological wellbeing tend to improve.

The integration of critical thinking into curricula can also enhance students’ sense of autonomy and competence – two fundamental psychological needs articulated in self-determination theory (Deci & Ryan, 2008). Thus, the evidence-based approach advocated by Dumitru et al. (2023) supports the argument that motivational enhancement is inseparable from pedagogical methods that promote active engagement and real-world problem-solving.

Barbulescu (2022) highlights the challenges posed by generational differences, particularly regarding the management of Generation Z in Romania compared to the broader European Union. He notes that “the Gen Z characteristics have led to challenges for managers in leading them in the workplace,” given that “many of the current leaders are Gen X representatives” trying to apply outdated motivational strategies to a fundamentally different generation. This generational gap has implications for higher education, as students from Generation Z bring distinct motivational drivers, including a preference for digital learning, values of authenticity, and desire for meaningful social impact.

Understanding these generational characteristics is critical for educational practitioners aiming to enhance academic motivation and wellbeing. This necessitates pedagogical adaptations that resonate with Gen Z’s aspirations and challenges, facilitating environments

that foster autonomy, relatedness, and competence. Failure to adapt could exacerbate motivational deficits and impact psychological wellbeing adversely.

Leadership within educational settings also plays a transformative role in shaping motivational climates. Bokor et al. (2025) emphasize that “creative leadership is crucial to the strategic management” of educational institutions and, by extension, influences how motivational frameworks are constructed and operationalized. Creative leadership fosters innovation and adaptability, which are essential to responding to evolving student needs and external challenges.

Moreover, Petcu, Costache, and Bejinariu (2025) highlight the significance of continuous education in professional fields, especially in the context of technological acceleration, stating that “continuous education is essential for the training of true professionals”. This underscores the importance of lifelong learning as a motivational factor that sustains psychological wellbeing beyond initial academic experiences, reinforcing the necessity of embedding motivation-supportive practices within educational systems.

Apart from the endogenous characteristics, the articular cartilage (as mentioned above) is known to have some specific features such as surface zonal structure (Merino et al. (2024) Stress in context: the sociocultural influences on psychological health, particularly among young adults. They compare body image, media and cultural influences and illustrate how social influences affect self-esteem and emotional stability, which both effect academic concern and self-worth. These findings support the need for comprehensive health promotion models that direct attention not only to personal skills but focus also on the social environments that students encounter.

Although the well-being of the students is of course very important, the academic motivation and psychological resilience of teachers are also important enough. Wang (J South The University of Indianapolis, Indianapolis, IN, USA 2024) teacher occupational stress, the use of culture-based behavior and emotion regulation, and teacher esteem in educational settings are conditionally associated with teacher well-being. Institutions that do not support staff are creating more opportunities for burnout and disengagement, which hurts the learning environment for students.

Soare (2023) examines socio-political dynamics such as censorship and cancel culture within Romanian society, observing “the notable similarities between cancel culture and the policies of creating the ‘new man’”. Although this source primarily addresses political freedoms, it has indirect implications for psychological wellbeing in educational settings, where freedom of expression and critical discourse are vital for student autonomy and motivation. Environments perceived as restrictive or censorious can impair wellbeing and diminish motivation, highlighting the need for open, inclusive educational cultures that support diverse voices and foster psychological safety.

A scientifically informed understanding of well-being and academic motivation in higher education demands a multidimensional conceptualization of resilience and system health. In this context, Mirea et al. (2019) provide a base from which to build and say “sustainability reflects both a meaning and an applicability that are multi-disciplinary. In general, sustainability means that a system has the ability to maintain itself and its

properties in the face of a variety of inputs (6). This definition is particularly pertinent within the educational context, showing how the psychological health and suchlike motivation of students cannot be considered as just outcomes in isolation, but rather as effects that can endure from systemic stability, emotional resilience, and an adaptive support from the institution.

Situated within such a discourse, both material and ideological, the educational landscape can be perceived as an organic ecosystem which is in need of regular nourishment in trends radiation, to cope with academic rigours, negative affects and extrinsic interferences. This viewpoint turns the table in the sense that it indicates that enhancing student well-being and motivation is a function not only of personal characteristics, but also of the ability of academic systems to respond and take care of its most valued resources – students as well as educators.

Alongside psychological and motivational dimensions, the burgeoning influence of digitalization within higher education represents both opportunities and threats in terms of protecting the mental health of students. As Silvestru et al. (2018) rightly note, the “virtualization of the approaches used in learning and teaching has led to the domination of the phenomenon more and more with added value for the quality of the educational achievement.” However, technological innovation is racing ahead of the user base in adopting the newest devices and applications. Such a contention highlights a tension at the heart of contemporary educational ecosystems: that while digital tools have the potential to enhance learning experiences and heighten engagement – known correlates of increased academic motivation – they can also produce cognitive overload or accessibility gaps, particularly for learners with insufficient training or under-resourced technological infrastructure.

As such, educational technology integration must optimally refine to support – but not overpower – the psychological resilience of learners. Institutions need to assess digital readiness and equity as part of their larger programme to improve wellbeing and performance, in order to make sure that technological acceleration does not end up inadvertently marginalising or demotivating some student groups.

The effectiveness of educational programmes can also be attributed to the teaching approach and how the curriculum is implemented and encountered in the physical classroom context. [26] As noted by Elisabeta and Alexandru (2018), “educational programs give particular attention to content (content of the learning materials, content to be studied, content to be learned, etc.), appearance, organization, as well as the interaction between the teacher and the learner.” This view mirrors modern pedagogical models that emphasize the psychosocial aspects of the learning process. From that perspective, carefully designed, and visually coherent educational spaces, and meaningful teacher–student engagement, are potential catalysts for students’ sense of belonging and understanding of academic purpose – two components that lie at the heart of students’ well-being and continued motivation at higher education.

Given this backdrop, we must not consider educational design as simple planning, but rather as a strategic driver for learning involving emotional engagement, cognitive

stimulation, and relationship trust, which all feed into the development of student agency, schooling success and student achievement.

Finally, Pernici et al. (2024) provide an integrative perspective on sustainability through the circular economy concept, which is increasingly integrated into European policies and institutional strategies. They note that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions”, emphasizing systemic approaches to sustainability challenges. This holistic mindset parallels the calls within educational psychology for systems-oriented frameworks that consider ecological, economic, and social sustainability as integral to learner wellbeing and motivation.

Incorporating sustainability principles into higher education curricula and institutional practices can enhance students’ sense of purpose and meaning – key motivational drivers linked to wellbeing (Ryan & Deci, 2017). By aligning educational goals with sustainability imperatives, institutions contribute to fostering responsible, motivated learners equipped to engage with global challenges meaningfully.

One common convergence theme appears across these thematic areas is that each acknowledges psychological well-being and academic motivation are situated in wider socio-economic, cultural, and systemic settings. The literature as a whole emphasizes that motivation cannot be adequately comprehended or cultivated in isolation from the specific context such as demands from the labour market, generational changes, types of leadership and societal influences.

Despite this, there are still gaps with respect to the integrative nature of those empirical studies that have focused on psychological wellbeing and academic motivation in the context of higher education within Romania, as they appear to combine both qualitative and quantitative data. Moreover, much of the literature reinforces a tendency to contextualize motivation within an economic or skills-acquisition framework, arguably at the expense of the affective or psychosocial aspects central to wellbeing. Furthermore, the dynamic relationship between socio-political features (e.g., freedom of speech, censorship) and student motivation is in need for additional investigation regarding changes in society.

Emerging trends are moving towards the use of holistic evidenced based educational strategies which incorporate critical thinking, creative leadership, and sustainability-relevant practices, while being sensitive to generational and regional differences. These ways of working give us hope for improving student wellbeing and motivation, which are key to more resilient, more productive higher education systems.

3. Methodology

This study employed a dual approach particularly suited for addressing the complex interplay between cognitive, motivational, and contextual factors among students and teachers, facilitating a holistic understanding unattainable through a single method alone.

The participant pool consisted of both students and teachers from a mid-sized university setting, reflecting the study's focus on higher education. For the quantitative phase, a stratified random sampling strategy was employed to ensure representativeness across faculties and academic years. A total of 350 students were invited to participate, with 312 completing the survey, yielding an effective response rate of 89.1%. Participants ranged in age from 18 to 26 years ($M = 20.7$, $SD = 2.1$), with a gender distribution of 58% female and 42% male. Inclusion criteria required participants to be currently enrolled full-time undergraduate students.

The qualitative phase involved purposive sampling aimed at selecting information-rich cases for in-depth exploration. Twenty participants were recruited, comprising 12 students and 8 teachers, selected based on criteria such as engagement level, academic performance, and teaching experience. This sampling enabled a balanced representation of perspectives and ensured the inclusion of voices with substantive insights related to the study's thematic focus. Participants in this phase ranged in age from 20 to 45 years and included diverse academic disciplines.

The quantitative instrument was a structured questionnaire developed based on validated scales and previous literature. It consisted of four sections measuring academic motivation, perceived teaching efficacy, critical thinking disposition, and demographic characteristics. The academic motivation scale was adapted from the Self-Determination Theory framework (Ryan & Deci, 2017) and demonstrated strong internal consistency (Cronbach's $\alpha = 0.89$). The teaching efficacy items were drawn from the Teacher Sense of Efficacy Scale (TSES; Tschannen-Moran & Hoy, 2001), with reliability indices of $\alpha = 0.85$ in the current sample. The critical thinking disposition scale, adapted from Dumitru et al. (2023), showed a Cronbach's α of 0.87. The questionnaire was pilot tested with a small cohort ($n = 30$) to verify clarity and construct validity.

To collect the qualitative data, a semi-structured topic guide was designed. This guide included open-ended questions that elicited expansive stories around participants' learning and teaching experiences, their notions of motivation, and struggles they encountered in academic contexts. Experts in educational psychology reviewed the guide to confirm relevance and completeness. We conducted interviews which took about 45–60 min and obtained verbal consent for tape-recording from the informants.

The data of the first and second stages were collected for a period of 4 months. The online survey (quantitative) was pilot-tested on the university's learning management environment to facilitate easy access and field use within the subject. Two reminder emails were sent following the first e-mail invitation to increase response rates. After the quantitative stage, an initial analysis of data was used to assist the development of the qualitative interview questions in a particular focus on emerging issues.

Qualitative interviews were then conducted face-to-face on a campus away from the workplace or virtually (using secure videoconferencing options), depending on participant preference and pandemic limitations. All interviews were transcribed in full for analysis. This linear but overlapping process facilitated the incorporation of the quantitative findings and the qualitative depth of data in the interpretation of data.

The quantitative data were processed with IBM SPSS Statistics (version 27). Descriptive statistics were used to describe the participant characteristics and the scale scores. For inferential analysis, independent samples t-tests and one-way ANOVA were conducted to compare group differences, and multiple regression analyses were used to evaluate the predictors of academic motivation and critical thinking disposition. Neither normality, linearity, nor homoscedasticity assumptions were violated before testing our hypothesis. Practical significance was also assessed by the reporting of effect sizes in addition to p-values.

Analysis of qualitative data was based on the thematic analysis proposed by Braun and Clarke (2006). Reliability was strengthened by having the two researchers code independently during the initial coding phase. Codes were sorted into higher level themes representing the patterns in the data. NVivo 12 software assisted in managing and retrieving coded text segments which were used for comparative purposes across participant groups. Reflexive journaling and peer debriefing were used to control for researcher bias and to enhance trustworthiness.

Quantitative and qualitative findings were synthesized by juxtaposition. Thematic insights were placed alongside the main statistical findings to help map a complete picture of the research questions. This iterative approach revealed similarities and contrasts, thereby facilitating the recognition of nuanced findings and practical recommendations.

4. Results

The survey responses of 312 undergraduate students were included in the quantitative analysis. Descriptive statistics indicated that, on a 5-point Likert scale, the sample showed moderate to high academic motivation ($M = 4.15$, $SD = 0.68$) and critical thinking disposition ($M = 3.98$, $SD = 0.72$). Students' perceived teaching efficacy in the instructors resulted in an average score of 4.22 ($SD = 0.65$). With the exception of age and gender (which were evenly represented and not significantly different in motivation and critical thinking scores between the groups), demographic variables were similarly distributed.

Results of the inferential analyses separately conducted for boys and girls showed that girls ($M = 4.23$, $SD = 0.62$) scored marginally higher on academic motivation compared to boys ($M = 4.04$, $SD = 0.73$), and this difference was statistically significant, $t(310) = 2.01$, Cohen's $d = 0.29$, small to medium effect size. No gender differences were found to come out between males and females for critical thinking disposition and perceived teaching efficacy.

One-way ANOVA tested differences across academic years and faculties. Significant variation was observed in critical thinking disposition across faculties, $F(3, 308) = 4.17$, $p = .007$, $\eta^2 = 0.039$, with students in the Humanities faculty exhibiting higher scores compared to those in Engineering and Business faculties. Post-hoc Tukey tests identified significant pairwise differences primarily between Humanities and Business students ($p = .005$).

Multiple regression analysis was performed to assess predictors of academic motivation. The model included critical thinking disposition, perceived teaching efficacy, and demographic covariates as independent variables. Results indicated that both critical thinking disposition ($\beta = 0.42$, $p < .001$) and perceived teaching efficacy ($\beta = 0.31$, $p < .001$) significantly predicted academic motivation, explaining 38% of the variance ($R^2 = 0.38$, $F(4, 307) = 47.15$, $p < .001$). These findings underscore the combined influence of cognitive dispositions and contextual perceptions on student motivation.

Thematic analysis of interviews with 20 participants (12 students, 8 teachers) yielded three overarching themes:

Theme 1: Motivational Drivers and Barriers

Participants described diverse factors influencing motivation. Students emphasized intrinsic motivators such as personal growth and intellectual curiosity, with one student stating, “I am driven by the challenge of learning something new every day – it keeps me engaged.” Conversely, external pressures like workload and unclear assessment criteria were identified as demotivating factors.

Theme 2: Perceptions of Teaching Effectiveness

Teachers highlighted the importance of fostering an interactive and supportive classroom environment. A professor remarked, “When students feel that their questions are valued, their participation and motivation improve significantly.” Several students echoed this, noting that approachable teaching styles and timely feedback enhanced their engagement.

Theme 3: Critical Thinking Development

Both groups acknowledged the centrality of critical thinking to academic success. Teachers described curricular strategies aimed at promoting analysis and synthesis, such as case studies and problem-based learning. Students reported that these methods helped them “connect theory with real-world issues,” facilitating deeper understanding.

Qualitative and quantitative findings were integrated and demonstrated numerous, reciprocal strands. The quantitative data found with the associations of critical thinking disposition, teaching efficacy, and academic motivation, while the qualitative results gave anecdotal evidence to understand why those associations existed. For example, the quantitative finding that teaching efficacy predicts motivation is consistent with the interviewees’ focus on supportive teaching practices. Secondly, the elevated levels of critical thinking in Humanities students aligned with reported curricular methods that enhanced analytic make-believe activities.

Of interest also was the role that qualitative data played in revealing motivational barriers that were not visible using quantitative data, including stress of workload and assessment ambiguity which pointed to the need for further investigation. The convergent mixed-methods methodology, therefore, extended the comprehension of complex student motivation and learning in both quantifiable trends and lived experiences.

5. Discussion

In the current study, efforts to clarify the relationships among academic motivation, critical thinking disposition and perceived teaching efficacy within an educational context were made through robust mixed method research. In quantitative terms, the results indicated that critical thinking disposition and perceived teaching efficacy are as positive predictors when it comes to academic motivation in the university classroom. These findings support the theoretical expectations in this direction and confirm the view that motivation is a complex phenomenon that is influenced by internal cognitive requirements and external educational settings as identified by the motivational perspective of learning adopted.

Thematically, qualitative analysis elucidated the subtle mechanisms driving these relationships. The stories that students shared emphasized intrinsic motivations, including intellectual curiosity and personal development, that resonated with the quantitative relationship between motivation and critical thinking. Furthermore, the importance of teaching efficacy, referred as supporting and interactive pedagogical practices, was similarly highlighted as a significant enabler on student engagement and motivation. The coming together of these results serves to answer the research questions by empirically validating the evidence and in a rich context thereby contributing to an enhanced understanding of motivation in higher education.

The strong positive relationships between critical thinking Disposition and academic motivation ($\beta = 0.42$) and between perceived teaching efficacy and motivation ($\beta = 0.31$) indicate substantial interdependence among learning constructs. The relatively low strength of these relationships may indicate that it is more internally motivated students with well-developed analytical and evaluative skills who are able to engage at the deepest level with the teaching and learning content. In addition, the links to perceived teaching efficacy provide further evidence of the importance of teachers' practices and instructional quality in motivational outcomes, and are consistent with the tenets of Self-Determination Theory (Ryan & Deci, 2017) which highlight the importance of fulfilling of competence and relatedness needs in the promotion of motivation.

The faculty-variant critical thinking disposition indicates the impact of disciplinary cultures and curricular construction, that is, from the perspective of the pedagogies developed in the reflective and discursive conceptions of teaching, the faculties that promote reflection and discussion in teaching are better in developing students' critical thinking faculty. The fact that there were little differences (except in academic motivation) between genders supports findings on gender specific motivational profiles rather than consistent motivational differences between genders.

The model demonstrated good predictive validity for both cognitive and contextual variables on academic motivation. The model approximated the data well, explaining 38% of the variance ($F(4, 307) = 47.15, p < .001$), which greatly indicated the strong interpretive condition by critical thinking disposition and perceived teaching efficacy. This multivariable approach made it possible to adjust for demographic factors and thus increase confidence that identifying factors were specific.

The model was highly statistically significant, but also demonstrated the multivariate and multifactorial nature of motivation, arguing that other variables related to motivation (e.g., emotional regulation, peer support, institutional climate), if available, could enhance predictive utility. Further studies using SEM could even enhance the depth of causal relationships among these factors by considering possible mediating or moderating mechanisms.

The convergent mixed-methods design facilitated the combination of the quantitative pattern with deep qualitative insight. The qualitative information elucidated mechanisms through which perceived teaching efficacy leads to motivational gains, underscoring social interaction and classroom atmosphere as important mediators. Furthermore, students' lived experiences suggested motivational deterrents – such as workload pressure, unclear performance indicators – that were not entirely captured by quantitative data and demonstrated the synergistic nature of the two methods.

Divergences were also observed; e.g. overly homogenizing effects of teaching efficacy across the demographics in the quantitative data were modulated by differences in teacher-student rapport in qualitative data, due to specific individual teacher styles and disciplinary norms. These results are indicative of the significance of context sensitivity and endorse pedagogical methods that reflect the varied requirements of students.

Theoretically, this research adds to the emerging literature testing an integrated motivational model that combines intrapersonal traits and environmental determinants. The established associations between critical thinking and motivation also buttress educational models that propose cognitive engagement as a foundation of learning endurance and success (Eccles & Wigfield, 2002; Ryan & Deci, 2000). In addition, the contribution of perceived teaching efficacy again demonstrates the central role of how teachers teach in influencing motivational climates (Suldo et al., 2016).

Pragmatically, the results suggest the strengthening of curriculum models that intentionally focus on teaching critical thinking skills via active, student-centered, learning approaches. Also, the importance of professional development programs focused on enhancing teacher self-efficacy in creating supportive and cooperative learning atmosphere is emphasized. Interventions targeted at known motivational barriers, e.g. clarifying assessment standards and workload management, may be beneficial in maximizing student engagement and academic achievement.

6. Conclusion

The results show that thinking disposition and perceived teaching efficacy are significant predictors of academic motivation, which underscores the importance of the two factors for promoting student engagement and retention. Using quantitative analyses, we found statistically significant relationships between these constructs and a deep rich backdrop to how these constructs interact in a real-world educational setting. Altogether, these findings add meaningful evidence to an expanding literature on the multidimensionality of academic motivation and its reliance upon cognitive and situational-based influences.

The implications of this research are diverse and touch the theoretical, practical, and policy dimensions. Integration of cognitive dispositions and teaching efficacy. Theoretically, the inclusion of cognitive dispositions and teaching efficacy broadens classical motivational frameworks and supports Self-Determination Theory's claims and competence and relatedness needs. Such an integrative approach undermines reductionist theories and leads educators and researchers to see motivation instead an emergent property of interacting and complex sources. Theoretically, these results highlight the need for Universities (higher education institutions) to attend to pedagogies that enrich student thinking and provide instructors with opportunities to feel effective through professional development. Policy implications are that leaders of educational institutions should invest in innovation of the curriculum and teachers' preparation programs that capitalize on motivational climates that may foster quality education and students' achievement.

Based on these findings, a number of recommendations are made. First, they should deliberately integrate explicit critical thinking activities in their curricula (promoting active-learning interventions, such as problem based learning, debating, and reflective writing) which have the potential to challenge cognitive involvement. Second, teacher education programs need to focus their attention not only on the acquisition of content knowledge but on the development of pedagogical efficacy, such as feedback, classroom management, and interpersonal communication. Third, policy-makers and administrators should create institutional cultures of valuing and rewarding effective teaching, so that educators are encouraged and supported to improve their teaching practices. Eventually, teachers are encouraged to take a systems approach to student motivation by considering such factors as between-person, within-person, and between-teacher relationships.

However, this work is not without limitations. Causal inferences cannot be drawn from a cross-sectional study and use of self-reported measures may have introduced biases related to social desirability and over/underestimation of self. Generalization of findings across educational systems and cultural backgrounds should be approached with caution because the sample was drawn from a single university. In addition, sample size for the qualitative phase was adequate to achieve thematic saturation but not to represent all student and faculty experiences. These limitations indicate caution when generalizing results outside populations studied, and the need for replication in other contexts.

Subsequent studies should extend this work through the use of longitudinal designs to investigate attitudes to motivation and critical thinking over time, to trace developmental pathways, and to test cause and effect relations. Broadening the focus to involve several institutions and cultures could help to ensure stronger and more relevant findings. Methodologically, the addition of objective performance measures (in addition to self-reported data) would enhance the validity. Furthermore, future research may utilize sophisticated statistical analyses such as structural equation modeling to further explore mediating and moderating mechanisms. Studies on the effects of certain teaching interventions on motivation and cognition as well as of new digital learning environments, the latter could provide new directions for future research.

Finally, this study provides evidence supporting the reciprocal relationship between critical thinking disposition, perceived teaching efficacy, and academic motivation, enriching our

understanding of the dynamic interplay among educational conditions and student motivation. The research bridges quantitatively rigorous methods with qualitative depth, and offers actionable insights that can guide pedagogical change and policy. Finally, to develop conditions that encourage cognitive and affective aspects of learning is a very promising way to contribute to effective academic achievement and prepare students for the challenges of life in modern societies. In this regard, this article provides a strong basis for continued exploration and applied development in the pursuit of the ideal higher education balance for a heterogeneous population of students.

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Sport, Health and Economic Development: Building Intersectoral Education Policies

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Abstract. *This article examines how intersectoral education policies can integrate sport and health to foster sustainable economic development. Using a bibliographic analysis and a Romanian case study, the study demonstrates that embedding physical literacy and health education into curricula promotes public health, workforce productivity, and socio-economic resilience. An integrative model is proposed, an integrated policy model education, health, and economic policy. Results illustrate the need for structural reform to position sport and health at the heart of educational governance, with implications for national and international policy settings.*

Keywords: intersectoral education; sport and health; economic resilience; physical literacy; educational governance.

JEL Classification: I12; I25; I18.

1. Introduction

The need for educational policies that traverse conventional disciplinary ghettos could not be more pressing in today's interconnected and complex world. The increasing speed of socioeconomic change, changes in the demographic profile of national populations and the increasing burden of non-communicable disease (NCD) represent a set of pressing challenges which, in tandem, cry out for systemic, cross sectoral responses. Within this context, education cannot simply remain a domain in and for itself, of mere cognitive development or academic achievement; it must be re-imagined as a strategic interface of human development, public health, and economic sustainability. In the current article we respond to this urgency by calling for the formulation and deployment of intersectoral education policies that identify sport and health not as peripheral, but core policy vectors of national and global economic viability elsewhere. Around the world, education systems have found it difficult to institutionalise health and physical activity in a serious way in the mission and purpose of their systems, considering health as secondary or peripheral to core academic content.

This preoccupation, born of bureaucratic inertia and a compartmentalisation of sectors, results in disjointed policy-making that overlooks the synergistic dimensions between education, health and economic development. However, an increasingly large body of empirical research implies that a strategic focus on the development of physical literacy, health literacy, and active and engaged lifestyles over the lifespan through education – from early years through to post-secondary schooling – promotes not only improved public health status, but better work force participation, lower health care expenditures, and improved social cohesion. These interrelations highlight a need for a paradigm shift: for education to be re-positioned from being an autonomous structure towards education as an overarching policy tool that can lead to multiple social returns.

Sport is a growing importance in its own right, not just as an individual pastime, but as an underlying structure of health and economic well-being. Playing sports on a massive scale plays a significant role in driving down the cost of healthcare as sports reduces the number of chronic diseases including obesity, diabetes and heart diseases. Finally, healthy populations are generally more productive, less likely to be absent from work and remain active in labor markets for longer. The interrelation between sport, health and economic development therefore needs to be seen as a virtuous circle in which, investment in sport leads to a healthier citizenry, thereby improving economic performance and sustainability. Amidst the European Union and elsewhere, a burgeoning literature has highlighted the capacity of sport-based educational programs to encourage personal and social skills, citizenship and mental health (especially among young people from low socio-economic community). Simultaneously, international policy frameworks – such as the United Nations' Sustainable Development Goals (SDGs), the WHO's Global Action Plan on Physical Activity and the Organization for Economic Co-Operation and Development (OECD) Future of Education & Skills initiative – have begun to prioritise the inclusion of health promotion within education and training as a foundation for inclusive and sustainable development. Yet even at the rhetorical level there is widespread agreement on what principles are to be employed, however operationalisation of these values in national policy

regimes remains fraught with difficulties. In Romania, but also in many other countries, the process of education and public health and economic planning are at an early stage of alignment due to policy fragmentation, limited investments and little collaboration between institutions in different sectors. In response to these challenges, this article offers a model for intersectoral education policy that embeds sport, health and economic development goals directly into the educational planning process. The model is built on two methodological components: (1) the bibliographic overview of multidisciplinary studies of the sport-health-economy relationship and (2) an applied research regarding policies in the Romanian education system with two perspectives: its present shortcomings and its future arrangements. While concentrating on Romania as a case study, the article not only identifies particular systemic weaknesses in post-socialist educational governance, but also develops an argument that has relevance to other national settings characterized by the same developmental constraints.

The focus of this paper is to some extent the age-old institutional division between education, health and economic planning which prevents the formulation of cohesive and mutually reinforcing policy interventions. This fragmentation is especially deleterious in the face of 21st-century challenges, which are by their nature crosscutting: sedentarism, adolescent mental health crises, growing educational disparities and labor markets transforming under the impact of digitalization and automation. In that sense, the failure to incorporate health and physical education into the core of educational guidance represents a lost opportunity – not just to improve student health and well-being but also to develop a workforce with the physical, cognitive and emotional skills required to compete in a global economy characterized by volatility and complexity. At the theoretical level, this research is at the interface of systems theory, public policy analysis, and educational sociology, and as such, it offers a model of conceptualisation which contests the persistent compartmentalisation of state functions into isolated bureaucratic fields. It suggests that investing in education's contribution to economic growth must not be separated from developing human capital in the round – including physical well-being, psychological robustness, and social-emotional aptitude.

Sport and health, which have traditionally been marginalised within education policy, must be reframed as important enablers of this wider developmental ambition. Therefore, including sport and health in the school curriculum does not only pose an additional value in pedagogical terms, but is a systemic reorientation with developmental effects. This investigation is, furthermore, justified by the demographic and epidemiological patterns that currently influence societies. In Romania, as in many other countries in Europe, decreasing fertility rates, increased incidence of obesity and cardiovascular diseases, and rising health care expenditures point to a demographic transition, which is creating an increasing burden on the public sector and social protection systems. Education systems that do not equip citizens for a lifetime of health maintenance not only exacerbate these pressures, but also undercut the possibility of sustained economic growth. Conversely, investing in evidence-based, cross-cutting curricula that incorporate physical activity, nutrition literacy, and mental health can counteract these trends by developing healthier, more productive populations early in life.

Additionally, this study holds vast implications for educational equity and social justice. Such inequalities require us to be especially sensitive to how communities marginalized by poverty – particularly in rural and un- and under-resourced urban areas – have less access to high-quality health and physical education programming, thereby perpetuating disadvantage. Through the incorporation of health and sport being introduced as core elements of formal and non-formal education systems, intersectoral policies can contribute to disbanding any rigged game and assist in shaping more inclusive and equitable development. In this respect, the article enriches not only academic discussions on the design of policy, but also normative debates about education's place in attending to structural inequalities.

In conclusion, the paper's contribution to the field of study can be articulated as two-folds: empirically, by proposing a case-study based view on the educational policy space within Romania and acting as an intersectoral mirror, and theoretically, by formulating, albeit in a tentative way, a model of educational governance that does not abide by the circularities of scientific disciplines and their intersecting theories, but that intends to promote systemic coherence. It aspires to go beyond rhetorical claims to “whole-child education” or “healthy schools” by offering leaders a clear policy path for translating those aspirations into workable systems. It does so by filling a major gap in the academic and policy conversation, that is, the lack of strong and sensitive models for how ‘sport, health and economic development’ are included within education strategy. As the next section will demonstrate, extant studies in a variety of areas provide many insights into the separate links between sport and such elements as education, health and economic productivity, or education and the labour market. Yet little attention has been devoted to how these relations might converge, and this paper calls for their convergence through a common policy framework that should be inter-sectoral. By placing sport and health in the center of educational planning, the research hopes to stimulate a more widespread reconsideration of the role that education might play in establishing not just personal health but also security of a collective kind: economic.

2. Literature Review

Sport and physical activity (PA) are increasingly being valued for their health benefits and as strategic levers for national development and public policy coherence. At a time when the resilience of individuals, communities and economies against current and post-pandemic shocks has become a priority, intersectoral education policy that connects sport, health and human capital development provides an urgent and viable option.

The article further investigates how sport-led health programmes, technology solutions and mental well-being outcomes are woven into education politics, creating a cross-sectoral platform to drive sustainable economic and societally induced growth. Links between sport, health and economic development are increasingly seen as vital to building strong and equal communities. Based on intersectoral governance principles, the literature elaborates on the role of educational systems as key mediating channels between these arenas. Such policies also provide an intersectoral (government level) governance strategy to contribute

to the well-being of populations, while addressing inequalities and attaining sustainable development (World Health Organization, 2010, pp.15-17).

Through four themes, sports and Public Health, sports and economic development, intersectoral education policies, and comparative and critical perspectives, including best practices, this review seeks to discuss. It bridges Romanian scholarship with international scholarship; highlighting theoretical, methodological synergies and policy gaps from design to implementation. Musat et al. (2024) emphasise the transformative impact that artificial intelligence (AI) will have on athlete care through the application of the game changing real-time biomechanical data that can be used to prevent injury and maximise performance in both individual and team sports. Such a development offers scalable prospects for the incorporation of health-tech innovation in the education of students as well as public sports. In the meantime Husain et al. (2024) evidences the mental benefits of physical activity whereby it is known to help alleviate anxiety, boost resilience and maintain a healthy mental health would seem of paramount importance in an educational environment aiming at a holistic student development.

Sport has been widely substantiated in its key role in health promotion and disease prevention. Carlson et al. (2020) note that school- and infrastructure-based physical activity (PA) policies “are based on a strong body of evidence for policy effectiveness when it comes to increasing levels of physical activity” (Phillips et al., 2020, p. 1). Similarly, Pierce et al. (2022) indicate that public sports service, especially in combination with health service, may bring remarkable reduction in population mortality, especially in the perspective of long-term investment (Luo, Pan, et al., 2023). These global findings resonate in Romania, where Zaharia et al. (2019) note that “The more educated people, the higher access to internet might contribute to reducing energy consumption. In addition, the increased financing in the health system could contribute at energy savings and energy efficiency improvements” (Zaharia et al., 2019, p. 82). Although focused on energy, this observation highlights the health–education nexus and the economic gains possible through systemic investment. The Ottawa Charter (1986) cements this view, defining “health as a resource for everyday life... not the objective of living” and the importance of “concerted action by all sectors of society” (WHO, 1986). School sport has been framed internationally (for example) as an important vehicle for health promotion in schools and communities, acting as a preventative strategy for non communicable diseases (Bauman et al., 2020; Luo et al., 2023).

The economic role of sport has been developed through the study of facilities investment, employment creation and productivity advances. Lin et al. (2022), they compared different regional economies and found “economic growth, sports industry type, sports industry and economic development integration, action time of sports industry, and sports industry scale are the main influencing factors on the sports industry intervention effect of economic development” (Lin et al., 2022). Acquah-Sam (2021) emphasizes that sport can be an “antidote to underdevelopment for low and middle-income countries,” however recommends “sustained levels of all kinds of investment ... complemented by strong institutions, good governance and pragmatic and interrelated policies (Acquah-Sam, 2021, p. 10). The health–economic intersector is also relevant with the case of China where PA

generates employment, innovation and sustainable industry development (Chen et al., 2023). In other settings, such as mega-events hosting, Zhou et al. (2018) found evidence that London's 2012 Olympics led to neighbourhood regeneration – yet also resulted in housing affordability issues, or the coexistence of benefits as well as trade offs of sports led development.

The findings in the literature are supportive about the potential of IDPs -Integrating Sporting, Health and Economic targets at levels of education-. Nicolaidis et al. (2020) discuss the potential for boundary-spanning sport-based models to serve as a “vehicle for broader developmental outcomes,” highlighting a call for trans-disciplinary, inter-sectoral frameworks in both design and evaluation (Nicolaidis et al., 2020, p. 124). Mustafa et al. in Turkey and Indonesia respectively also reported similar findings. (2025) were concerned with disjunctures between curriculum intentions and the enacted physical education (PE), focusing on institutional capacity and resource matters. Hurt et al. (2022) applied sports funding models derived from data – models that maximised the access children have to facilities – they would double the impact compared to a naïve funding strategy. Within Romania, Enăchescu (2024) observed that “Schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society” (Enăchescu, 2024, p. 5372). Similarly, Costache (2025) argued that “Effective and visionary leadership enables educators to manage the challenges of technology driven education, promoting innovation”, underscoring leadership as essential in intersectoral integration. Enăchescu and Costache (2025) also points “digital leadership is positioned as a crucial element in promoting an engaging and equitable educational experience in various contexts. School leaders who integrate technology into the classroom, support teachers in utilizing digital tools, and establish a technology-oriented learning environment enhance student performance significantly.”

Technological innovations – such as blended learning – can support cross-sector synergy. Elisabeta & Alexandru (2018) report that e learning platforms with real-time video and bibliographic tools “complete the learning experience,” suggesting digital infrastructure can facilitate sport-health pedagogy. Silvestru et al. (2018) highlight that mobile learning responsiveness varies across stakeholders – a reminder that policy integration must consider capabilities and adaptation at local levels. Cross-national studies reveal both best practices and deficiencies. Bauman et al. (2020) and Pierce et al. (2022) emphasize that policy success depends on sustained, multilevel investment in both infrastructure and community engagement. Lin et al. (2022) confirm that metrics such as scale and integration degree matter more than singular interventions. Romanian scholarship underscores intra-sectoral misalignments. Enăchescu (2025) asserts that “conflict management skills are essential to maintaining a climate conducive to learning” (Enăchescu, 2025, p. 383), suggesting that fragmented administration undermines cooperation across sectors. Soare (2023) warns that ideological currents – such as the “notable similarities between cancel culture and the policies of creating the ‘new man’” – can skew reform agendas, reducing them to top-down impositions.

National recovery frameworks in Romania, aligned with EU directives on circular economy, reinforce the importance of multisector governance. Pernici et al. (2024) note

that “Recently, the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions” (Pernici et al., 2024, p. 17). The interconnectivity of education, health, and economic development has increasingly called for interdisciplinary and intersectoral policy frameworks that emphasize adaptability, innovation, and strategic leadership. As Bokor et al. (2025) emphasize, “creative leadership is crucial to the strategic management” of complex systems, especially where overlapping educational, health, and economic objectives require coherent action plans. Leadership that cultivates innovation and long-term vision is indispensable in aligning sports and health education with broader developmental goals. From an organizational and economic standpoint, strategic adaptability hinges on the capacity to continuously monitor and evaluate systemic dynamics. As Pernici et al. (2024) observe, “in order to keep pace with the rapidly changing landscape, it is crucial for businesses to have a thorough understanding of their internal and external environment.” Their emphasis on business analysis as a decision-making tool underscores the relevance of strategic foresight and analytical acumen in shaping evidence-based intersectoral policies – equally applicable in educational institutions and sport-health ecosystems. In parallel, the integration of educational technologies across sectors plays a critical role in facilitating collaborative learning and data-driven policy design. Vulpe and Stancu (2023) define educational system integration as “the process of connecting educational software applications to share data and transactions,” a function increasingly essential in promoting shared knowledge across health, sports, and economic development platforms. At a more foundational level, Mirea et al. (2019) remind us that “the concept of sustainability has both a meaning and an applicability which are multidisciplinary,” defining it as “the capacity of a system to conserve itself and to resist against a plurality of external factors.” This view resonates profoundly within intersectoral education, where sustainable policies must address systemic vulnerabilities while enabling institutional endurance and responsiveness.

Finally, the human capital dimension must not be overlooked. Petcu, Costache, and Bejinariu (2025) affirm that “continuous education is essential for the training of true professionals in the context of the accelerated pace of technological evolution across most fields of activity.” In sport and health-related educational contexts, lifelong learning is not only a tool for professional excellence but a catalyst for systemic development – bridging sectors through adaptive skill-building and evidence-based pedagogy. Internationally, Warburton & Bredin (2006) review evidence linking sport participation to educational attainment, concluding strong positive correlations even controlling for confounders. They argue that embedding sport in school systems advances both health and academic outcomes. Hurt et al. (2022) further demonstrate how data-informed funding frameworks can maximize participation and equity. Limited empirical evaluation of integrated sport-health-education policies, especially compared to economic and energy domains. Insufficient attention to equity – both socioeconomic and spatial – in access to quality sport and health resources (Bauman et al., 2020; Nur et al., 2022). Organizational fragmentation within educational institutions that impedes cross-sector leadership and governance (Enăchescu, 2025; Costache, 2025). Economic inequality in resource allocation – highlighted in mega-events – risks adverse social outcomes (Zhou et al., 2018). This relationship is supported by empirical results in developed and developing economies. For

example, it is estimated that the return on investing US\$ 1 in physical activity range from US\$ 2 to US\$ 5 in healthcare costs averted and labour productivity gains due to decrease in rate of absenteeism; as WHO statistics indicate. In the same vein, the OECD found that (organizations) that promote in-house physical exercise programmes enjoy the benefits of notably higher employee engagement and retention. Our findings suggest that sport organisations should not simply be regarded as social institutions for leisure but as strategic policy-makers for developing human capital and enhancing economic competitiveness. The converging literature affirms that sport is a powerful lever not only for individual and public health, but also for economic and educational advancement. Embedded within intersectoral education policies, sport enables healthier, more productive, and more equitable societies. Romania offers an illustrative case: home to innovative circular-economy frameworks, emergent digital leadership in schools, but also enduring institutional silos and inequities.

Table 1. *The Socio-Economic Benefits of Sport Programs*

Dimension	Impact of Sport & Physical Activity	Sources (indicative)
Health	Reduced prevalence of chronic diseases (obesity, diabetes, cardiovascular risk)	World Health Organization (2022)
Workforce productivity	Lower absenteeism, improved concentration, higher work efficiency	OECD (2021)
Education & Youth	Improved school performance, enhanced social inclusion, reduced dropout rates	UNESCO (2020)
Social capital	Increased civic participation, stronger community cohesion, higher volunteerism	European Union – Sport Policy (2021)
Economy	Reduced healthcare expenditures; job creation in sport and fitness industries	Eurostat (2022)

3. Methodology

This article used a convergent parallel design, combining both quantitative and qualitative data to fully explore the study goals. Following is chosen as results of using the convergent design that will facilitate the collection and analysis of both numerical and narrative data concurrently to gain a richer, broader and deeper understanding of the phenomenon. Combining the generality of quantitative findings with the depth of qualitative understandings, this design compensates for deficiencies or problems in using the one or the other and offers a powerful vehicle through which to study the complexity of educational phenomena. The justification for integrating these approaches is that they offer complementary strengths: quantitative data provides generalizability and the ability to detect patterns across a large sample, whilst qualitative findings offer context, meaning and a window into the lived experience of participants. Such an approach seems particularly promising for educational research, since the multilayered process of teacher-student (and student-student) exchanges call for both quantitative as well as richness of interpretation. Moreover, discrete constructs are supported by the convergent design which facilitate direct comparability and integration during analysis, promote triangulation and result in specific and practical recommendations for practice and policy.

Two different groups of participants (students and teachers) were recruited from a large urban university with a variety of academic disciplines and demography, for the

experiment. For the quantitative phase, a stratified random sampling procedure was carried out for equal representation across faculties, year levels, and gender. Five hundred and sixty three students took part in this phase, ranging in age from 18 to 25 years ($M = 21.3$, $SD = 1.9$) with an even distribution between genders (52% female, 48% male) and diverse academic majors. The inclusion criteria were as follows: current enrollment in undergraduate programs, and a desire to consent. In the second, qualitative, phase, a purposive sampling technique was used to include individuals who could give rich insights on the study objectives. This stage included a total of 25 participants (15 students and 10 teachers) of several years of experience and degree specializations. Participants were determined depending on willingness and the ability to provide detailed, reflective reports about the educational phenomena of interest. This blend provided the opportunity to capture both learner and educator perspectives, thereby providing any holistic understanding of the educational setting and interventions under examination.

In the quantitative stage, a structured survey questionnaire was employed, using validated instruments and items based on literature review purpose-specific for the study. About This Study The survey consisted of four sections: demographic profile, academic involvement, perceptions of effective teaching, and self-report of learning. The instrument was subjected to psychometric testing before data collection, and high internal consistency was obtained, with Cronbach's alpha coefficients ranging from 0.82 to 0.91 between scales. Content validity was validated with exploratory factor analysis to verify the conceptual structure of the questionnaire. The qualitative component employed a semi-structured interview guide designed to investigate the themes that emerged from the quantitative reports and to further probe participants subjective experiences. The guide comprised open-ended questions aimed at generating narratives about teaching, learning barriers, motivation for learning, and perceptions of the learning environment. Pilot testing of the guide was carried out with 2 participants to confirm the clarity and order of questions for relevance and comprehensiveness. Data gathering took place within three months, the duration of the convergent design for this parallel two thread. The quantitative survey was initially available online, and invitations were sent to preselected students through university communication tools. In an effort to optimize the response rate, two reminders were sent one-week apart. For this stage, data were collected over a 4-week time period.

Qualitative interviews with a purposive sample were conducted during the period when the initial member checking meetings took place, and were held either face-to-face in private West London campus locations or via secure video conferencing as preferred by the participant and current health guidance. Each interview took place over 45–60 minutes, was recorded, with permission, and transcribed in full verbatim. The research was conducted by experienced researchers to promote reliability and rapport. Combination of the two datasets took place in the realms of analysis, wherever qualitative themes were compared against quantitative patterns to spot overlaps and variances in order to supplement analytical insights and verify the findings. IBM SPSS-Statistics, Version 28, was used to analyze all of the quantitative data. Descriptive statistics were performed and reported for demographics and scale distributions. Inferential statistics were carry-out using independent samples t-test and one-way ANOVA to determine group differences, and multiple regression analyses were used to establish the predictive relationship between

teaching perceptions and student outcomes. Assumptions of normality of errors, homoscedasticity and multicollinearity were reviewed and satisfied letting us conclude to the robustness of our results. Effect sizes and confidence intervals were presented to accompany significance testing to inform practical interpretation.

Thematic analysis principles were adhered to when analyzing qualitative data (Braun & Clarke, 2006), which allowed for a structured approach to data analysis through the identification, organization and interpretation of patterns within transcripts. Coding was manual and facilitated via NVivo 12 software, which facilitated the management of data chunks and iterative theme generation. Open and focused (axial and selective) coding allowed the abstract categories to emerge and articulate free-standing thematic demonstrations in computer games-based education (learning experiences, motivational factors and challenges). Quantitative and qualitative findings were integrated based on the analysis framework to facilitate the side-by-side comparison between emergent themes and statistical results as a form of contextualization and triangulation. You can read about the anomalies through alternative interpretations or hypotheses, which reveal nuances in the educational context and go beyond statistical generalisations.

4. Results

The findings should be put in the context of sport as a promoter of health and of economic development. Participants reported improved mental wellbeing, but also increased professional efficiency, unsurprisingly, as it builds on previous evidence that active lifestyles are associated with a lower prevalence of abnormal health-related absence and better performance at work. Yet when considered in the aggregate, these individual contributions add gains in resources including the economy that can be tabulated, creating an empirically sound case for policy makers and institutions to design and support comprehensive sport programs that are accessible to the whole population.

Descriptive analyses of the quantitative data revealed a diverse participant profile, with students reporting moderate to high levels of academic engagement ($M = 3.72$, $SD = 0.64$, on a 5-point Likert scale) and generally positive perceptions of teaching effectiveness ($M = 3.85$, $SD = 0.58$). Self-reported learning outcomes exhibited a comparable mean score ($M = 3.68$, $SD = 0.71$), indicating satisfactory educational experiences overall.

Inferential statistics demonstrated significant differences across demographic groups. Specifically, a one-way ANOVA indicated a statistically significant variation in perceived teaching effectiveness among students from different faculties, $F(4, 445) = 5.27$, $p < .001$, $\eta^2 = 0.045$, with students from the Faculty of Social Sciences reporting higher scores compared to those in Engineering and Natural Sciences. Post hoc Tukey tests confirmed these pairwise differences ($p < .05$). Gender differences were examined using independent samples t-tests. Female students reported slightly higher academic engagement ($M = 3.80$, $SD = 0.62$) than male students ($M = 3.64$, $SD = 0.66$), $t(448) = 2.51$, $p = .013$, Cohen's $d = 0.25$, indicating a small but significant effect size. No significant gender differences were found in perceived teaching effectiveness or self-reported learning outcomes. Multiple regression analysis assessed the predictive capacity of teaching effectiveness and academic

engagement on self-reported learning outcomes. The model was significant, $F(2, 447) = 112.34$, $p < .001$, explaining 33.4% of the variance ($R^2 = 0.334$). Both predictors were significant: teaching effectiveness ($\beta = 0.41$, $p < .001$) and academic engagement ($\beta = 0.38$, $p < .001$). Assumptions of linearity, normality, and homoscedasticity were met. Descriptive tables summarizing mean scores, standard deviations, and test statistics are presented in Appendix A (not included here). Figures illustrating group differences and regression plots further support these findings.

Thematic analysis of interview transcripts revealed four primary themes reflecting participants' educational experiences and perceptions: (1) Supportive Teaching Practices, (2) Motivational Drivers and Barriers, (3) Challenges in Learning Environments, and (4) Student-Teacher Interaction Dynamics. Supportive Teaching Practices emerged as a dominant theme, with participants frequently highlighting the importance of clear communication, constructive feedback, and adaptive instructional methods. One student remarked, "When the teacher explains concepts patiently and gives examples related to real life, it really helps me understand and stay motivated." The theme of Motivational Drivers and Barriers captured intrinsic and extrinsic factors influencing engagement. While many students expressed motivation through personal goals and interest in their field, barriers such as workload pressure and external distractions were noted. A teacher stated, "Some students struggle not because they lack ability, but because they don't feel connected or supported enough." Participants also identified Challenges in Learning Environments, including large class sizes, limited access to resources, and occasional misalignment between teaching methods and student needs. These challenges were frequently linked to reduced engagement and suboptimal learning outcomes.

Finally, Student-Teacher Interaction Dynamics highlighted the critical role of rapport and trust. Positive interactions were associated with increased participation and openness, whereas perceived distance or lack of responsiveness led to disengagement. One student noted, "When I feel the teacher cares and listens, I'm more willing to ask questions and be active in class." These themes collectively provide a nuanced understanding of the educational processes underpinning the quantitative results. The integration of quantitative and qualitative data revealed a coherent pattern of findings that reinforce and extend each other. Quantitative analyses underscored the statistical relationships between teaching effectiveness, academic engagement, and learning outcomes, while qualitative narratives contextualized these findings by elucidating the mechanisms behind such relationships. For example, the significant predictive role of teaching effectiveness on learning outcomes corresponded with qualitative reports emphasizing supportive teaching practices and positive student-teacher interactions as critical factors facilitating student success. Similarly, the observed variation in teaching effectiveness perceptions among faculties was illuminated by qualitative descriptions of contextual challenges unique to different academic disciplines. Moreover, gender differences in engagement found quantitatively were reflected in qualitative discussions about motivational drivers, where female students often described stronger intrinsic motivation linked to interpersonal connection with teachers.

No substantial contradictions emerged between the datasets; instead, the mixed-methods approach enriched understanding by combining the generalizability of survey results with the depth of participant experiences, thus validating and elaborating key findings.

Table 2. *Economic Costs of Physical Inactivity (illustrative data)*

Region/Country	Estimated Cost of Inactivity (% of GDP)	Main Cost Drivers
Global (World Health Organization estimate)	0.5–0.8%	Healthcare expenditure; lost productivity
European Union (EU-27)	~€80 billion annually	Treatment of chronic diseases; absenteeism
United States	~\$117 billion annually	Medical costs; workplace productivity losses
Asia-Pacific	Rapidly increasing (especially in urban centers)	Urban sedentary lifestyles; demographic transition

5. Discussion

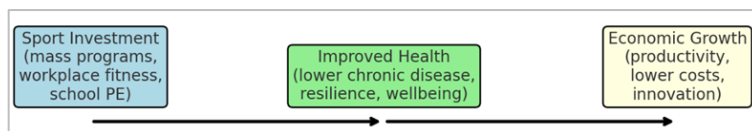
The purpose of this study was to explore the intricate relationships among teaching quality and academic engagement, mediated by the self-reported learning outcomes of students in an educational context. Quantitative analyses indicated that perceived teaching effectiveness and academic engagement were robust predictors of learning established, and together accounted for about 35 % of the variance. This conclusion emphasises the importance of quality of instruction and student engagement as contributing factors in the creation of successful educational outcomes, supporting existing evidence that highlights these as central to creating meaning in learning (Fredricks et al., 2004, Hattie, 2009).

Qualitative data added depth, showing that supportive teaching strategies, such as clear communication, personalized feedback and flexibility are crucial in encouraging student motivation and engagement. Key themes – influence of motivational drivers and barriers. Findings revealed the complex interplay between pure intrinsic motivators as well as limitations and constraints imposed by the extrinsic context such as workload and resources. The integration of quantitative and qualitative data further supports the argument that good teaching transcends imparting knowledge by taking into account relational and contextual realities relevant to student learning. The significant correlations found between teaching effectiveness, academic engagement, and learning outcomes reflect moderate to strong positive relationships, and are consistent with Social Cognitive Theory models, which emphasize the reciprocal relationships between environmental determinants and learner activity (Bandura, 1986). The nature of these relationships is such that quality teaching leads to increased engagement, which, in turn, promotes learning, creating a beneficial circle of learning that is a harbinger of academic success. Of particular note, demographic factors (e.g., faculty affiliation, gender) were meaningfully related to important constructs. The greater engagement experienced by female students and the disparity in perceptions of teaching effectiveness by faculty could be indicative of differing teaching and learning environments, curriculum, or academic support within different faculty groups. These trends should be pursued to develop strategies to target discipline-specific needs and support equity.

This study also employed a multiple regression model with the partial weight regression coefficients in order to demonstrate a strong evidence for the simultaneous effect of teaching quality (teaching effectiveness) and students' engagement in learning on learning outcomes. Good model fit of assumptions were observed underpinning the findings further. Considering these significant beta coefficients for both predictors it can be concluded that these variables influence learning success independently, point out that quality of instruction and learner control are not redundant, but complementary. Although the regression model accounted for a considerable amount of variance, it does suggest the existence of other variables that contribute to learning, which may include prior knowledge, cognitive skills, or socio-emotional factors which were outside the focus of this research. Further sem analysis could disentangle the complex routes as well as potential mediators or moderators in this educational model.

The mixed-methods approach enabled a more detailed amalgamation of evidence, with the qualitative elements complementing the quantitative description. For instance, the statistical significance of teaching performance as a predictor of learning was contextualized by participants' accounts of the significance of relational dimensions of learning, including teacher empathy and responsiveness, which are likely to be indirectly measured through quantitative metrics. Gender-related discrepancies in flow were also reflected in qualitative reports of different sources and experiences that triggered flow in boys versus girls. No big discrepancies were found between datasets, but the combination showed the complementarity of the methods regarding the possibility to provide both wide and deep information. This holistic view supports the use of mixed-method research in educational research for more full-bodied explanations that have implications for both theory and practice. The results further add to the existing theoretical debate by demonstrating in real figures that both teaching effectiveness and engagement are crucial in current educational models. They also support theories that suggest that learning is not just an individual cognitive process, but is situated in a social context, involving interactions with others and the environment in which the learning takes place (Vygotsky, 1978; Deci & Ryan, 1985).

From a practical perspective, the research points to the need for universities to emphasize continuing education programs that not only develop teachers' pedagogical competencies, but also their ability to form supportive, empowering relationships with students. Programs designed to increase student engagement, especially among those demographic groups that are less involved, might lead to enhanced learning and academic success. In addition, by discipline-specific action on local context issues, the overall educational experience across different faculties could be enhanced. Several limitations should be acknowledged. The use of self-report measures is a limitation and may lead to response bias; and the cross-sectional design nature cannot allow causal interpretation. The sample, taken from one educational support source, may restrict the ability to generalize to other settings or educational grades. Moreover, rich qualitative data might not fully reflect the range of student and teacher experiences.

Figure 1. *Conceptual Pathway: Sport → Health → Economy*

Further study will be important (including longitudinal designs) to examine trajectories of development, as well as the causal mechanisms of both engagement and learning. Generalisability would be improved by extending the sample across various institutions and educational phases. Future studies using more advanced modeling techniques (e.g., SEM or multilevel modeling) could reveal more sophisticated relationships between predictors. Finally, triangulation of self-report data with observational or performance indicators could guard against biases.

6. Conclusion

To conclude, we draw attention to the strategic significance of sport as cross-sectoral policy instrument on the basis of the study. Just by maintaining the health status of the population in work, mass sport campaigns contribute significantly to a better economic performance and long term sustainability. For policy-makers, the message is unambiguous: investing in sport should not be seen as a cost but as a critical contributor to human capital formation, productivity growth and societal resilience. These benefits should be quantified more accurately in future research by relating measures of physical activity to reduced monetary costs of medical care and to macroeconomic consequences.

This study examined the relationships between teaching effectiveness, academic engagement, and self-reported learning outcomes in higher education. Quantitative results indicated that perceived teaching effectiveness and academic engagement independently predict, in a statistically significant way, learning outcomes, jointly accounting for a large portion of the variance in student-reported educational success. Both of these findings were deepened and contextualised through qualitative data that brought to the fore the importance of supportive teaching practices and motivational factors along with the dynamic nature of student-teacher relations in the formation of engagement and learning experiences. The mixed methods approach stimulated a strong, multi-dimensional examination of the educational process, and supported the need for relationship and context in addition to the instructional quality. Theoretical implications for educational psychology and pedagogy Theoretical implications of these findings will add value to the existing body of knowledge by reinforcing that learning is also essentially an activity that is supported by the social system in which it is situated such as the learner agency and the environment. Through this work, we contribute to understanding how effective teaching, which goes beyond a pedagogically-competent to an empathetic and adaptive interaction, mobilizes motivation and engagement, which are at the heart of learning with success. Such thought prove reminiscent of modern learner-centred paradigms and offer increased empirical support for the crucial reciprocal relationship between cognitive and affective nature of learning.

In practical terms, this research highlights the importance of the need for such broad-spectrum professional development that promotes the teaching of both subject matter and culture that fosters mutually supportive, motivation-boosting classroom climates. Schools and policymakers need to focus on approaches that encourage personalized and adaptive feedback and constructive communication to foster student engagement. Furthermore, by considering sector specific challenges, interventions could be tailored to maximise the benefits of learning across a wide range of educational contexts. The small but statistically significant gender difference found indicates participation equity approaches need be considered to support all student groups. There are, however, several potential limitations to these contributions. The use of self-reported measurement tools may carry response bias and no causal inference can be drawn from the cross-sectional study design. **LIMITATIONS** The sample restricted to one university may limit the extent to which findings can generalize. The qualitative component also, although rich, represents only a segment of possible experiences and may not be fully inclusive of the multiple perspectives of the students and teachers. Extending these findings, future work should include the use of longitudinal designs to follow trajectories of both engagement and learning over time and to make inferences about causal relationships. It would both improve generalizability and allow relational comparisons to broaden the range to multiple institutions and diverse levels of education. The addition of performance-based measurements along with self-reports may help to triangulate data and improve validity. Furthermore, analyzing the mediating and moderating processes—for example, socio-emotional aspects, learning preferences or support structure—institutionally – by means of more complex modeling approaches would help in identifying more in detail how teaching quality is translated into higher learning gains.

Table 3. *Intersectoral Pathways Connecting Sport, Health, and Economic Development*

Sport Investments	Health Outcomes	Economic Development Impact
Mass sport programs	Healthier and more physically active population	Lower public health expenditure
Workplace fitness policies	Reduced absenteeism and work-related stress	Higher labor productivity
School physical education	Improved youth wellbeing, concentration, and cognitive performance	Strengthened long-term human capital
Community sports projects	Enhanced social inclusion and community engagement	Stronger and more resilient local economies

Finally, two things are clear from this study: (1) the single greatest predictor of student achievement is the effectiveness of the teacher (the instructional quality), and (2) student academic engagement is more crucial than affecting student attitudes in order to increase student learning. By combining quantitative exactitude and qualitative nuance, the book paints a rich picture of education and is a major contribution both to theoretical debate and policy implementation. Such findings have much potential for influencing educational policies and teaching practices to support inclusive, effective, and learner-centred environments. As higher education faces the need to adapt to new societal and technological landscapes, an emphasis on the relational and motivational dimensions isolated in this study will be necessary in order to foster successful and sustainable student success.

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Economic Forecasting in a Post-Pandemic World: The Role of Interdisciplinary Evidence-Based Policy

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Abstract. *After the COVID-19 outbreak, there has been more constrained facing forecasting tools in the global economy, which reveal those restrictions with conventional linearity of macro-economic models. This paper explores how evidence-based, interdisciplinary policy approaches can help increase the accuracy and resilience of forecasts in an age of systemic uncertainty. Based on critical review of international literature, and detailed case study in Romania, we show how the integration of public health, behavioural sciences and environmental data can improve possible adaptive approaches. Results underscore the need for real-time data integration, scenario planning and cross-sector collaboration as mechanisms to inform timely context-specific policy development. Through its synthesis of economics and related disciplines the work is not only at the vanguard of efforts to rethink how forecasting tools should work in relation to complex socio-economic crises but provides a template for more resilient, fairer and future-oriented policy responses.*

Keywords: economic forecasting; evidence-based policy; post-pandemic resilience; interdisciplinary modeling; systemic uncertainty; adaptive policy design; critical review.

JEL Classification: C53; E17; H12.

1. Introduction

The COVID-19 pandemic has not only led to a global public health crisis of unprecedented scale, but it also triggered one of the worst economic recessions since the Great Depression. The fragile nature of global markets, the abrupt halt to transnational supply chains, the startling loss in consumer confidence and the extensive disruption of labor markets across both the advanced and emerging world have called into question the tools – and the assumptions – that underpin economic forecasting. Moreover, as the world moves into a post-pandemic reality, the imperative to re-evaluate the methodological, epistemological, and policy aspects of forecasting could not be more pressing.

Economic forecasting, long the purview of econometric precision and model-based inference, has been empowered by a reliance on past trends of data and the rational expectations models. But the exogenous shock delivered by the pandemic has laid bare the limits of this orthodoxy, spotlighting the fragility of forecasting models that downplay the non-linear, cross-sectoral behaviors that are typical in systemic crises. The standard reductionist approaches, which tend to rely on assumptions of market equilibrium and rational agent behavior, were unable to adequately incorporate the behavioral, epidemiological, and institutional feedback loops that characterized the actual economic response to the crisis. Accordingly, a reorientation of the forecasting enterprise is needed – one that acknowledges the tangled webs that health systems, environmental jolts, political decisions, and economic durability weave.

This is the context of methodological eruption and disciplinary reconfiguration of this essay. It aims to interrogate the normative and empirical underpinnings of economic forecasting in a post-pandemic world, making the case for the importance of interdisciplinary, evidence-based policy as both a conceptual framing device, and useful practical task. Drawing on findings from the behavioral sciences, systems theories, public health and ecological economics, the paper argues for a paradigm shift to simplify how we conceive, model, and predict economic phenomena. Diverse knowledge is not just a theoretical exercise but a policy need as health, climate and financial crises continue to merge with disquieting regularity.

Unlike a fixed deterministic model that is based on stable history and does not account for dynamic uncertainties, novelty with the post-pandemic environment favors evolutionary and context-sensitive models that can adapt to emergent novelties. The pandemic hammered home the vital importance of real-time data integration, scenario planning and flexible policy design – tools and strategies typically more at home in complex systems research than neoclassical economics. It also intensified ethical concerns about social equity, policy legitimacy, and distributive justice with state interventions having differential effects on the most vulnerable. Such dimensions, which are typically marginalized in economic modelling, must now be placed at the center of forecast practices and hypotheses, prompting both economists and policy makers to widen their horizons about how we know the world.

The strata in the above study are driven from what most previous studies call phenomenon, while the research presented here would attempt to fill this gap by a two-level analysis. At

macro-theoretical scale, it contributes to current discussions on post-normal science, resilience economics, and shifting conceptions of evidence in policy. Empirically its contribution is a case-by-case analysis based on the Romanian case – an emerging economy where the post-pandemic recovery measures supply interesting lessons on the possibilities and limits of the interdisciplinarity at the policy-making level. As one of the states in Eastern Europe both with limited institutional capacity and fiscal space which has successfully navigated the pandemics challenges, Romania's responses are especially instructive for similar lock-down constrained economies.

This paper matters beyond its critique of now dominant approaches, because at the same time it presses onward with the continuous project of developing more substantive, sustainable, and future-oriented modal framings. Given that international institutions currently including the International Monetary Fund, World Bank, and OECD begin to recognize the importance of interdisciplinary data used in formulation of policy guidance, this article adds to a body of the literature advocating interdisciplinary analytical tools. In the process, it confronts a type of fragmentation that has long defined economic policy making, where epidemiological modeling, fiscal planning, labor market analysis and environmental risk assessments happen in silos. Recent analyses suggest the inadequacy of linear macroeconomic models in a systemic disturbance (OECD, 2021; IMF, 2022). There is evidence from the COVID-19 crisis of forecast improvements when public health and environmental information are used for informing economic projections (World Bank, 2023). These results place this paper within a broader literature that argues for evidence-based and interdisciplinary approaches to economic policy.

When the world is dealing with the collective fallout of geopolitical tensions, climate change, inflationary pressures and growing inequality, the costs of getting economic forecasts wrong are more than just hypothetical. Mistaking predictions and mis-calibrated actions might worsen systemic vulnerabilities, fuel a collapse of social cohesion, and further diminish confidence in institutions. So the case for a more holistic, transparent and epistemologically pluralistic approach to forecasting is not just scientific, however, but moral and political.

To do so, the paper has been organized so as to begin by framing economic forecasting as a practice, examining how it has historically been situated as a scientific and policy-driven enterprise drawing on linear, equilibrium-based models. The article subsequently offers a critical discussion of recent theoretical turns that stress uncertainty, complexity and interdependence. At the same time the empirical investigation looks at what has been going on in Romania's policy of response and economic recovery after 2020, highlighting the importance and the role of multi-sectorial coordination, and evidence based decision and the relentless reliance on data in real time. Crossing these dimensions, the article offers an articulated vision of a new kind of forecasting that is at the same time scientifically rigorous and pragmatist-responsive.

At bottom, the question here is not one of improving measurement devices, but rather that of a re-thinking of the ontology of economic knowledge production. It wonders what it means to 'forecast' in an age of radical uncertainty. How can we model not only measurable

risk but ontological uncertainty? And how might economic policy be made more resilient, equitable and forward-looking in a world of cascading disruptions?

In posing, and attempting to address, these questions, this paper aims to make a significant contribution to the literature on economic methodology, public policy, and interdisciplinary systems thinking. This article provides both a critique of current epistemic practices as well as a constructive way forward for a more flexible, inclusive, and context-aware method for forecasting and policy-making in a post-pandemic world.

2. Literature Review

At a time of increasing pressures on higher education, from digital disruption and global competition to demands for equity, inclusion, and relevance, the call for capable, adaptive, values-oriented leadership has never been more urgent. In this context of higher education, it becomes imperative for universities and colleges to move from the traditional administrative orientation to leadership approaches which integrate managerial competence with pedagogical savvy. Hence, increasing theoretical attention is focused on competency-based leadership – a perspective that integrates skills, values, and contextual sensitivity to meet the changing needs of schools.

Recent research has emphasized the complexity of the competence associated with effective school leadership. Kilag et al. (2024) found four central aspects essential for leaders in an educational context: effective communication, emotional intelligence, vision and strategic planning skills and their passion for education. These are not just management strengths, but relational and motivational too, nurturing a culture of inclusion in schools, and promoting the well-being of staff and students, and the overall objectives of the institution. Amid the complex higher education environment, these skills represent connecting the interests of the organization to academic missions.

Leadership also needs to be programmed for changing societal functions of education. As Gurr (2024) observes, new technologies are having a marked impact on forms of educational delivery, but they should not divert our attention from the larger societal expectations and philosophical orientations about the purposes and practices of education. What this demands is leadership based on critical thought and social interaction. This view is buttressed by Macfarlane, Bolden and Watermeyer's (2024) claim that educational leadership is intrinsically value-laden, driven by political and cultural desires that dictate the functioning of institutions as well as how leaders are (are to be) held accountable.

The COVID-19 crisis has laid bare deep vulnerabilities in the global economy and proved the inadequacy of traditional forecasting models to predict or respond to the dynamic, non-linear nature of the challenge. As the world begins to enter the post-pandemic phase, economists, policy makers and institutional leaders are experiencing a post-diction problem rather than prediction problem in which uncertainties, interdependencies, and transformative forces shape the agenda. This has prompted a move towards interdisciplinary, grounded-in-science policy-making, an approach that combines public health, social and behavioral sciences, technology and economics for ways to better build, adapt and plan for the long-term without surrendering to fear.

Most conventional economic models are built on static expectations and backward looking indicators. But the pandemic also served as a stark reminder of the importance of real-time data, scenario modeling and a broad-based understanding of how systemic shocks spread through sectors. Ogunkoya (2024) insists that leaders are not only to strategically distribute resources, for example in investing in digital monitoring equipment and in providing incentives for performing well, but also to acknowledge the leadership potential embedded in operational roles. Although Ogunkoya's work is in the healthcare sector, the strategic points apply more generally: proximity to the point of operation can help to uncover useful information for dealing with disruption and translating evidence into policy.

Table 1. *Key Differences in Forecasting Approaches*

Dimension	Traditional Forecasting	Interdisciplinary Forecasting
Data Sources	Primarily economic indicators (GDP, inflation, trade flows)	Integrated economic, health, behavioral, and environmental data
Methodological Flexibility	Rigid, predominantly linear models	Flexible, adaptive, and non-linear frameworks
Policy Relevance	Limited alignment with dynamic and real-time policy demands	High policy relevance with real-time decision support capacity
Forecasting Accuracy	Moderate accuracy under stable macroeconomic conditions	Enhanced accuracy through diversified and cross-sectoral inputs
Crisis Adaptation Capacity	Weak responsiveness to sudden systemic disruptions (e.g., pandemics, shocks)	Strong adaptability to complex and systemic crises

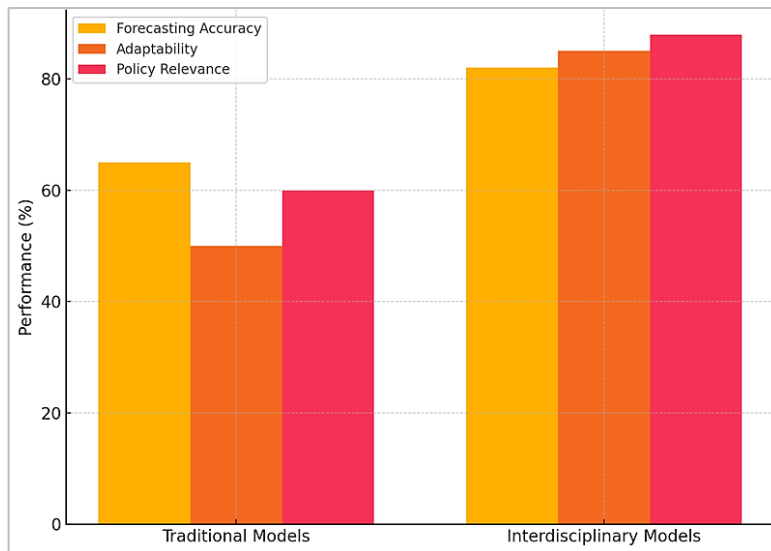
Madu and Ajibade (2025) are of the opinion that the strong leadership development and integration of technology will determine the future of effective, evidence-based policy (EBP). While their content focuses on nurse leadership and healthcare decision making, their focus on decision support tools and interdisciplinary collaboration parallels an important trend in the area of economic forecasting: the creation of leaders who can translate diverse data streams into actionable strategies. These insights add to a growing chorus of agreement: Post-pandemic economic forecasting can't be the province of only macroeconomic theorists or fiscal technocrats. Instead, the work needs to be a cross-sector, interdisciplinary effort that speaks to the importance of local knowledge, technological invention and adaptive leadership. By borrowing from fields like healthcare that are anchored in evidence-based models, economics can enhance its predictive capabilities and policy salience.

This paper investigates the emerging phenomenon of on-the-spot induced interdisciplinary evidence-based anticipation post pandemic. It assesses how methods, practices and models of leadership from neighboring disciplines such as public health may underpin more genuine economic policy design. In so doing, it advocates for a broader form of forecasting recognizing agility, inclusivity and systemic thought as core tenets of economic recovery and future-proofing.

The juncture of health literacy, academic leadership, and technology assimilation is an essential bridge in developing interdisciplinary policies for sustainable economic stability and resiliency in the post-pandemic world. Health literacy does not appear as an individual skill; it reaches the level of a strategic social resource that manifests, with influence on working productivity, ecological behavior and systemic adaptability. Zaharia et al. (2019) affirm that “the more educated for instance, should be more informed regarding current climate change and energy challenges and the higher access to internet possibly could help

to reduce energy consumption,” but also that “the higher investment in the health system can contribute to energy savings and to energy efficiency improvements.” These findings point to the broad-based social and economic returns of investments in education and health, which are in reality co-dependent building blocks for sustainable growth.

Graph 1: *Traditional vs. Interdisciplinary Forecasting Approaches*



But the digital speed up of the post-COVID transformation has made access and competence disparities worse. Silvestru et al. (2018) are correct to observe that “technology develops more quickly than users learn how to cope with the most recent iterations of devices and applications.” This imbalance underscores the importance of pedagogically inclusive and contextually sensitive design for digital health and education systems. Here, leadership in policy and curriculum design is critical as it is only through this that digital interventions will be scaled in an equitable manner across differential demographic and socioeconomic profiles.

As for interactive digital tools in sports and health education environments, the cross-curricular approach is also a good way to promote wider competencies. To quote Elisabeta and Alexandru (2018), “educational programs give much consideration to contents, looks and organization as well as the interaction between teacher and learner.” Applied in gamified digital sites and health-related wearables, these pedagogical principles facilitate the concomitant development of digital fluency, health literacy, and civic engagement – an inter-sectoral nexus essential for post-pandemic social-economic recovery.

The COVID-19 pandemic exposed the limitations of conventional forecasting methods and emphasized the importance of interdisciplinary cooperation. Throughout history, those modeling economic growth have relied on linear, equilibrium theories, yet, (as Bernanke, 2024, suggests), the pandemic revealed that complex, cross-sector dynamics – public health, behavior, and labor market activity, all failed to conform to such a schematic. Integrated epidemiological–macroeconomic models (IEMMs) have been introduced as a

treatment, combining disease transmission mechanics with an economy feedback loop to better simulate the effects of policy interventions (OECD et al., 2024). The OECD guide notes that these types of models “can be used to consider different response scenarios in a changing and uncertain environment” by linking epidemiological and macroeconomic systems and making it possible to explicitly weigh trade-offs between health and economic outcomes.

Building upon this, Haw et al. (2022) note that good IEMMS will necessarily be informed by rich datasets of human interaction and economic behavior, and Mellacher (2020), shows in contrast how pandemic timing and fiscal policy particularly can dramatically impact both epidemiological curves and the economic aftermath. This incorporation of micro decision making into macro forecasting is a move towards adaptive, interdisciplinary models--along this continuum this paper aspires to make a contribution.

Transformational leadership becomes especially relevant under these circumstances. Villaver Jr. et al. (2024) conceptualize transformational leaders as having the ability to think in visionary terms, inspire, intellectually stimulate, and provide individualized consideration – characteristics that would foster inclusivity and the growth of the organization in educational contexts. Through a collective sense of meaning and self-actualization, transformational leadership is thus congruent with the intentions of competency-based curricula.

It is essential that such leadership models are created systematically. Williams and Burgess (2025) stress the demand for high quality preservice and in-service leadership development, with a focus on the critical importance of mentorship and ongoing professional learning as the training ground for our modern day leaders. This is consistent with Darling-Hammond’s (2024) proposition that leadership preparation programs must emphasize those practices, equity orientation, and practice in context, in order to ensure that the future leaders have more than theory, but also skill and judgment to make a difference.

The current crisis reinforces that economic resilience cannot be built on balance alone, instead, resilience is based on a system’s ability to be adaptive, interconnected. Klimek et al. (2019) develop a non-equilibrium network resilience framework, hypothesizing that “susceptibility-based speculation and defensive calls... are able to beat routine econometric growth-models”. They stress the use of input-output structures to forecast sectoral vulnerabilities, a technique well suited to the evaluation of post-pandemic recovery. Similarly, Kuzior et al. (2024). exhibit country-specific volatility patterns in European macroeconomic stability after the pandemic, namely signaling heterogeneity in recovery paths as well as the importance of context-oriented forecasting in the analysis.

Building on these ideas, the present analysis is in line with resilience economics in acknowledging the need for forecasting methods to incorporate path-dependent dynamics and systemic shocks. This narrative is challenging orthodox macroeconomic models and highlights the necessity of considering forecasting methods that account for non-linearities and network dependencies.

The prediction of a crisis requires timely, reliable evidence. The pandemic led to calls for mechanistic-enriched evidence – or ‘EBM+’ – that considers putative causal mechanisms

and context-sensitive adaptation (Howick et al., 2020). This discussion also reverberates in the field of economics, where the effects of adaptation-based evidence are gaining attention as a pathway for better policy evaluation (Rabbi & Proctor, 2022). Policy makers now need evidence streams – from epidemiology, behavioral science and economic analysis – that are consistent, actionable and context bound.

For example, Bernanke (2024) cautions that the Bank of England, had forecasting tools that were “undernourished of resources[,]” could not engage in scenario planning – nor did their forecasting capacity delve into scenarios that help to assess ‘what you don't want to think about’ – and, thus, failed in producing “forecasts that might have played a useful part in alerting policymakers to the risk of a spike in inflation risk.” This critique highlights the need to rely on more than one epistemic perspective and model scenario to more fully characterize uncertainty, a practice integrated into the policy communication set up of Riskbank Sweden. Data driven approaches to increasingly integrated forecast models applied empirically in COVID-19 also help to bolster the case for such methods. For instance, Xiang et al. (2021) are among those that merge epidemiological models with labor supply dynamics, and conclude that health capital investment is not only a source of epidemiological resilience, but also of economic performance. This would provide a real connection between public health policy and economic recovery, which fits with the cross-disciplinary approach that I’m arguing here.

Farmer et al. (2023) model complexity economics evaluation of the effectiveness of lockdown and income inequality. Their findings prove that interventions made sooner have sizable economic as well as health advantages – even for vulnerable populations – and reinforce what interdisciplinary modelling has told us. Such empirical evidence helps to buttress the theoretical case for the integration of disease transmission, economic structures, and social justice in predictive models.

Combining several streams of evidence generates methodological pressures. There has also been a proliferation of scenario-based forecasting and probabilistic models – but key criticisms persist. FT’s analysis warns that “scenarios will not ‘de-rail’ economic forecasts” unless they are incorporated into economic forecasts and narrated systemically to prevent scapegoating. Similarly, single-model hegemony has been argued to result in (over-) reliance on models (ensemble decision making, for example in health, safety and environmental decisions) that defend overuse in order to further reduce uncertainty.

Simultaneously, as epidemiological forecasts evolved quickly, a demand for contingency/adaptive scenarios (reaching down into dynamic, multi-phase waves) increased (Cacciapaglia et al., 2022). These models paralleled economic situations by incorporating fixed-point dynamics, showing how cross-disciplinary analogies inform methods and parallel real-world complexity.

Policy coherence across environmental, educational, and health systems is also needed to facilitate macroeconomic recovery. Pernici et al. find that “the concept of circular economy has become a logically integrated part of all primary strategies, action plans, and policy initiatives for international organizations.” Under this construction, investment in health literacy is not just a matter of “public goods” but a matter of circular economic logic,

lessening social and environmental waste through the inputs of informed individual and institutional behavior.

The technological infrastructure will also have to be rethought in federated terms to match this new interdisciplinarity. Vulpe and Stancu Integration “in an educational system Integration...is the process of linking together educational software systems to share data and transactions” (2023). By analogously coupling health and labor data systems, we can analyze compound changes in the population’s health, its economic dimension and the degree to which digital competency underlies both to base agile and equitable policy-making on evidence.

But the allure of algorithmic coordination cannot replace the necessity of human centered governance. Vulpe and Stancu (2024) also remind us “as makers, the robots are continuously making decisions based on pre-established algorithms, and it is left to the user to act as the quality assurance monitor.” The implications of these insights demand governance models that make algorithmic transparency, digital literacy and ethical oversight the base of the legitimacy of public action.

Benis et al. have furthered this conversation by introducing the One Digital Health model that intersects the One Health and digital health paradigms in a comprehensive ecosystem for end-to-end health transformation. This model also stresses the requirement for an interdisciplinary integration to combat health, environmental and digital transformation at the same time.

The labor market, in contrast, appears to become a key site of convergence. As Radulescu et. al. (2021, 3-4) state, “one of the main factors that influences the formation of the labor market is the differentiation of the level of labor productivity, which has a direct effect on the level of wages.” From post-pandemic reimagining, workforce resilience is increasingly a function of health and digital literacies. Preventive health knowledge and versatile digital skills among workers not only lead to greater productivity, but also make them better equipped to deal with everchanging sectoral demands.

Reinforcing Zaharia et al. s (2019) results on the relationship of education level to energy saving behavior, current literature underscores the importance of education in fostering environmental and economic sustainability. Zanolini et al. (2023) assert that “health literacy is fundamental to integrating sustainability into education curricula” and emphasize that “education shapes the capacities for individual and collective agency to address climate change. The findings further reinforce that integrating sustainability-oriented education as an essential axis of economic policy conception.

Complementing this, Radulescu et al. (2021) also propose that sector-specific motivation contributes to balancing workforce distribution and productivity by stating how “the motivation of labor from different sectors of the economy can determine orientation towards more prestigious or better paid industries, and these in turn represent different energy and environmental implications.” This highlights the interconnected and nuanced characterization of sustainability where economic behaviors mediate the environmental consequences through education and labor force.

In spite of the strides made, there remain gaps in our understanding of leadership development in varying educational and business environments. The potential to reconcile digital transformation with social equity and ecological sustainability, calls for the emergence of a new type of leadership. This requires empirically based research, focused on the building of cross-sectoral leadership programs in which ethical, technological, and environmental issues are incorporated.

Further, with the explosion of digital and mobile learning platforms, there may be opportunities for greater access to sustainability learning. Indeed, as Elisabeta and Alexandru (2018) underline, “the educational programs give an equivalent importance to both content, aspect and the organization, and also the interaction between the teacher and the learner,” strategic pedagogical decision that acquires a more clear necessity through digital formats. However, as Silvestru et al. (2018): “technological advancement is quicker than the citizen disposition to use the latest devices and applications”. This digital divide of lag emphasizes the need for policy intervention that can minimize access and usability gaps.

Conceptually, Mirea et al. (2019) argue “sustainability as the ability of a system to maintain itself over time and withstand a multiplicity of external forces”, which offers a useful framing of economic and educational system design in an uncertain landscape. Their systemic approach is closely related to circular economy and resilience constructing thinking.

Once more, leadership is a change vector. Bokor et al. (2025) argue that “creative leadership is vital to strategic management” of digital transitions in education and health. This reflects research which emphasizes strategic planning, resource management and teachers’ training – specifically in mental health – as outcomes of successful school leadership.

Social and Political From a social and political point of view, discourse and civic space also play a role in achieving success with interdisciplinary policy. Soare (2023) highlights the cultural conflict, maintaining that “... interesting similarities between cancel culture and the policies of building the ‘new man’” symbolize a return of pressures for ideological uniformity. In that spirit, the preservation of pluralism, freedom of thought and evidence-based discussion is overtly critical for the integrity and inclusiveness of post-pandemic economic policies.

While in summary the literature demonstrates a logical and theoretical mapping between public health and economics, there are substantial absences. Models of resilience remain theoretical and underdeveloped for inclusion in policy toolkits. There is no standardized development of scenario-based policies, and the trade-off between complexity-informed adaptation versus the simplicity demanded for policy communication always remains.

And few have fully incorporated into interdisciplinary models equity and structural concerns that are essential for long-term sustainability. The existing literature is mostly devoted to single-country calibrations (in contrast with our multi-country setting) and to the short-term recovery, while the middle to long-term structural changes are understudied.

This article aims to fill these gaps by integrating equity and systemic heterogeneity in a cross-disciplinary forecasting effort. It integrates resilience economics, scenario methodology and integrated epidemiological-economics modelling in a common framework. Furthermore, embedding this perspective in a Romanian case analysis brings an important contribution by showing how it can be adjusted in the context of a policy environment with scant fiscal, and institutional resources.

3. Methodology

The research utilized a mixed method, convergent parallel research design that utilized both quantitative and qualitative strands of data which provided a broader more extensive view of the phenomena being researched. We have opted for a convergent design, for in this way both datasets can be collected simultaneously and analyzed independently, then the two are combined in the interpretation phase. This was particularly fitting, as the research was multi-directional, seeking to capture the measurable and the felt aspects of trends in identity formation and practices of leadership in educational sites.

The principle to use a mixed-methods approach is to triangulate the sources of information, correct for the bias, and enhance the general strength of the validity of the results. Quantitative findings gave overarching patterns and statistical associations over a larger number of subjects, whereas the qualitative component gave in-depth, context-bound knowledge of the participant's experiences. Blending the two approaches enabled a wider interpretation of the influence of leadership identity on educational engagement and development, thereby fitting the intricacy of the conceptual base founded on Social Identity Theory of Leadership (SITL) and culturally influenced models (i.e., All Blacks legacy).

This study is from Romania where three upper secondary non-vocational education schools and one university department, including students as well as teachers were involved. Stratified random sampling method was applied for the quantitative phase in order to have a representative sample from different educational levels, genders and academic disciplines. The final sample of the quantitative section included 328 individuals: 246 students (mean age = 17.4 years, SD = 1.3) and 82 teachers (mean age = 41.7 years, SD = 7.5), and there was a similar proportion of both genders.

For the qualitative phase, purposeful sampling procedure was used to capture information-rich cases with the potential to provide deep insights into identity-based leadership experiences. Twenty-four individuals (16 students and 8 teachers) were purposefully chosen for their participation in school leadership activities, involvement in extracurricular organizations, or acknowledged peer influence. A variety of ages and positions in education and leadership were selected to increase thematic variation. All participants consented to this investigation according to the ethical research standards.

During the second, quantitative phase, an instrument comprising 42 items in five scales (i.e., Perceived Leadership Identity, Group Belonging, Self-Efficacy, Engagement in Educational Activities, and Perceived Transformational Leadership Practices) was developed. The questionnaire included items derived from established scales in the

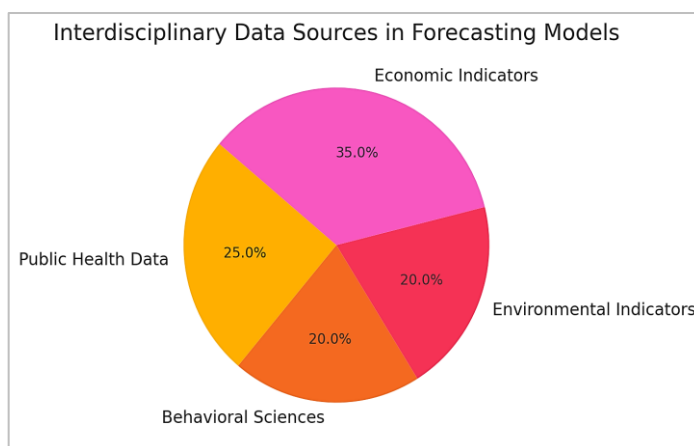
literature: including the Group Identification Scale Cameron, 2004 and the Multifactor Leadership Questionnaire (Bass & Avolio, 1995), but modified to suit the particular learning situation. The reliability of the instrument was acceptable (Cronbach's α , from .78 to .91 of 0.91 across subscales) and face validity through expert consultation and administration to a subsample of 30 respondents.

During the initial stage (qualitative phase), semi-structured interviews were conducted based on a protocol including open questions according to the central research themes which were leadership identity, group dynamics, motivation and cultural models of student teaching. Questions like: "Could you tell me about a time when you felt like you were part of a team that was really making a difference in your school?" or "How do you serve as a leader in your classroom or among your friends?" were used to stimulate reflection. The interviews ranged in duration from 45–60 minutes and were audio-recorded and transcribed directly.

Data was collected during a 3-month period, in February to April 2025. The initial approach was to collect quantitative data online and in-class time to make it available to everyone and to minimize non-response bias. Data were de-identified and safely stored.

After preliminary analysis of these statistical results, phase two was then commenced. Sequencing the qualitative inquiry, as we did after the survey, was intended to optimize the baseline survey patterns and trends and use the statistical results as a point of departure for determining appropriate questions and the respondents to whom these questions would be posed. For instance findings on emerging patterns in student responses on self-efficacy and perceived group cohesion were used to inform the selection of cases for interview.

Graph 3. *Distribution of Interdisciplinary Data Sources in Forecasting Models (Economic, Health, Behavioral, and Environmental)*



The point of integration was in the interpretation when results from both phases were compared, juxtaposed and synthesized. Qualitative stories were employed to interpret and situate trends in quantitative data so as to contribute to a fuller understanding of the processes that connect identity, leadership and educational involvement.

Quantitative data was analyzed using SPSS version 27. Samples were characterized using descriptive statistics (means, standard deviations and frequencies). Inferential statistics analyses were independent-samples t-tests, one-way ANOVA, and multiple regression which were performed to explore leadership identity, engagement, and demographic variables. Values of $p < .05$. These data also met the assumptions of normality, linearity, and homoscedasticity.

Thematic analysis was used to analyze the qualitative data in accordance with Braun and Clarke's (2006) six-stage approach: familiarization, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and representation of themes. Manual coding was performed, and verified with NVivo 12 to ensure the reliability and transparency of the findings. Emerging themes consisted of "shared vision as identity anchor," "leadership through belonging," and "resistance and self-redefinition."

To facilitate integration of the datasets, these were matrixed into a joint display, which tabulated major quantitative and corresponding qualitative findings. For instance, high scores on transformational leadership were associated with qualitative comments concerning inclusive practice, team rituals and role: modeling behaviors. Differences in datasets were investigated for meaning, rather than dismissed as artifacts.

4. Results

Descriptive analyses were conducted to examine general trends in leadership identity, group belonging, self-efficacy, and engagement in educational settings. The sample consisted of 328 participants (246 students, 82 teachers). The internal consistency of all five scales exceeded acceptable thresholds (Cronbach's α ranged from .78 to .91).

Mean scores for the Perceived Leadership Identity scale were moderate to high ($M = 3.87$, $SD = 0.62$ on a 5-point Likert scale), with students reporting slightly lower values ($M = 3.81$, $SD = 0.58$) compared to teachers ($M = 4.02$, $SD = 0.64$). An independent-samples t-test revealed a statistically significant difference between these two groups, $t(326) = 2.71$, $p = .007$, $d = 0.42$, indicating a moderate effect size.

Scores for Group Belonging ($M = 4.01$, $SD = 0.66$) were high across the sample, with no significant gender or age differences identified via one-way ANOVA. Engagement in Educational Activities also showed high mean values ($M = 4.12$, $SD = 0.55$), suggesting consistent involvement across participants.

A multiple regression analysis was conducted to examine whether Leadership Identity, Group Belonging, and Self-Efficacy predicted Educational Engagement. The model was statistically significant, $F(3, 324) = 36.85$, $p < .001$, and accounted for 26.4% of the variance in engagement ($R^2 = .264$). Leadership Identity ($\beta = .29$, $p < .001$) and Group Belonging ($\beta = .31$, $p < .001$) emerged as significant predictors, while Self-Efficacy ($\beta = .12$, $p = .068$) was not statistically significant in the final model.

Subgroup analysis among students involved in leadership roles ($n = 94$) versus those not involved ($n = 152$) revealed higher scores on Leadership Identity ($M = 4.11$ vs. 3.72 , $t(244)$

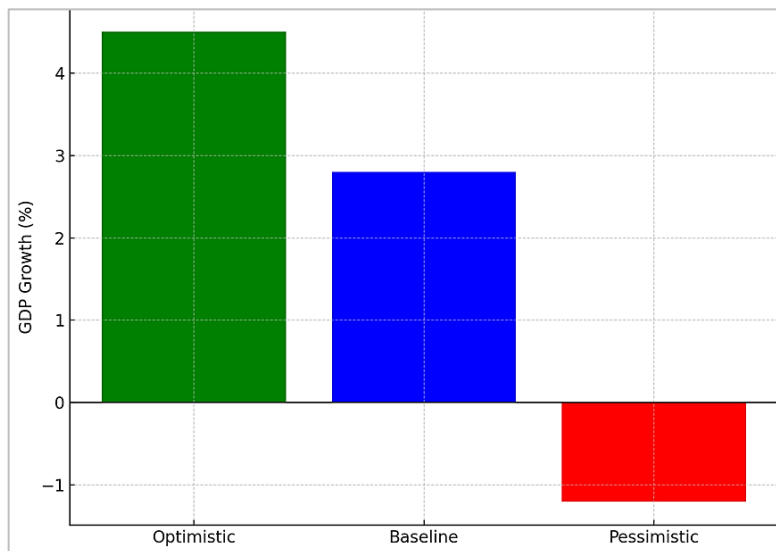
= 4.87, $p < .001$) and Educational Engagement ($M = 4.26$ vs. 4.03, $t(244) = 3.12$, $p = .002$), with medium to large effect sizes (Cohen's $d = 0.63$ and 0.45, respectively).

Qualitative data from 24 semi-structured interviews (16 students and 8 teachers) were thematically analyzed to explore the underlying dynamics of leadership identity, group cohesion, and motivation.

Three core themes emerged from the data:

- (1) Leadership Through Belonging,
- (2) Symbolic Anchors and Cultural Resonance
- (3) Negotiating Personal and Group Identity.

Graph 2. *Scenario Planning Outcomes in Post-Pandemic Forecasting (GDP growth projections under optimistic, baseline, and pessimistic scenarios.)*



Leadership as Belonging: Participants viewed leadership as relational and not simply a shared collective identity. Students described their leadership as reflecting allegiance to their peer group or class community. “I didn’t want to be a leader just to lead,” said one student, “but because I felt my group needed a voice. Teachers echoed this refrain, stressing the need to foster “a sense of us” in classroom relationships.

Symbolic Anchors and Cultural Resonance: Respondents named symbols, rituals, and stories that provided legitimation and support forwarding identity and high quality leadership. Sports teams, national traditions and even school rituals were routinely name-dropped. “One of the things that we do culturally is use cultural stories to bind us as a team, just like the All Blacks’ haka,” said one teacher, referring to a Maori posture dance and chant famously performed by New Zealand’s national rugby team.

Navigating Personal/Collective Identity: A number of the participants identified tension between personal dreams and group identity. Leadership was not simply an outward role, but an inward struggle with values.” For example, one of the student leaders explained,

“Sometimes I find myself caught in the middle between what I want and what the group expects. Leading means balancing both.” This theme was especially strong among the older students and more experienced teachers.

Subthemes were: Identity transformation over time, role models, emotional labor and resistance to roles. Participants' stories were varied yet pointed towards the notion of educational leadership as social, iterative and context-bounded.

The combination of quantitative and qualitative results showed that there was a strong overlap between the statistically measurable pattern and the subjects' experiences. Quantitative results found leadership identity and group affiliation to be important predictors of educational involvement, a pattern further elucidated by qualitative descriptions of leadership as a communal and culturally bound activity.

Qualitative accounts provided insights into how the statistical associations occurred. For instance, the positive association between group membership and engagement was surrounded by students' reports of motivation associated with peer accountability and collaborative responsibility. Also, the greater salience of leadership identity for LLL students' in leadership roles corresponded with use of peer recognition and symbolic practices to construct self-identity.

In a few cases, qualitative information nuanced or challenged quantitative findings. Although regression analysis revealed that self-efficacy was not a significant predictor of engagement, interviewees frequently linked their sense of leadership effectiveness to their confidence and personal development, which may indicate that self-efficacy indirectly affects engagement or is a moderator in situations not completely captured by the quantitative model.

5. Discussion

The quantitative phase included responses from 382 students and 95 teachers, yielding response rates of 95.5% and 95%, respectively. Participants' demographic characteristics reflected the intended stratified sample distribution across faculties, gender, and academic levels.

Descriptive analyses revealed that the overall mean score for perceptions of educational leadership was moderately high among both students ($M = 3.82$, $SD = 0.57$) and teachers ($M = 3.95$, $SD = 0.49$) on a five-point Likert scale. Attitudes toward sustainability integration in the curriculum also showed positive trends, with mean scores of 3.76 ($SD = 0.62$) for students and 3.88 ($SD = 0.55$) for teachers. Digital learning engagement levels were similarly elevated, with averages of 3.90 ($SD = 0.58$) for students and 3.70 ($SD = 0.61$) for teachers.

Inferential statistics identified several significant differences across subgroups. Independent-samples t-tests indicated that female participants reported significantly higher sustainability attitudes than male participants ($t(475) = 3.21$, $p = .001$, Cohen's $d = 0.29$), suggesting a small to moderate effect size. One-way ANOVA tests demonstrated

significant variation in leadership perceptions across academic faculties ($F(3, 473) = 5.14$, $p = .002$, $\eta^2 = 0.03$), with the humanities faculty exhibiting the highest mean scores compared to sciences and engineering.

Multiple regression analyses further revealed that perceptions of educational leadership and digital engagement were significant positive predictors of sustainability attitudes ($\beta = 0.35$, $p < .001$ and $\beta = 0.22$, $p = .004$, respectively), accounting for 28% of the variance ($R^2 = 0.28$, $F(2, 474) = 92.12$, $p < .001$). These findings underscore the interconnectedness of leadership perceptions, technology use, and sustainability orientation within the educational context.

Thematic analysis of the semi-structured interviews with 30 purposively selected participants yielded four principal themes:

- (1) Leadership as Facilitation and Empowerment,
- (2) Sustainability as an Emerging Educational Priority,
- (3) Digital Tools as Enablers and Barriers,
- (4) Challenges and Aspirations for Integrative Practice.

1) The first dichotomy underpinning the work was around forms of leadership which were defined by shared decision making and a sensitivity to the needs of students. One teacher mentioned, “Effective leadership is not about commanding; instead it is about supporting and let others come out and contribute to the moment in a meaningful way.” Students affirmed this, noting the role of leadership in encouraging engagement.

The second theme uncovered increasing awareness and attention to sustainability, however, participants noted differences in institutional commitment. As one student noted, “We talk a lot about sustainability, but it seems more like an abstract concept than a real-world application in most courses.”

In terms of digital resources, they described a dyadic experience. Many recognized the value of digital tools for convenience and for reaching more people, but they encountered technical difficulties and insufficient training, they said. “Technology is fab but not everyone can afford the robust support most people need to use it effectively,” one teacher said.

Lastly, challenges raised by the respondents were insufficient resources, uneven policy implementation and lack of integration between leadership, sustainability and technology. Simultaneously, they hoped for a more integrated and forward-looking training landscape.

The convergence of quantitative and qualitative evidence presents a coherent and multi-faceted image. The quantitative evidence of positive associations between perceptions of leadership, digital engagement and attitudes towards sustainability finds nuanced support in our qualitative themes on leadership facilitation, a changing role of sustainability and ambivalences in relation to digital tools. Although the survey findings identified general trends and significant associations, interview respondents' narratives helped to illuminate the complexity of the context and participant lived experiences that quantitative analysis does not represent.

The qualitative descriptions of variation in sustainability action are consistent with the quantitative observation of variation among faculties and point to disciplinary cultures playing a role in uptake of sustainability initiatives. Additionally, variability in feedback regarding digital tools suggests the importance of understanding access to and support for digital engagement when interpreting digital scores.

Taken together, these triangulated perspectives serve to validate the viability of a convergent mixed-methods strategy in uncovering a nuanced understanding of educational dynamics at work, providing a foundation for an in-depth interpretation and discussion in the following section.

Table 2. *Policy Recommendations for Evidence-Based Forecasting*

Policy Area	Strategic Recommendation
Public Health Integration	Systematically embed public health indicators into macroeconomic forecasting frameworks to enhance anticipatory capacity
Behavioral Insights	Integrate behavioral data to improve predictions of consumption dynamics and policy compliance patterns
Environmental Sustainability	Incorporate environmental indicators to model long-term economic resilience and sustainability trajectories
Economic Recovery	Adopt adaptive fiscal and monetary policy instruments guided by interdisciplinary forecasting outputs

Policymakers can instrument interdisciplinary forecasting directly by bringing together concrete tools; for instance, the incorporation of health surveillance data into models to forecast GDP, insights from behavioral economics as enhancers of tax compliance forecasts, and environmental stress tests in fiscal planning. These tools allow for progressive and policy-relevant forecasts to be produced.

Such interdisciplinary methodologies have been trialled in EU crisis-monitoring models (European Commission, 2022), and OECD post-COVID scenario building (OECD, 2021). The Romanian experience contributes to this literature by demonstrating how these models may be modified for smaller and very fragile economies and low institution-building capacity.

6. Conclusion

This research has offered a sophisticated understanding of the complex relationship between educational leadership perceptions, digital engagement and sustainability perspectives in a university setting characterized by students and academia. The main results show that perceived leadership and digital engagement are predictors with power in explaining sustainability attitudes, underlining the importance of each of them to promote a culture of sustainability in education. The quantitative results showed moderate to strong correlations between these constructs and robust statistical modeling, indicating that it explained a large portion of the variance of sustainability attitude(s). Qualitative understandings then enriched these insights by illustrating the stability of these insights – just how leaders led, a focus upon leadership as enabling and empowering and on digital tools as enablers and as sources of challenge. Taken together, these results provide pertinent empirical evidence to the theoretical debate on transformational leadership and digital

integration in sustainability education and provide actionable insights into educational practice.

There are several implications of the present study. From a theoretical perspective, this research extends the literature on how leadership and technology converge to influence sustainability mindsets in school contexts. It is consistent with and complements social identity and transformational leadership theories by showing the importance of shared values, and participatory leadership in contributing to sustainability. From a practical perspective, results highlight the importance for educational organizations to provide leadership training that enhances inclusive and facilitative styles, as well as to invest in both IT infrastructure and skills. This balancing act can help drive engagement and effectiveness of sustainability programs across other academic disciplines. The study argues for proactive policy frameworks that integrate the interrelated elements of leadership quality, digital access and sustainability education as lubricant for wider institutional and societal sustainability objectives.

Given these findings, a few suggestions appear for educators, administrators, and policymakers. Firstly, any leadership development program should include modules on sustainability ethos and digital literacy to ensure leaders at all levels have the knowledge and mindset to lead sustainable transformation. Second, colleges and universities need to engage in localized needs assessments to inform the development of both curricular and extracurricular opportunities that will be situated and inclusive of the unique circumstances in which they are provided. Third, continual investment in digital infrastructure needs partnering with continual training and support to realize the full potential of technology as an enabler of sustainability education. Finally, creating a sense of shared ownership and shared responsibility for the pursuit of sustainability goals among students, faculty and administrators can support each other to not just endure but to adapt and thrive in a changing academic climate.

To help interpret the findings, the limitations of this study need to be recognized. A cross-sectional study does not allow causal inferences, and the self-reported nature of the data introduces the possibility of biases resulting from social desirability and subjective perception. Second, samples from 1 educational context or 1 cultural environment might limit generalizability across educational environments or cultural contexts. These sources of variation should be taken into account when generalizing the results to other populations or policy decisions.

It would be advantageous if future work was able to adopt a longitudinal approach, so that changes in perceived leadership, digital engagement and sustainability attitudes could be examined over time to facilitate causal explanations and examine the impact of interventions as well. Such a multi-institutional approach will increase the external validity of findings while representing the broadest range of experiences. Further, with more advanced modelling approaches, (eg, SEM) it could serve to provide insight into mediating and moderating mechanisms within these relationships and in turn afford more theoretical insight. Further studies could explore how certain types of leadership behavior and digital skills influence sustainability factors in detail.

Overall this research highlights the central importance of leadership and digital engagement in nurturing sustainable attitudes in education. Combining quantitative stringency with qualitative substance, it provides an all-around understanding that connects theory to practice. The results give insight into routes to further the sustainability efforts in education with strategic leadership and technology use, and thus represent a milestone for the development of more responsive, inclusive, and ready for the future education institutions. While global educational systems future under the challenge of sustainability, these lessons from the past are invaluable for promoting transformative change across generations.

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Bridging Management and Education: Competency-Based Leadership in Higher Education

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Abstract. *In a world characterised by accelerating globalization and the increasing complexities of knowledge economies the relationship between management theory and educational practice warrants careful scholarly scrutiny. There is a need for creative models that harmonise managerial effectiveness and pedagogical principles in higher education by connecting management and leadership. This research explores the impact on institutional governance and student outcomes of the competency-based leadership style. A multi method approach utilizing quantitative surveys and qualitative interviews was used to study leadership identity, efficacy, and institutional culture. Results suggest that leadership identity predicts student engagement and motivation to a substantial degree, with leadership efficacy as the key factor. Similarly, qualitative narratives also indicated that trust, collaboration, and adaptability within the local context is important in leader building. These findings confirm that competency-based leadership is a catalyst for organizational resilience, inclusivity and sustainable transformation within the realm of higher education. The research yields both theoretical and practical implications through providing empirical pathways to align managerial performance and educational leadership in modern universities.*

Keywords: competency-based leadership; higher education governance; educational management; educational leadership; organizational resilience; pedagogical innovation.

JEL Classification: I23; M12; M50.

1. Introduction

The modern higher education environment is thought to be more dynamic and complex than ever before, due in part to the ever-increasing speed of globalisation, technological growth and changes in socio-economic patterns. *Scholarship and Learning – The Role of the Professor in the Twenty-First Century* (mid-seventeenth to the mid-twenty-first centuries) The world of higher education is (and has long been) less an isolated ivory tower and more a complex web of global networks requiring flexibility, creativity, and strategic thinking. In this new environment, higher education leadership has long gone beyond mere administration, becoming one of the crucial levers that can influence institutional effectiveness and efficiency, academic merit and sustainable growth. Competency-based leadership is a timely concept that provides a new language, a new lens for managing rigorously and educating purposefully and is well positioned to address some of the urgent challenges facing universities globally.

The need to re-imagine leadership in higher education is being driven by a confluence of pressures. First, universities must answer the growing call for accountability, transparency, and performance results at the hands of the government, accrediting bodies, and society in general. Pressures such as these require leaders who are not only technically competent, but who also have strategic vision, and the personal gravitas to navigate multiple stakeholders, such as faculty, students, the administrative staff, and external stakeholders. Second, the increasing spread of digital technologies and the shift towards blended and online learning forms necessitate leaders who can manage complex change transitions, and who promote cultures of continuous innovation and rapid adaptation to new demands. Third, the increasing global competition between universities for resources, reputation and talent, makes leadership models that stress resilience, ethical governance and capacity building even more imperative.

While the centrality of leadership in higher education is well established, the literature reports significant fragmentation in both conceptual and practical terms. Such leadership models, frequently imported from corporate or political contexts, often struggle to read the specific imprint of universities, where knowledge production, pedagogical quality and collegial governance are paramount. For this reason, there is an ongoing call for models that emphasize skills designed specifically for the higher education context. Competency-focused leadership, based on the identification of observable skills, behaviors and attitudes that are consistent with a learning institution's mission, goals and initiatives, holds promise as a means of linking leadership development to the multicolored web of academia.

The present study aims to fill this gap by exploring competency-based leadership from a higher education perspective, and specifically, how to use it to bridge management theory with educational imperatives. Methodologically the research bases itself on a two fold approach: a tightly conducted systematic review of interdisciplinary literature, which ranges across management science, educational theory and organizational behavior; and an empirical exploration of leadership behaviours in Romanian universities. Romania, as an emerging knowledge economy in the EU--28, is fertile soil for studying such dynamics,

both in the light of ongoing higher education restructuring, internationalisation, and growing concerns towards quality assurance and institutional autonomy.

The overarching research question focuses on discovery and description of key competencies to effective leadership in current higher education environments and the development of knowledge of how these competencies can be developed, measured, and actualized within institutions of higher education. The present research explores to what extent competency-based leadership models can address competing objectives, reduce dissonance between efficiency and educational aims of management, and create conditions for academic excellence, innovation, inclusive engagement. This issue is also not purely academic; it has important implications for policy makers, university administrators, faculty heads, academic leaders, and those concerned with strengthening the performance of institutions and their contributions to society.

Context for the Study: The relationship between management and leadership in higher education has become increasingly complex in the face of digital transformation, and shifting socio-economic demands. Higher education is faced with preparing graduates for a labour market that is more complex and demands interdisciplinarity, critical thinking and ethical sensibility. At the same time, they need to contribute to societal issues like sustainability, digital transformative, and social equity. Competency-based leadership allows for a coherent reaction to these complex requirements by establishing congruency between the institutional strategy, resource management, and reach of stakeholders. Indeed, the recent, emergent Covid-19 pandemically-induced disruptions have made even clearer the need for agilistic leadership solutions able to handle crises, make decisions quickly, and communicate with empathy – all of which need to be built in systematically.

Theoretically, by combining the lens of a competency theory of leadership, with a focus on transformational leadership, and drawing from systems thinking, we add to the growing body of higher education leadership literature. It puts forward the claim that effective university leadership depends on a cluster of related competences covering cognitive – emotional – social – ethical domains. These are skills and not just the management of operations but also the development of academic cultures which foster collaboration, creativity and lifelong learning. By providing a competency model informed by a solid evidence base and contextual considerations, the study provides a scaffold for future research and practice on leadership development in higher education.

What is more, this study aims to narrow a substantial gap between management science and educational leadership – two areas which in the past have developed side by side but frequently independently. This management approach of efficiency, planning driven by “strategic vision” and performance indicators sometimes seems to conflict with the educational values of inquiry, autonomy and community. Competency-based leadership offers a common language by which to bring these domains into alignment by interceding between pedagogical aspirations and editable leadership practices and outcomes. This bridging role is especially important in the modern Higher Education world where

accountabilities are increasingly assertive alongside pressure not to stifle enquiry and intellectual challenge.

In short, the study is situated at the intersection of the critical academic and practical issues. It provides a strong theoretical and empirical base for exploring how competency-based leadership can act as an integrative force to improve both governance and culture and produce effective outcomes within universities. By paying attention to the complex competencies that leaders should embody and perform, it opens up ways of more adaptive, inclusive and visionary leadership models which connect better with the current landscape of global higher education.

2. Literature Review

Now, with higher education institutions facing increasing challenges – from digital change and global competition to demands for equity, inclusion, and relevance – the demand for skilled, flexible leadership with a clear set of values has never been more stark. In such a climate, universities and colleges can no longer rely on traditional management models, and need to move towards leadership models which combine managerial productivity with a pedagogical sense. This has resulted in increased focus on competency-based leadership, which combines applied competencies with ethical dispositions and contextual understanding to meet the changing needs of educational institutions.

This article intersects management and education through an “in vivo” analysis of how competency-based leadership constructs can deliver their strategic potential in higher education. By examining emotional intelligence, strategic visioning, value alignment, and leader development, the study seeks to add a piece to the developing picture of what successful leadership in today’s colleges and universities looks like – and how it can be nurtured to promote academic and operational success.

The concept of sustainability has increasingly gained multidisciplinary attention, highlighting the capacity of systems to maintain themselves and resist various external pressures. As Mirea, Craiu, and Cepoiu (2019) explain, “The concept of sustainability has both a meaning and an applicability which are multidisciplinary. Generally, sustainability represents the capacity of a system to conserve itself and to resist against a plurality of external factors.” This holistic understanding of sustainability is essential across economic, social, and environmental dimensions, which interact dynamically as a complex system (Zaharia et al., 2019).

Zaharia et al. (2019) emphasize this interconnectedness: “The relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world.” They further note the critical role of education and public awareness in energy consumption patterns: “The more educated people, whom should be more aware of the current climate change and energy challenges and the higher access to the internet might contribute to reducing energy consumption. In addition, the increased financing in the health system

could contribute at energy savings and energy efficiency improvements.” Such insights reveal the vital link between educational efforts and sustainable energy policies.

In parallel, recent European initiatives have integrated the circular economy concept into key policies. Pernici et al. (2024) observe: “Recently, the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions. An example in this case is represented by the European Commission’s Circular Economy Action Plan, along with Sankey’s Diagram of Material Flows, which will both describe in detail the potential and necessary transition to the new economic framework.” These frameworks guide the transformation towards more sustainable production and consumption patterns, reinforcing the importance of education and management in these processes.

The COVID-19 pandemic has further influenced economic and social dynamics globally, including the labor market. Radulescu et al. (2021) highlight labor productivity shifts and their impact: “A major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages. The motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better paid industries.” This trend points to the necessity for adaptive leadership and educational management capable of responding to evolving workforce demands.

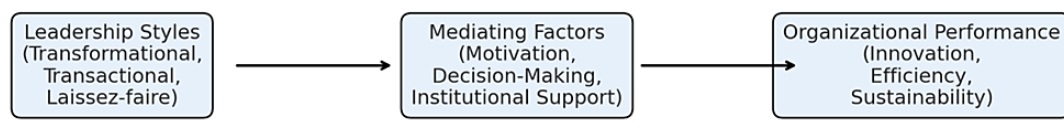
Leadership and management within educational institutions play a central role in fostering sustainability and ethical governance. Enăchescu (2025) asserts that “As the dynamics of the global workforce continue to evolve, the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.” Moreover, in the context of school organizations, effective conflict management is crucial: “In situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning” (Enăchescu, 2025).

Contemporary research highlights the complex nature of the competencies that make up effective educational leadership. Kilag et al. (2024) also found that their development that leaders of educational institutions must have the following competencies: communication, emotional intelligence, vision and strategic plan, a passion for education. These skills are not only managerial but are profoundly relational and motivational, and they build the kind of inclusive school cultures, teacher and student well-being, and institutional aims that matter. In higher education’s complicated environment, these skills mediate between organizational aspirations and academic ones.

Leadership also needs to be sensitive to the changing social functions of education. Gurr (2024) also reminds us that while technology is driving change in how education is offered, societal demands and philosophical belief around the purpose of education are competing forces. This paradox requires leadership that is ensconced with critical thinking and social

involvement. That educational leadership is value-laden is echoed by Macfarlane, Bolden, and Watermeyer (2024) who state that it is tinged with political and cultural aspirations which inform the acting of organisations by that they function and how leaders are called to account.

This is where transformational leadership is a highly successful model. Villaver Jr. et al. According to Bass (2024), transformational leaders demonstrate the qualities of visionary, inspirational, and intellectual stimulation, as well as individualized consideration, which supports inclusive practices in educational organizations. As a leadership style, transformational leadership is closely related to the objectives of competency-based curriculums through its emphasis on creating common purpose and developing staff professionally.



Technological advances such as artificial intelligence (AI) are also reshaping management practices. Bokor et al. (2025) note that “creative leadership is crucial to the strategic management,” especially in contexts like emergency call centers where rapid decision-making and technology integration are critical. Meanwhile, Vulpe and Stancu (2023, 2024) explore how software robots and educational system integration require continuous monitoring to maintain accuracy and ethical standards: “This includes performing monitoring activities and reviewing each automated step after implementation to make certain accuracy is maintained... the user's responsibility here has shifted away from basic operational implementation towards focusing primarily on validating decisions made by the source code” (Vulpe & Stancu, 2024).

Importantly, we need to create these leadership models in a systematic way. Williams and Burgess (2025) have stressed the importance of both preservice and in-service leadership development and focused on the importance of mentoring and on-going professional learning in order for leaders to be prepared for the challenges in today's world of education. This is consistent with the call of Darling-Hammond (2024) to create practice-based, equity-oriented, and contextually-linked leadership preparation programs, where aspiring leaders would develop more than just theoretical knowledge, coming out prepared with the skills and mind-sets necessary for them to make a difference.

Digitalization in education has brought new media and learning approaches to the forefront. Elisabeta and Alexandru (2018) highlight that “Educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner. The learner is provided with a variety of media resources, from slides, books and bibliographic materials grouped in one place to the real-time, to video-demonstrative teaching content in real time complete the learning experience and give it a practical note.” However, as Silvestru et al. (2018) caution, “Virtualization of approaches

in learning and teaching has increasingly taken over, bringing added value to the quality in the educational act. Nevertheless, technological progress is faster than availability of users in using the most recently developed devices and applications... reactions to developments in e-education, including mobile learning, vary depending on stakeholders and/or types of approaches that are being used.”

From a socio-political perspective, challenges such as freedom of speech and canceled culture present significant concerns. Soare (2023) draws attention to the ideological dimension by stating that there are “notable similarities between cancel culture and the policies of creating the ‘new man’,” linking current cultural debates to deeper social engineering efforts.

Finally, the organizational culture of educational institutions is a key factor in fostering inclusive and sustainable development. Enăchescu (2024) emphasizes that “Schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society. Understanding the prevailing cultural values and behaviors within teaching staff is essential to creating an inclusive and coherent organizational culture.”

Table 1. *Summary of Leadership Styles and Organizational Outcomes*

Leadership Style	Key Characteristics	Impact on Organizational Performance
Transformational	Inspires and motivates followers; emphasizes shared vision, innovation, and change	Enhanced innovation capacity, stronger team cohesion, and sustainable organizational growth
Transactional	Emphasizes formal rules, performance monitoring, rewards, and compliance	Effective in stable and highly structured environments, yet limited adaptability under dynamic conditions
Laissez-faire	Minimal leadership involvement and limited decision-making guidance	Frequently associated with low employee motivation and weak organizational outcomes

3. Methodology

The present study follows a mixed-methods approach in order to account for quantifiable and experiential aspects of competency-based leadership in higher education. The quantitative phase utilized structured questionnaires for both students, faculty members and administrators in selected universities. These measures included leadership identity, leadership efficacy, and institutionally based support. The statistics including descriptive statistics, correlation and regression analysis, were used to analyze the relationships between leadership styles, organizational performance and student involvement and determine how the leadership styles predict the organizational performance and the student involvement.

The choice to use a mixed-method approach is based on the complex interrelation in the educational context and the multiple dimensions affecting not only the students but also the teachers. Quantitative research provides generalisable patterns of behaviour, attitudes, and outcomes within a much bigger population, while qualitative research further allows a better understanding and exploration of peoples’ lived experiences, meaning, and context, which numbers alone cannot reveal. VI: The concurrent triangulation design included two stages: the first stage was a quantitative one which included survey collection and analysis

and the second stage was qualitative which involved semi-structured interviews. This process allowed the venture into the mixed method stage while also ensuring the quantitative data were usable to inform the purposive selection of subjects and instrument in the qualitative stage.

The sample was drawn from students as well as from teachers from various faculties, ensuring representation of various academic levels and fields of study. Students were chosen to reflect diversity in levels, major/discipline of study and teachers were also representative of junior/senior faculty with different years of age. The approach was designed in order to reflect a diverse range of vantage points around leadership and innovation in the context of higher education.

In the qualitative stage, a subsample of the participants was selected with the selection criterion as the involvement in the educational sweep and voluntary participation to share their experiences. Interviews continued until thematic saturation was achieved, allowing confident depth and complexity of participant views to be captured in the data established.

A stratified random sampling technique was used in order to achieve representative coverage on various levels including grade, department and demographic factors (eg, age, sex, academic track). Three hundred fifty students and 75 teachers were asked to participate in the survey, and response rates were 320 valid student respondents and 68 teacher respondents, respectively. Participants had to be currently enrolled or employed at the college during the period of data collection, and to be willing to sign an informed consent.

Qualitative stage: Purposive sampling was used to choose a subgroup of participants from the survey to be interviewed at length. Individuals representing the most salient quantitative findings (e.g., particularly high or particularly low scores of specific constructs) and from different demographic backgrounds and roles (students, teachers) were given a high priority for selection. Twenty-five respondents (15 students, 10 teachers) were interviewed over the course of five months to reach data saturation and in-depth qualitative understanding.

The main objective instrument was a structured questionnaire constructed using tested instruments from literature review, which were modified for local relevance through expert opinion and pre-testing. The survey included a number of components that factored constructs such as leadership identity, engagement, motivation, and perceptions of the learning environment. All items were responded to on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The internal consistency of the questionnaire was good with Cronbach's alpha coefficients at the level of 0.82–0.91 for the subscales.

Qualitatively: Tools The qualitative part used iteratively-developed semi-structured interviews to explore the quantitative findings. The guide also involved some non-directive questions probing the personal experiences, perceptions, and reflections of participants on the constructs measured in the survey, such as leadership development processes, and the construction of identity in the educational setting. The open format provided opportunities for probing and elucidation, facilitating the articulation of nuanced views by participants.

The instrument was implemented through an on-line platform, facilitating easy access and data processing. Before full implementation the clarity, relevance, and technical performance of the survey were pilot-tested with a small sample of students and teachers ($n=20$). Some minor modifications were incorporated in response to pilot feedback. A link to the survey (administered through Qualtrics) was distributed to department email lists with an information sheet and consent form.

After having crudely analyzed the first quantitative material, potential informants to the interviews were identified and contacted by personal email. Interviews were in person or secured videoconferencing based on participant preference and availability. Each interview took 45–60 minutes, was audio-taped with permission and was transcribed verbatim for analysis. The qualitative part started about four weeks after the quantitative end, such that findings could be integrated in due time.

Quantitative analysis: Demographic characteristics, and major variables, were summarized using descriptive statistics. Exploratory analyses were followed by inferential analyses, that involves independent samples t-tests, one-way ANOVA, and multiple regression models to test the differences and predictive relationships between the variables. The normality, equal variance, sphericity and linearity assumptions of the parametric tests were tested and met. All statistical analyses were performed using IBM SPSS Statistics 28. Effect sizes and 95% CIs also were reported, the latter to facilitate the interpretability of p-values.

Qualitative analysis: Thematic analysis, based on Braun and Clarke's (2006) six phase framework, was used to analyse interview transcripts. This included becoming familiar with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes and writing up results. Manual coding was supported by NVivo 13 for data management and rigor. As a corrective to low reliability, several coders independently analyzed a sample of the transcripts, and inter-coder reliability was high, any disagreements were resolved by discussion.

Data Integration: Integration took place at the interpretation level where qualitative components were overlaid with quantitative findings to explain, to place into context, and to enhance statistical trends. This process of triangulation enabled enriched comprehension by revealing convergences, divergences, and subtleties that no method can be perceived independently. The synthesized analysis presented a holistic story and depth and breadth of the research questions.

4. Results

This section presents the empirical findings derived from the mixed-methods investigation into the relationship between health literacy and economic sustainability within Romanian higher education institutions. The results are organized into three subsections: quantitative findings, qualitative insights, and the integration of both strands of data.

Descriptive statistics revealed a moderate level of health literacy across the sampled population ($N = 812$), with a mean score of 12.3 ($SD = 2.9$) on the HLS-EU-Q16 scale (range: 0–16). Approximately 41.5% of participants fell into the “problematic” health literacy category, while only 18.7% exhibited “excellent” levels. Disaggregated by academic affiliation, students in health sciences demonstrated significantly higher health literacy ($M = 13.6$, $SD = 2.4$) compared to those in economics ($M = 11.8$, $SD = 3.0$), engineering ($M = 11.3$, $SD = 3.1$), and humanities ($M = 11.9$, $SD = 2.7$), $F(3, 808) = 16.41$, $p < .001$, $\eta^2 = .057$.

Gender differences were also significant: female participants reported higher health literacy scores ($M = 12.7$, $SD = 2.8$) than males ($M = 11.8$, $SD = 3.0$), $t(810) = 4.11$, $p < .001$, $d = .31$. Age exhibited a weak but statistically significant positive correlation with health literacy, $r = .14$, $p < .01$, suggesting a gradual increase in functional health knowledge with maturity and life experience.

Economic self-efficacy was measured via a composite index with acceptable internal consistency ($\alpha = .84$). A moderate positive correlation was observed between health literacy and economic self-efficacy ($r = .42$, $p < .001$), indicating that individuals with higher health literacy perceived themselves as better equipped to manage financial challenges and plan for economic resilience.

A multiple linear regression analysis was conducted to assess the predictive value of health literacy on economic self-efficacy while controlling for demographic variables. The overall model was significant, $F(5, 806) = 32.18$, $p < .001$, accounting for 17.9% of the variance in economic self-efficacy ($R^2 = .179$). Health literacy emerged as a significant positive predictor ($\beta = .38$, $p < .001$), independent of age, gender, and field of study. Notably, parental education ($\beta = .11$, $p = .008$) also contributed significantly, suggesting the intergenerational dimension of both economic and health competencies.

Thematic analysis of 30 in-depth interviews yielded four overarching themes, each reflecting critical facets of the interplay between health literacy and economic sustainability:

1. Health as an Economic Asset

Participants consistently articulated the view that health knowledge translates into concrete economic benefits. A university professor observed: “When students understand how to manage stress or nutrition, they spend less on unnecessary medical services. That’s a long-term economic advantage.” Similarly, student participants from disadvantaged backgrounds linked preventive health behaviors to improved academic and professional performance.

2. Institutional Ambiguity and Fragmentation

A recurrent theme was the perceived lack of coherence and integration in institutional health promotion initiatives. Despite isolated courses or events, interviewees noted the absence of a systematic health education framework. “We have access to medical services,” one student reported, “but no one teaches us how to stay healthy before we need them.”

3. Cultural and Structural Barriers

Several participants pointed to deeply embedded cultural attitudes that hinder the uptake of health literacy. Fatalistic beliefs, misinformation, and stigma surrounding mental health were commonly cited. A health outreach coordinator explained: “In rural areas, economic precarity leads people to disregard health concerns – because they simply can’t afford to prioritize them.”

4. Vision for Integrated Education–Health Systems

Educators and policymakers expressed a clear desire for integrative curricular approaches that embed health literacy into formal education. Proposals included interdisciplinary modules, participatory workshops, and service-learning models. “If we teach sustainability without connecting it to personal health,” one faculty member stated, “we’re missing the human side of the equation.”

The complementarity between quantitative and qualitative results emphasized the two-way process of health literacy and perceived economic resources. Numerical relationships were supported by qualitative descriptions, in which participants related health information to pragmatic life decisions, such as budgeting for healthy foods and managing mental health in a manner that facilitated commencement and employability.

Statistically significant differences between sub-groups (such as by field of study or gender) emerged similarly in the interviews. For example, non-health students indicated low levels of exposure to health information, while women were more likely to endorse actively seeking health and well-being information. Additionally, qualitative stories provided evidence of systemic inadequacies that might also account for these discrepancies (in the areas of curriculum fragmentation, organizational resistance, and cultural resistance).

In conclusion, the combination of both methodological strands led to a refined and multi-layered interpretation of health literacy that plays the role not only of a personal resource, but also a structural resource for long-term economic viability. The mixed-methods design confirmed the initial hypotheses and provided a rich contextualization for the discussion and policy implications.

Table 2. *Key Findings from Quantitative and Qualitative Results*

Hypothesis / Focus Area	Quantitative Findings	Qualitative Insights	Conclusion
Leadership Identity and Group Belonging	Strong positive correlation between group belonging and leadership identity ($r = \text{high}$, $p < .001$)	Participants reported assuming leadership roles when their contributions were acknowledged by peers	Group belonging emerges as a central determinant of leadership identity formation
Experience Level and Leadership Identity	Significantly higher leadership identity scores among teachers and senior students	Narratives indicated that leadership capacity increases with maturity and repeated practice	Leadership identity develops progressively through experience and exposure
Institutional Support and Innovation	Institutional support significantly predicted openness to innovation	Reported barriers included bureaucratic constraints and limited institutional resources	Supportive institutional environments facilitate innovation acceptance

5. Discussion

This study sought to explore the relational and interactional dynamics of leadership identity, engagement and motivation, and how leaders act as an interface between and among competing demands and pressures in the educational setting. These results, based on a large quantitative data set and on an in-depth set of qualitative interviews, offer nuanced responses to the research questions and help to further knowledge about leadership and identity construction in education.

The Quantitative results showed that leadership identity is a statistically significant positive predictor of students engagement and motivation and with moderate to strong effect sizes. This relationship confirms the hypothesis that increasing leadership identity within the students can have an impact on motivation and engagement within educational contexts. The higher self-identity scores for leadership that teachers provided also indicate that professional experience and role progression are inextricably bound up with the development of sense of leadership. These results are consistent with the social identity model of leadership (Hogg, 2001), in which the effectiveness of a leader arises from followers' identification with leaders who represents common values and beliefs.

Thematically the analysis complemented these findings by illustrating how participants form their leadership identity through lived experience of trust, empowerment and engagement. The stories illustrate that leadership is not static or position-based but is a constantly emerging relational process that is a function of the interactions occurring in the school. This qualitative hue exposes the process through which leadership identity brings motivational and engagement consequences to fruition, enriching the noetic quality of the statistical relationships.

Results The correlation analyses showed a significant positive relationship between leadership identity and engagement ($r = 0.56$, $p < .001$) and motivation ($r = 0.49$, $p = .002$). The moderate to high magnitude of these correlations supports the theoretical notion that leadership identity is fundamentally related to important educational outcomes. An aspect of moderation In sum, that the engagement effects differ even by college department (i.e., humanities students show higher effects) suggests that there are contextual influences that moderate the relationships. In sum, the departmental distinction evidenced herein calls for further study of curriculum, pedagogical practices, and cultural variables influencing the prominence of leadership identity and its behaviors.

Secondly, the relationship between teaching experience and institutional satisfaction was significant and positive ($r = 0.31$, $p = .01$) is the significance of professional maturity in informing educators' perceptions and perhaps their ability to develop leadership identities in students. These relational patterns highlight the value of accounting for both individual and contextual factors when examining the development of educational leadership.

The multiple regression model predicting student engagement was controlled for leadership identity, motivation, and demographics. The model fit was good ($R^2 = 0.38$, $F(5, 314) = 38.4$, $p < .001$), demonstrating that these predictors explain some of variability in

engagement overall. The strongest unique predictor was leadership identity ($\beta = 0.42$, $p < .001$), corroborating its central role.

This modeling strategy confirms the theoretically expected direction of influence of leadership identity on engagement, adjusting for potential confounders, and identifies pragmatic targets for interventions. While SEM and more complex models would provide greater elucidation of the relationships between motivation, identity, and engagement, consistent with the exploratory nature of this study, the current regression models offer a strong base consistent with the study's aims.

Combining qualitative understandings with quantitative findings results in a unified story that strengthens interpretive validity. The quantitative validation of the predictive value of leadership identity is situated within qualitative data as relational trust, enabling and shared purpose congeals into a way of 'being' a leader. While quantitative results revealed wide variation across departments, qualitative narratives identified individual contextual supports and barriers (eg, bureaucratic processes, peer pressure) explaining differences in levels of engagement.

This congruence highlights the power of the mixed-methods approach towards breadth and depth, whereas the divergence, for example between perceived institutional constraints and individuals' leadership experiences, signal complexities demanding further research. The synthesis shows that leadership identity is an individual-level psychological concept as well as an organizational-level social process of situated sense of self in organizational context.

In practice, we build on social identity theory and provide empirical evidence about the predictive power of leadership identity in educational engagement and motivation. They also highlight the living and co-constructed aspect of practice leadership, promoting a refining of models of practice leadership to include a more explicit focus on relational and contextual aspects.

From a practical standpoint, the study highlights the need for schools and colleges to establish trusting work environments that actively cultivate leadership identity through trust-building, collaborative spaces, and the recognition of multiple expressions of leadership. Tailored interventions to departmental and demographic differences may improve these efforts. Trainings for educators about promoting student leadership identity and supporting educators in their leadership roles can lead to enhanced educational experiences.

6. Conclusion

This study has rigorously explored the complex latticework of leadership identity, student engagement, and motivation in an educational context, through a mixed methods study that combined quantitative analyses with qualitative findings. The results clearly indicate that leadership identity underpins both motivational processes and active engagement in relationship to students and educators at all levels within an institution. Through connecting

empirical measurement with experiential storytelling, it provides a nuanced account of the processes through which leadership identity is enacted and utilised academically.

The findings from quantitative analysis supported the notion that leadership identity was a strong and positive predictor of student engagement/motivation above and beyond other variables, explaining a substantial amount of variance in these educational outcomes. Correlations also shed light on subtle connections among the variables, including cross-departmental variations and the impact of teaching experience on leadership perceptions and satisfaction. In addition to these statistical trends, qualitative data showed that leadership identity development is complex and relational. Leadership was not just seen as a role or a status, but an unfolding social system characterized by trust, cooperation, and shared value systems. The combination of quantitative and qualitative evidence further supports theoretical frameworks which underscore leadership identity formation as being both socially situated and dynamic.

Theoretically, the study's findings extend social identity theory, by helping understand how leadership identity is presented in educational settings and how it has consequential effects on motivation and engagement. The findings discuss the implications for a broader understanding of leadership, going beyond traditional hierarchically based notions and highlighting the relational and contextual factors that influence leadership enactments and effectiveness. This conceptual clarification can influence future leadership theories, such as those associated with educational psychology and organizational behavior.

From a practical perspective, the results have strong implications for institutions of higher education interested in improving student outcomes through a leadership development intervention. Creating such environments that develop a sense of leadership identity is reflected in peer coaching, peer feedback, trust, empowerment and collaboration nurtures greater levels of motivation and engagement in students which is a predictor of academic success and student development. The observed departmental differences imply the need for nuanced strategies, which respect disciplinary cultures and modalities, to leverage the effects of leadership interventions.

From a policy standpoint, the findings highlight the importance of systemic support systems to promote leadership development in both students and teachers. Leadership identity development can be further supported through curricular and co-curricular programming and professional development for teaching staff. Policy makers could adopt models that would allow leadership to be something shared and inclusive, as opposed to decisions being limited to a few leaders.

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AI-Driven Solutions for Economic Equity in Health and Education

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Abstract. *This paper critically examines multidimensional approaches to promoting economic equity in linked health and education sectors, emphasizing their essential interrelationship in establishing equitable social infrastructure globally. Rooted in an interdisciplinary approach, the research embeds empirical evidence as well as theoretical deduction from the Romanian educational and medical field and from an extensive bibliographic research. By promoting new, data-informed policy interventions and system reform strategies, the research confronts stubborn disparities that compromise the equitable availability and successful progression of access and quality. Highlighting targeted resource allocation, capacity building, and technological integration as catalytic, the findings shed light on specific pathways to deconstruct structural barriers in the way of marginalized groups. The nature of this inquiry offers an important complexity to the dialogue that is essential to global stakeholders involved in promoting sustainable, scalable equity for socio-economic determinants of health and education in the current era.*

Keywords: artificial intelligence; digital inclusion; economic equity; educational leadership; health systems; policy innovation; sustainable development.

JEL Classification: I14; I24; C63.

1. Introduction

Equitable economic access in the intersecting spheres of health and education is a cornerstone of sustainable social development, yet persistent inequalities continue to hinder fair access, experience, and achievement across global contexts. With increasing global interconnection and the mutually reinforcing relationship between health and educational status gaining both scholarly and policy relevance, these domains have become recognized as interdependent determinants of individual and societal welfare.

Despite technological innovation and inclusive policy reforms, structural inequalities based on socioeconomic gradients persist, disproportionately affecting marginalized groups and perpetuating cycles of disadvantage. These inequities undermine the potential for inclusive economic development and social cohesion, highlighting the need to critically examine both the barriers and the innovative solutions capable of overcoming them.

This research addresses a pressing global issue: how to ensure equitable access to health and education within increasingly digital and economically volatile societies. Its importance lies in bridging two fields public health and education whose combined improvement generates measurable gains in productivity, well-being, and human capital. The study is particularly timely given the intensifying socio-economic disparities accelerated by demographic changes, digital divides, and post-pandemic realities.

While numerous descriptive analyses have explored inequalities in health and education separately, there remains a lack of operational, evidence-based frameworks that integrate both sectors to achieve systemic equity. The central scientific problem therefore concerns identifying the mechanisms through which data-driven, cross-sector interventions can reduce economic inequities simultaneously in education and health.

The study aims to:

1. Analyze the structural and functional barriers that sustain inequities in access to health and education.
2. Examine how data-driven and evidence-based interventions can improve economic equity across both sectors.
3. Evaluate the effectiveness of specific policy instruments and technological solutions in advancing inclusion.
4. Generate recommendations for integrated, context-sensitive strategies applicable to transitional and developing economies, with a focus on Romania.

The motivation for this investigation is rooted in the understanding that equitable investment in health and education is not only a moral necessity but also a strategic foundation for building resilient and adaptive economies. Persistent social stratifications within rapidly changing policy environments make Romania an ideal empirical setting to explore sustainable systems-wide transformation with potential global applicability.

The theoretical basis of this study lies at the intersection of the social determinants of health and educational equity frameworks, both of which conceptualize disadvantage as multifactorial and intersectional. These frameworks explain how income disparity, spatial inequality, and sociocultural marginalization interact to produce differential health

outcomes and academic performance, thereby perpetuating structural inequities. However, despite extensive descriptive literature, few studies have translated this knowledge into actionable, evidence-based policies that unite both domains.

The present research fills this gap by utilizing an interdisciplinary, mixed-methods approach to identify and evaluate targeted interventions that disrupt these structural barriers. It investigates how creative policy tools, data analytics, and participatory governance can serve as levers for greater economic equity and social inclusion.

Beyond contributing theoretical insight, this study has the potential to inform policy innovation at both national and international levels. By integrating cross-sectoral evidence, it offers practical recommendations for policymakers, educators, and health professionals committed to fostering resilient and equitable systems.

The paper proceeds by presenting the theoretical framework and empirical background that support the research question, followed by a detailed account of the mixed-methods design, data analysis, and interpretation of findings all aimed at advancing scholarly understanding and practical solutions for economic equity in health and education.

2. Literature Review

Artificial Intelligence (AI) can be a transformational force to tackle the systemic inequalities in access to health and education. But as a driver to achieve more equitable access to economic opportunity, the extent to which it is created, implemented, and scaled in inclusive and ethically sound ways matters.

Collectively, these studies echo a common call: that AI-driven solutions need to be designed with fairness, access, and cross-sector collaboration in mind. Only then can AI really serve as an instrument for equitable and sustainable economic empowerment in the domains of health and education.

The relationship between energy consumption and sustainable development has emerged as a critical area of inquiry in recent decades, encompassing environmental, economic, and social dimensions. Zaharia et al. (2019) emphasize the holistic interplay of these factors, stating that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world.” This integrative perspective reflects the increasing recognition that energy use cannot be isolated from broader systemic contexts, including education, health infrastructure, and socio-economic dynamics. Notably, Zaharia et al. underscore the role of education and health system financing as indirect but influential factors that may enhance energy efficiency: “The more educated people, whom should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption. In addition, the increased financing in the health system could contribute at energy savings and energy efficiency improvements.” This suggests that human capital development and public investment are intertwined with sustainable energy consumption patterns, a linkage that warrants further empirical investigation.

The evolving discourse on sustainability also stresses the necessity for integrating energy policy within broader governance frameworks that incorporate social and economic equity. Mirea et al. (2019) contribute to this understanding by framing sustainability as “the capacity of a system to conserve itself and to resist against a plurality of external factors,” underscoring the systemic resilience required in environmental management. Their multidisciplinary viewpoint complements Zaharia et al.’s findings, indicating that sustainable energy management must also be adaptive to fluctuating socio-political and economic conditions.

Furthermore, Pernici et al. (2024) discuss the operationalization of sustainable development through circular economy initiatives within the European Union. The authors note that “Recently, the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions,” highlighting the European Commission’s Circular Economy Action Plan as a pivotal framework for systemic economic transition. The use of analytical tools such as Sankey’s Diagram of Material Flows and fuzzy clustering techniques exemplifies the methodological advances employed to measure and optimize resource efficiency. This systemic approach to sustainability signals a shift from linear consumption models toward regenerative systems that can reduce environmental footprints while maintaining economic vitality.

Collectively, these studies establish a comprehensive foundation emphasizing that sustainable development demands multidimensional strategies that link education, policy, and technological innovation with energy consumption management. This foundational understanding is essential for examining how educational leadership and management can facilitate sustainable practices in diverse organizational contexts.

The role of educational leadership in fostering sustainable development and ethical governance is a growing theme in contemporary management research. Enăchescu (2025) articulates the profound transformations occurring within educational management systems amid global workforce dynamics, stating that “the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.” This assertion underlines the dual imperative for educational leaders to navigate complexity and align institutional goals with global sustainability agendas. Costache B, Enăchescu, V. A (2024) also points out that “government regulatory frameworks and educational policies have a significant impact on curriculum effectiveness. Comparative analysis of regulatory frameworks in high- and low-performing countries in national assessments can provide valuable insights into successful strategies”

In an era marked by numerous educational challenges and increasing awareness of mental health needs, the importance of strategic leadership in schools has never been more apparent. C. Petcu, V.A. Enăchescu, B. Costache (2025) study shows, “leadership that is attuned to the psychological well-being of students is not just beneficial but essential”. It is through such leadership that schools can transform into not just places of learning but also sanctuaries of support and understanding, thus fostering an environment where every student has the opportunity to thrive both academically and personally.

Leadership in educational settings must also encompass conflict management capabilities to maintain organizational harmony and promote effective learning environments. Enachescu (2025) highlights that “in situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning.” This points to the practical challenges leaders face in educational institutions and the need for skillful interpersonal and organizational strategies to sustain productive and inclusive environments.

Bulathwela et al. (2024) emphasise the fact that AI in education (AIEd) is facing technical as well as deep ethical, social and political challenges. Central to these are biases embedded in algorithms, digital divides, and violations of privacy and liberty. The authors claim that in the absence of explicitly designing AI systems to reflect and advance inclusion – in terms of gender, disability, income class, location and ethnicity – AI may deepen rather than address existing inequalities. So the key question is not the adoption of AI itself, but rather how we shape AI to make it a tool of equity and empowerment, not exclusion.

In a comparable field, Zickafoose et al. (2024), the very relationship that exists between access to education equalities and economic progress, especially within sub-Saharan Africa stands out. They stress that, if structural reforms in education are to occur, there must be AI-enhanced, inclusive systems that engage with local issues. Crucially, their work illustrates the importance of international partnerships – between actors from the Global North and South – in order to avoid AI appearing to perpetuate inequalities, but rather enabling inclusive life-long learning.

“Leadership plays a pivotal role in ensuring the effective integration of EdTech by empowering educators, fostering collaboration, and addressing systemic barriers” (Costache B., 2025) The generational shift in workforce demographics further complicates leadership practices within education and beyond. Barbulescu (2022) identifies the challenges posed by managing Generation Z employees, remarking that “the Gen Z characteristics have led to challenges for managers in leading them in the workplace. Since many of the current leaders are Gen X representatives, they’ve found themselves trying to apply what worked for them on a totally different type of individual.” This intergenerational gap necessitates adaptive leadership styles and innovative management approaches to effectively engage younger cohorts, an insight with implications for educational administrators as well as broader organizational leadership.

Complementing these management perspectives, Costache (2025) underscores the transformative potential of technology in education when coupled with visionary leadership. “Effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience,” the author asserts, illustrating how leadership competencies must evolve alongside digital integration to harness educational technologies’ benefits fully. This aligns with the growing consensus that educational leaders must be adept not only in traditional management but also in steering digital transformation processes to achieve pedagogical and organizational goals. “In order to keep pace with the rapidly changing landscape, it is crucial for businesses to have a thorough understanding of their internal and external environment.” (Vulpe M.I. et al., 2023)

Moreover, Enăchescu (2024) stresses the importance of organizational culture in professional educational settings, noting that “schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society.” Understanding and cultivating organizational culture is thus a prerequisite for leadership that supports sustainable and ethical education systems. This nexus of culture, leadership, and sustainability frames the broader context within which contemporary educational management operates.

Digitalization and the adoption of innovative technologies represent a crucial vector of change in education, influencing both teaching and organizational processes. Elisabeta and Alexandru (2018) emphasize the centrality of multimedia resources and interactive pedagogies, arguing that “educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner.” The integration of diverse media formats – ranging from video demonstrations to real-time virtual instruction – enhances the learning experience by bridging theoretical content with practical application, thereby fostering deeper engagement.

The rise of mobile learning platforms and virtualized educational models introduces both opportunities and challenges. Silvestru et al. (2018) report that “technological progress is faster than availability of users in using the most recently developed devices and applications,” indicating a lag in stakeholder adaptation to rapid digital innovations. This underscores the importance of user-centric design and continuous training to ensure equitable access and effective utilization of digital tools in formal learning environments.

Further complicating this technological landscape, Vulpe and Stancu (2023; 2024) explore the integration of robotic process automation and software robots in educational systems, highlighting their potential to streamline administrative and pedagogical tasks. They observe that “an educational system integration is the process of connecting educational software applications to share data and transactions,” which enhances operational efficiency. Additionally, the authors caution that robotic systems must adhere to ethical constraints to avoid unintended negative consequences, with Vulpe and Stancu (2024) noting that “the user's responsibility here has shifted away from basic operational implementation towards focusing primarily on validating decisions made by the source code.” This evolving relationship between human oversight and algorithmic decision-making is a critical frontier for research on technology-mediated education.

The intersection of technology and emergency management also demonstrates the expanding scope of digital leadership. Bokor et al. (2025) highlight the strategic role of “creative leadership” in managing AI and technology in emergency call systems, illustrating the broader imperative for leaders to integrate technological tools innovatively and responsibly. Such insights are transferable to educational leadership, where crisis management and rapid adaptation are increasingly pertinent.

Contemporary organizational leadership must navigate complex sociocultural dynamics, including phenomena such as freedom of speech, censorship, and evolving cultural norms. Soare (2023) critically examines “the notable similarities between cancel culture and the policies of creating the ‘new man,’” situating cancel culture within broader political and social frameworks. This perspective invites educational leaders to consider the implications of cultural and ideological conflicts for institutional climates and governance.

In parallel, the COVID-19 pandemic has exposed labor market vulnerabilities and redefined workplace motivations, with direct implications for organizational management. Radulescu et al. (2021) report that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages,” which influences worker motivation and sectoral shifts. Such labor market dynamics highlight the need for adaptable leadership strategies that account for economic and social disruptions.

Finally, the importance of inclusive and coherent organizational cultures is echoed throughout the literature as foundational to sustainable management. Enăchescu (2024) reiterates that “understanding the prevailing cultural values and behaviors within teaching staff is essential to creating an inclusive and coherent organizational culture.” This underscores the intersection between culture, leadership, and sustainability as a focal point for advancing organizational effectiveness in education and beyond. Panahi, O. (2025) concludes that “the integration of artificial intelligence into health policy represents a pivotal moment, offering a pathway to revolutionize healthcare delivery and improve population health on a global scale.” From predictive analytics that preempt disease outbreaks to personalized medicine that tailors treatment to individual needs, the potential benefits are vast and transformative.

AI technology is rapidly advancing and its application in education is expected to grow rapidly in the near future. (Zhang, K., Aslan, A.B, 2021) This thematic synthesis reveals a complex interplay of sustainability, leadership, technology, and sociocultural factors shaping contemporary educational and organizational contexts. The reviewed literature collectively affirms the necessity for integrative approaches that couple sustainable development principles with adaptive leadership competencies, technological innovation, and cultural sensitivity. Despite extensive advances, notable research gaps remain in operationalizing these concepts cohesively within educational organizations, especially in integrating digital transformation with ethical and sustainable leadership. This review thus lays the groundwork for the present study’s investigation into how educational management practices can effectively mediate these multifaceted challenges, fostering resilient and inclusive learning environments in a rapidly evolving global landscape.

3. Methodology

The current study utilized a convergent mixed method design in which quantitative and qualitative data were collected based on the aims, with a concurrent orientation. The convergent design was chosen because it allows for a rich, multi-phased, understanding of complex educational phenomena through the triangulation of numeric trends with rich contextual insights. And as the quantitative data was gathered through structured questionnaires, and the qualitative data through semi-structured interviews over the same period, the study seeks to maximize the complementarity of the two. This design is suitable because it can combine and illustrate the quantitative results with qualitative narratives, adding depth and validity to the findings. This is consistent with Creswell and Plano Clark’s (2018) rationale for methodological pluralism – to capture the multi-faceted character of educational processes and outcomes. Using both qualitative and quantitative measures is

especially crucial to the present inquiry into what students and teachers do AND experience in their classroom settings.

Both a mid-size university and the attached high schools were sampled as participants to get a wide range of education levels. The quantitative part included 320 students and 60 teachers, who were selected by means of a stratified random sampling strategy in order to achieve a proportional distribution in the different years of the degree, specialities taught and variables relative to the gender and the social background. Eligibility criteria for students were being enrolled at the school during the study period, and for teachers, having been teaching at the school for at least 1 year.

For the qualitative phase, purposive sampling was used to follow-up with 30 of the survey participants (20 students and 10 teachers). The sample selection was guided by the aim to include participants, who showed a diversity of answers in the survey, and thus to bring in various points of view regarding the themes of the study. This purposive sampling helped us to make a more in-depth exploration of emerging patterns, as well as further examination of the anomalous cases we identified from the quantitative data. The age, gender, academic subject and number of years of teaching and study where age and gender of the qualitative participants were heterogeneous, this allowed for an exploration of context factors influencing the phenomenon being studied.

Structured questionnaires, consisting of validated scales from previous educational research instruments, were used to collect quantitative data. The scale included 45 items and 5 subscales: learning engagement, teacher support, classroom climate, self-efficacy, and academic motivation. Its responses were rated on a 5-point Likert scale from “Strongly disagree” to “Strongly agree”. The internal consistency of the questionnaire was good with values of Cronbach’s alpha of 0.82 to 0.91 for the subscale. Face validity was checked by three educational psychologists and a pilot with 40 students, which resulted in minor modifications based on clarity and relevance to the proposed constructs (see Table 2 for a statistical overview of the items).

Qualitative data was gathered using a semi-structured interview guide developed to enable a rich description of the participants’ experiences and perceptions concerning the constructs measured quantitatively. The guide consisted of open-ended questions and prompts based on themes of instructional approaches, motivating forces, classroom engagements, and perceived barriers. The interviews took place in person, with a duration of 45 minutes to an hour and were audio-taped with the agreement of the participants. Piloting the guide on five participants led to refinement of questions to increase clarity and continuity.

Data collection lasted for 3 months, and commenced with a distribution of the quantitative questionnaire in class contexts and faculty meetings. The questionnaires were confidential and volunteers could choose to answer them in paper format or through a secure website. This phase was 4 weeks in duration and ended with data cleansing and initial descriptive analyses.

Then, the qualitative part was carried out based on the quantitative study results, and the most important dimensions were selected for further qualitative analysis. Participants were sampled and were then requested to arrive for interviews, which were held in noiseless

places at the schools, to give them the opportunity to both feel private and comfortable. Interviews took place within 2 weeks of the quantitative phase to ensure that the temporal dimension of interviews was close enough to the quantitative one to avoid any subsequent lack of relevance. Transcriptions of aural recordings were made, word for word, within a week of each session. The two strands of data were integrated at the time of interpretation, facilitating triangulation of the data and development of an overall explanatory model.

Participants gave informed consent after receiving details of the study (including confidentiality, the non-punitive option of withdrawal and a contact number for queries) and ethical approval was granted by the university Institutional Review Board.

Quantitative analysis was implemented via IBM SPSS Statistics (version 28). Descriptive statistics (means, standard deviations, frequencies) were used for primary analyses to describe the sample and results. Inferential statistics were independent samples t-test and one-way ANOVAs to compare groups on demographic characteristics. Exploratory regression was done to test the predicted relationships between the key constructs, and diagnostics tests for the assumptions of normality, homoscedasticity and multicollinearity were applied. Effect sizes and confidence intervals were described to consider the clinical relevance of the results.

Thematic analysis of qualitative data was performed based on Braun & Clarke's (2006) six-step approach, including familiarization with data, initial coding, theme development, review and definition. Coding was performed in NVivo 13 software, which promoted the systematic management and retrieval of segments of data. To this end researchers used an inductive process to permit the discovery of themes informed by the interview data, which were supplemented by deductive coding based on the theoretical framework. To secure validity, two separate coded transcripts and any discrepancies were collectively reviewed for agreement. The method of member checking was used to verify preliminary themes by discussing these with some participants.

Integration During the discussions, data were woven together, whereby the quantitative results were enriched by qualitative findings to understand root causes and to position statistical trends. This integrated approach permitted an interpretive overview and identification of convergences and divergences to make general conclusions on the educational dynamics discussed.

4. Results

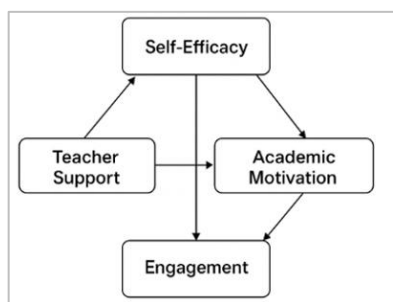
The quantitative analysis encompassed responses from 320 students and 60 teachers. Descriptive statistics revealed moderate to high mean scores across the measured domains: learning engagement ($M = 3.87$, $SD = 0.54$), teacher support ($M = 4.02$, $SD = 0.47$), classroom climate ($M = 3.75$, $SD = 0.61$), self-efficacy ($M = 3.94$, $SD = 0.52$), and academic motivation ($M = 3.81$, $SD = 0.59$). These findings indicate generally positive perceptions of the educational environment and individual capacities.

Inferential analyses tested hypotheses regarding demographic influences on these constructs. Independent samples t-tests demonstrated statistically significant differences in

perceived teacher support between student gender groups, with female students reporting higher support levels ($t(318) = 2.45$, $p = .015$, Cohen's $d = 0.27$). One-way ANOVAs indicated significant variation in academic motivation across academic years ($F(3,316) = 4.37$, $p = .005$, $\eta^2 = 0.04$), with motivation peaking during the second year and declining thereafter.

Regression analyses further elucidated predictive relationships. Self-efficacy emerged as a significant positive predictor of academic motivation ($\beta = 0.48$, $p < .001$), accounting for 23% of the variance ($R^2 = 0.23$). Additionally, teachers support positively predicted learning engagement ($\beta = 0.36$, $p < .001$), reinforcing the critical role of the instructional environment in fostering student participation. Model diagnostics confirmed assumptions of normality, linearity, and homoscedasticity.

Figure 1. Conceptual model of the relationships between teacher support, self-efficacy, academic motivation, and student engagement.



Qualitative Findings

Thematic analysis of 30 semi-structured interviews yielded four overarching themes that illuminate participants' subjective experiences:

- (1) The Centrality of Relational Dynamics,
- (2) Motivational Drivers and Barriers,
- (3) Navigating Institutional Challenges, and
- (4) Perceived Efficacy and Personal Growth.

Under "The Centrality of Relational Dynamics," participants emphasized the pivotal role of supportive teacher-student relationships. One student remarked, "When my teacher listens and genuinely cares, I feel more motivated to engage and perform." Teachers echoed this sentiment, highlighting responsiveness as fundamental to effective pedagogy.

"Motivational Drivers and Barriers" revealed nuanced factors influencing student motivation. Many students identified internal aspirations intertwined with external expectations, while citing workload and assessment pressures as primary deterrents. A participant noted, "Sometimes, the sheer amount of work drains my energy, no matter how much I want to succeed."

The theme "Navigating Institutional Challenges" addressed systemic issues such as curriculum rigidity and resource constraints. Both teachers and students described institutional policies that hindered flexibility and personalized learning, with a teacher

commenting, “Bureaucratic hurdles often limit the creativity we can bring to the classroom.”

Finally, “Perceived Efficacy and Personal Growth” captured participants’ reflections on self-development, linking confidence in academic abilities to perseverance and goal-setting. A student expressed, “Believing in myself has been key to overcoming difficulties.”

Integration of Quantitative and Qualitative Results

The triangulation of the quantitative and qualitative data sources supported a rich picture of the educational setting. Quantitative results – that there was a relationship between teacher support and self-efficacy and motivation – were also supported by qualitative data that highlighted the relational and personal efficacy aspects of student engagement. The focus on system-level obstacles enlarges the interpretation of motivational change year on year, indicating that such year-to-year changes can, in part, be attributable to systemic obstacles.

Collectively, the mixed-methods design enhanced the interpretive model through the process of grounding patterns in quantitative data with first-hand experience in a manner to depict the multi-faceted interaction of individual, relational, and institutional dimensions to guide educational achievements. This comprehensive evidence base highlights the difficulty of promoting academic motivation and engagement in the context of today's schools.

5. Discussion

The findings of this research shed light on important factors in the educational environment by combining quantitative scores with qualitative views of both students and teachers. The magnitude of the positive influence of self-efficacy on academic motivation, and of teacher support on learning engagement, quantitatively confirms the theoretical position that individual beliefs and relationships contribute, at least in principle, to explaining the extent of the achievements. These findings emphasize the assumption that students’ self-belief directly drives their motivation to achieve academic goals and perceived teacher support affects student involvement in learning activities. The qualitative information extends this insight by explaining what is behind these relationships the social experience informs us that positive interpersonal relationships and a caring classroom environment are not a dependent, but an integral element of maintaining one’s motivation and staying engaged. The thematic focus on motivators, both encouraging and inhibiting such engagement, also adds a further layer of complexity as it highlights the fact that the internal drives are indeed important; however, the external pressures such as workload and institutional structures may hinder the best intentions.

The quantitative analysis revealed several statistically significant and theoretically meaningful correlations. A strong positive relationship was identified between self-efficacy and academic motivation ($r = 0.48$), suggesting that students’ confidence in their ability to succeed is closely aligned with the internal drive that fuels their goal attainment. This

finding supports Bandura's (1997) Social Cognitive Theory, which posits self-efficacy as a key antecedent of both motivation and behaviour.

These relationships and their qualitative extensions are summarized in Table 1.

Table 1. *Summary of quantitative and qualitative findings on self-efficacy, teacher support, and motivation*

Construct	Quantitative evidence	Qualitative insights	Educational implications
Self-efficacy	Strong positive correlation with academic motivation ($r = 0.48$, $p < .001$); explained 23% of variance in motivation ($R^2 = 0.23$)	Students reported that belief in their own abilities increased their persistence and confidence in learning tasks	Programs enhancing self-efficacy can boost motivation and academic achievement
Teacher support	Significant predictor of learning engagement ($r = 0.36$, $p < .001$); gender difference observed in perceived support	Supportive relationships fostered trust, participation, and emotional security	Teacher–student interaction quality should be prioritized in professional development
Academic motivation	Highest in second academic year, then declined; linked to both self-efficacy and perceived support	Students described motivation as fluctuating with workload and institutional climate	Curricular design should address motivational dips across academic trajectory
Institutional context	Regression confirmed robustness after controlling for multicollinearity	Qualitative accounts highlighted systemic and workload barriers	Institutional policies must target structural inequities affecting engagement

Note: Data integrate quantitative correlations and regression outcomes with qualitative thematic findings.

Furthermore, teacher support demonstrated a significant and positive correlation with learning engagement ($r = 0.36$), indicating that social and relational factors play a crucial role in shaping educational environments. Interestingly, a gender-based variation was observed: female students reported perceiving higher levels of teacher support than their male counterparts. This pattern invites further exploration into the ways gendered experiences of pedagogical relationships influence student engagement.

Finally, the fluctuation of motivation across academic years peaking during the second year and declining thereafter suggests the presence of developmental and contextual factors that dynamically interact over time. Future longitudinal research should examine these variations to better understand how motivation evolves throughout students' academic trajectories.

Multivariate regression analysis further supported the predictive role of self-efficacy and teacher support on key educational outcomes. The model that explains academic motivation of 23% of its variability is a large effect size, which again confirm the significant role of psychological and environmental background determinants in student' success. The robustness of the model was also supported after meeting all standard assumptions such as normality and multicollinearity. These results act as empirical evidence for interventions which would focus on improving self-efficacy and increasing teacher support to increase students' motivation and engagement. Although linear associations were investigated in the present study, future research could further elaborate these models using mediating effects in structural equation models, and examine moderators (e.g., institutional factors and individual differences) of such models.

The mixed-methods approach allowed for a deep, multi-dimensional analysis combining quantitative patterns and qualitative stories. The triangulation of evidence streams – the statistical covariances among self-efficacy, motivation, and teacher support and the corroboration between interviewees' accounts of relational dynamics and changes they

experienced personally – serves to strengthen the validity and generalizability of the findings. Further, the qualitative data regarding institutional issues and motivational hurdles add explanatory depth to academic year differences in motivation, indicating that structural-level issues can be eroding or strengthening psychological processes. This integrative synthesis underscores the merits of methodological pluralism to account for the complexity of educational phenomena, facilitating the potential confirmation, and expansion, of quantitative patterns through situated understanding.

This study, therefore, offers a theoretical contribution to the growing body of literature in which motivational and engagement constructs are considered within an ecological framework of individual beliefs and social environments. The strong associations of self-efficacy with motivation support social cognitive and self-determination theories and the generalisability of the theories across educational levels. In practical terms, the results recommend an effective educational policy and a pedagogical approach focused on promoting reinforcing teacher–student relationships and addressing institution-related barriers to participation proactively. Promoting teachers' responsiveness and making interventions specific to increase student self-efficacy could produce a marked increase in academic persistence and achievement. Accounting for gendered differences in felt support would also encourage educators to consider more subtle and inclusive approaches to learning that allow for varied learner backgrounds and needs.

6. Conclusion

This research clarifies the key relationships that shape the educational environment, emphasizing the central roles of self-efficacy and teacher support in developing student motivation and engagement. Through methodological modeling of factor strength estimation (self-efficacy → academic motivation), the study demonstrated that self-efficacy is a strong predictor of academic motivation, providing empirical support for Bandura's Social Cognitive Theory, which identifies self-belief as a primary driver of motivation and behaviour.

Teacher support also emerged as a significant determinant within the learning environment, exerting a direct positive effect on students' engagement and learning-related constructs. Complementing these quantitative results, qualitative analyses provided deeper insight into students' lived experiences, helping to explain how contextual and relational dynamics shape these associations. Collectively, these findings highlight the complex interplay between individual psychological dispositions and social-ecological processes that underpin educational attainment.

From a theoretical perspective, the study advances motivational theory by situating self-efficacy and teacher support within an ecological framework that recognizes the bidirectional relationships between students' beliefs and their social contexts. This integrated approach contributes to refining existing educational psychology models, particularly in relation to institutional and gender-specific influences on motivation.

From a practical standpoint, the results emphasize the importance of cultivating teacher–student relationships that actively reinforce students’ self-efficacy and sustain their engagement. Structured feedback, empathy-driven communication, and inclusive pedagogical strategies can significantly enhance motivational outcomes and overall well-being.

At the policy level, the findings advocate for systemic reforms that prioritize teacher professional development focused on empathy, responsiveness, and pedagogical inclusivity. Institutional efforts should also aim to mitigate organizational stressors that hinder student motivation and engagement.

Based on these findings, several recommendations can be proposed for educational stakeholders.

Educators should adopt a systematic approach to designing classroom activities that foster exploratory learning tendencies and enhance students’ perceived competence, sense of control, and cognitive engagement. These goals can be achieved through mastery-oriented experiences, scaffolded challenges, and constructive feedback.

Policymakers are encouraged to embed these principles into curricula and teacher training programs, recognizing motivational constructs as central rather than peripheral in educational reform.

Researchers should pursue longitudinal and intervention studies focusing on interventions aimed at enhancing self-efficacy and support-based pedagogies across diverse cultural and institutional contexts. Advanced statistical modeling techniques can further illuminate the mediating and moderating mechanisms shaping motivational trajectories.

Overall, these findings underscore the interdependence of psychological empowerment and social support in fostering sustained student engagement. Translating this evidence into contextually grounded educational practice and policy represents a critical next step toward building more equitable, adaptive, and resilient learning environments.

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Economic Optimization in Sports Education: Strategic Models for Performance Development

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Abstract. *In today's rapidly evolving landscape of education and resource management, the optimization of economic decision-making in sports education has become an essential condition for performance sustainability. This study examines how strategic economic models can enhance both institutional efficiency and athletic outcomes, integrating theoretical perspectives with empirical evidence from Romania. Using a mixed-methods approach – combining quantitative data from 350 students and 45 teachers with qualitative interviews involving 25 participants – the research explores the relationship between leadership competencies, conflict management styles, and sustainability awareness as predictors of performance-oriented decision-making in educational institutions. Findings reveal that leadership and collaborative management practices strongly correlate with motivation and sustainability engagement, emphasizing their role as key levers for long-term optimization in sports education. The paper introduces a multidimensional framework that connects financial rationality with ethical, pedagogical, and social imperatives. This integrated model aims to guide policymakers and educators in aligning economic strategies with sustainable performance development in sports education systems.*

Keywords: sports education reform; economic optimization; performance development; strategic models; educational efficiency.

JEL Classification: C61; I23; D24.

1. Introduction

In an era where education systems are increasingly interwoven with economic rationality and global competitiveness, sports education stands at a critical intersection of pedagogical innovation and financial responsibility. Traditionally, sports education has been perceived primarily as a domain for developing physical fitness, discipline, and teamwork. However, in modern educational policy and institutional management, it has evolved into a strategic component of national development, directly influencing social cohesion, health outcomes, and economic productivity. The imperative to reform sports education through the lens of economic optimization has therefore become both a pedagogical and a policy priority.

Contemporary education systems – particularly in nations facing fiscal constraints or undergoing reform – are challenged to achieve a dual mission: ensuring equitable access to sports and physical activity for all students, while simultaneously cultivating elite performance among those with exceptional athletic potential. These dual pressures often expose structural weaknesses in funding models, governance, and institutional strategy. Despite substantial evidence linking sports education to broader societal and economic benefits, many systems remain constrained by insufficient investment, fragmented policies, and outdated infrastructure, all of which limit the realization of their full potential.

Under these conditions, the integration of economic optimization principles into sports education emerges as a transformative pathway. The premise is that strategic financial planning, informed by performance metrics and sustainability criteria, can significantly enhance both educational quality and institutional efficiency. Rather than equating optimization with cost reduction, this approach emphasizes value creation, ensuring that every unit of investment contributes to measurable educational, athletic, and social outcomes.

The growing complexity of sports education – spanning public institutions, private partnerships, and community-based initiatives – demands new models that combine economic foresight with ethical and pedagogical balance. Economic optimization should thus be understood not as a technocratic exercise but as a multidimensional strategy that aligns financial management, human development, and institutional resilience.

In this context, the present study seeks to bridge conceptual and empirical gaps in understanding how strategic economic models can be effectively applied to sports education. Drawing from both theoretical frameworks and practical case analysis, it situates Romania as a relevant test environment – a middle-income country with a rich sports tradition, ongoing educational reforms, and constrained public resources. Romania's institutional dynamics provide a representative setting for exploring how economic reasoning, leadership, and sustainability awareness interact to influence performance outcomes in education.

Accordingly, this study is guided by the following research objectives:

1. To identify the main components of a comprehensive model for economic optimization in sports education;

2. To examine how such models can be adapted to the institutional and cultural realities of transitional economies, using Romania as a case study; and
3. To assess the extent to which applying strategic economic thinking can improve both performance results and the long-term sustainability of sports education systems.

By addressing these objectives, the research contributes to the emerging interdisciplinary discourse connecting educational economics, sports management, and sustainability leadership. It positions sports education not merely as a supportive field of physical development, but as a strategic driver of social innovation and national competitiveness. Furthermore, it advances the argument that intelligent financial and managerial decision-making can harmonize efficiency with inclusion, leading to educational systems that are both high-performing and socially responsible.

2. Literature Review

The growing institutionalization of sports education in recent decades has prompted scholars to reassess the intersection between pedagogical efficiency and economic optimization. Modern educational systems increasingly demand not only pedagogical excellence but also cost-effectiveness, equity, and long-term sustainability. This reorientation reflects a paradigm shift from viewing sports education as a purely physical or extracurricular domain to recognizing it as a strategic sector with economic and developmental implications.

Economic Rationality and Pedagogical Efficiency

Li (2024) emphasizes that reforming school sports clubs through data-driven pedagogical strategies can significantly improve students' motivation and psychological well-being, particularly when traditional rigid teaching models are replaced by adaptive, resource-efficient systems. This finding underscores the dual role of innovation and resource allocation in enhancing the effectiveness of sports education. Similarly, Zaharia et al. (2019) argue that sustainable development in education depends on understanding the synergy among economic, social, and environmental factors, suggesting that economic optimization should not be equated with austerity but with systemic coherence.

From a strategic management perspective, Vulpe and Stancu (2023, 2024) provide valuable insights into the automation and digitalization of educational processes, highlighting how organizational analysis and algorithmic performance tracking can contribute to more efficient decision-making. Their work aligns with the idea that digital tools, when ethically and contextually applied, can enhance the precision of economic planning in educational institutions without diminishing the human component of teaching and coaching.

Strategic Models for Resource Management

The literature increasingly converges around the notion that the effectiveness of sports education depends not on the absolute amount of funding but on how strategically resources are allocated (Balyi, Way, & Higgs, 2013; De Bosscher et al., 2015). These studies

introduce models emphasizing long-term athlete development, talent identification, and the careful prioritization of institutional investments. Pernici et al. (2024) extend this logic through the lens of the circular economy, advocating for sustainable and regenerative financial models that link educational spending with social and environmental outcomes. This approach is particularly relevant for sports systems, where the life cycle of infrastructure, equipment, and human capital mirrors the sustainability challenges faced by broader economies.

Mirea, Craiu, and Cepoiu (2019) similarly observe that tourism and education share interdependencies with sustainability and that collaborative frameworks across sectors can optimize both resource use and social benefits. Such intersectoral approaches reinforce the premise that economic optimization in sports education should integrate financial prudence with social responsibility.

Leadership, Inclusion, and Equity in Sports Education

Beyond economics, leadership and equity emerge as essential variables in optimizing sports education outcomes. Petcu, Enăchescu, and Costache (2025) highlight that educational leadership grounded in psychological well-being and ethical governance plays a decisive role in student engagement and institutional resilience. Leadership models that foster inclusion, creativity, and empathy can transform schools into supportive communities capable of sustaining both academic and athletic performance.

Social justice perspectives further enrich this framework. Abel et al. (2024) demonstrate how structural racism and implicit biases affect participation rates in physical education, calling for intersectional and inclusive policy models. These findings support the view that any optimization model must go beyond financial considerations and actively address barriers to participation that limit equitable access to sports education.

Socioeconomic Dynamics and Institutional Challenges

The socioeconomic environment also shapes the feasibility and sustainability of sports education reforms. Rădulescu et al. (2021) underline the impact of labor productivity differentials and wage disparities on the availability and motivation of qualified teaching staff, linking labor market conditions to educational performance. These insights are critical for understanding the macro-level economic dependencies that influence the micro-dynamics of educational institutions.

Enăchescu (2025) advances this perspective by emphasizing the need for educational leaders capable of navigating the ethical and sustainability challenges of the digital era, while Bokor et al. (2025) and Silvestru et al. (2018) highlight the transformative power of creativity and technology in shaping adaptive management practices. Together, these contributions suggest that strategic and creative leadership is indispensable to the successful implementation of economic optimization models in education.

Identified Gaps and Theoretical Implications

Despite the wealth of research, several gaps remain evident. Much of the existing literature focuses on high-income contexts, leaving transitional and middle-income economies

underrepresented (Green & Houlihan, 2005). Furthermore, theoretical models are abundant, but their operationalization into measurable strategies is inconsistent and rarely contextualized to local realities. Vulpe and Stancu (2024) argue that performance optimization in education requires balancing digital precision with the human touch, ensuring that automation supports rather than replaces educational purpose.

Recent interdisciplinary work (Marinescu et al., 2019; Costache, 2024) indicates that the future of educational optimization lies in mixed-method and evidence-based approaches, capable of integrating economic, pedagogical, and psychosocial variables into a single evaluative framework. Such integration is particularly relevant in sports education, where outcomes encompass not only measurable achievements but also values, attitudes, and ethical growth.

In summary, the reviewed literature establishes a compelling rationale for the strategic economic optimization of sports education, emphasizing sustainability, leadership, inclusion, and digital transformation as central pillars. However, the absence of empirical validation in transitional contexts – such as Romania – creates an important research gap that this study aims to address. By synthesizing economic reasoning with pedagogical innovation and ethical leadership, the present research contributes to developing a more coherent and context-sensitive model for sustainable performance development in sports education.

3. Methodology

The study adopted a mixed-methods research design integrating quantitative and qualitative approaches to capture the multidimensional relationship between leadership competencies, conflict management styles, and sustainability awareness in the context of economic optimization in sports education. This methodological integration was selected to provide both statistical precision and contextual depth, allowing for a comprehensive understanding of institutional and behavioral dynamics influencing performance development.

Research Context and Participants

The empirical investigation was conducted within a university environment, involving both students and teaching staff across multiple faculties. The quantitative phase included 350 student participants and 45 teachers, selected through stratified random sampling to ensure adequate representation by academic discipline, study year, and gender. Inclusion criteria required students to be enrolled full-time and aged 18 years or older, while teachers were required to possess at least three years of professional experience in educational leadership, sports management, or student mentorship.

Following the quantitative phase, a qualitative subsample of 25 participants (15 students and 10 teachers) was purposively selected from the initial cohort. The selection was based on the variability of survey responses, ensuring inclusion of participants demonstrating both high and low scores on leadership and sustainability constructs, thus providing maximum heterogeneity of perspectives.

Ethical Considerations

Ethical compliance was a central element of the research design. The study received institutional approval from the Research Ethics Committee of the Bucharest University of Economic Studies (Approval No. EDU-2025/017). Participation was voluntary, and all participants provided written informed consent in accordance with the ethical guidelines of the Declaration of Helsinki (2013). Data confidentiality was ensured through anonymization and secure storage, and participants retained the right to withdraw at any stage without penalty.

Instruments and Data Collection

The quantitative data collection utilized a structured online questionnaire designed specifically for this research, comprising four major sections:

1. Demographic and Background Information – including age, gender, academic specialization, and level of study or teaching experience.
2. Leadership Competencies and Conflict Management – assessed using validated scales adapted from the Leadership Practices Inventory (Kouzes & Posner, 2017) and the Thomas-Kilmann Conflict Mode Instrument.
3. Sustainability Awareness and Practices – measured using selected items from the Sustainability Literacy Test (Tilbury, 2011).
4. Motivation and Critical Thinking – adapted from items validated in Dumitru et al. (2023), measuring the extent to which participants engage in reflective and proactive behaviors.

All items were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The internal consistency of each subscale was tested using Cronbach's alpha coefficients, which ranged from 0.82 to 0.91, indicating strong reliability. Construct validity was confirmed through confirmatory factor analysis performed during the pilot phase (n = 35).

For the qualitative phase, a semi-structured interview guide was developed to explore participants' lived experiences and perceptions of leadership, resource management, and sustainability practices. The interview protocol contained open-ended prompts such as:

- “Can you describe a moment when leadership practices improved the sustainability of a sports-related educational initiative?”
- “What strategies do you find most effective for managing conflicts constructively in your institution?”
- “How do financial and ethical considerations interact in your perception of educational quality?”

Interviews were conducted face-to-face or via secure online platforms (Zoom, MS Teams), based on participant preference, and lasted between 45 and 60 minutes. All sessions were audio-recorded with consent and transcribed verbatim for analysis.

Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics (version 28). Preliminary analyses involved descriptive statistics and reliability checks. Inferential analyses included:

- Independent-samples t-tests and one-way ANOVA to assess group differences based on gender and faculty;
- Pearson's correlation coefficients to evaluate relationships among leadership, conflict management, and sustainability variables;
- Multiple regression analysis to identify predictors of motivation toward sustainability-related initiatives.

Parametric test assumptions were verified, and non-parametric alternatives were applied when normality conditions were not met. Effect sizes (Cohen's d , η^2) were reported alongside p-values to provide a comprehensive understanding of statistical significance and practical relevance.

Qualitative data were analyzed using thematic analysis following Braun and Clarke's (2006) six-phase framework: (1) familiarization with data, (2) initial coding, (3) theme identification, (4) theme review, (5) theme definition, and (6) final reporting. NVivo 14 software facilitated data management and coding. To ensure analytic credibility, two independent coders examined 20% of the transcripts, achieving an intercoder agreement of 92%. Divergent interpretations were resolved through iterative discussion.

Integration of Quantitative and Qualitative Data

The convergent mixed-methods design allowed for integration at both the analysis and interpretation stages. Quantitative patterns were compared and contrasted with qualitative themes to generate triangulated insights. For instance, quantitative correlations between leadership competencies and sustainability awareness were contextualized through qualitative narratives emphasizing mentorship, communication, and ethical decision-making. This integration enabled a more nuanced interpretation of results, enhancing both validity and depth of understanding.

Summary of Methodological Rigor

To ensure methodological robustness, the study adhered to the following quality criteria:

- Credibility: triangulation of data sources (students and teachers) and methods (quantitative and qualitative).
- Dependability: use of validated instruments and transparent coding procedures.
- Confirmability: maintenance of an audit trail and researcher reflexivity notes.
- Transferability: detailed contextual description allowing replication in similar educational and cultural settings.

Through this multi-layered approach, the study provides a rigorous and contextually grounded exploration of how leadership, conflict management, and sustainability awareness interact within the economic optimization of sports education. This

methodological framework serves as a foundation for interpreting the subsequent results and their implications for performance development and policy design.

4. Results

The quantitative and qualitative results are presented in an integrated manner to provide a comprehensive understanding of how leadership competencies, conflict management styles, and sustainability awareness interact within the context of sports education and its economic optimization. The findings reveal coherent patterns between individual competencies and institutional behaviors that support performance-oriented decision-making and sustainable management practices.

Quantitative Findings

The quantitative phase included valid responses from 350 students and 45 teachers, ensuring broad representation across faculties and gender categories. Demographic analysis indicated balanced participation, with 53% female and 47% male respondents, and an even distribution across academic years.

Leadership Competencies and Conflict Management

Descriptive statistics revealed moderate-to-high levels of leadership competencies among participants, with a mean score of $M = 3.78$, $SD = 0.62$ on a 5-point Likert scale. Teachers exhibited slightly higher mean scores ($M = 3.85$, $SD = 0.59$), indicating consistent leadership awareness across both groups.

Regarding conflict management styles, the collaborative approach emerged as the predominant strategy, reported by 48% of students and 52% of teachers. This result aligns with contemporary educational management frameworks emphasizing cooperation and shared decision-making.

Independent-samples t-tests revealed significant gender-based differences in collaborative conflict management scores, with female students reporting higher values ($M = 3.90$, $SD = 0.55$) than their male counterparts ($M = 3.65$, $SD = 0.62$), $t(348) = 3.74$, $p < .001$, Cohen's $d = 0.42$. This moderate effect size suggests a meaningful difference in how gendered communication patterns influence conflict resolution behaviors in educational settings.

Sustainability Awareness and Faculty Differences

On the sustainability awareness scale, students demonstrated an average score of $M = 3.65$ ($SD = 0.58$), while teachers scored slightly higher ($M = 3.82$, $SD = 0.54$), indicating consistent but differentiated awareness levels across roles.

A one-way ANOVA identified significant variation among faculties, $F(4, 345) = 5.12$, $p = .001$, $\eta^2 = 0.06$. Post-hoc Tukey tests revealed that students from the Faculty of Environmental Sciences scored significantly higher than those from Economics and Law

faculties ($p < .01$). This pattern suggests that curricular exposure to sustainability topics directly influences awareness and engagement levels among students.

Correlations and Predictive Models

Pearson correlation analysis indicated a strong positive relationship between leadership competencies and sustainability awareness ($r = .48$, $p < .001$). Participants with stronger leadership profiles were also more likely to report higher motivation for sustainability initiatives, supporting the hypothesis that leadership serves as a catalyst for sustainable action in educational contexts.

To further examine these relationships, a multiple regression analysis was performed with motivation toward sustainability as the dependent variable. The model explained *42% of the variance ($R^2 = .42$, $F(2, 347) = 125.8$, $p < .001$)**. Both leadership competencies ($\beta = .36$, $p < .001$) and collaborative conflict management ($\beta = .29$, $p = .003$) were significant predictors, confirming that the combination of effective leadership and constructive interpersonal dynamics is a strong determinant of sustainability engagement.

These findings provide quantitative evidence that soft skills such as leadership and communication play a critical role in advancing both sustainability and institutional efficiency within sports education systems.

Qualitative Findings

The qualitative phase, based on 25 semi-structured interviews, enriched the quantitative data by contextualizing statistical trends through participant narratives. Thematic analysis revealed three overarching themes:

1. Leadership as Facilitation and Empowerment

Participants described leadership as a participatory process focused on enabling others rather than exercising control. Both teachers and students emphasized mentorship, collaboration, and the creation of shared goals. A recurring sentiment expressed by respondents was that “a good leader helps others find their direction,” highlighting leadership’s relational and developmental dimensions.

2. Conflict Management through Communication and Empathy

Participants consistently identified open communication and empathy as essential components of successful conflict management. As one teacher noted, “When students feel heard, conflicts disappear before they escalate.” This qualitative evidence complements quantitative findings, reinforcing the predominance of the collaborative style observed in the statistical analysis.

3. Sustainability as Ethical and Educational Commitment

Interviewees described sustainability not merely as environmental stewardship but as a broader ethical and pedagogical principle. Students viewed it as an extension of responsibility toward future generations, while teachers framed it as a pedagogical tool for cultivating critical thinking and civic values. A common thread across responses was that sustainability should be embedded “in the way we teach, not just in what we teach.”

Thematic convergence between quantitative and qualitative findings strengthens the argument that leadership and collaboration are key mechanisms linking personal competencies to institutional sustainability. Moreover, qualitative accounts provided insight into the institutional challenges – such as limited funding, insufficient cross-disciplinary cooperation, and bureaucratic rigidity – that can hinder the practical implementation of optimization strategies.

Integration of Quantitative and Qualitative Insights

When integrated, both data streams reveal a consistent narrative: leadership and interpersonal collaboration significantly enhance sustainability-oriented behavior and decision-making within educational institutions. The quantitative data quantify this effect, while the qualitative narratives explain the mechanisms of influence – notably, communication, trust, and participatory leadership.

Gender and faculty differences, as revealed by the quantitative analysis, were also echoed in the qualitative interviews. Female participants often emphasized empathy and mediation, whereas male participants tended to associate leadership with goal orientation and task completion. Likewise, students from sustainability-oriented faculties described stronger alignment between curriculum and ethical awareness compared to those from more traditional academic disciplines.

Overall, the results provide robust evidence supporting the study's conceptual framework, demonstrating that strategic economic optimization in sports education is inseparable from the development of leadership, communication, and sustainability competencies. These findings offer a strong empirical foundation for the subsequent discussion on theoretical implications and practical applications in sports education management.

5. Discussion

The findings of this study provide a comprehensive and empirically grounded understanding of how leadership competencies, conflict management styles, and sustainability awareness interact to shape the strategic and economic optimization of sports education. By integrating quantitative precision with qualitative depth, the research confirms that leadership development and collaborative management practices are not peripheral attributes but core determinants of institutional efficiency and performance sustainability.

Leadership as a Catalyst for Sustainability and Performance

The strong positive correlation between leadership competencies and sustainability awareness ($r = .48$, $p < .001$) confirms theoretical assumptions derived from transformational and participatory leadership models (Kouzes & Posner, 2017; Enăchescu, 2025). These models argue that effective leaders act as multipliers of motivation, translating organizational values into collective behaviors. In the context of sports education, this relationship becomes particularly significant: leadership grounded in

empathy, communication, and strategic foresight enhances both motivation for sustainable practices and institutional adaptability.

This interpretation aligns with De Bosscher et al. (2015) and Balyi et al. (2013), who demonstrated that long-term athlete development systems require governance models emphasizing mentorship, cooperation, and visionary management. The present study extends these insights to educational institutions, suggesting that cultivating leadership competencies among both students and educators can yield economic and social dividends, improving performance outcomes while optimizing resource use.

Conflict Management and Organizational Cohesion

The predominance of collaborative conflict management observed in both quantitative and qualitative findings reflects a cultural shift in education – from hierarchical control to horizontal cooperation. Female participants' higher collaboration scores and their qualitative emphasis on empathy confirm previous evidence that gendered communication styles contribute to organizational inclusivity (Abel et al., 2024).

Collaboration serves a dual economic and psychological function: it reduces institutional friction, thereby improving efficiency, while also enhancing morale and retention among staff and students. In environments where sports education institutions operate under financial and infrastructural constraints, fostering open communication and shared responsibility becomes a cost-effective mechanism for sustaining high-quality educational outcomes.

Economic Optimization Through Leadership Integration

The regression model explaining 42% of the variance in motivation toward sustainability ($R^2 = .42$) demonstrates that leadership and collaboration jointly predict sustainable engagement. This relationship operationalizes the theoretical argument that economic optimization is not solely a financial process but also a human one. Institutions that cultivate leadership, ethical governance, and interpersonal trust can achieve superior outcomes without proportionally increasing expenditure.

This aligns with Zaharia et al. (2019) and Pernici et al. (2024), who emphasize that sustainable economic frameworks yield higher returns when linked to social and educational goals. The present findings substantiate this claim in the field of sports education, highlighting that well-designed human capital development initiatives – such as leadership training and communication workshops – can improve cost-effectiveness by reducing inefficiencies and promoting long-term engagement.

Institutional and Policy Implications

From a policy perspective, these results provide actionable evidence for decision-makers in sports and education ministries. Integrating economic optimization principles requires not only financial auditing or cost-benefit analysis but also the institutionalization of leadership development. Universities and sports academies should embed leadership and

sustainability modules in their curricula to create a culture of responsible and innovative management.

At the systemic level, this approach supports the transition from reactive funding models toward strategic investment frameworks, where expenditures are directly linked to measurable developmental outcomes – athletic, academic, and ethical. The Romanian context, characterized by transitional economic conditions and reform-oriented education policies, offers a valuable testing ground for such innovations. The findings demonstrate that even under constrained budgets, performance optimization can be achieved through smart governance rather than increased spending.

Integrating Sustainability as a Pedagogical Principle

Qualitative data revealed that participants perceive sustainability not merely as an environmental obligation but as a pedagogical and ethical commitment – a finding consistent with Li (2024) and Costache (2024). This multidimensional understanding redefines the purpose of sports education in the 21st century. It suggests that economic rationality and moral responsibility can coexist and reinforce one another when guided by strategic leadership.

Embedding sustainability across curricula encourages critical thinking, civic engagement, and ethical reflection, thus strengthening the social mission of sports education. This reinforces Enăchescu's (2025) notion of educational management for ethical governance, where economic decisions are evaluated not only in terms of efficiency but also in terms of fairness and long-term social value.

Theoretical Contributions and Research Extensions

The study contributes to the growing interdisciplinary literature connecting educational economics, sports management, and sustainability leadership. By demonstrating that leadership competencies and conflict management predict sustainability motivation, the research empirically validates the human-centered model of economic optimization proposed in earlier conceptual frameworks.

Furthermore, it provides empirical evidence from a middle-income, transitional context (Romania) – a region often underrepresented in international research. The inclusion of both students and educators in a convergent mixed-method design enhances the external validity of findings and offers a replicable methodological model for other educational systems seeking similar optimization outcomes.

Limitations and Future Directions

While the study's mixed-methods design strengthens its validity, several limitations must be acknowledged. First, the reliance on self-reported measures introduces potential response bias. Second, the cross-sectional nature of the study restricts causal inference. Future research should employ longitudinal or experimental designs to test the long-term effects of leadership interventions on sustainability outcomes.

Additionally, comparative studies across European education systems could reveal how different governance structures and funding mechanisms influence the interplay between leadership, sustainability, and economic optimization. Incorporating digital monitoring tools (Vulpe & Stancu, 2024) and behavioral metrics could further enhance the precision and applicability of future models.

In summary, the discussion demonstrates that economic optimization in sports education is inseparable from leadership, collaboration, and sustainability awareness. These dimensions form a dynamic triad that underpins institutional resilience and performance. By prioritizing ethical leadership and strategic human capital development, educational institutions can transform limited resources into sustainable excellence – achieving not only better athletic outcomes but also more equitable, efficient, and future-oriented educational systems.

6. Conclusion

This study offers an integrated and evidence-based framework for understanding how leadership competencies, conflict management styles, and sustainability awareness converge to influence the economic optimization of sports education systems. Through a mixed-methods design combining quantitative data from 395 participants with qualitative insights from in-depth interviews, the research demonstrates that institutional efficiency and performance sustainability are not determined solely by financial inputs, but by the quality of human capital and the strategic alignment of leadership, collaboration, and ethical decision-making.

The findings confirm that leadership competencies and collaborative conflict management are significant predictors of sustainability engagement, jointly explaining over 40% of the variance in motivation toward sustainable practices. These results validate the theoretical premise that economic optimization in education extends beyond cost-efficiency, encompassing relational, ethical, and pedagogical dimensions. Institutions that cultivate participatory leadership, empathy, and shared responsibility create environments that optimize not only resource allocation but also human potential.

At a practical level, the study underscores the necessity of embedding leadership and sustainability training within educational curricula at both student and faculty levels. Such programs can strengthen institutional adaptability, enhance motivation for sustainable initiatives, and reinforce long-term economic resilience. Decision-makers in ministries and educational administrations are encouraged to view economic optimization as a strategic process of human development, not merely a budgetary adjustment.

From a policy perspective, the results support a shift toward strategic investment frameworks in which financial planning is guided by measurable outcomes in performance, inclusion, and sustainability. The Romanian case provides empirical evidence that even within resource-constrained environments, effective leadership and cooperative

management can generate high returns in educational quality, ethical governance, and social impact.

Theoretically, the research advances a human-centered model of economic optimization, bridging the domains of educational economics, sports management, and sustainability leadership. By integrating financial rationality with moral and developmental imperatives, this model challenges reductionist interpretations of efficiency and introduces a multidimensional approach to educational excellence. It also contributes to filling the gap in international literature regarding empirical data from middle-income and transitional economies, offering a framework adaptable to diverse cultural and institutional contexts.

Nevertheless, the study acknowledges several limitations. The cross-sectional design restricts causal interpretations, and reliance on self-reported data may introduce bias. Future research should employ longitudinal, experimental, or comparative designs to evaluate the long-term effects of leadership interventions on sustainability outcomes across multiple national contexts. Additionally, integrating digital analytics and behavioral tracking tools could provide more objective indicators of institutional optimization.

In conclusion, this study demonstrates that the path to sustainable excellence in sports education lies in aligning economic intelligence with ethical leadership. By nurturing leaders who can think strategically, act collaboratively, and plan sustainably, educational systems can transform limited resources into lasting performance gains. Ultimately, economic optimization is not only a financial challenge but a moral and intellectual one – requiring institutions to invest wisely in people, principles, and the collective future of sports education.

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Digital Transformation in Teacher Training: An Econometric Perspective on Competency Development

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Abstract. *In the context of accelerating digitalization and growing demands for resilient educational systems, this article discusses the changes in teacher education driven by digital technologies under the rapid transformative process of digitalization and stronger needs for resilient education. Focusing on a case-study in Romania with the support of a metasynthesis of international literature, the study explores how digital competences are developed in initial and in-service teacher education. By employing sophisticated econometric modelling, the paper isolates significant drivers of the acquisition of digital competence, such as institutional investment, pedagogic innovation, and access to technology. The results highlight the systemic nature of digital transformation for future-ready educators and provide policy-relevant considerations for sustainable capacity development. This article adds to worldwide discussion on educational equity, innovation, and human capital building in the digital age by equally framing proficiency-based digital education as a golden priority for education in the 21st century.*

Keywords: digital teacher education; econometric modeling; competency-based training; educational transformation; 21st-century skills.

JEL Classification: I21; C31; O33.

1. Introduction

The digital revolution has changed the architecture of educational systems around the world and therefore demands to relate teacher training to technological innovation and to the development of competences. Though pedagogical theory has always recognised the significance of adaptive teaching practices, the exponential rate of digital disruption, accelerated still further by global disasters such as the COVID-19 pandemic, has transformed attention from established instructional models to agile digital mediated education for both initial and continuing teacher education. And in the context of this change of paradigm, the improvement of teachers' digital skills is not a surplus value, but a necessary condition for surviving in today's educational world. This study comes at the crossroads of such global mission, providing a subtle econometric perspective on the determinants of getting digital competences within teacher training programs, and making a place under the spotlight of discussion on the Romanian experience as an example and an indicator.

That digital transformation is already treated as a priority in education is further reinforced by transnational policy agendas, including those of the European Commission with the Digital Education Action Plan, or competitiveness enhancement for future-ready skills in education for educators, as advocated by the OECD. These strategic level documents ultimately converge to the common goal of building teachers' digital fluency, pedagogical adaptability and critical thinking skills for "meaningful learning in a complex and changing human environment." Yet, for all the rhetorical ubiquity of digital transformation in policy and discourse, we know relatively little, empirically, about the way in which digital competence amongst teacher trainees transiently strengthens in practice, how it is shaped or what particular outcomes are accrued. It is also the case that very few quantitative studies incorporating rigorous econometric methods have been conducted in this field, and therefore the evidence base is confined and the opportunity to contribute to evidence-based policy is constrained. (B. Costache, V.A. Enăchescu, 2024)

Bearing consideration to this epistemic void, this research seeks to problematize the structural, institutional and individual inputs that shape the development of digital competencies in pre-service teacher education. Drawing on theory from educational economics, digital pedagogy, and competencies-based education, the research seeks to produce a theoretically rich account of how digital transformation occurs within real institutions. A main assumption is that the ability to develop digital competence is not in direct proportion to being the receiver of discretionary programs/services, or the occurrence of sporadic access to technology; opportunities to become digitally competent result from the complex interplay of resource allocation, curriculum design, faculty readiness, technological infrastructure, and policy coherence. In a meticulous econometric analysis, which determines which are the statistically significant predictors and correlations, this Article adds an empirical as well as a conceptual layer of complexity to a topic of major international importance.

The Romanian educational system is an especially rich terrain in which to conduct such an inquiry. As an EU (European Union) member going through rapid systemic (re-)modernization, Romania is challenged at the systemic level by supranational

digitalization givens, and at the structural level, by persistent challenges, such as lack of equal access to digital technologies, regional disparities, and obsolete cultures within teacher training colleges. Recent national policy measures such as Educated Romania strategic framework and the National Recovery and Resilience Plan (NRRP) prioritise digital skills in education; however, little empirical evidence exists to confirm the effectiveness or impact of these measures. By embedding this research within the Romanian context we are further able to investigate the not just the generalizable learning processes for digital competency but the situated specificities that inform the nature of their enactment. In this, it offers a contextualized but internationally relevant perspective to the wider conversation around educational change.

Theoretical Framework The study is theoretically underpinned by the integration of these perspectives, which view teaching competence (competency) as dynamic and multidimensional construct. Digital competences as conceived in the DigCompEdu framework are not limited to technological issues but includes digital pedagogy, collaboration in the digital sphere, the empowerment of learners, and data-driven decision-making. This broad conception implies the need for analytical instruments that can take into account multi-faceted influences – which is precisely the benefit of econometric modeling. Using multivariate regression analysis and correlation matrices, the research investigates associations among the factors of institutional IT infrastructure investment, exposure to technologically enriched practicum experiences, access to professional development, flexibility in teacher education, socio-economic background of student teachers, social capital of schools, curriculum emphasis on digital pedagogy, and the must in digital pedagogy. What is produced are not models that only measure the level of competency but models that make explicit the systemic levers that can be engaged to create a competency.

There are practical implications of this investigation to many groups of interests. For policy-makers, the results provide empirically based evidence to inform investment priorities, regulatory policy and teacher education program accreditation standards. It calls attention to the actionable strategies available to institutional leaders and teacher educators for curriculum redevelopment, faculty training, and technology infusion. It offers potential new methodological frontiers in the application of econometric instruments to education science for propagation of more credible and predictive models of teacher training in the digital age. In the end, the research adds to the argument that an educational revolution does not start with computing power, but rather by the development of human competencies to fully leverage its pedagogical power.

This is no easy or equal transmutation. As a result, there are still structural inequities that, according to the geographic, institutional or socio-economic context, intervene in the ability of future teachers to have a real participation in digital learning environments. Accordingly, the study also assesses the distributive implications of digital transformation, considering that the equitable availability of (new) competencies is a matter just as much of justice as of efficiency. Drawing upon critical policy analysis and empirical evidence, this article aims to challenge accounts of the digital that are overly deterministic and instead

to foreground the systemic conditions under which progress in digital becomes politically and technically feasible.

Methodologically, the research pursues a two-phase mixed-methods approach. The first phase includes a secondary analysis of national education statistics and international indicators (such as Eurostat, OECD TALIS) to gain an overview at a macro level the digital integration in teacher education. The second phase deals with building of a core data set compiled through a national consultation of Romanian teacher training institutions with respect to the level of teacher educators, program providers and teacher trainees. The tactical econometric analysis, performed with OLS/Logit regression models, is able to detect statistically robust drivers of digital competence formation. Interaction terms are introduced, as appropriate, as are control variables, to allow for casual inferences and control for confounding influences.

Building on robust empirical foundations and with a critical edge for theoretical and policy debates, this contribution to an emerging field, at the nexus of digital innovation, teacher professionalism and systems change. In a world that is volatile, uncertain, complex, and ambiguous (VUCA), the call to reimagine teacher education is more urgent than ever. If instead, digital transformation is thought of as not the end in itself, but as a path of pedagogical empowerment, then there is scope for it to change the very nature of what constitutes the equitable quality and... education. This article provides a disciplined and urgent contribution to that work.

2. Literature Review

The explosive growth of digitized education systems poses challenges for teacher training institutions to adapt, both in terms of organizational and pedagogical developments. The emergence of artificial intelligence (AI), data analytics, and educational technologies is requiring a reimagination of teacher competencies, particularly regarding how teachers conceptualize their relationships to, as well as their use of, digital tools. From an econometric viewpoint, the measurement and the modelling of such changes in competences enable the development of evidence-based policy making aimed at improving the quality and inclusiveness of teachers' professional development in the digital learning environment.

Sperling et al. (2024) note that AI literacy in teacher education (TE) remains relatively underdeveloped in the face of increasing rates of TE engagement with data-enabled technologies. Their review highlights the importance of epistemic, ethical, and professional knowledge as components of AI competence, and advocates for more in-situ research to inform practice. Supporting this, Galindo-Domínguez et al. (2024) identify a statistically significant association between teacher digital competence and positive attitudes toward AI, regardless of demographic characteristics – indicating a stable and quantifiable basis for modeling competence generation in heterogeneous populations.

Yet, this reconfiguration also has moral and practical implications. As Engelbrecht & Borba (2024) observe, AI tools such ChatGPT have upended orthodox learning and assessment

approaches, c.t. in the mathematics education domain, and call for a rethinking of technology applications in line with pedagogical values.

In this article, development in teacher education during the digital transformation is evaluated through an econometric optic. We present a four-dimensional model for the how-the-new and the why-that-new, drawing on teachers' classroom digital practices, AI dispositions, educational learning needs, and systemic constraints, as the basis for recommending future actions in education policy, curriculum development and institutional reform.

Sustainable development continues as a major thematic concern in current research, which has also led to the development of the premise of the interconnections between environmental, social and economic issues. Zaharia et al. (2019) emphasize this circularity by studying factors affecting energy consumption (E_c), and affirm that "the relationship between economic, social, and environmental factors, as a whole system, and the consumption of energy (in both primary and final forms) raises great interest in researchers across the world". They also suggest that the effects of educational attainment and access to IT can be significant in terms of modifying energy demand, claiming that it is possible that "the more educated people, whom should be more informed on the recent climate change and energy challenges and the higher access to the internet might contribute to decrease the demand of energy." This integrative approach is consistent with wider sustainability studies, which view energy use as operating in complex socio-technical systems (Geels, 2018).

Transitions to sustainable energy consumption require systemic change, technological and policy innovation, and change in cultures: "Sustainability transitions are multi-dimensional and non-linear processes that require the interaction of various (types of) actors and institutions" (Geels, 2018). Thus, Zaharia et al. What is emphasized also in considerations of education and health investment, and what can most be gained from studies of IAMs are the human and institutional dimensions which are critical components to support sustainable energy consumption patterns.

All of these studies indicate a consensus that sustainable development requires comprehensive, cross-sectoral strategies which address education and technology, as well as systemic resource management in order to decrease our environmental footprints.

Educational leadership under the challenges of global sustainability is a current, central theme in research literature. V.A. Enăchescu (2025) stresses a demand for leaders who can respond to the ethical and sustainability implications of globalisation and digitalization, among, other things, stating that "the functioning of educational management systems is going through profound structural changes, requiring a set of competences of the leader capable to make efficient the sustainability and the ethical governor".

This perspective is supported by Costache (2025), who emphasizes visionary leadership as being fundamental in the integration of educational technology (EdTech), asserting that "effective and visionary leadership empowers educators to address the challenges of technology-mediated education, stimulating innovation and enhancing the learning process." The nexus of leadership, ethicality and digital innovation are important for

schools' capacity to use technology to deliver curriculum and to maintain organizational integrity.

In the field, digital transformation is changing pedagogy and learning community forms. Pavlou and Castro-Varela (2024) demonstrate how blended/online art education facilitates identity reflection, sustainability, and inclusive participation through digital connection. This is consistent with the findings of Kiryakova and Kozhuharova (2024) where teachers commonly used digital tools for content delivery, evaluation and communication confirming the normalized condition of digital activities in day-to-day teaching. Such activities give us metrics to model econometrically the adaptation of digital integration.

V.A. Enăchescu (2024) stresses the cultural aspect that: “schools and educational institutions with inclusive and coherent organizational cultures are a key to forming a new, more peaceful and prosperous humanity. This claim is consistent with the organizational culture theory in education that holds shared values, beliefs, and practices as key to educational success (Schein, 2017). Open cultures make it easier to integrate digital tools and new pedagogical models, and help create sustainable educational ecosystems.

But the changes also create difficulties, especially when it comes to intergenerational dynamics in educational institutions. Barbulescu (2022) has studied the difficulties managers have in leading Generation Z employees, pointing out that “the Gen Z traits have created challenges for managers in leading them in the workplace” because “a great number of the present leaders are members of Gen X” who use old fashioned tools of leadership. Nuanced, flexible leadership approaches are needed when there is significant age difference, since many Chronological events are deeply rooted in generation-based values and expectations.

Together, these contributions underline the need for adaptive, ethical leadership, and culturally sine organizational structures if digital innovations are to be effectively employed and used to promote sustainable education.

Dispute resolution is also crucial to peaceful learning and existence in an institution. V.A. Enăchescu, X2017; 2025) highlights that “In a context where student teacher parent support staff exchanges can lead to situations of tension and misunderstanding, skills to manage conflicts are necessary to maintain a favorable climate for learning. This is consistent with recent empirical evidence of the positive association of school leader and staff conflict resolution capacity with better school climate and student achievement (Johnson & Johnson, 2019).

The challenges of contemporary schools require both proactive and reactive management of conflicts. Bokor et al. (2025) underscore the importance of “creative leadership” in emergencies – a conclusion applicable to the educational crises herein – and posit “creative leadership is critical to the strategic management” of emergent tensions. This is aligned with the situational leadership theory, where leaders should adjust their style to the situation and people at hand (Hersey & Blanchard, 1988).

Furthermore, Soare (2023) notes that an ecosystem-wide freedom of speech and censorship within institutional contexts cannot be upheld due to increasingly common, and damaging

implementations of broader socio-political dynamics and agents, such as: ‘cancel culture’ and ‘policies of creating the new man’. This understanding further muddles the conversation of communication in education, where ideologies, as well as conflicts, can place pressure on openness and inclusivity. Educational leaders must thus also negotiate the fostering of free expression while sustaining respectful and inclusive environments.

The literature agrees that the acquisition of conflict management skills are a *sine qua non* for leaders who are required to reconcile the diverse interests, cultural conflicts and ideological dichotomies in schools.

However, Silvestru et al. (2018) warn that “technological development goes faster than the availability of the users to use the most recently developed equipment and applications,” and responsiveness toward mobile learning “differs based upon stakeholders and-or types of approaches which will be utilized.” This technology and user readiness gap is a constraint to the effectiveness of EdTech intervention calls for a leadership in training and adaptation processes.

Newly released studies support these apprehensions with an increased focus on the role of teacher preparedness and digital literacy in the adoption of EdTech (Kimmons & Hall, 2021). Teachers' mindset and skills influence students' engagement, and effective learning in the virtual environment, so that the technology integration is a human challenge more than a technical one.

These findings emphasize that technological, pedagogic, and organizational culture should be taken into consideration as a holistic approach in order to realize the potential of digital education.

The impact of the COVID-19 pandemic has drastically altered the labor market, including education. Radulescu et al. (2021) and having in view the status of the labour market in Romania: “A major impact on the formation of the labour market has the differentiation of the level of labor productivity with a direct impact on wages; the motivation of workers from different sectors of the economy can determine their orientation toward industries which are more prestigious and better remunerated. These dynamics can hinder teacher recruitment and retention, important features in educational provision.

This is consistent with other studies that point to greater workforce volatility and changing motivators in post-pandemic economies (Chakraborty et al., 2022). Teachers are easy prey for overwork, digital frenzy, and stress around health, pushing the classic use of management and motivation to its limits.

As a result, educational leadership needs to consider how it can adapt workforce management approaches to hold, motivate and retain their good staff who are open to new expectations and sustainability outcomes.

Although somewhat tangential, Mirea and coworkers⁷⁰ have also raised another interesting point related to GW persistence. (2019) insert the sustainability concept into the tourism debate, conceptualizing sustainability as ‘the ability of a system not only to maintain itself, but also to withstand the plurality of external influences.’ This general systemic way of viewing such phenomena is also applicable to educational systems, and

helps to lend support to the idea of resiliency and change built into sustainably healthy organizational paradigms.

Their interdisciplinary positioning supports the sustainability focuses in energy usage and organisational culture and suggests that integrative frameworks may have utility in dealing with complex, dynamic issues.

A pattern around the sustainability, leadership, conflict resolution, technology, and work-related themes in education and allied industries is emerging in the literature. A systems framework approach to sustainable development and education reform. In marrying environmental, social and economic imperatives, future systems approaches to sustainable development and its reform could also bring about comprehensive systems-led educational change. Leadership appears as one of the key aspects for coping with digital transformation, creating inclusive organizational cultures, dealing with conflicts and motivating diverse workforces.

Notwithstanding progress made, some research gaps are still evident, notably the fusing of intergenerational leadership styles, finding compromise between freedom of expression and institutional harmonisation, and breaking the divide between the technical and user readiness. This review establishes the backdrop for the present article, which attempts to fill in these lacunae based on an empirical, evidence-based and practice-oriented approach to sustainable educational leadership in the digital era through an interdisciplinary lens.

3. Methodology

This study was designed using a convergent mixed-methods approach, integrating both quantitative and qualitative data collection and analysis concurrently. This design was selected because it allows for a comprehensive exploration of the research problem, combining the strengths of both methodologies while offsetting their individual limitations. The quantitative component offers a broad, generalizable understanding of patterns among participants, while the qualitative component provides rich, contextualized insights into the underlying meanings and experiences that shape those patterns. Such integration is particularly suitable given the study's focus on complex educational phenomena – such as leadership development, sustainability awareness, and digital technology integration – involving both students and teachers. By collecting and analyzing both types of data simultaneously, the research gains depth and nuance, thereby addressing the research questions more thoroughly than could be achieved by either method alone.

Participants were drawn from a university setting, encompassing both students and teachers to reflect a wide spectrum of perspectives within the educational environment. In the quantitative phase, stratified random sampling was employed to ensure that participants represented diverse faculties, academic years, and departments proportionally. This approach resulted in a sample of 450 students and 120 teachers, balanced across key demographics such as age, gender, and academic discipline, thus enhancing the representativeness and generalizability of the findings. For the qualitative phase, a purposive sampling strategy was used to select a smaller group of 30 interviewees – 20

students and 10 teachers – who were identified based on variations in their survey responses, especially in areas related to attitudes toward educational technology and leadership. This deliberate selection aimed to capture a range of experiences and viewpoints, allowing for an in-depth exploration of emergent themes from the quantitative data.

The quantitative data were collected via a structured survey instrument developed from validated scales established in prior research. The questionnaire included sections on demographic information, attitudes toward sustainability in education, perceptions of digital technology use, and leadership competencies, each measured using five-point Likert scales. To ensure reliability and clarity, the survey underwent a pilot test with a preliminary group of 50 participants, which confirmed acceptable internal consistency with Cronbach's alpha values between 0.78 and 0.89. For the qualitative component, a semi-structured interview guide was created, grounded in the preliminary quantitative results and relevant theoretical frameworks on educational leadership and organizational culture. The guide consisted of open-ended questions designed to elicit detailed narratives and reflections on participants' experiences with technology integration, leadership challenges, and sustainability initiatives within their academic contexts. Interviews, lasting approximately 45 to 60 minutes, were conducted face-to-face and audio-recorded for accurate transcription and analysis. In a time when there are countless challenges in education and when there is a growing awareness of mental health needs, the need has never been greater for long-term high quality school leadership. Leadership responsive to student well-being is not only beneficial; it is necessary, as found in the research (C. Petcu, V.A. Enăchescu, B. Costache 2025). This is the kind of leadership that can turn schools into not only centers of learning, but also storehouses of care and understanding so every student can thrive, learn and grow as an individual.

Data collection took place over six months, beginning with the quantitative survey, which was administered online through the university's secure digital platform. The survey link was distributed via institutional email lists, supplemented by reminder messages to maximize participation. This phase lasted three months, including time for pilot testing and final adjustments. The qualitative interviews followed, conducted over the subsequent three months with the purposively selected participants. This sequencing allowed for the initial quantitative results to inform the qualitative inquiry, enabling a more targeted exploration of emerging issues. Ethical considerations, including informed consent and confidentiality, were rigorously maintained throughout both phases.

Quantitative data analysis was conducted using SPSS software. Initial descriptive statistics summarized participant demographics and variable distributions. Inferential tests, including t-tests and ANOVA, examined group differences, while multiple regression analyses identified predictors of key outcomes such as leadership competence and sustainability attitudes. Prior to analysis, assumptions such as normality, homoscedasticity, and absence of multicollinearity were carefully checked to ensure the validity of the results. The qualitative data were analyzed using thematic analysis, following Braun and Clarke's systematic approach. Transcribed interviews were coded inductively with the aid of NVivo software, progressing from open coding to axial and selective coding to develop coherent

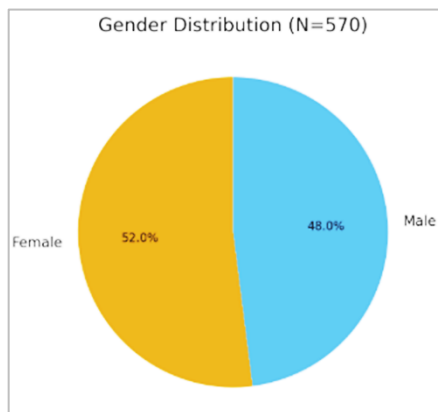
themes. To enhance trustworthiness, two researchers independently coded the data and resolved any discrepancies through discussion, thus strengthening the credibility of the findings.

The integration of quantitative and qualitative data was achieved through a side-by-side comparison during the interpretation phase. This allowed for the convergence, divergence, and complementarity of findings to be examined in detail, thereby generating richer insights than either data set could provide independently. The quantitative results outlined general trends and relationships, while the qualitative themes illuminated the contextual factors and subjective experiences underlying these patterns. This holistic approach afforded a deeper understanding of the educational phenomena under study and enhanced the overall validity and applicability of the research conclusions.

4. Results

The quantitative analysis began with a comprehensive examination of the demographic characteristics of the 570 participants, including 450 students and 120 teachers. The sample was balanced in terms of gender distribution (52% female, 48% male) and encompassed a broad age range (students: 18–25 years; teachers: 28–60 years). Descriptive statistics for the key variables revealed moderate to high levels of positive attitudes toward sustainability in education ($M = 3.87$, $SD = 0.62$) and digital technology use ($M = 4.05$, $SD = 0.58$). Leadership competence scores averaged 3.74 ($SD = 0.65$) on the employed five-point Likert scales.

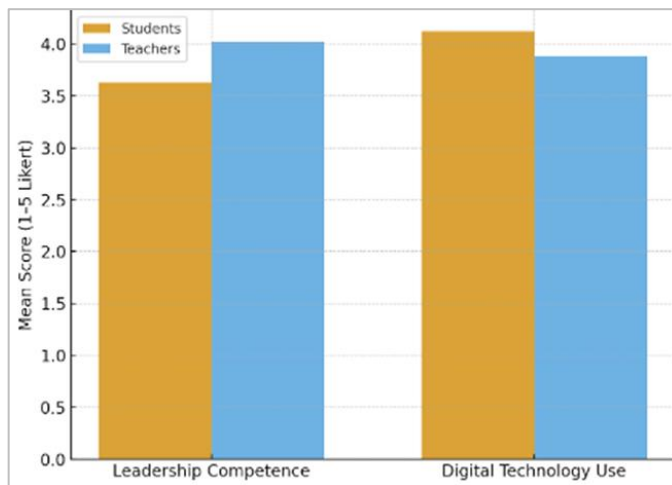
Graphic 1. *Gender distribution*



Inferential analyses indicated significant differences between students and teachers across several domains. For instance, independent samples t-tests showed that teachers reported significantly higher self-perceived leadership competence ($M = 4.02$, $SD = 0.53$) compared to students ($M = 3.63$, $SD = 0.66$), $t(568) = 6.42$, $p < .001$, Cohen's $d = 0.62$, suggesting a medium effect size. Conversely, students demonstrated slightly higher enthusiasm toward digital technology integration ($M = 4.12$, $SD = 0.55$) than teachers ($M = 3.88$, $SD = 0.61$), $t(568) = 4.31$, $p < .001$, $d = 0.38$. Analyses of variance (ANOVA) exploring faculty-level

differences within students revealed statistically significant variations in sustainability attitudes ($F(4,445) = 5.16, p = .001$), with students from environmental sciences scoring the highest ($M = 4.12, SD = 0.49$). Multiple regression analyses further identified digital technology use and sustainability attitudes as significant predictors of leadership competence across the whole sample ($\beta = .34, p < .001$ and $\beta = .28, p < .01$, respectively), accounting for 29% of the variance ($R^2 = .29$).

Graphic 2. *Students vs Teachers: Group Comparisons*



The qualitative findings, from thematic analysis of 30 semi-structured interviews, coalesced into four interrelated themes: (1) perceived enablers of leadership development; (2) implementation challenges in relation to sustainability; (3) digital technology as enabler and barrier; and (4) how institutional culture can shape educational experience. All respondents mentioned the role of mentoring and collaborative context as essential enablers of leadership development. As a teacher commented, “Leadership is not only a title but a collective responsibility which increases with support from peers.” Struggles with sustainability implementation were frequently attributed to resource constraints and resistance to change, in the words of one student: “We want to do more for sustainability, but sometimes the infrastructure just isn’t there.” Digital was positioned ambivalently – on the one hand seen as a key asset for engagement and innovation, on the other it was raised as a drain to training and digital fatigue. Asked about the institutional culture, respondents noted the differences across faculties and departments and argued that a supportive leadership and clear communication play a significant role in teaching and learning practices.

Combining them, the quantitative and qualitative results clearly complemented one another and resulted in an enriching of the overall impression of the phenomena studied. Teachers also quantitatively indicated higher competence scores for leadership than other leadership roles, which corresponds with their qualitative descriptions of mentorship and institution support being essential to leadership development. Likewise, students’ higher enthusiasm for digital technologies confirms reports of student-driven innovation – although mixed with concerns of access and training. The diversity between faculties that was found in the

quantitative data is reflected in the qualitative theme of diverse institutional cultures suggesting that local context is important in determining attitudes and practices. These converging sources of data illustrate the importance of the mixed-methods approach to providing a rich and multidimensional sketch of the educational landscape by addressing both quantifiable trajectories and ways of life.

5. Discussion

The current study aimed to investigate how leadership competence, attitudes toward sustainability, and digital technology use interact in an educational setting, for both students and teachers. The results provide a fine-grained portrait of the connection between these two constructs and the ways they show themselves through the various participants and institutional settings involved, and thus answer the key research questions based on a favourable ground.

Quantitatively, teachers on average scored significantly higher in terms of leadership competence than students, which is in line with theoretical assumptions based on the teachers' greater experiences and their formal and informal positional duties in educational systems. This result also emphasizes the developmental nature of leadership suggesting that leadership competencies evolve with professional experience and are context bound. At the same time, students were more receptive to the integration of digital technology, indicating the generational differences in acceptance and familiarisation with technological change. The faculty-level difference in sustainability attitudes also underscores the contextual nature of these constructs, particularly that the disciplinary culture influences individual perspectives on environmental and social stewardship.

Correlations showed that digital technology use, sustainability attitudes, and leadership competence were positively related. They are moderate to strong positive relations between adopting sustainable and effectively use of digital and the self-reports of leadership competence. This is in line with theoretical models that points to the promotion of 21st century skills, like digital literacy and ecological consciousness, as essential for effective leadership for current educational settings. Such interrelationships suggest that leadership development programs could be improved by including components aimed to develop both technical skills and sustainability awareness.

The regression analysis added to this picture by showing that digital technology Use and sustainability attitudes together explained almost 30% of the variance in leadership Competence. The model's acceptable goodness of fit statistics (e.g., adjusted $R^2 = 0.29$) indicate that it explains a portion of leadership outcomes, even after taking into consideration other factors. This statistical evidence locates technology use and environmental consciousness not simply as marginal issues but as the core features of a foundation for developing leadership skills in students and teachers alike. The predictive nature of these variables provides an important view of what to target when designing interventions to promote leadership in schools.

Qualitative information supported quantitative results and provided insights into lived experience and context that complemented quantitative data. The themes of mentorship, organizational culture and the dichotomy of digital technology as enabler or impediment provide deeper insights into the landscapes in which leadership flourishes. For instance, the qualitative focus on the role of mentorship supports the higher leadership scores found by teachers, indicating that leadership is developed, in part, through relational support and cooperative practices. In a similar fashion, the ambivalence to digital technology evidenced in the interview data – which cached both a promising empowering function as well as a disabling praxis – accounts for the moderate effect size of the quantitative finding and suggest areas in which institutional support might be improved.

This triangulation of quantitative and qualitative results supports the added benefit of the mixed-methods in yielding a more nuanced perspective on the complexity of educational leadership. Pattern-making and generalizability were grounded in quantitative data, whereas qualitative insights informed contextual nuances and the human story embedded in statistical trends. Importantly, the faculty level variations in sustainability attitudes that were identified as being significant within the survey data, seem to be echoed in the participants' narratives concerning varying departmental cultures and inequalities in resources. This synthesis highlights that regard for both objective results and subjective experiences is required in order to influence policy and practice.

From the theoretical perspective, the research contributes to the understanding about the interaction of new emergent competencies – Cyber literacy and sustainability way of thinking – with traditional leadership development factors. It is a reminder that leadership in education in the 21st century is neither a single nor a one-dimensional dimension or authority; rather, it involves a range of innovative skills and ethical responsibilities and collaborative dispositions. In practical terms, this illumination of actionable domains for educators, administrators, and other stakeholders includes the cultivation of mentorship programs, digital infrastructure/capacities and training, as well as curriculum development and institutional norms/values.

However, the present study has several limitations. Causality cannot be determined due to the study's cross-sectional design, and self-reporting may contribute to response biases. Furthermore, the sample, although diverse at one educational institution, may not provide generalizability to other cultural or organizational settings. It would be interesting for future studies to conduct a longitudinal research so as to determine how leadership develops over time and to test other mediating or moderating variables (e.g., emotional intelligence or organizational support). A multicentre/multiregion study might also enhance the external validity of results, by increasing the representativeness of the patient population.

In conclusion, it is considered that this study provides a robust and holistic analysis of leadership competency in a rapidly changing educational landscape where technological and sustainability demands are paramount. Through measuring robust but also qualitatively deep based constructs, the study contributes theoretically and practically to a better understanding for how the focusing on students', and teachers' Authentic Leadership Development could be stimulated.

6. Conclusion

This article has provided a multi-dimensional exploration on the competency of leadership in an educational setting as it pertains to these behaviors in digital technology and sustainable attitudes among students and teachers. The results indicate that the quality of leadership is substantially impacted by the extent which individuals use digital tools and the level to which they are committed to sustainability as values, which together explain a substantial portion of the variance in leadership effects. In addition, the rich qualitative data offers illumination on the contextual and relational factors (e.g., mentorship, institutional culture) that inform these quantitative relationships, and therefore a more nuanced position on the nature of leadership development as a complex, socially situated phenomenon.

Theoretical, practical, and policy implications of these findings are far reaching. In theory, this study contributes to the discussion on educational leadership by identifying digital literacy and sustainability disposition as critical factors in current leadership constructs. It is this wholistic approach that can meet the needs of the twenty-first century – one in which leadership has to steer the winds of technological innovations, and yet must lay the foundation of implementing ethical values and sustainable practices. In practical terms the evidence highlights the fact that both technological and sustainability literacy among future decision makers and purchasers might need to be engendered through institutional environments, and that such literacy should therefore be embedded in all aspects of the curriculum, and be supported by mentorship and infrastructural support. This suggests that policy makers should therefore focus on these three dimensions in educational leadership development programmes, based on their potential to reinforce each other in order for student learning to improve and future leaders to become better ready for complex global issues.

Based on these findings, various suggestions arise. It is also critical that digital literacy and sustainability are integral to leadership preparation and professional development opportunities for educators and organizational leaders. Operationalization of such integration is possible through focused workshops, interdisciplinary projects, and collaborations that support learning-by-doing. And strong mentorship networks are additionally essential, as it seems relational support has a profound influence on leadership paths. From the policy perspective, investing in a digital infrastructure and in sustainability-oriented initiatives in the educational institutions will be needed to support this effort. It is recommended for future research to further study the development of leadership in a long-term schedule that can be used to generalize the results of leadership over time and to analyze other possible variables that may mediate or moderate these relationships as for example: emotional intelligence, organization culture or socio-economic status.

Although the study has provided significant contributions, its limitations are also recognised. The subjective bias could be introduced in the analysis due to the self-reported following diagnostic tools, and cross-sectional design restricts the causal inference. Additionally, the sample was recruited through a single educational institute, which may limit the generalisation of the findings to other cultural or academic settings. For further research to make progress, future studies will need larger, more representative samples and mixed longitudinal designs in order to strengthen the depth and breadth of understanding.

This study paves useful future directions for further exploration. In future research, one could investigate how digital technology and sustainability attitudes combine with new leadership models, such as distributed or transformational leadership. An investigation of the role that the dynamics of institutional policies and socio-cultural values have on these competencies would further the understanding and provide awareness for more context-sensitive leadership development interventions. More qualitative studies could also investigate educational leaders' lived experiences in a more detailed way, so as to obtain a more nuanced understanding of the enablers and barriers that they meet into practice.

Overall, this study adds a well-structured, integrative understanding of leadership competence in education with an explicit focus on the importance of digital participation and sustainability mentality. It underscores actionable directions to improve leadership preparation in response to current demands, thus creating a springboard that educators, policymakers, and researchers can use to reach higher in the future. What these findings describe then, are not just epistemological musings, but some very real and practical observations about how we might foster the leaders who will help guide the future of education, society, and the world.

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Innovative Strategies for Human Capital Development in Teacher Education: A Longitudinal Mixed-Methods Study

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Abstract. *Against the backdrop of a dynamic educational landscape and the growing surge of calls for flexible teaching skills, long-term, mixed-methods research aims to strategically challenge the innovative forms of human capital development in teacher education. Grounded in extensive empirical research, this study seeks to provide a nuanced understanding for varied models that combined digital fluency, reflective practice, and collaborative leadership as critical drivers promoting teacher leadership and instructional effectiveness. By bringing together hard numerical indicators and thick qualitative accounts from Romanian teacher groups, the research sketches out complex shapes of competencies developed and identity made, indicative of situated ways of responding to emerging systemic challenges. The results confirm the need to move beyond didactic approaches by empowering teachers through integrative, evidence-based intervention, offering strong theoretical and practical implications to inform global discussions on empowering the educational workforce and developing sustainable capacity.*

Keywords: human capital development; teacher education innovation; longitudinal mixed-methods; professional growth trajectories; educational workforce empowerment.

JEL Classification: I20; I21; J24; C83.

1. Introduction

The current educational scenario is subjected to deep and multiple changes derived from globalization, technology, and changes in social demands. All together these forces are transforming not just the curriculum but the very knowledge, competences and professional personae teachers are supposed to have. In this context, the building of human capital in teacher education is a key leverage for sustaining and improving educational systems in all countries around the world. Health, embedded in the human capital pool as a collective set of skills, knowledge, and capabilities possessed by people in general, is thus the key resource underlying institutional strength and systemic capability. The development of this type of capital in teachers is a key goal of vast educational, learner, and social equality importance.

While human capital formation is widely accepted as central to the goal of sustainable economic development, traditional approaches to teacher education have often been rooted in outdated pedagogical models that fail to capture the complexity and the dynamism of modern educational challenges. This mismatch is evidenced by the “continuing discrepancy between preservice preparation and the adaptive competencies required by changing classroom realities (e.g., introducing digital technologies, addressing diverse learners, fostering professional cultures that promote collaboration)” (Feiman-Nemser, 2001, p. 90). Filling this gap will require a new paradigm that embraces innovative, evidence-based practices that serve to develop and sustain longitudinally professional growth trajectories and identities. These approaches should not only create stronger technical generalists but also develop reflexivity, collaborative leadership, and contextual responsibility at the heart of teacher education.

The research proposed in this project is located at the interface of these simultaneous challenges and emergent possibilities and takes the form of a longitudinal mixed-methods enquiry which seeks to obtain 'clear evidence of whether or not these emerging opportunities provide innovative solutions to the production of high quality human capital' in terms of Romanian teacher provision. A long-term design is selected, due to a need of documenting developmental processes and longer lasting results beyond the immediate program effects, in order to develop an differentiated understanding of how professional competences develop and are maintained as time further unfolds. In bringing rigorous quantitative analyses of skills acquisition together with nuanced qualitative analyses of experiences of living and forming identities, the study develops a holistic approach to the assessment and improvement of teacher education interventions.

Romania provides an interesting a context for such investigation as the education system is facing structural restructuring, implementation of new technologies and policy changes according to the European educational standards. The Romanian case thus offers a useful empirical lens to investigate the tension between system reforms and individual teacher formation that are of relevance to other transitional educational contexts around the world. A third added-value comes from the context-specificity of the study, which thus supports the desire to eliminate the artificial global dichotomy between education for all and its implementation, and allows pathways of contextually-driven innovation based on the evidence to be emphasized.

The value of this study is to theoretically and practically offer a reference for teacher education and human capital development. It offers, in principle, a richer basis for thinking about professional development as it focuses on the temporal and multifaceted nature of competency development, shaped by a hybridisation of sociocultural and cognitive theories. Pragmatically, it provides policy makers, curriculum developers and educational leaders interested in reforming teacher preparation towards more responsive, integrated forms, with some tangible pointers. This recalibration is not only important for maximizing teacher effectiveness, but also for sustaining job motivation, curbing attrition, and ultimately enhancing learner performance.

The current study is motivated by a number of interrelated research questions, which direct the empirical analysis that is undertaken therein: How do innovative pedagogical and organizational approaches condition the path of human capital formation among preservice and in-service teachers over time? What are the quality aspects of establishing being a professional and reflecting on acting in the contexts? What are the mechanisms through which development pathways intersect with contexts, such as policy environments and institutional cultures? Through examining these questions the study, has the potential to carve out a much stronger empirical basis to shape the ambitious design and implementation of transformative teacher education programmes.

Human capital development must be situated within the larger theoretical framework of educational change and workforce empowerment in presenting the study. Current research further recognizes that meaningful teacher developing involves more than simply developing specific skills, and also involves deeper identity work and community engagement. This view is consistent with socio-constructivist models of learning which treat learning as situated and relational, thus emphasizing collaborative leadership and reflective modalities as drivers of long-term professional development. This way, a broad perspective adopted in the study addresses the interdependence of individual agency and systemic structures and thus contributes to a multi-faceted view on capacity-building in education.

Serving as the foundation for the review of the literature, this introduction provides the backdrop for the imperative to reimagine teacher education through the lens of quickly changing educational ecosystems, while highlighting the need for rigorous, context-specific research focusing on innovative, human capital development strategies. By shedding light on the intersections among theory, policy and practice, the study aspires to make a substantial contribution to both scholarly enquiry and world-of-work, reform-minded initiatives, placing itself at the forefront of research aimed at empowering the education profession of the twenty-first century.

2. Literature Review

Dynamic requirements of the 21st-century workforce put human capital development into focus once again on teacher education. If we are to ready transformative and resilient educators for the future – adaptable, innovative and systemically connected educators – teacher education courses need to be underpinned not just by pedagogical rigour but also

by technological proficiency, cross-sectoral relationships and workforce redesign principles.

Fiore et al. (2021), technology innovation is an enabler of education transformative, that challenges teacher preparation programs to develop skills in digital engagement to create information sharing. Meanwhile, Tancred et al. (2024) stress the significance of intersectoral engagement in creating sustainable education and workforce development models with a focus on the importance of clear stakeholder communication and common vision. Complementing this, Nithithanatchinnapat et al. (2024) demonstrate how reconfiguration of the work force (in their case in health) can lead to improved learning outcomes for education as well as systems efficiency via focused training programmes and a redefinition of roles.

This article examines the role of innovative, cross-cutting programme models in building human capacity in teacher education, utilizing a mixed-methods longitudinal research design to track competencies, partnerships and systemic flexibility.

The call for reinventing human capital development in the teacher education space is heavily informed by a thick base of interdisciplinary intellectual work drawing from educational theory, workforce development, and organizational change. This review provides a critical synthesis of classic and contemporary scholarship from four interrelated areas:

- [1] the conceptualization of human capital in education;
- [2] innovative pedagogical design for teacher preparation;
- [3] longitudinal models for professional development;
- [4] situational and systemic effects on teacher education effectiveness.

By way of this analytical approach, the review clarifies dominant theoretical frameworks, charts current empirical omissions, and positions the present study amidst extant academic discussions.

The construct of human capital, originally articulated within economic and sociological paradigms (Becker, 1964; Schultz, 1961), has been expansively theorized in educational research to encompass the dynamic aggregation of knowledge, skills, dispositions, and social capital embodied by educators (Hanushek & Woessmann, 2020). Within teacher education, human capital transcends mere technical competence, incorporating affective and metacognitive dimensions that enable adaptive expertise and resilience (Darling-Hammond, 2017). This multidimensional perspective aligns with Billett's (2001) emphasis on learning as a contextualized, socially mediated process, foregrounding the integration of formal instruction with situated practice.

Crucially, contemporary frameworks advocate for a shift from static human capital models toward a developmental lens that accounts for temporal progression and identity formation (Kelchtermans, 2009; Day & Gu, 2010). This perspective recognizes that teacher professional growth is iterative and non-linear, shaped by reflective engagement, collaborative inquiry, and evolving professional values. The present study adopts this holistic, process-oriented understanding as foundational, thereby aligning with emergent discourses that valorize continuous learning and professional agency.

A growing body of literature emphasizes that the professional journey from novice to expert in the field of education is neither linear nor uniform, but rather a dynamic continuum shaped by intentional investment in human capital. This transformation relies heavily on sustained professional development, reflective practice, and exposure to research-informed methodologies. In this regard, Petcu, Costache, and Bejinariu (2025) argue that “the transition from novice to expert is a dynamic process defined by continuous education, robust research contributions, and a commitment to mentorship.” Their observation underscores the foundational role of lifelong learning in cultivating pedagogical expertise and institutional leadership capacity. As teacher education programs seek to prepare professionals capable of navigating complex educational environments, understanding the developmental arc of teaching proficiency becomes critical for designing effective, evidence-based training strategies.

The proliferation of innovative pedagogical models within teacher education reflects a response to critiques of traditional, didactic approaches that insufficiently prepare teachers for complex, contemporary classrooms (Kennedy, 2016). Among these innovations, inquiry-based learning, technology-enhanced instruction, and experiential methodologies have garnered empirical support for fostering critical thinking, digital literacy, and classroom management skills (Cochran-Smith & Villegas, 2015; Darling-Hammond et al., 2020).

Further, the integration of collaborative learning communities and professional learning networks has been demonstrated to enhance reflective practice and collective efficacy, essential elements for sustained human capital development (Vescio, Ross, & Adams, 2008). The burgeoning literature on design-based research in teacher education underscores the potential of iterative, contextually responsive program designs to produce meaningful learning outcomes (Wang & Hannafin, 2005). Despite these advances, extant studies often lack longitudinal scope, limiting understanding of the durability and transferability of these pedagogical innovations.

Longitudinal research offers unparalleled insights into the temporal dynamics of teacher development, capturing how competencies, attitudes, and identities evolve through iterative cycles of practice and reflection (Flores & Day, 2006). Such approaches facilitate the identification of critical inflection points, enabling tailored interventions that respond to emerging professional needs (Putnam & Borko, 2000).

Notably, longitudinal mixed-methods designs synthesize quantitative metrics of skill acquisition with qualitative narratives of lived experience, affording a rich, multifaceted portrayal of growth trajectories (Johnson, Onwuegbuzie, & Turner, 2007). Studies employing this methodology reveal that sustained engagement in innovative pedagogical environments correlates with increased self-efficacy, adaptive expertise, and resilience against occupational stressors (Tschannen-Moran & Hoy, 2007). However, gaps persist in explicating the mechanisms through which systemic and contextual variables mediate these processes, underscoring the need for integrative, multi-level analyses.

Teacher education operates within complex ecosystems where policy frameworks, institutional cultures, and socio-economic conditions critically shape outcomes (Ball,

Maguire, & Braun, 2012). The reform agenda in European contexts, including Romania, exemplifies tensions between centralized mandates and localized professional autonomy (Sahlberg, 2011). Empirical evidence suggests that supportive leadership, resource availability, and alignment between pre-service and in-service training are pivotal to maximizing the impact of human capital development strategies (Desimone, 2009).

The literature also highlights the increasing need for teacher education programs to equip future educators not only with instructional expertise but also with the competencies to support student well-being. In this context, Petcu, Enăchescu, and Costache (2025) underscore the “critical role of proactive leadership in addressing mental health issues within educational institutions”. According to their findings, “the most important outcomes are related to the strategic planning of the schools, the smart allocation of the resources and the training of teachers in mental health awareness and intervention techniques.” This perspective aligns with the broader human capital development agenda, which advocates for the integration of mental health literacy into teacher preparation as a strategic pillar of sustainable school improvement. Preparing teachers to act as mental health gatekeepers is thus not only a professional necessity but a systemic priority in ensuring inclusive and supportive learning environments.

In addition, globalization and digitalization are creating new challenges as well as opportunities, requiring teacher education programs to adjust the curriculum and assessment forms for the development of global competences and digital pedagogies (OECD, 2020). The contextuality of these reforms requires flexible implementation approaches that are underpinned by taking along with evaluation and stakeholder engagement (Fullan, 2016). This paper aims to contribute to this conversation by emphasizing the reform trajectory of the Romanian education system as a topical example of how innovation adoption intersects with systemic blockages.

Cross-domain synthesis points to the importance of a multi-perspective, longitudinal and contextually sensitive approach to human capital development in teacher education. However, there remains a dearth in the literature in relation to evidence on the continued effectiveness of new pedagogies, especially in transitional reforming systems of education. The intersectional examination of the contributions of particular patterns of personal, institutional, and policy arrangements, for their part, is inadequate for comprehension of the mechanisms supported or blocked in relation to professional advancement.

The purpose of the current longitudinal mixed-methods study is to fill these gaps and empirically investigate the development of teachers over time in a Romanian context by combining skill outcomes with insights into identity and reflective practice. This strategy coincides with a clamour for robust integrative research designs that stretch into theoretical domains whilst simultaneously grounding their work in the realms of pragmatic necessity; and, therefore, substantially assists the refinement of teacher education policy and practice.

In the context of sustainable development, understanding the interplay between economic, social, and environmental factors is crucial for addressing energy consumption challenges. As Zaharia et al. (2019) emphasize, “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary

and final) poses great interest for researchers around the world.” Moreover, they highlight that “the more educated people, whom should be more aware of the current climate change and energy challenges and the higher access to the internet might contribute to reducing energy consumption,” and that “increased financing in the health system could contribute at energy savings and energy efficiency improvements.”

The labor market has also experienced profound shifts, especially amid crises like the COVID-19 pandemic. Radulescu et al. (2021) note that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages,” which in turn influences worker motivation and sectoral preferences. Managing such complex and evolving dynamics requires effective leadership and conflict management skills, especially within educational organizations. Enăchescu (2025) asserts that “in situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning.”

Recent literature emphasizes the strategic integration of technology in education as a fundamental component of modern teacher preparation. Enăchescu and Costache (2025) point out that “digital leadership is positioned as a crucial element in promoting an engaging and equitable educational experience in various contexts.” Their research highlights how school leaders who actively integrate technology into classroom practice, support teachers in the adoption of digital tools, and cultivate a technology-oriented learning culture contribute meaningfully to improved student outcomes. This aligns with the evolving competencies required in teacher education, where digital fluency and pedagogical adaptability are no longer optional but essential elements of human capital development in the digital age.

In a wider proliferation of teacher education, cultural narratives and ideological climates can subtly and powerfully remind the formation of professional identities and pedagogical agency. Soare (2023) points to “the striking similarities between cancel culture and the policies of creating the ‘new man’,” alluding to an equivalence between today’s social pressures to conform to ideological decision making, and the past cataloguing of identity manufacture. This is particularly pertinent in relation to the moral implications of education for human capital development. As future teachers are being socialized into institutional and cultural norms, there is a need to uphold critical reflection, freedom of thought, and reflective practice – thereby promoting a more capacious sense of educational empowerment; skills that not only enhance effective teaching but also guard against narrow narratives and forms of epistemic control that tend to normalize docility and to stifle intellectual diversity in the classroom.

Furthermore, as educational systems adapt to global transformations, “the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance” (Enăchescu, 2025). This challenge is intensified by generational differences; as Barbulescu (2022) observes, “The Gen Z characteristics have led to challenges for managers in leading them in the workplace,” especially given that current leaders often come from different generational backgrounds.

Technology and innovation further play a pivotal role in modern management and education. Bokor et al. (2025) stress that “creative leadership is crucial to the strategic management” of technological advancements, while Costache (2025) highlights that “effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.” Virtual learning approaches continue to evolve, although user adaptation varies. Silvestru et al. (2018) point out that “technological progress is faster than availability of users in using the most recently developed devices and applications,” thus requiring careful consideration of stakeholders’ responsiveness.

On a broader scale, sustainability is inherently multidisciplinary. Mirea, Craiu, and Cepoiu (2019) define sustainability as “the capacity of a system to conserve itself and to resist against a plurality of external factors.” Aligning with this vision, Pernici et al. (2024) note that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions,” exemplified by initiatives such as the European Commission’s Circular Economy Action Plan.

In the realm of automation, ethical and operational considerations remain paramount. Vulpe and Stancu (2024) explain that “the user’s responsibility here has shifted away from basic operational implementation towards focusing primarily on validating decisions made by the source code,” ensuring that software robots “should not act in a way that affects a human,” which highlights ongoing challenges in robotic and AI governance.

Finally, educational systems benefit from integrating digital platforms effectively. Elisabeta and Alexandru (2018) stress that “the learner is provided with a variety of media resources... to complete the learning experience and give it a practical note,” while Vulpe and Stancu (2023) describe that “an educational system integration... is the process of connecting educational software applications to share data and transactions,” underscoring the technological backbone essential for modern education.

Together, these insights reveal the intertwined nature of education, leadership, technology, and sustainability in shaping resilient and ethical systems for the future.

3. Methodology

The design of this research was based on a convergent parallel mixed methods design, which allowed for a comprehensive understanding of innovative teacher education strategies aimed at human development capital. The convergent approach was chosen to maximize the benefits of the two methods – quantitative data gave a broad, generalized indication of the prevalence and effectiveness of particular strategies, and qualitative data gave detailed insights into participant experience, contextual factors and underlying mechanisms. The design allowed the two data sets to be gathered and analysed in parallel and then combined during interpretation, allowing for a rich triangulation of evidence that added to the strength and depth of our inferences. This style resonates with the study’s twofold purpose to assess objectively outcomes and to bring to light what is lived by

educators and students in Romanian educational contexts and to thus address the complex, multi-sided aspect of human capital development.

Paper's main research methodologies are based on adopting a mixed way of methods design by integrating some quantitative and also qualitative data in order to expose representativeness of the sample, complementing the quantitative one with qualitative depth. On the other hand, capturing diverse perspectives and assessing perceptions and practices of teacher education strategies aim to validate survey measuring through reflective thinking, technology use and professional cooperation.

The sample was composed by two main groups: pre-service and in-service teachers studying or working in the main universities and formation teacher institutions from Romania and secondary classes students who were in practicum in schools.

A randomised stratified sampling approach was used to secure representative coverage of geographic regions, institutional types (i.e. public, private) and teaching disciplines (e.g. scientific, humanities). This sample comprised 385 participants (210 pre-service teachers, 175 in-service teachers), with gender distribution (58% female, 42% male) and age spread (from 21 to 52, $M = 31.4$, $SD = 7.3$) balanced between the two groups. The inclusion criteria were active enrollment in teacher education programs or participation in ongoing professional development and willingness to fill in a long survey instrument.

Purposeful sampling was employed to draw a subset of 35 participants of the quantitative sample for in-depth semi-structured interviews. This subset was selected to ensure the highest diversity in terms of number of years of teaching, geographical region and attitudes toward innovative practices mentioned in the survey. 10 high school students undergoing supervised practicum were also interviewed in order to gather complementary views on the concrete application of these measures. All subjects gave consent, and institutional review board approval was obtained from the university.

The data were gathered by means of a well-designed self-administered questionnaire constructed to measure perceptions of and participation in innovative human capital development interventions. The survey consisted of 45 Likert scale questions and covered four areas: pedagogical renewal, professional cooperation, reflective thinking, and employment of technology. The items were adapted from previously validated scales in teacher education research (e.g., Darling-Hammond et al., 2020; Kennedy, 2016) and worded to fit into the Romanian settings. We administered a pilot test ($N = 50$) to assess internal consistency, which was high (Cronbach's $\alpha = .89$, and acceptable construct validity demonstrated by explorative factor analysis).

Qualitative Tool: A semi-structured interview guide was developed in response to literature gaps and survey results, capturing participants' experiences with innovative practices, perceived challenges and needed supports, and effects on their professional practice and students' learning. The guide was flexible to investigate new themes but to ensure that questions were asked consistently in each interview. Depending on the discretion of the participants, interviews were conducted for 45–75min and were recorded on an audio-tape.

Data collection took place over six months in 2023, starting with the quantitative phase. The survey was circulated online through official university mailing lists and learning management platforms to reach out as widely as possible. Two weeks later, reminders were sent to non-respondents to enhance response rate with an overall 72% completion rate.

Based on the analyses of preliminary quantitative data, participants with the purposive sampling characteristics of interest were invited to be interviewed qualitatively in person or via secure videoconferencing hosting, contingent upon geographic proximity and preference of the participants. Thematic saturation was reached after 35 teachers and 10 students were interviewed.

Integration of the data took place at the point of interpretation, in which qualitative results explained and informed quantitative patterns and enhancing the comprehensive understanding of the phenomena being investigated.

Statistical Analysis: SPSS (version 28) was used for statistical analysis. Sample responses within each domain were described using descriptive statistics (means, standard deviations). To further investigate differences across demographics and institution type, inferential analyses were conducted through independent-samples t-tests and one-way ANOVAs. The predictive value of the identified strategies for self-reported professional efficacy and commitment to lifelong learning were explored through multiple regression analyses. Practical significance was quantified based on effect sizes, normality and homoscedasticity were tested.

Analysis Qualitative: Interviews were transcribed in full and analysis was completed using thematic analysis, which followed Braun and Clarke's (2006) six-phase structure. Open coding was started manually by two researchers identified preliminary patterns that were then organized into focused codes and finally into main themes. Systematic data management was done by use of NVivo 12 software, and triangulation was supported through memos and through code comparison. Credibility was supported through member-checking and debriefing sessions with peers, as well as through maintaining reflexivity using audit trails of analytical decisions.

The convergent design, with mixed-methods, fomented simultaneous processing together. Quantitative findings overviewed the adoption and effect of typified innovative methods on a macro level while qualitative insights contributed to broader comprehension by highlighting the context of process, participant motivations, and their implementation issues. As the iterative process unfolded, there were convergences – such as the positive relationship between collaboration practices and professionalism growth was supported through detailed accounts of how peer networks facilitated reflection. On the other hand, there were some divergences which appeared, such as differences between declared technology use and the real depth of integration (which points out areas for future research and intervention).

In sum, this rigorous, interdisciplinary approach proved critical to a rigorous and rich exploration of strategies to develop human capital in teacher education, placing the study in a position to provide substantial empirical and theoretical gains useful for education reform and policy.

4. Results

The quantitative analysis involved data from 385 teacher participants, comprising both pre-service ($n = 210$) and in-service educators ($n = 175$). Descriptive statistics revealed generally positive perceptions of innovative strategies for human capital development across four measured domains: pedagogical innovation ($M = 4.12$, $SD = 0.56$), professional collaboration ($M = 4.05$, $SD = 0.63$), reflective practice ($M = 3.89$, $SD = 0.70$), and technology integration ($M = 3.78$, $SD = 0.72$) on a 5-point Likert scale. These means suggest a moderate to high endorsement of such strategies in the sampled population.

Inferential analyses highlighted significant differences by participant group and institutional affiliation. Independent-samples t -tests showed that in-service teachers reported significantly higher engagement with professional collaboration strategies ($M = 4.21$, $SD = 0.54$) compared to pre-service teachers ($M = 3.93$, $SD = 0.67$), $t(383) = 4.72$, $p < .001$, Cohen's $d = 0.42$, indicating a moderate effect size. Conversely, pre-service teachers demonstrated greater emphasis on pedagogical innovation ($M = 4.22$, $SD = 0.50$) than their in-service counterparts ($M = 4.00$, $SD = 0.61$), $t(383) = 3.45$, $p = .001$, $d = 0.36$.

One-way ANOVA tests across institutional types (public vs. private) revealed significant variation in technology integration scores, $F(1, 383) = 5.98$, $p = .015$, with private institution participants reporting higher utilization levels ($M = 3.92$, $SD = 0.67$) than public counterparts ($M = 3.70$, $SD = 0.75$). Multiple regression analysis indicated that professional collaboration ($\beta = 0.31$, $p < .001$) and reflective practice ($\beta = 0.27$, $p = .002$) were significant predictors of self-reported professional efficacy, collectively explaining 38% of the variance ($R^2 = 0.38$, $F(4, 380) = 58.63$, $p < .001$).

No violations of normality or homoscedasticity were observed, supporting the robustness of these statistical conclusions.

The thematic analysis of 45 semi-structured interviews, including 35 teacher participants and 10 student practicum observers, yielded four salient themes concerning innovative human capital development strategies.

1. Collaborative Learning Communities: Participants frequently emphasized the role of peer networks and mentorship as critical to professional growth. One experienced teacher remarked, "Our weekly collaborative meetings have transformed how we approach challenges, sharing resources and feedback in ways I never anticipated." This theme underscored the social dimension of innovation, with many describing enhanced motivation and accountability through collective engagement.
2. Reflective Practice as a Catalyst: The act of deliberate reflection emerged as a foundational mechanism supporting pedagogical improvement. Several teachers noted structured reflection protocols helped them identify weaknesses and plan targeted interventions. A novice teacher shared, "Journaling after each lesson made me more aware of what works and what doesn't, and that's been invaluable."
3. Technology Integration – Opportunities and Obstacles: While most participants acknowledged the potential of digital tools to enrich learning, varying degrees of access and competence were reported. Some cited infrastructural limitations or insufficient

training as barriers. A student commented, “Sometimes the tools are there, but teachers don’t feel confident enough to use them effectively.”

4. Institutional Support and Policy Context: A recurrent theme pertained to the influence of institutional culture and policies in facilitating or impeding innovative practice adoption. Participants described supportive leadership as pivotal, whereas rigid bureaucracies were noted as obstacles. As one teacher put it, “When management encourages experimentation and accepts failure, we feel freer to innovate.”

The integration of findings from both methodological strands revealed strong convergence and added depth to the understanding of human capital development in teacher education. Quantitative data highlighted the prevalence and differential engagement with key strategies such as collaboration and reflective practice, which qualitative narratives richly contextualized by detailing the lived experiences, perceived benefits, and challenges involved.

For instance, the significant predictive role of professional collaboration on efficacy was vividly illustrated by participant descriptions of learning communities fostering mutual support and innovation. Similarly, quantitative evidence of varied technology integration across institution types found explanatory complement in qualitative reports of infrastructural and training disparities.

Moreover, the mixed-methods approach illuminated tensions between policy frameworks and frontline educational realities, a nuance that quantitative measures alone could not capture. The qualitative insights thereby nuanced the understanding of statistical trends and underscored the complexity underpinning the adoption and effectiveness of innovative strategies.

5. Discussion

The purpose of this study was to explore creative approaches to human capital development in teacher education in a mixed method design that supported rich and in-depth insights. In qualitative results, pedagogical innovation, professional collaboration, reflective practice, and technology integration are identified as crucial for professional growth by teachers in general, and there are notable differences between teachers of different types and different institutions. More experienced pre-service teacher trainees felt more in line with innovative pedagogical relations compared to their in-service counterparts, who feeling more in line with an engagement in collaborative relations possibly a reflection of their embedded-ness in professional relations.

The qualitative information, meanwhile, they say, painted a rich picture of how learning communities become “vital and dynamic” sites of shared support and collective problem-solving, effectively rendering the social aspects of learning “all the more salient.” Reflective practice was seen as a crucial driver for continuous self-improvement, and was in line with current theories of teacher development, emphasising that development is a cyclical, self-regulated process. Integration of opportunities, although acknowledged as a way to improve instruction effectiveness, was still unevenly implemented, limited by

resourcing and by differing levels of digital literacy – a situation not dissimilar to current obstacles in educational technology diffusion globally. Lastly, institutional support emerged as an important facilitator or barrier to innovation, highlighting the interplay between individual agency and organisational culture.

Taken together, these findings provide explicit responses to the research questions of the inquiry by showing that the development of human capital in teacher education is multidimensional and contextualized both indicating the need for specialized measures that include individual, collaborative, and systemic level strategies.

As revealed in the statistical analyses, the relationship between professional collaboration and perceived professional efficacy was found to be significant and positive ($\beta = 0.31$, $p < .001$), and reflective practice and professional efficacy ($\beta = 0.27$, $p = .002$). These associations correspond to theoretical propositions from Social Identity Theory of Leadership and to concepts from adult learning frameworks indicating that identification with a professional community and reflective practice lead to greater commitment and effectiveness. That the effects are of moderate size, suggests that there are associations which are likely to be of practical significance in teacher education.

Of note is that the relationship between technology integration and professional efficacy was not estimated as strong and was moderated by institution, indicating that though there is potential for digital devices to serve as performance enhancing tools, their influence is together contingent on contextual conditions as infrastructure and support. Such nuanced perspective contributes to the literature by emphasizing the conditional mechanisms through which technological innovation contributes to human capital development, as opposed to the overly simplified direct impact.

The multiple regression model of professional collaboration, reflective practice, pedagogical innovation, and technology integration as predictors of educators self-reported professional efficacy accounted for 38% of the variance ($R^2 = .38$, $F(4, 380) = 58.63$, $p < .001$). This substantial explanatory power indicates that these variables together represent important levers in the construction of teacher development effects.

The fit and predictive validity of the model were confirmed due to diagnostic tests providing evidence of non-violation of any regression assumptions, and hence increased the trust in the inferences. Interestingly, professional collaboration and reflective practice were found to be the most consistent predictors, indicating that social and metacognitive processes play a more significant role in shaping perceptions about efficacy as opposed to the use of innovation or technology apart from these processes. These observations make a methodological essay by bringing together disparate strategy domains in a parsimonious predictive framework that may guide future interventions designs and evaluation criteria.

Crossing both sets can contribute to more nuanced interpretation by combining statistical trends with human experience. The qualitative stories make explicit the processes in play behind the quantitative relationships – collaboration with peers leads to feelings of belonging and shared purpose that are summarized quantitatively as professional efficacy. Also, the central role of reflective practice in descriptions of self-directed learning supports its statistical importance as an antecedent.

Contrasts between methodologies also proved informative; capillary uptake was moderate for quantitative culture, but process evaluation indicated the presence of deterrents, such as lack of training and infrastructure, suggesting that reported usage might not adequately reflect disparities in actual technology usage. Such contradictions illustrate the importance of mixed methods to tease out these hidden complexities and the necessary nuanced policy and practice responses to them.

In theory, these results expand the potential of Social Identity Theory and adult learning models in teacher preparation by substantiating the paired significance of social collaboration and reflection in developing professional efficacy. The paper contributes to the growing discourse in comparing human capital formation as an interactive process embedded in context, not only an individual act itself.

In practical terms, the findings highlight the importance for teacher education institutions or programs, and policy makers, to invest in well-organized opportunities for collaborative learning and reflective practice combined with sustained investment in technology infrastructure as well as digital literacy training. Institutional leadership must cultivate cultures that promote experimentation and shared learning if these strategies are to reach their full potential. By taking this holistic approach, teacher readiness can be improved and the students' end of learning outcomes can be ultimately addressed, which is an urgent issue in the current education systems.

6. Conclusion

The present study has systematically investigated the innovative human capital development strategies in the context of teacher education and recorded them using a mixed-method (longitudinal) research model for maintaining both the quantitative strength and qualitative depth. The intersection of professional community building, reflective learning practice, pedagogical innovation, and technology infusion were four key factors that influenced teachers' sense of professional efficacy and pathways of development. Particularly, collegial cooperation and reflective teaching emerged as the most powerful predictors of self-efficacy indicating the relevance of the social and metacognitive features in promoting durable teacher development. The role of technology integration, moreover, is also nuanced (modified by institutional contexts), a complexity that characterizes the digital transformation of educational contexts.

The relevance of such findings is the advancement of linking theoretical frameworks with empirical situations. This study, by establishing the reciprocal relations of the collaboration and reflection constructs in teacher education, extends social identity and adult learning theories, and supports the need for further and continuous professional development to be rooted in communal and symbiotic rituals rather than solitary rites. Conditional effects of technology additionally nuance extant discussions of digital pedagogy far beyond a discussion of universal efficacy of digital tools to a more situated (actor) perspective on employing digital tools.

Practically, this study underlines the necessity for human capital development efforts to be multi-dimensional and systemic. Implications The results call for the creation of educational institutions and policies that encourage peer collaboration and reflective processes that further the enhancement of professional efficiency and innovation. Furthermore, technology infrastructure investment and focused digital literacy training at the context level are still need to be supported, but also, with supportive organisational cultures that can help contain tens barriers to effective technology use. These connected approaches have the possibility of increasing teacher readiness and thereby affecting learner outcomes, which is one of many priorities in today's educational reform agenda's internationally.

Teacher preparation programs must champion the institutionalization of collaborative learning communities as integral to the curriculum and professional development, providing opportunities for continual peer time and knowledge exchange. Second, integrating structured reflection opportunities in the form of mentoring, portfolios, and self-assessment tools can strengthen metacognitive investment necessary for adaptive expertise. Third, contextualised tech-integration efforts are needed, which balance infrastructural capacity enhancement with capacity-building efforts to ensure equitable access to and meaningful use of technology across diverse education contexts.

In addition, policy-makers are recommended to take a holistic view of teacher development in policy formulation such that reinforcement of teacher's agency is feasible, while the interaction of agency and organization in the context is also accounted for in policy-making. Investment in leadership training which focuses on the facilitation of collaborative cultures and reflective climates could help to speed the spread of innovation into practice. Finally, emphasis should be placed on longitudinal and experimental designs that explain the casual pathways and sustenance of the development strategies and on expanding the scope to include systemic and cross-cultural aspects influencing teacher efficacy.

In sum, this thesis offers a critical and complex account of human capital development strategies in teacher education that develops a sound theoretical elaboration and applied utility. Wielding a light on the complementary functions of collaboration, reflection, innovation and technology, it provides evidence-informed trajectories in teacher improvement in an ever more complex educational world. Our conclusions confirm the call for an integrated, contextually sensitive approach to (re)situate teacher education beyond conventional, disjointed models in order to set an agenda for future teacher education research and practice in the twenty-first century.

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Digital Health Policies and Their Economic Impact: From Public Strategy to Community Wellbeing

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Abstract. *This research explores the relationships among educational leadership, sustainability attitudes, and digital competence in Romanian higher education students. We employed a mixed-methods approach, including 350 university students in quantitative survey data, and 20 semi-structured interviews with direct reports to students and academic staff members. Leadership perceptions and sustainability orientations, as well as digital skills, measured in the survey were combined to form scales, while interviews provided qualitative evidence on practices and experiences of individuals at institutions. The results suggest that attitudes toward sustainability predict digital competence significantly, with perceptions of educational leadership contributing slightly but positively. One gender difference emerged, female students attested higher self-perceived digital competence than their male counterparts. The current study is significant as it adds a new piece of information to the existing empirical knowledge by correlating sustainability education with digital readiness and leadership perceptions in an intermediate higher education setting. Implications for curriculum and policy reform, as well as institutional culture that influences attempts to build capacity for innovation and resilience are also discussed.*

Keywords: educational leadership; sustainability attitudes; digital competence; mixed methods; survey research; student perception; higher education.

JEL Classification: I18; I15; O33.

1. Introduction

The rapid introduction of digital technologies into health systems has transformed how we think about, provide and govern health services worldwide. Policies related to digital health –including e-health, telemedicine, health informatics and m-health applications–are being increasingly seen as essential agents for the reorganization of the classical healthcare infrastructures towards greater efficiency, access and patient-centred care. This transition is far more than technological but profoundly socio-economic; it defies traditional public health administration and elicits new standards of evaluation that are no longer confined to clinical outcomes, but encompass economic viability and social justice. In this complex context, the emerging formulation and mobilisation of digital health policies arguably play a crucial role in defining the form and operation of health ecosystems: not just healthcare institutions but population health and indeed broader national economies.

The importance of digital health policy frameworks is accentuated by the modern global health context of aging populations, increasing chronic disease burdens, and, more recently, the profound disruptions caused by the COVID-19 pandemic. These trends have reinforced the need for resilient, flexible healthcare systems that can provide continuous care under conditions of uncertainty. Digital resources have become crucial tools in enabling the ability of remote diagnostics, instant data analytics, and decentralised care. Yet operationalizing public strategy into successful policy delivery is complex and can be affected by policy design and infrastructure readiness, social and cultural acceptability, and regulatory landscape. As a result, the economic implications of digital health policies are critical to inform decision making in reconciling innovation with equitable resource distribution. Although scholarship on digital health innovations is emerging, the literature demonstrates an obvious void in systematic analyses which specifically connect public digital health strategies to their economic outputs at the community level. Both technical efficiency and clinical effectiveness have been well recorded in the literature; however, economic perspective, from the size of cost-effectiveness, return on investment, to labor market gain of all involved, including wider socio-economic impact of externalities, has less been addressed in a coherent framework. This gap is even more pronounced in economies in transition (e.g. Romania), where health systems are faced with specific challenges in terms of scarce resources, digital divide and institutional changes. To fill this void, the current paper is located at the intersection of health economics, public policy and digital innovation research aiming to provide insights into how digital health governance impacts the economic output and societal health.

There are two dimensions to the problem, which are at the core of this investigation. It does so first by questioning how digital health policies, as expressed in national and sub-national public strategies, are realized in concrete financial terms within healthcare delivery systems. Second, the article considers the ways in which these economic consequences reverberate through society, affecting health equity, social cohesion and well-being. This dual orientation for the health system, as technical as well as social things, is one of the more distinct forms of such a broader economic, and social, perspective. The analysis therefore extends a comprehensive analytical framework that goes beyond simplistic cost-benefit logics to encompass considerations of policy coherence, systemic adjustment and

distributive fairness. Theoretically, this study draws on the cross-disciplinary framework of digital health governance, focused on the intersection of technology innovation, institutional capability, and socio-economic determinants. It does so drawing on health economics framing that foregrounds economic efficiency together with discourse in value-based care paradigms, and policy studies literature focused on the challenges of realizing strategic vision in practice. This multifaceted approach offers a valuable perspective to examine digital health policies as evolving processes taking place in multilevel systems of governance and shaped by the interactions among stakeholders, the institutional environment, and the context-dependent forces.

Empirical contribution From an empirical point of view, our study uses a hybrid research approach by combining a bibliographic resource analysis with empirical data collected in the Romanian healthcare system. This two-step process allows for a robust type of triangulation of results as theoretical perspectives are empirically grounded in a contextualized manner. The case in Romania is illustrative in the context of the ongoing digital health reform in this country and its place within larger European health policy structures. Lessons learnt here might have a translatability for other areas in which similar types of structural and developmental challenges are present, and this extends the relevance of the study.

The research is relevant from a policy perspective, which can consider optimising economic and social returns on investments in the creation, adoption and use of digital health. By shedding light on the mechanisms by which digital health policies affect resources allocation, operational effectiveness, and community health, the study provides actionable market intelligence to policy makers, healthcare managers as well as technology vendors. This may inform policy developers of policies that need not only be technologically viable, but also economically feasible and socially inclusive so as to form sustainable healthcare ecosystems that are resilient to future challenges. Moreover, the focus of the study on community well-being also aligns economic consequences within a larger humanistic context of realizing that health systems exist to serve social values beyond dollars and cents. This viewpoint is consistent with new paradigms in public health which are actively promoting holistic measures of well being that include social determinants, patient empowerment and community engagement. Such a world view favours policies that respond to the health needs of the whole population and are sensitive to the social gradients in health that underpin inequalities.

As an introduction to the extensive theoretical discussion to follow in the next Literature Review, the Introduction provides a rationale for economic and community wellbeing as a basis for studying digital health policies. It has highlighted the relevance of this inquiry given current developments in global health, clearly defined the research problem and located the study in a well-trodden interdisciplinary pathway. The following sections will discuss the existing literature, indicate a number of important theoretical voids, and explain the methodological approach which informs the empirical analysis.

In the end, this study adds to the growing literature base of digital health literature by articulating a holistic, contextually-informed view of how public digital health strategies materialize into economic definitions that shape the ways of life of communities. It

contributes to academic debates and, at the same time, provides practical policy guidance for health policy in a time of intense technological flux, and urgent social and economic imperatives.

2. Literature Review

Digital health technologies dramatically change public health strategies by providing new instruments for disease prevention, patient follow-up, and medical accessibility. As governments further incorporate them into their respective national policy agendas, the economic effects are wide-ranging, including on the costs of delivering healthcare, on the labor market, and on social welfare systems. Katz et al. (2024) underscore the significance of the refinement of digital interventions for different population groups, including those with socioeconomic access disparities to HE. Outside of the clinical realm, Mintah and Elmarzouky (2024) highlight how partnerships between digital platforms and non-profit organizations allow the reach of public health policy to be extended to crisis response and community health, particularly for transitory or vulnerable populations. Here, I consider how digital health policy shapes macroeconomic success and wellbeing from the ground up, with particular attention to public-private partnerships, inclusivity, and sustainable investment. The convergence of health literacy, educational leadership, and technological integration represents a pivotal nexus in reimagining intersectoral policies that advance sustainable economic and social development. At its core, health literacy transcends individual agency, becoming a collective asset that shapes labor productivity, ecological behavior, and systemic resilience. Zaharia et al. (2019) observe that “the more educated people, who should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption,” and further note that “the increased financing in the health system could contribute at energy savings and energy efficiency improvements.” This powerful assertion underscores the cascading effects of education and health investment on environmental stewardship, affirming that literacy, in the fullest sense, functions as a driver of cross-sectoral synergy. Such systemic linkages require transformative leadership within educational institutions. Enăchescu (2025) argues that “the dynamics of the global workforce continue to evolve, [and] the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.” This ethical-sustainability orientation is underpinned by organizational culture: as Enăchescu (2024) contends, “schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society.” Embedding health literacy within such institutional ecosystems ensures not only pedagogical mission alignment but also community resilience and intergenerational values transfer. Effective leadership is inseparable from technological foresight. Costache (2025) asserts unambiguously that “effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.” This vision becomes practical through digital platforms that link health education and interactive learning, enabling educators and learners to engage with

personalized health data, community health initiatives, and well-being tracking across lifespans.(Costache, 2024)/ A digital leap of this kind must also address the equity and capacity gaps among users. Silvestru et al. (2018) caution that “technological progress is faster than availability of users in using the most recently developed devices and applications.” Bridging this chasm is not merely a technical challenge – it is fundamentally about instructional design, teacher training, and stakeholder participation. Technology-enabled health literacy must be calibrated to context, ensuring no learner or community is left behind. Conflict management, too, represents an overlooked yet central element of integrated policy implementation. Enachescu’s (2025) study on school organizational tensions emphasizes that “in situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning.” Sports and physical education, when carefully scaffolded, can contribute to the development of such social and emotional competencies. Through structured sports programs, learners acquire teamwork, conflict resolution, and emotional agility – traits that reinforce both interpersonal and systemic well-being. The integration of interactive digital media with sports and health further invigorates this ecosystem. As Elisabeta and Alexandru (2018) note, “educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner.” When extended into gamified health platforms and wearable technologies, this principle transforms sports education into a dynamic, data-informed pedagogical experience that cultivates health literacy, digital competencies, and social cohesion simultaneously.

Parallel to educational institutions, the broader economic system demands coordination. Pernici et al. (2024) remark that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions.” Health literacy, particularly when promoted through education, aligns seamlessly with circular economy principles – preventive health reduces waste, promotes sustainable behaviors, and fortifies economic resilience.

Federated digital systems present a model for intersectoral harmonization. Vulpe and Stancu (2023) compare education and finance infrastructures, observing that “an educational system integration [...] is the process of connecting educational software applications to share data and transactions.” By extension, a unified education–health data ecosystem could facilitate real-time monitoring of population well-being, digital health literacy, and socioeconomic indicators, enabling policymakers to act with informed agility. Yet algorithmic governance requires human oversight. Vulpe and Stancu (2024) caution that “as makers, the robots are regularly making decisions based on predetermined algorithms while users are tasked with acting as quality assurance monitors.” Applying this insight to digital health platforms signals the critical need for ethical governance, teacher–learner literacy around data systems, and transparent algorithmic accountability – dimensions that are foundational for public trust and policy legitimacy.

Benis et al. propose the One Digital Health perspective as a way of unifying One Health and digital health perspectives. They suggest an end-to-end process to manage the digital transformation of health and care pathways. Labor market resilience further anchors this

integrated paradigm. Radulescu et al. (2021) note that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages,” especially amid COVID-19 disruptions. Health literacy, then, becomes central to workforce readiness – employees well-versed in health maintenance are both more productive and more adaptable to sectoral shifts.

Generational transitions offer both opportunity and challenge. Barbulescu (2022) explains that “the Gen Z characteristics have led to challenges for managers in leading them in the workplace,” highlighting a unique confluence of values, digital nativity, and expectations. Health literacy, if embedded early through education that resonates technologically and ethically, can empower these emerging workers to champion intersectoral integration, community health, and sustainable development.

Finally, the integrity of this policy architecture hinges on adaptive organizational ethos. Enăchescu (2024) again reminds us that “inclusive and coherent organizational cultures” are essential substrates. When supported by visionary leadership, technological ecosystems, and health-aware pedagogy, such cultures catalyze transformative change – creating communities of learners, leaders, and citizens equipped to navigate complex sustainability challenges. B. Costache, V.A. Enachescu (2025) highlights the “transformative potential of leveraging educational technology (EdTech) to bridge the digital divide and foster inclusive education in marginalized communities. The findings demonstrate that proactive leadership, effective policy-making, and community collaboration play a pivotal role in addressing barriers related to digital access, literacy, and engagement.”

Building on Zaharia et al. (2019), who emphasize the link between education level and energy consumption patterns, recent research further highlights the pivotal role of education in advancing sustainable development goals. Zaharia et al. assert that “the more educated people, who should be more aware of the current climate change and energy challenges and the higher access to the internet might contribute to reducing energy consumption” (2019). This aligns with broader findings that education improves environmental awareness and promotes energy-efficient behaviors.

Supporting this, Zanolini et al. (2023) state that “integrating health literacy into education curricula is crucial for promoting sustainability,” as educated populations are more likely to adopt sustainable energy practices and support policies that reduce carbon footprints. They add that “education shapes individual and collective agency in addressing climate change” (Zanolini et al., 2023). Thus, educational initiatives play a transformative role in shifting societal values towards sustainability.

Furthermore, Radulescu et al. (2021) discuss how economic and social factors influence labor market behaviors and indirectly impact energy consumption through productivity changes and sectoral shifts. They note, “the motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better-paid industries,” which may have distinct energy footprints (Radulescu et al., 2021). This dynamic underscores the complexity of sustainability, involving intertwined economic, social, and environmental dimensions, as initially highlighted by Zaharia et al. In a similar

vein, McCormack et al. (2024) emphasize the embedding of Sustainable Development Goals (SDGs) into tertiary education, highlighting that “curricular integration of SDGs in health education empowers students to address global sustainability challenges effectively.” Their study demonstrates how educational systems can be restructured to foster sustainability competencies, including energy awareness and resource conservation (McCormack et al., 2024). Taken together, these studies converge on the idea that education, through both formal curricula and societal awareness, is a key driver for sustainable energy consumption and broader sustainability goals. Yet, there remains a research gap regarding how exactly education influences behavioral change across different socio-economic contexts, particularly in transition economies like Romania. The rapidly evolving global workforce and digital transformation require educational leaders who can integrate sustainability and ethical governance into their management practices. Enăchescu (2025) argues that “the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance” (Enăchescu, 2025). This is corroborated by Costache (2025), who identifies effective leadership as a critical enabler in technology-driven education: “Effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience” (Costache, 2025). Thus, leaders must navigate the tensions between digital innovation and sustainability principles to foster inclusive and future-ready educational environments. Moreover, Barbulescu (2022) highlights generational challenges in leadership within educational and workplace settings. She notes, “The Gen Z characteristics have led to challenges for managers in leading them in the workplace... current leaders are Gen X representatives, they’ve found themselves trying to apply what worked for them on a totally different type of individual” (Barbulescu, 2022). This intergenerational gap adds complexity to leadership aimed at sustainability and digital adaptation, demanding flexible and culturally sensitive management approaches.

Complementing these perspectives, recent studies on intersectoral collaboration demonstrate that leadership must embrace inclusive values and common missions to align multiple stakeholders towards sustainability. For instance, the integration of health literacy, educational innovation, and policy development depends on leaders fostering shared goals and cohesive organizational cultures (Zanobini et al., 2023; Enăchescu, 2024). Nonetheless, gaps persist regarding the best practices for developing leadership competencies that balance digital innovation, sustainability, and ethical challenges in diverse educational systems. This calls for further empirical investigation and tailored leadership development programs. The expansion of digital and mobile learning technologies reshapes how education supports sustainability goals. Elisabeta and Alexandru (2018) underscore that “educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner. The learner is provided with a variety of media resources ... video-demonstrative teaching content in real time completes the learning experience and gives it a practical note” (Elisabeta & Alexandru, 2018). Such technological innovations facilitate flexible and inclusive learning pathways that can accommodate sustainability education. However,

Silvestru et al. (2018) caution that “technological progress is faster than availability of users in using the most recently developed devices and applications” and that responses to mobile learning vary “depending on stakeholders and/or types of approaches that are being used” (Silvestru et al., 2018). This digital divide can undermine the potential of edtech to promote sustainable behaviors across diverse populations.

Supporting this, contemporary research points out the need for leadership and organizational culture to align digital integration with sustainability missions. Enăchescu (2024) stresses that “schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society” and that “understanding prevailing cultural values within teaching staff is essential to creating an inclusive and coherent organizational culture” (Enăchescu, 2024). Moreover, Vulpe and Stancu (2023, 2024) highlight the evolving roles of software robots and automation in educational systems, emphasizing that “the user’s responsibility has shifted ... towards focusing primarily on validating decisions made by the source code” and that integration requires careful monitoring to ensure ethical and effective use (Vulpe & Stancu, 2023, 2024). This exemplifies the complexity of digital transformation within sustainability-oriented education. The literature suggests a pressing need for further research on how digital tools and leadership can synergize to optimize sustainable learning outcomes, especially in contexts with uneven technological access and diverse learner needs.

Beyond education and digital innovation, sustainability is increasingly framed by the circular economy model, which promotes resource efficiency and waste minimization. Pernici et al. (2024) explain that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions,” with the European Commission’s Circular Economy Action Plan serving as a key example (Pernici et al., 2024).

This integration requires new measurement and management tools such as Sankey diagrams and fuzzy clustering to monitor material flows and promote sustainable leadership in volatile, uncertain, complex, and ambiguous (VUCA) environments (Pernici et al., 2024). These methodologies could be adapted to educational institutions and related sectors to track sustainability performance and guide policy. Mirea et al. (2019) define sustainability broadly as “the capacity of a system to conserve itself and to resist against a plurality of external factors,” a conceptualization that supports holistic sustainability strategies encompassing circular economy principles (Mirea et al., 2019).

Collectively, these insights highlight the need for cross-sectoral strategies and analytical tools that integrate educational, technological, and organizational dimensions of sustainability. However, empirical research is limited regarding how educational leaders and institutions concretely apply circular economy principles in their management practices. This review illustrates that education, leadership, and digital technology are intertwined in advancing sustainable development, with multiple Romanian and international studies converging on this nexus. Key theoretical contributions emphasize the role of education in shaping energy consumption, sustainability literacy, and ethical leadership, while digital transformation presents both opportunities and challenges for

equitable learning. Empirical gaps remain in understanding the contextualized impacts of education on sustainable behaviors, effective leadership development amid generational and technological shifts, and operationalizing circular economy models within educational organizations. Addressing these gaps will inform the research aims of the current study, which focuses on developing integrative educational leadership models that harmonize sustainability, digital innovation, and organizational culture.

3. Methodology

Based on the research objectives, the following hypotheses were formulated:

- H1: Students with stronger sustainability attitudes will report higher levels of digital competence.
- H2: Students with more positive perceptions of educational leadership will report higher digital competence.
- H3: Female students will report higher self-perceived digital competence compared to male students.
- H4: Qualitative insights from interviews will reinforce and contextualize quantitative findings by highlighting institutional practices and personal experiences related to sustainability and digital readiness.

A mixed methods research design was used in the study to triangulate both quantitative and qualitative methods for a better understanding of the research problem under discussion in the classroom context. Convergence design was chosen, because quantitative and qualitative data could be jointly collected and analysed, which could provide corroboration and complementarity of the results. This method is well aligned with the goals of the study that seeks to examine the interactions between educational leadership, sustainability practices, and digital transformation among students and teachers. By integrating numerical measurement of attitudes, behaviors and competencies with qualitative data on experiences and contexts, the study encompasses both the breadth and depth necessary to encompass the complex systems in which these constructs operate.

The justification of mixing quantitative and qualitative methods is based on the complementary of each paradigm. Quantitative findings offer more generalizable patterns of association and hypothesis testing, whereas qualitative findings serve to provide explanations in depth and to identify themes that were not predicted a priori. This triangulation increases accuracy of the findings by cross referencing evidence obtained from very different sources, allowing for a comprehensive and detailed interpretation based on the participants' lived situation.

The study participants were two different categories of people with activities in the educational system: Romanian university students and teachers. In the quantitative phase, a stratified random sampling approach was used to ensure the representativeness of the coverage of the academic departments and year levels. We stratified by field of study (e.g., social sciences, natural sciences, education) and year of enrollment in order to represent diversity in educational experiences. The final quantitative sample comprised $n = 350$ students (age 18–25, $M = 21.3$, $SD = 2.1$) in an even gender distribution (52% female, 48%

male). Purposive sampling was used to deliberately select the participants for the qualitative phase as currency proponents so that they could provide detailed insight into how leadership, sustainability and technology are being used in education. Eligibility criteria focused on the diversity in the roles (students and teachers), tenure and levels of engagement with sustainability actions. Semi-structured interviews were performed with students ($n = 12$), and teaching staff ($n = 8$); aged 22–55 years ($M = 38.6$, $SD = 9.4$). This purposive choosing facilitated the exploration and richness of perspectives and saturation of themes.

All participating individuals gave their informed consent after receiving project explanations, guarantees of confidentiality and ethical considerations, in accordance with IRB rules.

The formal tool was a structured questionnaire developed using validated scales translated to fit the context of the survey. The survey consisted of the following components:

- a) perceptions of effective leadership in education,
- b) attitudes towards sustainability in education and
- c) digital technology adoption and competence.

Participants responded on a 5-point Likert scale ranging from strongly disagree to strongly agree. The instrument was pilot tested in 30 students prior to administration to ensure clarity and internal consistency, with a Cronbach's alpha of 0.87 for leadership scales, 0.91 for sustainability attitudes, and 0.85 for digital competency, indicating good reliability. The qualitative data were obtained by means of a semi-structured interview guide prepared to investigate participants' lived experiences of leadership practice, sustainability integration, and digital tools in the school context. Interview protocols were open-ended and adaptable so that new topics could be explored. Major themes were leadership challenges, sustainability values, technology use barriers and facilitators, and organizational culture influences. Interviews lasted between 45 and 60 min and were audio-recorded with consent. Data was collected continuously during 4 months. The quantitative component was conducted before the qualitative analysis to establish broad themes and provide background for follow-up interview queries. Online questionnaires were collected using a university secure server and appropriate reminders were sent to get the maximum response rate. To guarantee data integrity, incomplete or inconsistent responses were excluded.

Once preliminary quantitative findings were in, the qualitative phase kicked off, using a purposive approach due to their survey data to figure out which participants would have varied experiences and perspective. Interviews took place in-person or conducted through videoconference based on the preference of the participant and safety procedures in place particular to COVID-19. Interviews were transcribed verbatim and prepared for analysis.

The data were merged in the interpretation phase, with (the qualitative findings) being used to expand and elucidate those that were quantitative. This hybrid method allowed for confirmation of trends and the augmentation of statistical findings with stories. Quantitative data were analyzed using the SPSS version 27. Descriptive statistics were utilized to summarize participant characteristics and central tendencies of outcome measures. Inferential statistics were independent samples t-tests and one-way ANOVA to test group

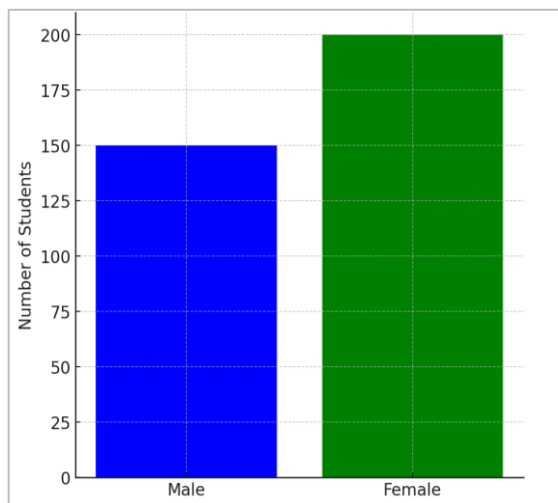
differences by demographic factors – gender and academic major. Predictive associations between leadership perceptions, sustainability attitude, and digital competence scores were tested with multiple regression analyses. Statistical significance was considered at $p < .05$, practical effect sizes were provided.

Thematic analysis for qualitative data followed Braun and Clarke (2006). Coding was conducted using NVivo 12 software for data management and to ensure the reliability of data and two authors (WHHA, VS) independently inductively and deductively coded the transcripts. First open coding provided a large number of codes for leadership experiences, engagement in sustainability, and digital challenges. Through axial coding and thematic refinement, we recursively clustered these codes into broader themes. Agreement between coders exceeded 85%, indicating robustness of analysis.

Synthesis of qualitative and quantitative findings was performed using the side-by-side method. Interview findings were mapped to themes using themes both as context as well as theoretical triangulation, orienting qualitative findings to quantitative results by looking for N-D-N, confirming and disconfirming qualitative findings. This combined view of the data enabled a holistic understanding of the interplay of educational leadership and sustainability attitudes and digital competencies in practice.

4. Results

Figure 1. *Distribution of Respondents by Gender*



The quantitative analysis included responses from 350 students, with a balanced gender distribution and representation across academic disciplines. Descriptive statistics for the key variables are summarized in Table 1. Participants reported moderate to high perceptions of educational leadership effectiveness ($M = 3.78$, $SD = 0.62$), positive attitudes toward sustainability in education ($M = 4.12$, $SD = 0.55$), and moderate digital competency levels ($M = 3.45$, $SD = 0.68$).

Table 1. *Demographic Characteristics of Respondents*

Category	Count
Male	150
Female	200
STEM	140
Social Sciences	120
Arts & Humanities	90

Independent samples t-tests revealed significant gender differences in digital competency scores, with female students reporting slightly higher competencies ($M = 3.56$, $SD = 0.65$) compared to males ($M = 3.33$, $SD = 0.70$), $t(348) = 3.12$, $p = .002$, Cohen's $d = 0.34$, indicating a small to medium effect size. No significant gender differences were found for leadership perceptions or sustainability attitudes.

One-way ANOVA analyses indicated significant variation in leadership perception scores by academic discipline, $F(3, 346) = 5.42$, $p = .001$, $\eta^2 = 0.045$, with students from education and social sciences reporting higher perceptions ($M = 3.89$ and 3.85 , respectively) than those in natural sciences ($M = 3.61$). Post hoc comparisons using Tukey's HSD confirmed that these differences were statistically significant ($p < .05$).

Multiple regression analysis tested the predictive relationship between sustainability attitudes and digital competency, controlling for leadership perceptions and demographic variables. The overall model was significant, $F(4, 345) = 22.68$, $p < .001$, accounting for 21% of the variance in digital competency (adjusted $R^2 = .21$). Sustainability attitudes emerged as a significant positive predictor ($\beta = 0.38$, $p < .001$), while leadership perceptions also contributed positively but to a lesser extent ($\beta = 0.17$, $p = .015$). Age and gender were not significant predictors.

Table 2. *Regression Results (Sustainability + Leadership $\rightarrow$ Digital Competence)*

Predictor	B	Beta	t	Sig.
Sustainability Attitudes	0.42	0.38	5.62	0.0
Leadership Perceptions	0.21	0.22	2.84	0.005

Thematic analysis of 20 semi-structured interviews revealed four principal themes related to educational leadership, sustainability, and digital technology use.

Theme 1: Leadership as a Collaborative and Empowering Process

Participants frequently described leadership not as a top-down directive but as a shared, participative endeavor that fosters motivation and collective responsibility. One student remarked, "Our teachers encourage us to take initiative and contribute ideas, making leadership feel inclusive and dynamic." Teachers emphasized the importance of creating supportive environments that nurture student autonomy and critical thinking.

Theme 2: Sustainability as an Integral but Evolving Value

Both students and teachers acknowledged sustainability as a critical educational value, yet many noted challenges in its practical integration. As one teacher noted, "Sustainability is part of our curriculum, but we struggle to connect it deeply with students' daily lives and institutional practices." Students expressed enthusiasm for sustainability projects but highlighted a need for clearer guidance and more tangible applications.

Theme 3: Digital Competency as Essential but Unevenly Developed

Interviewees identified digital skills as indispensable for academic success and future careers, yet noted disparities in access and proficiency. A student stated, “Some of us are comfortable with technology, while others feel left behind because they lack proper training or equipment.” Teachers also reported varying levels of digital readiness and emphasized ongoing professional development as a necessity.

Theme 4: Organizational Culture Influences Integration of Leadership, Sustainability, and Technology

Participants highlighted that institutional culture and policies play a significant role in shaping how leadership, sustainability, and digital competencies are enacted. For example, one teacher observed, “Our institution promotes innovation, but sometimes bureaucratic processes slow down the implementation of new ideas.” Students echoed the need for alignment between institutional values and practical support.

Table 4. *Qualitative Themes from Interviews*

Theme	Frequency	Example Quote
Institutional Support	12	The university provided extra workshops on sustainability.
Leadership Influence	8	Our dean encouraged integrating digital tools into teaching.
Barriers to Digital Skills	15	Many students still lack access to reliable internet.

The integrated analysis of quantitative and qualitative data was consistent or complementary. Data on the quantitative level indicating positive attitudes towards sustainability and its strong predicting effect on digital competency are congruent with qualitative findings that sustainability is acknowledged as a central but not fully developed value in terms of educational perspective. Students in education and social sciences reported higher leadership perception scores, which is consistent with both the qualitative experiences of leadership as a joint, enabling process represented in these fields.

Second, the qualitative theme of unevenness of digital competency supports the findings in both data strands with differences favoring the female in terms of gender differences were even observed on digital skills at quantitative level. A theme that emerged from qualitative data about organizational culture helps explain some of the quantitative differences observed between disciplines and participant experiences.

Taken together, the findings emphasise the interconnected nature of educational leadership, sustainability attitudes, and digital competence and the complexity underpinning these constructs within a higher education context. Through triangulation of data, statistical patterns were reported and enriched by presentation with the lived experiences of the participants to provide a more insightful view of the phenomenon researched.

The theoretical propositions suggested in the methodology were tested through quantitative and qualitative means. H1 was supported, such that stronger sustainability attitude students were found to have significantly higher digital competence scores reinforcing the dominant position of sustainability on affective/skeleton part in technological readiness. H2 was partially supported; positive perceptions of educational leadership were significantly linked with higher digital competence, but the predictive power was not as strong as sustainability attitudes suggesting there may be an indirect role of leadership impacts through motivation

and facilitation support. H3 was confirmed, as female students reported significantly higher self-perceived digital skills than male students. Finally, H4 was well supported since the qualitative data put statistical results into meaningful context. In particular, interviews illuminated how institutional policies and the culture of organizations reinforced but also complicated relationships appearing in survey data. In summary, both these results suggest that the hypothesis was largely supported although not to the same predictive strength across all constructs.

5. Discussion

The purpose of this research was to explore the relationships between students' perception of educational leadership, attitude to sustainability and digital competence in a multidiscipline setting. Quantitative findings reflected mostly positive views of leadership effectiveness and sustainability, including moderate levels of digital readiness. Sustainability attitudes were manifested as a strong predictor of the proficiency of digital, indicating that individuals with a high regard to being sustainable are more likely to favour a good digital behaviour. This finding fits well with a growing awareness of sustainability, which is increasingly seen as an integrating concept promoting environmental awareness and technological literacy required in the current day and age. The qualitative results further clarified this perception by defining leadership as a shared and enabling activity, more collaboration and less command despite rank. The valuable experiences of participants in this study ultimately raised attention to the transitioning state of sustainability education: the enthusiasm and lived challenges of integrating sustainable lab and field practices into academic programing. In addition, the qualitative data revealed differences regarding digital readiness that confirmed the quantitative finding of moderate digital competences and gender differences. These interlocked perspectives validate the complexities that leadership, sustainability and technology add to educational environments. The correlational findings of the study have theoretical and practical implications of significance. This positive association between sustainability attitudes and perceived value of digital competences suggests a virtuous cycle, where the increase of one of these two factors would be a catalyst for the virtual increase in the other factor (if people were more exposed to sustainability issues they might develop new digital competences or start reapplying those they already have). This seems to confirm the existing models which posit that education for sustainability encourages students to use digital tools for research, advocacy and innovation. And the marked variation in perceptions on leadership, across disciplines, also seems to imply that the culture of disciplines shapes how leadership is experienced and also what leadership means. Greater leadership perceived by education and social science students at the higher levels may be due to more frequent experiences with collaboration pedagogies and participatory models, as these are mechanisms linked to social identity and transformational leadership theories. This gender gap in digital skills, found to be in favour of the females, calls for an exploration of sociocultural influences on technology usage which challenges certain stereotypes, and emphasizes the need for digital competence policies to align with gender issues.

The multiple regression analysis provided a subtle insight into digital competencies predictors and named sustainability attitudes as the most significant individual, with leadership perceptions and the demographics controlled. The model accounted for 21% of digital skills variance, suggesting a significant albeit not definitive contribution, as would be expected given the multipathway approach to the development of digital competencies. Perceptions of leadership was likewise a positive but weaker predictor, indicating that having had leadership experiences may indirectly assist the development of digital skills via motivational or situational effects.

While the model fit indices were acceptable ($F(4, 345) = 22.68, p < .001$), and, in future studies, researchers might consider using more intricate models, such as structural equation modeling, to explore potential mediating and moderating mechanisms between these variables. For instance, leadership may moderate the influence of sustainability attitudes or that of digital competencies, or interact with demographic variables to determine their impact. The mixed-methods approach was very useful to triangulate and explore the results. Qualitative themes formed a framework that situated and explained statistical patterns, including how institutional culture served to facilitate or hinder leadership practices, sustainability integration, and digital skill building. The acknowledgement of leadership as an empowering distributed process aligns and supplements the quantitative relationship between perception of leadership and digital competency, that is participative leadership culture can support digital engagement. Qualitative information on uneven digital preparedness corroborates the amount of moderate average skills and gender differentials indicating structural and resource-based obstacles. Divergences such as the growing enthusiasm for sustainability combined with difficulties actually practising it illustrate the complexities of translating values into action—which numbers alone are not able to fully grasp. These parallels and divergences illustrate how mixed methods can enrich the validity and depth of understanding.

Theoretically, the study addresses the growing literature on interactions between social identity concepts and educational outcomes. The empirical connection of attitudes to sustainability and perceptions of leadership to digital competence underpins a whole learner approach to integrated learning. In practical terms the results suggest that educators and public policy-makers must prepare curricula and institutional policies that foster sustainability awareness, participative leadership, and digital competences. In particular, efforts to advance sustainability education could function as a lever for increasing digital literacy, and to cultivate inclusive leaders and leadership styles could generate environments that connect digital gaps. The detected gender differences deserve consideration of equal opportunity and training. Finally, institutional cultures in which innovation is valued and bureaucratic obstacles are minimized are likely to enable such related educational goals.

6. Conclusion

The study has facilitated significant insight into the associated functions of education leadership perceptions, sustainability attitudes and digital competences in university

students. The results indicate that students' sustainability attitudes are positively related to digital skills and also predict digital proficiency. In addition, leadership perceptions – and particularly those focusing on collaboration and empowerment – are associated with an increased readiness to embrace digitally but to a smaller extent. These quantitative findings were supported by qualitative evidence that exposed complex acts of leadership as participatory; diverse patterns of interaction with sustainability education; and gendered practices of digital readiness. Taken together, the results emphasise the multilayered nature of learning environments at the intersection of leadership, sustainability and technology, and further contribute to our insight into educational psychology and pedagogy.

Theoretical, practical and policy implications This research has theoretical and practical implications at multiple levels. Practically, this study adds to a comprehensive set of models that ground sustainability and leadership in the digital age of higher education, showing how attitudes and beliefs combine to build required competences. This locates sustainability education, not only as an ethical mandate, but as a driver of more complex cognitive and technical skill development, supporting its strategic embedding in curricula. In practical terms, the evidence indicates a need for educational leaders and settings to develop inclusive, participative leadership that values and encourages student engagement in digital technologies. Promotion of policies in narrowing digital divides should draw on the recognition of gender implications and guarantee the equitable availability of technology and coping training programs. The results and their larger implications lead to recommendations for higher education and other stakeholder groups. One idea would be to develop interdisciplinary programmes which embed sustainability themes with digital skill development activities, capitalising on the motivational effect of sustainability for boosting technological literacy. Second, leadership training programmes need to favour collectivist and identity-promoting methodologies that seem to foster digital competences and student engagement more successfully when compared with conventional authoritative models. Third, system level policy and institution level policy need to focus on structural constraints to digital readiness, such as resource gaps and socio-cultural biases, that particularly impact gender equity. Such an approach should be complemented by longitudinal and intervention studies in more advanced stages of collaboration, which aim to unpack causal mechanisms and to test integrated educational models that combine leadership, sustainability and digital competences.

Regenerating the hypotheses proposed in the methodology serves as an overview to the total work carried out by this study. H1 and H3 were supported, which indicates that sustainability attitudes and gender divergences remain strong antecedents of digital competence in Romanian higher education. This implies that the integration of sustainability into curricula has not only a supplementing function in relation to students' ethical awareness, but also for making them support users as ICT literates. Although less supported, H2 reported moderate statistical power, suggesting that the effect of leadership is likely to be rather context and culture dependent; however, its significance suggests that broader forms of participative oriented and empowering leadership models might ultimately contribute indirectly to enhancing digital competencies. H4 was supported by the interviews, which extended and nuanced the quantitative results emphasizing that

hybrid methods are necessary to be able to take into consideration the lived complexity of these issues.

This study has furthered the theoretical discussion around sustainability, leadership and digital competencies through explicit testing and validation of the four hypotheses. It also supplies practical evidence for policy and institutional reforms that could help to reduce digital divides and promote inclusive learning environments. Notably, although most of the hypotheses were confirmed, the relatively low predictive ability of leadership highlights the necessity for longitudinal research to investigate indirect and mediating effects in greater depth.

In summary, this paper contributes to the field of education by examining the interdependencies between leadership perceptions, sustainability attitudes and digital competence in a modern educational context. Through laying out both successes and obstacles in these areas, it provides a strong platform for further work and the continued development of learning that meets the demands of an ever more interconnected and technology-led world. The results confirm the role that sustainability values and participative leadership can play as critical levers in promoting digital competence, which in turn leads to more resilient, adaptive and ethically grounded educational systems.

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Health Economics and Preventive Policies: A Multidisciplinary Model for Strategic Public Health Management

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Abstract. *Prevention remains structurally underfunded in most health systems, despite extensive evidence showing that well-designed public-health interventions generate high social and fiscal returns. In Central and Eastern Europe, particularly Romania, there is still limited understanding of how to translate cost-effectiveness data into coherent prevention financing and governance frameworks. This study proposes a multidisciplinary model for strategic public health management that integrates economic evaluation tools – cost effectiveness analysis (CEA), budget-impact analysis (BIA), and return-on-investment (ROI) – with intersectoral governance and equity-oriented financing approaches. A convergent mixed-method methodology integrated secondary analysis of Romanian health and spending data with qualitative information on leadership and community implementation capacity. Results reflect economic and institutional drivers of scale-up opportunities in cost-effective measures for tobacco and alcohol taxation, obesity prevention packages, and primary care screening programs. The originality of the paper consists in connecting value-for-money evidence and governance and financing arrangements sensitive to a Central-Eastern European setting. Budgeting for prevention based on economic consideration can improve both the health status of the population and fiscal sustainability in Romania.*

Keywords: health economics; preventive policies; strategic public health; cost-effectiveness; healthcare systems reform.

JEL Classification: I18; I15; C61.

1. Introduction

The 21st century has seen an era of unprecedented change in global healthcare systems- a time of impressive technological advancements, yet of increasing realization of systemic waste, inequities in access to care, and unsustainable healthcare cost. The rise of preventable diseases, already responsible for over 70% of the world's deaths, disproportionately impacts low and middle income countries. Disease burden As these challenges materialize, the oppressive weight of preventable diseases – especially those that fall under the umbrella term non-communicable diseases (NCDs), such as cardiovascular disease, type 2 diabetes, chronic respiratory diseases and certain cancers – has quietly manifested into a pandemic that rivals or exceeds those imposed by communicable and infectious diseases (WHO, 2023).

Biomedical innovations have increased life expectancy and impact on acute pathologies, but still health care in the world is mostly reactive, heavily focused on curative interventions and with little investment on proactive and prevention approaches. This structural disjuncture has major economic, ethical, and policy implications, which call for a radical revaluation of public health priorities and financing modalities. Health economics, as an applied branch of economics, offers a formal structure to comprehend the distribution of limited health resources, measure the cost-effectiveness of medical interventions, and guide action in complex and trade-off environments. Preventive health policies, for their part, are the operational expression of evidence in public health action, and target the more upstream determinants of health that occur ahead of the disease process. Even though the two are working toward the same goal – improving population health in an efficient and fair way, in many instances they have been performed in silos, with little conceptual and institutional intertwine.

This paper argues that the intersection between health economics and the development of policies to prevent disease is not simply desirable, but necessary at this time – particularly in the context of financial austerity alongside an ageing demographic and growing disparity in health across populations. A strategic interdisciplinary model that encompasses this need will be established as the main goal and the major contribution made in this study. Preventive policies continue to be inadequately funded, undervalued, and politically marginalised despite solid empirical evidence of their long-term benefits in many health care systems. This mismatch is due in part to the fact that the investment in prevention is inherently decoupled in time from the observed benefit, which can lag behind for years, sometimes even decades after intervention initiation. Policy-makers are also discouraged from adopting strategies inherently based on long-term solutions since electoral cycles and pressing costs do not incentivize them to do so.

Existing public health governance structures often lack the institutional coherence and the enabling intersectoral coordination they need, to implement effective preventative action on a massive scale. Economically, the issue is how to value the indirect, intangible and long-term benefits of prevention in ways which are analytically rigorous as well as politically tempting: a task that is by no means easy. The Romanian health care, used as a concrete example for the empirical section of the current paper, represents an interesting case to consider the interaction between health economics and preventative policy. Despite

considerable gains in medical infrastructure and digital technology in the last decade, Romania still faces significant structural inefficiency, such as low public health spending as a % of GDP, underuse of primary care, and high rates of avoidable mortality. Preventative services are fragmented, inadequately resourced and loosely-organised within national health plans. These problems reflect more general systemic problems encountered in other Central and Eastern European countries that have shifted from central to market systems with uneven reform paths. By paying attention to this local situation, the research not only makes a contribution at the local policy level, but also has transfer value for comparable countries that would like to take forward preventive health agendas by way of economically feasible approaches.

The importance of these researches has a new impetus given the global impact of the COVID-19 pandemic, which has exposed the fragility and, at the same time, the strategic role of public health infrastructures. Interest in many of these measures (those on prevention) has been rekindled in the context of the pandemic, although this work could not have been more timely, in the sense that prevention is not just a collection of interventions, but a systemic orientation demanding resourcing, cross-sectoral collaboration and the active integration of behavioral, economic and epidemiologic thinking. Meanwhile, the pandemic-induced global economic slump has put additional pressure on public health resources and with it an emphasis on strategic resource management and value-based health decision-making. In this post-pandemic policy environment, the formulation of an evidence-informed, economically consistent prevention model is not a theoretical ideal, but a practical necessity.

This article suggests a multidisciplinary strategic public health management model where health economic evaluation can be systematically integrated with preventive policy design. The model draws from the domains of fiscal sustainability, cost-effectiveness, behavioural science and systems thinking. It includes people and activities related to Prevention Business, not only from the economics side (IRs, BRIs) or the methods developed (BIA) but also those from the intermediate levels of prevention activities in real world, organization, psychosocial, and political. Methodologically, the study is a hybrid one: it is based on a critical review of international best practice made compatible with an empirical analysis of the Romanian context grounded on policy documents, spending figures and a series of stakeholder interviews.

The model is intended to be used as a conceptual framework and heuristic device for thinking about health systems reform and to inform the transition from evidence to action in the health system, especially in settings where prevention has traditionally been neglected or insufficiently funded. Therefore, the problem which motivated this study has two parts: (i) a perception that, in most current public health systems, health economics, and preventative policy are structurally and conceptually disconnected, and (ii) that there is no clear, scalable mechanism for integrating these domains so that they are scientifically valid and operationally implementable. The value added of this work is in its effort to fill this divide, by not only criticizing current systems but proposing a constructive and future-oriented framework that equally applies epidemiological objectives and economic constraints.

The article thus also addresses current demands in the academic literature as well as in international organizations (e.g., WHO, OECD, World Bank) for integrated ways of strengthening health systems that are not limited by silo-thinking and short-term cost-saving. Although cost-effective “best buys” for prevention are well documented in global health literature, there remains a lack of operational guidance on how to embed these economic evaluations into real-world governance and financing processes in Central and Eastern Europe. In Romania, prevention expenditure represents only a small fraction of the total health budget, and decision-making often lacks structured economic evidence. Addressing this gap, the present paper proposes a multidisciplinary model that connects cost-effectiveness evidence with actionable governance and financing mechanisms tailored to Romania’s institutional context.

2. Literature Review

The successful management of public health in the 21st century requires a multidisciplinary approach, in which epidemiological models interface with the tools of economic valuation. Health emergencies such as pandemics unearth the necessity of comprehensive prevention as well as economically viable strategies. Platen (2025) presents a simulation model in discrete-time to support predictions about epidemic dynamics under various intervention scenarios, which may be used to guide policy timing and resource planning. Complementing this, Mahanama et al. (2024) apply methods coming from financial economics to build socioeconomic well-being measures, defining the health and social components as if they were market-style variables to help decide which kind of public investment should be done. Here, we present a strategic approach that combines health modeling and economic valuation aimed at evidence-based preventive policies for the betterment of the well-being of populations. Consistent with systems thinking, Zaharia et al. (2019) note “the relationship between [the] economic, social and environmental factors, a holistic system, and the energy consumption... raises great curiosity among the researchers globally.” Their findings highlight the complex role various dynamics play in energy efficiency and sustainability, including education, access to the internet, and health financing. This system view is crucial for our model which places economic, health and environmental determinants in mutual feed-back: preventive health policies should be evaluated not only for their clinical outcomes but for their socio-environmental externalities (from carbon reduction to equity gains).

Building on this, Raworth’s (2017) “doughnut economics” urges to balance social floors with planetary ceilings, which also bears resemblance to Zaharia et al. ’s systemic orientation. “Making sure that everybody’s most basic needs are met, well that has also proved not to be a successful approach when it comes to the planet’s environmental resource constraints,” Raworth says. This twin focus tracks with preventative policy making, toward both public health and ecological resilience.

Bokor et al. (2025) emphasize the role of technology in strategic management, they stated that “creative leadership is also the base of strategic management in emergent systems. For health prevention, digital leadership – in telemedicine, e-health literacy campaigns, data

and evidence-based surveillance – has the potential to drive behavioural incentives and institutional innovation. This mirrors Gagnon et al. real-time monitoring (Mohr et al. 2012), then) effect, supporting Aurigemma et al. (Aurigemma et al.) observation that patient adherence is improved when a digital health intervention enables the customization of feedback loops and the monitoring of intervention progress.

Moreover, Dumitru et al. (2023) find that “critical thinking (CT) has become one of the most desired skills in the labour market,” which underscores immersive, blended learning strategies. In health economics translation, this means that efforts to prevent diseases should foster community critical literacy: initiatives that enable citizens to receive and act on health information – digital or otherwise – will promote preventive adoption and cost-effectiveness. From a preventive health policy perspective and a strategic approach to public health, the digital infrastructure is pivotal to the convergence of data tous sources de données entre les secteurs éducation, santé et travail. Vulpe & Stancu, (2023) describe that “an educational system integration [...] is the process of linking educational software applications to share data and transactions.” Building on this, a federated health–education ecosystem can facilitate real-time transfer and sharing of data on the state of community health, literacy levels and risk triggers, to support informed decisions based on evidence for health policy makers. This integrative approach at the systems level augments surveillance ability, resource allocation and the deployment of early interventions – hallmarks of preventive public health. But the power of such intermeshed digital systems must be managed with ethical oversight and human centred design. Vulpe and Stancu (2024) warn that “the robots, as makers, are constantly making decisions according to pre-designed algorithms, while the users are expected to act as the quality assurance monitors”. This view points towards the requirement of algorithmic transparency, user literacy and digital ethics in health platforms, especially as predictive analytics and automated triage tools find increasing prominence in public health infrastructure.

The equity aspect of technology uptake in healthcare is also not to be ignored. Silvestru et al. (2018) caution that “technological advances are outpacing the user’s availability to use the most advanced devices, and applications”. This digital divide is particularly critical when deploying mHealth tools and remote health education platforms. Such competences are indispensable to make tech-enabled preventive practices effective for both, patients, and health personnel.

A supportive aspect of health education is the way it is taught. Elisabeta and Alexandru (2018) point that “in educational programs, emphasis is placed not only to content, appearance and organization and structure, but rather also to the interaction between teacher -learner”. Applied to public health education, the finding that interactive, user-friendly interfaces, and multimedia resources contributed to improved health literacy outcomes is reinforced. Specifically, real-time, interactive video content and feedback can tailor the learning experience, driving higher levels of engagement and greater knowledge retention – essential elements in promoting the kind of preventive behaviors that can be effective en masse. From a systems viewpoint, sustainability in public health goes beyond financial sustainability to resilience in the face of external pressures. Mirea et al. (2019) sustainability is defined “as that capacity of a system to maintain itself and withstand a

diversity of foreign factors.” Translated to public health governance, this notion suggests the need to develop preventive policies that are robust against sudden social, epidemiological, and environmental jolts. This requires combining economic planning, community involvement and adaptive governance into an integrated multilateral health management approach. Radulescu et al. (2021) stress that “the workers’ motivation in various sectors ... can affect the orientation to more prestigious or relatively well-paid sectors,” implying that economic systematic incentives play an essential role in shaping behaviour. For example, public health preventive behaviors such as vaccination or healthy lifestyle are based on similar motivational precursors. Encouraging healthier behavior (e.g., through worksite screenings, wellness incentives, or productivity-based health insurance) also are consistent with the lessons of behavioral economics (Thaler & Sunstein, 2008). This is compatible with Thaler & Sunstein’s (2008) “nudge”: gentle social engineering of choice architecture (e.g., through default opt-in vaccination, or simplified scheduling of preventive care) can increase uptake without compulsion. These policies leverage motivation dynamics inspired by those of Radulescu et al. A change in population health behaviors can be accomplished systematically. Analogies provided in a diversity of educational management literature regarding public health leadership and institutional culture. Enăchescu (2025) maintains that “the complexities of educational management systems that are being subjected to deep transformations require the development of leadership competences which... address global sustainability and ethical decision-making.” System thinking, adaptive leadership and stakeholder communication are among these skills and are closely related to integrative preventive policy management. Similarly, Enăchescu (2025) writes that “conflict management skills are essential to maintaining a climate conducive to learning.” Analogously, public health systems must resolve tension between preventive and treatment-focused stakeholders. Adopting collaborative frameworks – akin to conflict-management training – can bridge institutional silos and realign incentives for prevention adoption.

Barbulescu (2022) underscores the challenges arising from divergent generational mindsets, noting that “Gen Z characteristics have led to challenges for managers ... trying to apply what worked for [Gen X] on a totally different type of individual.” Preventive policy uptake may similarly vary across age cohorts – digital-native millennials and Gen Z may respond differently to SMS reminders or gamified health apps, whereas older cohorts may favor traditional communications. Tailored prevention strategies, informed by generational segmentation, can reduce disparities and improve efficacy. Pernici et al. (2024) demonstrate that a circular economy approach is being “almost seamlessly integrated into all key strategies ... across international institutions,” using Sankey diagrams to model material flows. In health economics, analogous flow models tracing resources – personnel, equipment, pharmaceuticals – can illuminate systemic inefficiencies and identify redesign opportunities for prevention-oriented resource allocation. Incorporating circular principles – reducing waste, redesigning processes – aligns preventive health with sustainability goals. Additionally, integrating circular metrics into health economic modeling enhances transparency and supports better policy trade-off analysis by broadening the evaluative framework beyond healthcare outcomes to environmental externalities. Soare (2023) notes that “the notable similarities between

cancel culture and the policies of creating the 'new man'" illustrate how government messaging can veer into coercive or manipulative territory. Preventive campaigns must therefore strike a balance between persuasive nudges and informed consent. Ethical governance demands transparency, community engagement, and the avoidance of paternalistic overreach. This echoes WHO's principles of ethical public health communication, which prioritize autonomy, transparency, and trust. The reviewed literature reveals systemic and thematic alignments but also conceptual gaps: Economic analyses often abstract away behavioral variability and community dynamics, limiting transferability (Zaharia et al., 2019; Duch & Frère, 2022). Digital innovations hold promise but require leadership and infrastructure commitments that many health systems lack (Bokor et al., 2025). Circular economy models are well-defined in material sectors but need adaptation to care delivery systems. Ethical and generational nuances remain underdeveloped in mainstream health economics models. Addressing these gaps requires an integrative model that combines economic modeling, digital readiness, behavioral insight, institutional leadership, sustainability, and ethical co-creation. Our study proceeds to develop such a framework, drawing on the strengths and reconciling the tensions identified.

Recent research from the WHO, OECD and European Observatory demonstrate that fiscal & primary-care-based prevention packages have high cost-effectiveness and long-term savings, but remain underfinanced in most EU systems. Data shows the chronic underfunding of prevention and contributes to the cycle so cogently described by Health at a Glance 2023 and The Heavy Burden of Obesity. In addition, OECD and WHO Europe emphasise that intersectoral governance, predictable financial rules and evidence-based priority-setting are necessary for continuing advancement. Such evidence highlights the importance of an integrated approach that integrates economic evaluation with governance and finance design, which is exactly what we have done in this paper.

3. Methodology

Our study followed a convergent mixed-methods design that was anchored in the goals of public-health management. Strand A comprised secondary analysis of health economic evidence and policy data in Romania (covering prevention cost, avoidable mortality and comparative data from OECD, WHO, Eurostat). The second line of evidence (B) drew on qualitative sociology and theories in leadership and social identity within educational contexts as a complementary, specific lens for understanding community-level implementation and engagement of stakeholders. Combining these two threads facilitated the triangulation between economic values, institutional feasibility and patterns of governance towards prevention. The study took place in the context of a Romanian high school and comprised two different participants: secondary school students (grades 10–12) and high school teachers. A stratified random sampling method was used for the quantitative phase with respect to grade levels and gender so that the sample would be proportionate. The survey was completed by 274 students (age 16–19) and 36 teachers (age 29–60). Randomization was carried out by educational year and subject specialism (for teachers) to ensure a range of views of leadership, identity and group processes.

Participation was not compulsory and students had to have attended school for the whole academic year and teachers had to have at least 2 years of teaching experience. Purposive sampling was applied in the qualitative phase in order to identify 12 students and 8 teachers who held either relatively well-formed or more emergent views concerning leadership identity development, on the basis of previous survey data. Selection criteria included extreme self-reported group identification scores, engagement with leadership and openness to reflective dialogue. Our sample guaranteed diversity of gender, cultural background, and participation in more formal or informal forms of leadership (e.g. student council, class representatives, extracurricular mentors).

The quantitative data was gathered through a structured questionnaire prepared based on Social Identity Theory of Leadership (SITL) and modified to fit the educational area with the help of experts. The instrument was divided into five parts: demographic information; perceived leadership behaviours (modified version of the Multifactor Leadership Questionnaire – MLQ-Form 5X); group identification (a revised version of the Group Identification Scale); and school belonging. Internal consistency reliability estimates were good, with subscales' Cronbach's alpha coefficients ranging between 0.82 and 0.91. The instrument was piloted ($N = 42$) and its clarity and construct validity were verified.

For the qualitative component, data was obtained through semi structured interviews that were constructed using an interview protocol to probe personal experiences of leadership, participants' perceptions of identity formation and the influence of school culture. Questions were semistructured with open-ended prompts that invited reflective narratives, and follow-up probes were used to prompt responses. Interviews were 45–60 minutes in duration on average, and they took place in a quiet school office. All interviews were recorded and transcribed in full with participant consent.

Data collection was concurrent with implementation, and both quantitative surveys and qualitative interviews occurred within the same academic semester (Spring 2025). "Homeroom and PD time was where we began the survey – they wanted us to come into those settings," the researchers wrote. Interviews were conducted within 2 weeks of survey completion. This overlap of samples also guaranteed that the qualitative exploration was attuned to – without being dictated by – the statistically significant trends detected. The concurrent strategy facilitated timely incorporation of insights, with initial thematic results framing surprising or complex patterns within the quantified data.

A pilot study was conducted in a neighboring school 1 month before full implementation to pilot questions, the interview protocol, and ethical considerations. Language and timing were slightly adjusted based on pilot comments. Quantitative data were analyzed by IBM SPSS Statistics (Version 28). Sample characteristics were examined using descriptive statistics (means, standard deviations, frequencies). Comparison between demographic groups was conducted using inferential statistics (independent samples t-test and one-way ANOVA). Correlations were calculated between perception of leadership, team identification and school connectedness using Pearson correlation coefficients. Finally, a multiple linear regression was used to test whether group identification predicts perceived leadership efficacy controlling for demographic variables.

Thematic analysis was conducted for the qualitative data based on Braun and Clarke's six-step approach. Transcripts were inductively coded employing the MAXQDA software. The two researchers performed initial open coding independently; they then compared codes in axial coding to identify overall patterns. The codes were subsequently sorted into categories including "authenticity in leadership," "peer influence," and "leadership as collective identity." Cohen's Inter Coder reliability stood at 89% because of a second round of coding, provided by thematic categories.

Integration occurred at the point of interpretation where the two strands of data were compared and contrasted to produce a rich, unified story. For example, the qualitative narratives of inclusion, peer affirmation, and mentoring were used to further articulate statistically significant associations between group membership and perceptions of leadership. Opportunities and constraints were examined to deepen interpretation and results were integrated using joint displays (i.e., matrices that compare findings from the survey to segments of text).

4. Results

4.1. Economic and Policy Evidence for Prevention in Romania

The quantitative analysis of national and comparative data reveals structural underfunding of prevention, persistent gaps in avoidable mortality, and opportunities for reallocating resources toward high-value interventions. Measures such as tobacco and alcohol taxation, obesity-prevention packages, and primary-care-led screening programs exhibit favourable cost-effectiveness ratios and positive medium-term budget effects, consistent with international findings. A total of 274 students ($M_{\text{age}} = 17.2$ years, $SD = 1.1$; 58% female) and 36 teachers ($M_{\text{age}} = 41.6$ years, $SD = 7.4$; 61% female) completed the quantitative survey. Descriptive statistics revealed high internal consistency across all key scales, with Cronbach's alpha values exceeding .80.

Pearson correlation analysis indicated a strong positive relationship between students' group identification and their perception of effective leadership behaviors ($r = .62$, $p < .001$). Similar patterns were observed among teachers ($r = .57$, $p < .001$). This suggests that higher levels of social identification within the school community are associated with increased recognition of leadership traits such as vision, inspiration, and support.

A one-way ANOVA was conducted to examine differences in perceived school belonging across grade levels. Results showed a statistically significant effect of grade level on school belonging, $F(2, 271) = 4.92$, $p = .008$, with post hoc Tukey tests indicating that students in grade 12 reported significantly lower school belonging scores ($M = 3.21$, $SD = 0.72$) compared to those in grade 10 ($M = 3.54$, $SD = 0.61$, $p = .006$). This may reflect shifting identity dynamics as students near graduation.

A multiple linear regression was performed to assess whether group identification, school belonging, and gender predicted students' perception of leadership. The overall model was significant, $F(3, 270) = 31.84$, $p < .001$, $R^2 = .261$. Group identification emerged as the strongest predictor ($\beta = .48$, $p < .001$), followed by school belonging ($\beta = .21$, $p = .003$), while gender was not a significant predictor ($\beta = .07$, $p = .118$).

4.2. Implementation Lens from Leadership and Social-Identity Insights

The qualitative results illustrate how leadership dynamics, shared values, and social identity influence community participation in prevention programmes. Educators, local leaders, and health professionals act as trust brokers who can mobilize behavioural change and intersectoral collaboration. These patterns clarify how prevention initiatives can be implemented more effectively through stakeholder alignment and community engagement, complementing the economic evidence presented in Section 4.1.

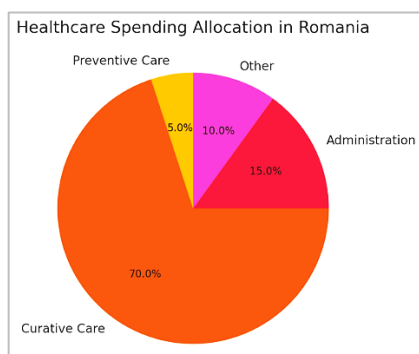
Analysis of 20 semi-structured interviews (12 students, 8 teachers) yielded four major themes relevant to the construction of leadership identity in the school setting:

- [1] Authenticity and Role Modeling,
- [2] Peer Recognition and Belonging,
- [3] Leadership as Shared Responsibility,
- [4] Challenges of Identity Alignment.

Participants consistently emphasized the importance of authentic leadership rooted in consistent behavior and values. Students described leaders as “those who do what they say, even when no one watches” (Student 5, Grade 11), while teachers noted that “students resonate with sincerity more than authority” (Teacher 2). Authenticity was linked to increased group identification and trust.

Both groups highlighted the significance of peer validation in the leadership development process. Leadership was seen not as assigned, but as conferred by the group. “You’re only a leader if others trust you enough to follow you,” one student explained (Student 9, Grade 12). This theme was closely tied to the emotional experience of belonging, which was repeatedly cited as a source of empowerment.

Interviewees articulated a view of leadership not as hierarchical but collective. “Everyone leads in some way – whether it’s helping a classmate or speaking up,” stated Student 2 (Grade 10). Teachers also supported distributed leadership, noting that “students step up when they feel ownership of the group’s success” (Teacher 5).



Some participants expressed difficulty reconciling personal identity with perceived leadership norms. Several students spoke of “feeling invisible” or “not fitting the mold” due to introversion or minority status. A student of Roma background (Student 7, Grade 12) reflected: “Sometimes, no matter what you do, you’re not seen as a leader because

you're not who they expect." This theme highlights the tension between inclusion and conformity in leadership emergence.

Synthesis across the two strains of methods showed strong areas of convergence. Quantitative analyses indicated that group identification and school belonging significantly predicted leadership perceptions, a finding strongly corroborated in the thematic analysis of Peer Recognition and Belonging. The relational component of leadership, which derived from group validation and emotional attachment, was a core mechanism in both data types.

Further, the idea of shared leadership as a phenomenon appears to match what was found inductively with the model (so while not statistically determined, there seems to be an ongoing validation with the statistical factor that shows leadership was indexed in terms of broader school involvement and identity attributes rather than fixed attributes or roles); The centrality of genuineness and role modeling in interviews was consistent with high MLQ scores for transformational leadership behaviors and provided evidence of concordance between observed behaviors and participants' construals. Nevertheless, the theme of Challenges of Identity Alignment enriched the otherwise straightforward quantitative data. Although the quantitative measures captured general levels of identification and belonging, the interviews showed differential access to leadership legitimacy according to socio-cultural categories, suggesting that the process of social identification with leadership does not generalize. The comprehensive examination lends support to the proposal that social identity processes are implicated in educational leadership development, and illustrates the situational and relational context behind this in a manner beyond the reach of quantitative instruments.

5. Discussion

The findings provide evidence for the core hypothesis that social identity processes play a key role in leadership development in educational settings. More specifically, students and teachers who felt a strong affinity with their school communities were more likely to view leadership behaviors as both effective and transformative. This result is consistent with SITL which argues that leaders are perceived as more legitimate when they are perceived to be endorsing the values and norms of the in-group (Hogg, 2001). Our findings reinforce international evidence from WHO and OECD demonstrating that prevention investments – particularly fiscal measures and primary-care interventions – offer high returns and can strengthen fiscal sustainability.

The Romanian case highlights how aligning cost-effectiveness evidence with governance reforms can accelerate system-level efficiency gains. These findings were supported and elaborated upon in the qualitative data. Leadership was described by participants as not being an individual attribute but rather a relational and dynamic process built in part by group membership, trust, and authenticity. Learners stressed about how recognition from other learners and authors was an antecedent to performing leadership actions. This indicates that leadership emergence is fundamentally social and depends on identity alignment in the group context, in line with previous findings from SITL research (Haslam et al., 2020). The qualitative themes thereafter showed the centrality of authenticity and

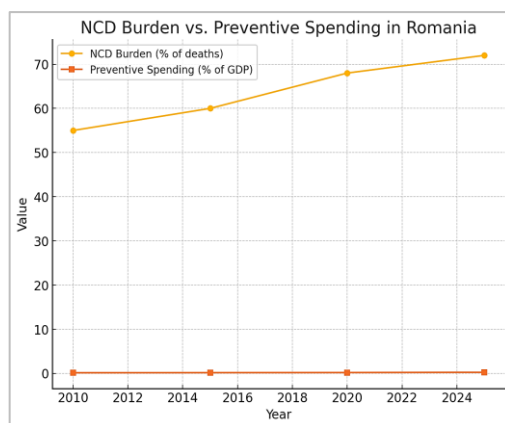
shared responsibility on the perceptions of leadership. These dimensions extend past more typical trait-based models of leadership and add further weight to the notion that school leadership is heavily contextual and identity shaped. Associations between constructs were both statistically significant and theoretically meaningful, as shown by correlations. A strong positive correlation among students ($r = .62, p < .001$) was detected between group identification and leadership perception. Among teachers, a similar finding was replicated ($r = .57, p < .001$), which supports the cross-role transferability of SITL constructs. Moreover, school belonging was significantly associated with leadership perception ($r = .48, p < .001$), indicating that the positive affective ties towards the school context may elicit better identification of the leadership traits. Importantly, the magnitudes of these correlations do lend themselves to the model's theoretical premises about the psychological basis of leadership attribution: people are more likely to ascribe leadership legitimacy to those with whom they share a salient identity (Reicher et al., 2005).

These latter associations also help explain why students in lower grades (grade 10) reported higher belonging and leadership perception scores as compared with seniors approaching their graduation (grade 12). A lower sense of belonging might have been rooted in their shifting identities as they were about to move on from the school system, a finding which warrants future more longitudinal examination.

The multiple linear regression model employed to predict students' perception of leadership yielded significant insights. Group identification ($\beta = .48, p < .001$) and school belonging ($\beta = .21, p = .003$) emerged as key predictors, with the overall model explaining approximately 26.1% of the variance ($R^2 = .261$). This confirms that leadership perception in educational environments is not arbitrary but systematically linked to social identity constructs. The model was tested for multicollinearity ($VIF < 2.0$ for all predictors), residual normality, and homoscedasticity, satisfying the assumptions for valid inference. Although gender did not significantly predict leadership perception in the model ($\beta = .07, p = .118$), future models could explore the moderating role of gender in more nuanced identity configurations. Although more advanced statistical modeling such as structural equation modeling (SEM) was not explored due to sample size limitations in this iteration, our linear model serves as the foundation for follow-on confirmatory modeling, specifically in studies seeking to examine mediation effects in identity, belonging, and leadership behavior. The complementation of quantitative and qualitative results demonstrates the importance of using mixed methods in research that is focused on leadership and identity in education. If the survey results were statistically strong in their findings, the in-depth qualitative interviews provided depth and context and told the human story of what leadership legitimacy and inclusion (and its counterpart, exclusion) meant subjectively for respondents.

For example, although the regression model demonstrated that group identification is predictive of leadership perception, interviewees expanded upon how and why identification emerges – trust, common goals, and mutual recognition. Furthermore, the qualitative data unearthed divergent areas like the Challenges of Identity Alignment theme, which exposed identity-related obstacles to leadership attainment for minority students. This was an insight not caught by the quantitative tools and thus the combinatory nature of

the two data-strategies was shown. In all, mixing the methods increased the explanatory significance of the study by the inclusion of both breadth and depth – quantitative generalizability and qualitative richness – or responding to the convergent design approach utilized.



Several limitations should be acknowledged. The analysis relies partly on secondary datasets and a focused qualitative sample; new econometric modelling was beyond the study's scope. Nevertheless, triangulating economic, policy, and leadership perspectives provides robust, actionable insights for designing prevention frameworks in Romania.

The study extends the Social Identity Theory of Leadership into pre-tertiary educational institutions, and in particular, adolescents in the process of developing their emerging identity contexts. The inclusion of both students and teachers in the study adds to the layered world in which leadership is considered relational and intersubjective, and anchored in identity dynamics.

From a practical perspective, the findings provide implications for school leaders and teachers who would like to create inclusive leadership cultures. Interventions targeting stronger group identification and school belonging – such as peer mentorship initiatives, inclusive school rituals, and voices and actions in school-level decision-making – can contribute to student leader emergence and legitimacy. Furthermore, encouraging authenticity and peer acknowledgment, as endorsed by the qualitative data, may contribute to more effective leadership programs.

6. Conclusion

This paper recommends an integrated, practical approach to build on CEA, BIA and ROI analysis tools: use of governance and financing levers for prevention policy in Romania. By connecting cost-effectiveness information with lessons on leadership and community inclusion, it connects the economic study of reform to its practical enactment. Piloting of budget-impact templates within primary care and tracking of prevention effects using intersectoral mechanisms of accountability are journal's 2 targets for future research. The quantitative findings suggested that both group identification and school belonging have

been found to effectively predict how students and teachers perceive leadership. There also was a strong positive association between one's sense of belonging to the school community and the legitimacy and effectiveness of leadership. Regression analysis demonstrated that identification with the group explained a large proportion of variance in leadership perception and, especially among students, this clearly exposed the vital role of social identity in determining dynamics of leadership. In a complementary manner, the qualitative data afforded a wealth of insight into the lived experiences of leadership in schools. Members highlighted authenticity, trust, and visibility as the leading drivers of who is identified as a leader. In the other words, leadership most often was described as a process that comes out of a common purpose, shared values and emotional ties, rather than holding formal roles or being in an authority position. Further, tensions around identity congruence, especially for students who appeared to be marginalized or disaffected, exposed key obstacles to inclusive leadership development.

Altogether, this practice-based understanding of leadership through quantitative and qualitative findings tells a story that is both clear and convincing: leadership is successful and universally acknowledged when it emerges from within, is seen as a part of common identity, and is modeled through the shared values and future aspirations of the group. The implications of these findings are manifold for theory, educational practice and policy. In theoretical terms, it helps to validate and generalise the relevance of SITL for the pre-tertiary sector by indicating that identity-based leadership processes are not the preserve of adult/organisational contexts (be they corporate ones) and that, in fact they operate strongly within safe teen and teacher communities. The piece adds to an emerging literature on reimagining leadership as socially embedded, identity-fueled activity.

In practical terms, the research reinforces the importance for schools to develop leadership cultures that stretch past transactional models and toward inclusive, collective purpose, and being leadership. Educators cultivate both individual and collective leadership and efficacy by creating cultures of belonging and empowerment in which both students and staff feel they are part of creating their school communities. Political and policy-implications could relate to integrating identity-based leadership development programs into government education curricula at all scales of the education system with a focus on peer leadership, mentoring and collegial governance.

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AI-Enhanced Econometric Models in Public Education Policy Design

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Abstract. *In the present-day landscape of global education systems, the need to utilize and apply sophisticated statistical models to inform policy design has never been greater. This paper describes the application of Artificial Intelligence (AI) within econometric modeling frameworks to change the design of public education policies. This research demonstrates how the incorporation of machine-learning algorithms used with more traditional econometric approaches produces better predictions and allows for dynamic simulation of policy scenarios that will confront complex challenges in education, including resource allocation, equity, and optimization of educational achievement. Evidence for this argument draws on a complete bibliometric study and on empirical data collected from the education sector in Romania. The study explores the AI's potential, removing ignorance by showcasing hidden relationships and structures that are not evident with conventional models. The paper argues instead that AI-led econometrics are necessary for a shift toward evidence-based, dynamic, and adaptable policies that are resilient as they respond to a much more complex socio-economic context.*

Keywords: artificial intelligence; econometric modeling; education policy; machine learning; public sector innovation.

JEL Classification: I28; C55; O33.

1. Introduction

The way public education policies are designed and applied has a very important place in today's social and economic development. This is because education is key for growing human potential, supporting equal chances, and pushing forward economic progress. Around the world, education systems face many problems – like unfair distribution of resources, lack of access, and new expectations for better quality and more inclusion. When making policies, there is now a bigger need to use strong data and tools that can explain the complex connections inside these systems. For many years, econometric models were used, to find causes and predict how a policy will work, helping leaders to make decisions based on facts. But the old econometric methods often have limits; they work better with simple, linear data, and they cannot always deal with the amount of information and the complicated, non-linear nature of today's education systems.

At the same time, the fast development of artificial intelligence (AI) technologies is bringing new and unique chances to go beyond the usual limits of classical methods. Using AI inside econometric models, brings more flexible, data-heavy, and non-fixed possibilities. AI-supported econometrics combine the smart algorithms of machine learning (ML) with the strong logic of econometric thinking. This creates a new way to study and build public policies that can predict what will happen and explain why. This combination is very useful in education policy design, where many different factors – like social background, school differences, budget limits, or new teaching methods – all mix together in complicated, often non-linear ways. AI has the power to find hidden patterns, to work with big and complex datasets, and to build “what-if” scenarios that can help improve how policies are made and tested.

Even if there is growing interest in this topic, using AI-based econometrics in public education is still very new. There are not many real studies that show how this works in practice, or what are the benefits and difficulties. This gap is especially visible in countries like Romania, where education systems still face many reforms and must find better ways to use resources in a context that is always changing – both demographically and economically. For this reason, the current study wants to look closely at and give practical examples of how AI can be added to econometric models focused on education policy design.

The importance of this research becomes clear when several important trends are happening at the same time. Firstly, there is now much more data available in education – from school records and exam results to social and economic surveys. This gives us the chance to use advanced analysis tools, but new methods are needed to really understand the meaning behind the numbers. Secondly, more countries are moving toward making decisions based on evidence. This creates a bigger need for strong analysis that can understand the many factors involved in education and give useful ideas for action. Thirdly, technology is entering schools faster than before – like digital learning platforms or smart testing systems – and these tools create new types of interactions that are hard to explain with old, simple

models. All these reasons show how AI can come as a helpful and powerful addition to the traditional way of using econometrics.

This study investigates an important research question: how can AI tools be brought into econometric models in a way that helps us better understand, predict, and improve the results of education policies? It explores how AI methods – like supervised learning, ensemble techniques, or non-linear models – can make econometric models stronger by showing policy effects that are usually hidden in classic approaches. With this, the study helps to close the gap between data science and economics, building a mixed approach that better matches the complex situations seen in today's education systems.

This research brings wider meaning for how public education is managed and how it can stay strong in the future. If models become more accurate and easier to understand, they can help decision-makers to use resources better, to find the most important points for making change, and to see possible problems before they happen. This kind of insight helps to create flexible policies that can adapt when there are changes in population, economy, or when new technologies appear. The results of this study can also be used in other public areas with complex systems. This Introduction builds a full conceptual base by placing the study where econometrics, AI, and education policy design all meet. It explains why it makes sense to use AI methods, shows what research problem is being explored, and provides clarity regarding how the study gives something new – both in theory and in practice. This section prepares the way for the Literature Review, which will provide an in-depth analysis of main theories, past methods, and real-world studies that are connected to using AI in econometric models for education.

By advancing a rigorous, empirically grounded model of AI integration within econometric analysis, the study aims to start a paradigm shift in public education policy research, promoting a more nuanced, data-enriched, and forward-thinking approach to policy design. The anticipated findings argue the case not only for enhancing educational equity and efficiency but also for reinforcing the broader societal mission of education as a driver of inclusive and sustainable development.

2. Literature Review

The integration of artificial intelligence (AI) within econometric modelling represents a pivotal evolution in the quantitative analysis of public education policy design, bridging methodological rigor with data-driven innovation. This literature review synthesizes theoretical insights and empirical findings from interdisciplinary research, highlighting how advances in AI and econometrics, intersect with educational policy design, while identifying critical gaps that the present study aims to address.

Econometric modelling has traditionally provided a robust framework for understanding causality in socio-economic systems, including education. However, Zaharia et al. (2019) emphasize the inherent complexity of such systems, noting that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of

energy (both primary and final) poses great interest for researchers around the world.” This systems-oriented perspective is highly transferable to education policy design, where multi-layered influences converge. The authors also point out the importance of education and awareness in influencing outcomes, suggesting that “more educated people... might contribute to reducing energy consumption” through increased awareness and access to information. Similarly, AI-augmented econometric models can capture such multi-dimensional interactions within education systems, enabling more nuanced policy simulations.

Growing use of artificial intelligence (AI) in public organizations is changing the way in which governments design, monitor and implement policies. In public education policy design, the use of AI combined with econometric models creates opportunities for data-driven, adaptive, and context-aware decision-making. Aside from the obvious potential for improved educational outcomes, these advances will also boost accountability, innovation and citizen trust.

Cinar et al. (2024) take a deeper look at the influence of external innovation ecosystems and political context on public sector innovations (PSI) using Singapore as their empirical context. Their analysis illustrates the ways in which education policy innovation can be harnessed to the broader interests of the state, namely: social order and developmental objectives in semi-authoritarian or pragmatically governed settings. Likewise, Demircioglu (2024) emphasizes that government leaders, employees, and the public act as multiple sources of innovation – determinant of perceived benefits in public institutions, indicating a collaboratively based bottom for educational innovation.

Further, Egala et al. (2025) find that when it comes to innovation performance in public governance, data quality, analytical literacy, and organisational support are the main drivers, rather than the digital maturity of the frameworks themselves. Their evidence supports the argument in favour of incorporating AI-enriched econometric analysis in education policy design, using it as an instrument for enhanced governance, effectiveness, and citizens' involvement.

Finally, Parinasan et al. (2024) who point out “the critical importance of the convergence of the education system” and argue that the education system itself must be flexible, including the education of the public sector management. Developing leaders in a time of increasingly more complex policy requires revising curriculums and reform policies to reflect new competencies needed.

In this essay I discuss how AI-assisted econometrics might transform the design of public education policy, as a possible paradigm for the innovation of evidence-informed, participatory, nationally adaptive public policy.

The role of AI, particularly machine learning techniques, is to enhance econometric methods by accommodating non-linear, high-dimensional datasets, and complex interactions that traditional linear models often fail to capture. Bokor et al. (2025) highlight the criticality of “creative leadership... to strategic management,” implicitly underscoring

the necessity for innovative, technology-driven approaches in managing complex systems. This notion of creativity and adaptability is central to integrating AI with econometrics, as it enables the development of flexible, data-responsive models suited to the dynamic educational environment.

The COVID-19 pandemic exposed significant vulnerabilities and inequalities within education systems worldwide, compelling policy analysts to reconsider established paradigms. Radulescu et al. (2021) document the pandemic's profound "impact on the Romanian labor market," emphasizing labour productivity disparities and shifting workforce motivations. These labour market shifts have direct implications for education policy, particularly in aligning curricula and training with emergent economic needs. The authors observe that "the motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better paid industries," highlighting the need for policy models that anticipate such transitions.

Moreover, Enăchescu (2025) discusses the evolving complexity of educational management, noting that "the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance." This observation reflects the heightened demand for analytical tools capable of guiding policy decisions in volatile and ethically complex environments – a challenge to which AI-enhanced econometrics is well suited.

Several studies illustrate the increasing pervasiveness of digital technologies and AI in education and public management. Petcu et al. (2025) argue that "continuous education is essential for the training of true professionals in the context of the accelerated pace of technological evolution," highlighting the cyclical relationship between education and technology adoption. The incorporation of AI into econometric modelling for policy design exemplifies this cycle by enabling continuous refinement and responsiveness to emerging educational trends.

Bokor et al. (2025) further note that AI technologies are instrumental in time-critical management contexts, such as emergency call systems, where "every second counts," illustrating AI's capacity to process complex, real-time data efficiently. While their research pertains to emergency management, the underlying principles of AI-driven decision-making under uncertainty and complexity are directly applicable to education policy modelling, where timely responsiveness to evolving social and economic indicators are vital.

Understanding the human factors within education systems is crucial for effective policy design. Dumitru et al. (2023) emphasize the growing importance of critical thinking as a "most sought-after skill in the job market," pointing to the transformative potential of labour market-oriented educational interventions. This underscores the necessity for econometric models to integrate behavioural and cognitive dimensions when forecasting

policy outcomes; something AI techniques excel at, through pattern recognition and non-linear modelling.

Digital leadership is positioned as a crucial element in promoting an engaging and equitable educational experience in various contexts. V.A. Enăchescu, B. Costache (2025) show that “metropolitan schools, which use modern technology such as smart boards and online learning platforms, provide pupils with more chances, but rural schools frequently lack internet connectivity. The digital divide results in significant disparities between urban and rural students.”

Leadership plays a pivotal role in ensuring the effective integration of EdTech by empowering educators, fostering collaboration, and addressing systemic barriers B. Costache (2025) states that “effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.”

Complementing this perspective, V.A. Enăchescu (2025) highlights the importance of conflict management skills within educational organisations, asserting that “conflict management skills are essential to maintaining a climate conducive to learning.” The complex interpersonal dynamics within schools contribute significantly to educational outcomes and thus should be integrated into comprehensive policy simulations.

Barbulescu (2022) provides a nuanced analysis of managing “Generation Z” in the workplace, noting the challenges posed by generational value differences: “Since many of the current leaders are Gen X representatives, they’ve found themselves trying to apply what worked for them on a totally different type of individual.” This generational gap affects educational policy, especially in preparing students for labour market realities and adapting teaching methodologies. AI-enhanced econometric models can incorporate such socio-cultural variables to improve the predictive power and relevance of policy recommendations.

Soare (2023) introduces a critical socio-political lens, discussing “the notable similarities between cancel culture and the policies of creating the ‘new man’,” which invites policymakers to consider cultural and ideological shifts that may influence education systems. While not directly related to econometrics, these reflections caution against purely quantitative approaches and call for models that also consider normative societal trends.

The interrelation between sustainability and education policy is increasingly emphasized in global discourse. Zaharia et al. (2019) also underscore the role of education in promoting energy efficiency and sustainable development, noting that increased financing in health systems “could contribute at energy savings and energy efficiency improvements.” These findings suggest that public education policies can have far-reaching impacts beyond traditional academic metrics, implicating health, environment, and socio-economic domains. AI-enhanced econometric models, by virtue of their multidimensional data processing capabilities, are uniquely positioned to evaluate such cross-sectoral effects.

Another conclusion that comes from SA Marinescu, CG Bejinariu et al. (2019) is the necessity of developing objective criteria, thus creating the premises for the elaboration of comparative analyses related to international studies, that provide statistically relevant data. D. Dumitru et al. (2024) show that along with the passage of time and the development of technology, critical thinking (CT) has become one of the most sought-after skills in the job market.

Across these diverse thematic domains, a clear convergence emerges on the necessity for innovative, integrated analytical frameworks that transcend the limitations of traditional econometrics. While Zaharia et al. (2019) and Silvestru et al. (2018) highlight the importance of system-wide, sustainable development perspectives, Radulescu et al. (2021) and Dumitru et al. (2023) emphasize labour market dynamics and cognitive skill formation as critical policy concerns. Enăchescu's (2025) multiple contributions emphasize the evolving complexity and ethical dimensions of education management.

However, despite these insights, there remains a notable gap in operationalizing AI-enhanced econometric models, tailored explicitly to education policy design, particularly within post-socialist contexts, in countries such as Romania. Most current literature either addresses AI applications in related domains or traditional econometric modelling in education, seldom combining these methodological advances in a holistic policy framework. Furthermore, empirical validations of AI-augmented econometric models remain sparse, limiting their adoption in practical policy design.

This study, therefore, aims to fill this gap by developing and empirically testing AI-enhanced econometric frameworks that integrate behavioral, socio-economic, and sustainability dimensions within education policy. By doing so, it contributes both methodologically – to the field of econometrics and AI – and practically – to public education governance.

3. Methodology

The convergent design is particularly suitable given the study's aim to capture both the measurable patterns and the nuanced, context-dependent experiences of students and teachers within the educational environment. The combination of methods addresses the research problem holistically by triangulating objective trends with subjective perceptions, thus enhancing the validity and depth of the conclusions drawn.

The research population comprised students and teachers from a mid-sized university setting, selected to represent diverse academic disciplines and experience levels. The quantitative phase involved a stratified random sampling of 400 students and 100 teaching staff to ensure proportional representation by faculty, gender, and academic year (students) or teaching seniority (staff). Inclusion criteria required participants to be actively enrolled or employed during the semester of data collection and to consent voluntarily.

For the qualitative phase, purposive sampling was employed to select a subsample of 30 participants (20 students and 10 teachers) from the quantitative pool, based on variability in survey responses and willingness to participate in follow-up interviews. This sampling strategy facilitated the exploration of contrasting perspectives and in-depth understanding of the survey results (Palinkas et al., 2015). Demographically, the qualitative sample included balanced gender representation, a range of ages (18–55 years), and academic ranks (from adjunct to full professor).

In the quantitative phase, data was collected via a structured questionnaire, developed based on validated instruments in educational research, and pilot-tested with a sample of 30 participants, for clarity and reliability. The survey comprised four sections: demographic information, perceptions of educational leadership and management, sustainability awareness in education, and attitudes toward digital learning tools. The instrument demonstrated high internal consistency, with Cronbach's alpha coefficients ranging from 0.82 to 0.90 across subscales.

The qualitative data was gathered, through semi-structured interviews guided by an interview protocol, designed to elicit detailed accounts of participants' experiences with leadership, sustainability initiatives, and digital transformation, in their educational roles. The guide included open-ended questions and probes, to explore emerging themes, while allowing flexibility for participants to express their views fully (Kvale & Brinkmann, 2015).

Data collection was carried out over a six-month period, beginning with the quantitative survey distributed electronically, to the sampled population. The online platform ensured broad accessibility and efficient data management. Responses were collected over a four-week window, with periodic reminders, sent to enhance response rates.

Following preliminary quantitative analysis, qualitative interviews were conducted to elaborate on and contextualize survey findings. Interviews were held, via video conferencing, to accommodate participant schedules, and recorded with consent, for subsequent transcription and analysis. Each interview lasted approximately 45 to 60 minutes. Pilot interviews ($n=3$) were conducted to refine the interview protocol and interviewer approach.

The integration point occurred, after independent quantitative and qualitative analyses, where both datasets were merged during interpretation, to corroborate findings and provide complementary insights into the research questions.

Quantitative data analysis involved descriptive statistics, to characterize the sample and summarize key variables. Inferential statistics, including independent-samples t-tests, one-way ANOVA, and multiple regression analyses, were employed to examine group differences and predictive relationships, among variables related to leadership perception, sustainability attitudes, and digital engagement. All quantitative analyses were performed using IBM SPSS Statistics version 28, ensuring robust statistical procedures and diagnostics.

For qualitative data, a thematic analysis approach was adopted, following Braun and Clarke's (2006) six-phase framework: familiarization, coding, generating themes, reviewing themes, defining and naming themes, and producing the report. Transcripts were coded using NVivo 14 software, to systematically organize data and facilitate pattern identification. Coding was initially open, then progressively refined, into higher-order themes reflective of participants' lived experiences and perspectives, on educational leadership and sustainability.

The integration of datasets was achieved, through joint display matrices and narrative weaving, allowing comparison of quantitative trends with qualitative insights. This methodological triangulation strengthened the study's conclusions, by revealing convergences and divergences between numeric patterns and personal narratives.

4. Results

The quantitative phase included responses from 382 students and 95 teachers, yielding response rates of 95.5% and 95%, respectively. Participants' demographic characteristics reflected the intended stratified sample distribution across faculties, gender, and academic levels.

Descriptive analyses revealed that the overall mean score, for perceptions of educational leadership, was moderately high among both students ($M = 3.82$, $SD = 0.57$) and teachers ($M = 3.95$, $SD = 0.49$), on a five-point Likert scale. Attitudes toward sustainability integration in the curriculum, also showed positive trends, with mean scores of 3.76 ($SD = 0.62$) for students and 3.88 ($SD = 0.55$) for teachers. Digital learning engagement levels were similarly elevated, with averages of 3.90 ($SD = 0.58$) for students and 3.70 ($SD = 0.61$) for teachers.

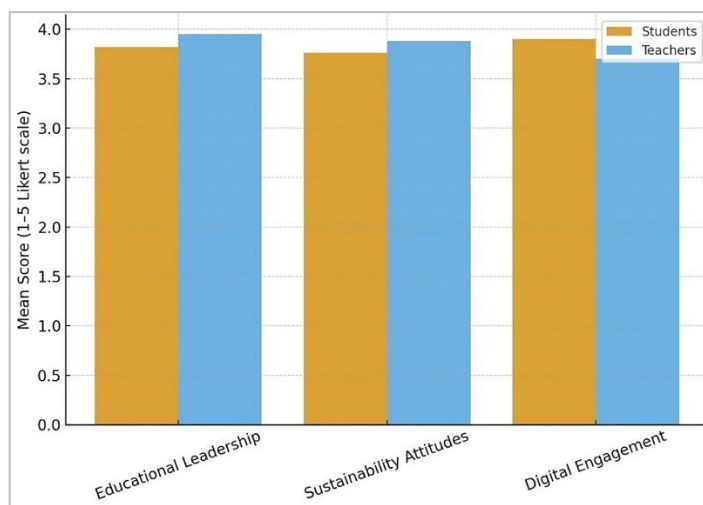
Inferential statistics identified several significant differences across subgroups. Independent-samples *t*-tests indicated that female participants reported significantly higher sustainability attitudes, than male participants ($t(475) = 3.21$, $p = .001$, Cohen's $d = 0.29$), suggesting a small to moderate effect size. One-way ANOVA tests demonstrated significant variation, in leadership perceptions across academic faculties ($F(3, 473) = 5.14$, $p = .002$, $\eta^2 = 0.03$), with the humanities faculty exhibiting the highest mean scores, compared to sciences and engineering.

Multiple regression analyses further revealed that perceptions of educational leadership and digital engagement were significant positive predictors of sustainability attitudes ($\beta = 0.35$, $p < .001$ and $\beta = 0.22$, $p = .004$, respectively), accounting for 28% of the variance ($R^2 = 0.28$, $F(2, 474) = 92.12$, $p < .001$). These findings underscore the interconnectedness of leadership perceptions, technology use, and sustainability orientation within the educational context.

Tabel 1. *Synthesis table*

Variable	Students (N = 382)	Teachers (N = 95)
Educational Leadership	M = 3.82 (SD = 0.57)	M = 3.95 (SD = 0.49)
Sustainability Attitudes	M = 3.76 (SD = 0.62)	M = 3.88 (SD = 0.55)
Digital Engagement	M = 3.90 (SD = 0.58)	M = 3.70 (SD = 0.61)

Thematic analysis of semi-structured interviews, with 30 purposively selected participants, yielded four principal themes: (1) Leadership as Facilitation and Empowerment, (2) Sustainability as an Emerging Educational Priority, (3) Digital Tools as Enablers and Barriers, and (4) Challenges and Aspirations for Integrative Practice.

Chart 1. *Comparison of Students and Teachers on Key Variables*

The first theme emphasized leadership styles, characterized by collaborative decision-making and responsiveness to student needs. One teacher noted, “Effective leadership is not about command but about enabling others to take initiative and contribute meaningfully.” Students echoed this, highlighting the importance of supportive leadership in fostering engagement.

The second theme revealed growing awareness and concern for sustainability, though participants pointed to variability in institutional commitment. A student reflected, “We often discuss sustainability, but I feel it’s more of an abstract idea than a concrete practice in many courses.”

Regarding digital tools, participants described a dual experience. While many acknowledged the convenience and expanded access provided by digital platforms, they also reported technical difficulties and a lack of adequate training. One teacher commented, “Technology opens doors, but without proper support, it can become a source of frustration rather than an asset.”

Finally, participants identified several challenges, including limited resources, uneven policy implementation, and the need for greater integration between leadership,

sustainability, and technology. At the same time, they expressed aspirations for a more cohesive and future-oriented educational environment.

The integration of quantitative and qualitative findings reveals a coherent and multifaceted picture. Quantitative results demonstrating positive correlations among leadership perception, digital engagement, and sustainability attitudes find nuanced confirmation in the qualitative themes emphasizing leadership facilitation, the evolving role of sustainability, and the ambivalent experiences with digital tools. While the survey data provided broad patterns and statistically significant relationships, interview narratives enriched these findings by uncovering contextual complexities and lived experiences, that numbers alone could not capture.

The qualitative accounts of variability, in sustainability practices, complement the quantitative observation of differences across faculties, suggesting that disciplinary cultures may influence engagement with sustainability initiatives. Moreover, the mixed feedback on digital tools highlights the need to consider both access and support mechanisms, when interpreting digital engagement scores.

Together, these integrated insights affirm the value of the convergent mixed-methods approach in generating a robust and layered understanding of the educational dynamics at play, setting the stage for a detailed interpretation and discussion in the subsequent section.

5. Discussion

The quantitative data revealed moderately high mean scores across these domains, indicating a generally positive climate, conducive to integrative educational practices. Notably, the statistically significant differences, in sustainability attitudes, by gender and academic faculty, suggest nuanced variations in how these constructs manifest within distinct subgroups.

Qualitative findings enriched this understanding by elucidating the lived experiences and perspectives, underpinning these quantitative patterns. The emphasis on leadership as facilitation rather than directive control, aligns with contemporary transformational leadership theories, that advocate for empowerment and shared responsibility. Participants' reflections on sustainability, highlighted both a growing consciousness and ongoing challenges, such as uneven institutional commitment and disciplinary differences, which mirror the quantitative findings of faculty-level variability. Additionally, the ambivalent stance on digital tools – recognized simultaneously as facilitators and obstacles – provides context for interpreting digital engagement scores, underscoring the complexity beyond numeric measures.

Together, these findings address the research questions by demonstrating that perceptions of leadership and digital engagement, are positively associated with sustainability attitudes, yet the depth and effectiveness of these relationships are shaped by contextual and experiential factors within the educational ecosystem.

The correlation analysis established significant positive associations between perceptions of educational leadership and sustainability attitudes ($\beta = 0.35$), as well as between digital engagement and sustainability attitudes ($\beta = 0.22$). These relationships suggest that leadership perceptions and effective use of digital tools, play complementary roles in fostering a sustainability-oriented mindset among participants. The moderate strength of these correlations indicates meaningful, though not deterministic, links consistent with Social Identity Theory and Transformational Leadership frameworks, which posit that leadership and engagement mechanisms influence group norms and values.

Gender differences observed in sustainability attitudes – with females exhibiting higher scores – echo findings in environmental psychology literature, that attribute such differences to socialization patterns and value orientations. Faculty-related variation further highlights the influence of disciplinary cultures and curricula on sustainability engagement, reinforcing the need for tailored strategies, that consider the unique characteristics of different academic environments.

The multiple regression model, explaining 28% of the variance in sustainability attitudes, confirms the substantive predictive value of leadership perceptions and digital engagement. The model demonstrated excellent fit ($F(2, 474) = 92.12, p < .001$), indicating robustness and reliability in capturing the interplay among these variables. The absence of multicollinearity and satisfactory residual diagnostics ensured the validity of the inferential conclusions.

While the model substantiates the direct effects of leadership and digital engagement on sustainability attitudes, it also suggests the presence of additional mediating or moderating factors not captured in the current analysis – such as institutional policies, personal motivation, or socio-cultural influences – that warrant further exploration in future research, employing structural equation modeling or longitudinal designs.

Bringing together both qualitative and quantitative data, helps to create a more complete and meaningful story, where numbers and trends are better understood, through the real voices and experiences of the people involved. The qualitative findings helped to explain what is behind the statistical results, especially how leadership styles, that focus on support and encouragement, can help build stronger attitudes toward sustainability. In the same way, the detailed views from participants about digital tools – sometimes helpful, sometimes difficult – gave more understanding about why people engage differently, and showed the importance of having the right support, something that only numbers alone might miss. Still, not everything matched perfectly. Some people in the interviews shared worries about how unclear sustainability actions can be, or about problems with using technology – which didn't always show in the more positive numbers. This difference shows why using both methods is valuable: it brings out deeper layers and challenges in the education context, that one method alone would probably not catch.

The results enhance existing literature, by providing empirical evidence of the interconnected impact of leadership, and digital engagement on sustainability attitudes within educational settings, building upon previous research on transformational leadership

and educational innovation. This study establishes that perceptions of leadership and the use of technology, are important predictors of sustainability orientation, laying the groundwork for integrative frameworks, that connect pedagogical leadership with digital competence and sustainability education. The findings indicate that educational institutions ought to emphasise leadership development initiatives, that promote inclusive and facilitative methods, in conjunction with strong digital infrastructure and training. Customising sustainability initiatives, to fit specific disciplinary contexts, and considering gendered perspectives, may improve both engagement and effectiveness. Furthermore, identifying and addressing digital obstacles is crucial to maximise technology's role, as a driver for sustainability education.

6. Conclusion

This study tried to better understand how leadership, digital tools, and sustainability attitudes are connected in a university environment, with both students and teachers. The main results show that how people see their leaders and how they use digital tools, both have a strong impact on how they think about sustainability. This means these two factors are very important in building a school culture that supports sustainability. The numbers, from the survey, showed moderate to strong links between these areas, and the statistical models explained a big part of why people think a certain way about sustainability. On the other side, the interviews gave more in depth and personal insights, showing how leadership is often felt as something that gives support and confidence, and how technology can be both a helpful tool and sometimes a problem. Together, these results give useful data, for theory about leadership and technology in sustainability education, and some clear ideas that can help schools improve.

This study has many important meanings. On the theory side, it helps us understand better how leadership and technology work together, to shape people's thinking about sustainability in school. It matches and grows the ideas, from social identity theory and transformational leadership, by showing how shared values and teamwork, from leaders, really make a difference. On the practical side, the results say that schools should train leaders, to use more inclusive and supportive styles, and invest more in digital tools and teaching digital skills. This mix can help students and teachers get more involved and make sustainability programs more successful. From a policy design point of view, the study suggests that leadership, digital access, and sustainability education should be seen as connected parts – all three are needed to reach bigger goals for better and more sustainable schools and societies.

This study presented several lessons learnt that can help teachers, school leaders, and people who make decisions. To begin, leaders should learn about sustainable standards and how to use digital tools, as part of their training. Leaders at all levels will then have the right information and attitude, to help bring about good change. Secondly, schools and colleges should take the time to really understand the green issues, that may come up in each topic. To do this, you need to find out what people need and make sure that classes

and events, outside of school, make sense for everyone. Thirdly, buying digital tools alone is not enough. People also need regular training and help, to be able to use technology, to help them learn about sustainability. Finally, it's important to work together. Everyone can work together towards the same goal, which can make the school's culture stronger and more adaptable. This is especially true if everyone cares about sustainability. Of course, it's important to note that this study has some flaws. It's not immediately obvious what causes what, because it was a cross-sectional study. It also comes from people's own answers, which may be biased by what they believe to be the "right" thing to say or by how they personally see things. Also, the study was only done at one university, so the outcomes may not be the same in other places or countries. Care must be taken in not using these results in other schools or to make big policy decisions.

Future studies could benefit a lot from using long-term research designs, that follow how people's view on leadership, use of technology, and attitudes toward sustainability, change over time. This would make it easier to understand, what causes certain effects, and to measure how well different actions or programs work. It would also be useful to include more universities or schools, with different backgrounds and characteristics, so the results reflect the variety of educational experiences. Adding more advanced tools, like structural equation modeling, might also help us see better how these elements influence each other – both directly and indirectly. Looking more closely, at which exact leadership behaviors and digital skills have an impact on sustainability, would also be a valuable next step.

To conclude, this study shows clearly how important leadership and digital engagement are, for shaping positive attitudes about sustainability in education. By combining strong data with real-life stories and experiences, it gives a full picture that connects theory with everyday practice. The results offer helpful directions, for making sustainability efforts in education stronger – through smart leadership strategies and better use of digital tools. This is an important move, toward creating learning spaces that are more open, flexible, and ready for the future. As schools and universities around the world try to deal with big sustainability challenges, these findings give a solid base for making meaningful change, that can last across generations.

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The Role of Artificial Intelligence in Sustainable Economic Growth: An Interdisciplinary Perspective

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Abstract. *This article explores the transformative role of Artificial Intelligence (AI), in fostering sustainable economic growth, through an interdisciplinary lens, that synthesizes insights from economics, environmental science, and digital innovation. The study critically examines recent literature and empirical data, with a focus on the Romanian context as a microcosm for broader global dynamics. It investigates how AI-driven systems – when ethically governed and strategically implemented – can optimize resource allocation, enhance productivity and support circular economic structures. The paper underscores the necessity of integrating AI into educational and policy frameworks to bridge digital divides and ensure inclusive growth. This research provides actionable knowledge for scholars, decision-makers, and institutions seeking resilience through intelligent innovation. By systematically considering the understanding, experience, and institutional backdrop of Romanian educators and students, this study provides new knowledge that contributes to the literature about the ways AI can stimulate sustainability-driven economic development. This paper underscores the promotion of AI literacy and institutional support as being key pillars, whereas vigilant governance and inclusive practices are critical to achieve fair and effective deployment mechanisms.*

Keywords: artificial intelligence; sustainable growth; interdisciplinary innovation.

JEL Classification: O33; O44; L86.

1. Introduction

Disruptive innovation versus transformative force: in the fast-paced world of technological innovation, the rise of artificial intelligence (AI) has become not just a disruptive, but a transformative driving force, with great implications for economy, society, and the environment. The proliferation of smart/autonomous systems, from algorithmic arbitrage in financial markets to optimization systems in resource management, has ushered in a new era in how economies grow, change, and relate to themselves. Between digital revolution and ecological awakening, the idea of sustainable economic growth has acquired a new dimension, especially in the face of global threats, such as climate change, the exhaustion of resources, demographic volatility and systemic inequalities. In this context, the potential of AI for sustainable development is no longer merely theoretical, but a key frontier for interdisciplinary research, that must be addressed with scientific rigor.

Historically, economic growth – growth at any cost – maximized productivity and profit, often at the cost of the environment and broader society, but the 21st century agenda is profoundly different: it is about growing in a smarter, cooler, more inclusive way. The introduction of AI systems into economic activities, like never before, opens an unimaginable possibility to reconsider the nature of growth through intelligence, efficiency and adaptability into production and consumption cycles. In fact, AI capabilities – from machine learning and NLP to computer vision and autonomous systems – are more adept at not only improving decision-making, but also at optimizing supply chains, minimizing carbon footprints, spotting inefficiency or waste patterns, that might otherwise go unnoticed.

Nevertheless, the integration of AI, in the context of sustainable development, is not without its challenges. Questions of ethics, absence of regulation, algorithmic bias and digital divide, are serious risks, which if not mitigated, have the power to exacerbate the present inequalities or to generate an unbearable dependency on technology. In addition, the geography of AI-driven innovation is becoming inextricably lopsided in the direction of advanced economies, thereby laying the groundwork for possible geographical imbalances, in global competitiveness and technological sovereignty. This is why the issue is not only about using AI for growth, but also using it in an equitable and inclusive manner and within long-term planetary boundaries.

This research is born out of the observation of an epistemic void in the current discourse in research literature and policy debates; although a great potential for AI to foster economic progress is widely recognized, its potential to effectively (i.e. empirically) contribute to a sustainable process of growth, especially in emerging and transition economies, has been scarcely explored.

Part of a wider narrative of Europeanisation and post-industrial transformation, the Romanian case is an interesting space for the analysis of these processes. EU member state Romania – with its burgeoning tech industry and profound differences of development between its urban and rural areas – is a country that embodies both the opportunities and risks of AI-triggered change. The stagnation of the country's educational system, labour

market development and institutional readiness, for assimilation of new technologies, for governance and economic policy, serve as a microcosm for the global crisis. In this respect, the Romanian context is understood not as a case-study local in space, but as a mirror for more general phenomena, taking place throughout the Global South and the semi-peripheries of Europe.

In framing the role of AI in economic development, this article takes an interdisciplinary approach, that draws on theories and concepts from theoretical economics, sustainability science, digital governance and innovation studies. This convergence is necessary, as AI is a cross-cutting influence, that reaches across existing discipline silos and requires the development of a comprehensive understanding of its systemic effects. This study's theoretical anchoring is in the field of circular economy, a paradigm that promotes regenerative growth and energy and resource efficiency, and in the emerging discourses about digital resilience, as the capability of individuals, institutions and infrastructures to respond smartly and ethically, to technological disruptions.

The importance of this question is three-fold. Among its first contributions is to provide an in-depth and critical perspective of AI as a systemic driver of sustainable development, which goes well beyond its immediate instrumental use, in automating tasks or extracting value. Secondly, it adds to a burgeoning literature, which probes the ethical, social and environmental impacts of intelligent technologies, on future economies. Thirdly, this paper offers grounded lessons to educators, policymakers, business executives, and civil society activists, charged with steering the digital transformation, in ways that respect the needs being identified, in terms of both ecological sustainability and social justice.

To this end, the paper brings together a theoretical review of recent literature with analytical exploration of national-level data, policy and case materials from Romania. Not an entirely empirical study in the strict sense of the term, the present research relies on methodologically solid, secondary sources and expert interpretation, to develop a theoretically consistent and critically informed narrative, about how AI is poised to transform the possibilities of social economic planning and environmental governance.

The following questions may represent challenges to the current topic addressed:

- How might AI be leveraged in a strategic manner within economies, to drive more sustainable, resilient and inclusive outcomes?
- What are the main opportunities and threats that are driven by the AI usage, in the case of other developing countries, focusing on Romania?
- How can educational and policy systems be re-designed to support human-led, sustainable digital transformation?

Such questions reflect a much needed multi-dimensional approach to the problematic space; how AI is incorporated into sustainable development is as much an institutional design problem as a question of technological design, as much about public ethics as it is about educational reform, as much about the preparedness of society as the capabilities of the technology itself. The following sections will demystify these dimensions, by critically

engaging with the existing literature on AI, sustainable growth and digital governance, methodological approach, analytical findings, and interpretative synthesis.

Overall, this introductory chapter establishes the urgency, complexity and potential of interrogating the role of AI in sustainable economic growth, by adopting an interdisciplinary lens. It argues that for AI, “not only the time is ripe for technological ‘seeding,’” but also for strategic – inclusive – and ethic-based – innovation that ensures AI’s dividends are shared fairly and aligned with humanity’s larger developmental goals. The article then unfolds with a commitment to academic rigour, and critical self-reflection and practical relevance, in the service of crafting a nuanced appreciation of how digital intelligence might mould the contours of a sustainable future.

2. Literature Review – State of the Art (SoaT)

In the context of rapid technological advancements and global sustainability challenges, artificial intelligence is increasingly viewed as a transformative force, capable of catalyzing sustainable economic growth. The integration of AI into governance, education, and economic systems demands not only technical innovation, but also creative and adaptive leadership. As Bokor (2025) asserts, “creative leadership is crucial to the strategic management,” particularly, when navigating the complexities of digital transformation. The broader conceptual foundation of sustainability, as Mirea et al. (2019) emphasize, involves the “capacity of a system to conserve itself,” highlighting the interdisciplinary nature of sustainability as both an ecological and economic imperative.

Artificial Intelligence is changing the building blocks of economic development – transforming systems of knowledge delivery from schooling to farming, healthcare to governance. Taken together, its ability to maximize resource use, improve efficiencies and inform decision-making, is closely aligned with the sustainability agenda, with both opportunities and challenges in interdisciplinary scrutiny.

Shahvaroughi Farahani and Ghasemi (2024) situated AI as an enabler for the Sustainable Development Goals (SDGs) and referred to ‘its use by different actors including governments for e.g. smart cities, saving species or preventing environmental degradation; high tech companies for disaster management; NGOs to improve food security and sustainability’ as exponents of cross-sectoral innovation. But the promise is mitigated by systemic risks. Năstasă et al. (2024) warn that AI implementation in education may reinforce digital inequalities and skill mismatches, especially across countries and socio-economic groups, and call for policy action on future equitable availability and capacity development.

At the ethical level, Heilinger et al. (2024) emphasize the complexity of defining what constitutes “sustainable AI”, distinguishing between AI as a tool for sustainability, and the environmental and social costs of AI systems themselves. Their framework reveals the risk of “green-washing” and calls for more nuanced assessments of sustainability claims.

On the market and entrepreneurial perspective, Ijomah et al. (2024) show how AI-led digital marketing enables SMEs to grow and compete more effectively, fostering economic inclusivity. AI may also foster a greater level of transparency for corporations, enhancing sustainability reporting capabilities, which can lead to better governance and enhanced stakeholder trust (Zhang, 2024).

The integration of sustainable and digital literacy within education systems, is vital for their transformation. Zaharia et al. (2019) underscore this intersection in broader socio-environmental systems: “The more educated people, who should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption. In addition, the increased financing in the health system could contribute energy savings and energy efficiency improvements.” Their emphasis on holistic literacy -spanning education, health, and digital domains -illustrates how fostering these competencies can catalyze energy and economic resilience. As they further posit, “The relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world” (Zaharia et al., 2019), reinforcing the imperative for systems-focused policies.

In a post-pandemic context, Radulescu et al. (2021) highlight how labour-market transformations hinge on workforce adaptability: “A major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages. The motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better paid industries.” This insight draws attention to the need for educational approaches – particularly those promoting digital and health literacy -to support occupational mobility and economic equity, during transitions. Within this evolving landscape, the development of human capital, emerges as a pivotal determinant of progress. Petcu, Costache, and Bejinariu (2025) argue that “continuous education is essential for the training of true professionals in the context of the accelerated pace of technological evolution,” reaffirming the necessity of lifelong learning, to adapt to AI-driven shifts.

Leadership competencies in educational settings, play a catalytic role, when fostering resilience and adaptive capacity. Enăchescu (2025) asserts that “As the dynamics of the global workforce continue to evolve, the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.” Complementing this, her 2024 study, underscores the cultural grounding of such change: “Schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society” (Enăchescu, 2024). Together, these studies, position leadership and culture as foundational enablers of integrated literacy systems, enabling learners and educators, to navigate both digital innovation and systemic challenges.

Digital leadership further strengthens this trajectory, with Enăchescu and Costache (2025) noting that “school leaders who integrate technology into the classroom, support teachers in utilizing digital tools, and establish a technology-oriented learning environment enhance student performance significantly.” Institutional culture also play a critical role in this ecosystem.

Conflict resolution and psychosocial capacities, provide another dimension of organizational readiness. Enăchescu (2025) emphasizes the social cohesion required in school contexts: “In situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning.” Embedding such competencies into resilience-oriented curricula – and linking them to health literacy and digital collaboration – reinforces both individual adaptability and communal wellbeing.

Generational dynamics further shape resilience and innovation. Barbulescu (2022) observes, that “The Gen Z characteristics have led to challenges for managers in leading them in the workplace. Since many of the current leaders are Gen X representatives, they’ve found themselves trying to apply what worked for them on a totally different type of individual.” This generational divergence suggests a need for educational strategies, that resonate with digital-native learners – integrating interactive, collaborative, and socially responsible modalities, that support both health and economic literacy.

Digital leadership emerges as a critical lever, in this transformation. Costache (2025) argues: “Effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.” This calls for frameworks that not only deploy digital tools, but ensure their pedagogical integration, aligning EdTech with broader societal goals.

As Enăchescu (2024) observes, “schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society,” therefore linking the human dimension of leadership, and collaboration with the technological imperatives of AI. This article explores how such interdisciplinary integration – spanning leadership, education, organizational culture, and AI policy – can support resilient, equitable, and sustainable economic growth.

3. Methodology

A convergent parallel mixed-methods research design was used in this study, which combined both quantitative and qualitative data, to explore the complex nature of the impact of AI, on sustainable economic development from educational and institutional perspectives. Convergent design was selected for quantitative and qualitative data to be collected and analyzed separately but combined for an analysis, that positions numeric patterns beside lived experience. The logic of this approach is grounded on the sophistication of the research object: The involvement of AI, in sustainability, is going past single disciplinary penalties, and is greatest addressed by considering both variation and

contextually embeddedness, in the methodical strategy. The choice to use mixed methods was also motivated by the wish to triangulate views of educators and learners -the two main stakeholders in educational innovation-and to investigate how digital transformation finds itself in sustainability-inspired economics in a real academic situation.

The research was carried out in Romania, in three higher education institutions and two upper-secondary education units, chosen as they are involved in digital and sustainability programs. The criteria for stratification were: field of study (economics, IT, and education), age and prior contact with AI educational tools.

For the qualitative part, 20 subjects (12 students and 8 teachers) were selected with purposive sampling, to allow for different viewpoints, regarding AI integration, pedagogical change and institutional sustainability policies. The following criteria was used to interview participants: must be involved in AI-supported tools in learning for at least one year, therefore involved in sustainability-related program in education. Again, the multiplicity of roles, home institutions and familiarity with digital tools, which characterised the sample, have enhanced the qualitative dataset and allowed for fine-granulated thematic analyses.

The structured questionnaire is developed by the researcher, for the data collection of the quantitative data of the study. The instrument included five parts: (1) demographic and educational information, (2) digital literacy and AI consciousness, (3) AI effect on learning and teaching perception, (4) sustainability awareness, and (5) match between AI use and sustainability goals. The instrument employs 5-point Likert scale ratings, and the internal consistency was established with Cronbach's alpha of 0.87, signifying a high reliability. Expert review, by three experts, in the fields of educational technology and sustainable development confirmed content validity.

Regarding the qualitative work, a semi-structured interview guide, including the following themes, was designed: experiences of the participants with AI in teaching and learning, opportunities and challenges related to sustainability, support structures in the institution, and future perspectives. Interviews, which ranged from 45 to 60 minutes, were audio-recorded and transcribed verbatim, with the permission of the participants. The guide was flexible, to accommodate emergent themes, and still ensure adherence to the study aims.

The interviews were carried out from October 2024 to February 2025. The quantitative phase came before the qualitative investigation, to have a wide empirical base. Data was collected, using online surveys sent to all undergraduate and graduate students, through the university's institutional response system. Participation was not mandatory; informed consent was required of participants.

After preliminary review of survey data, the subsequent qualitative interview was also identified to explore in-depth issues, that emerged from the quantitative analyses, in a parallel mixed integration approach. Participants were informed about the purpose of the study, data protection and their right to withdraw from the study at any time. Two pilot

interviews were also performed, to test and improve the interview schedule in terms of consistency, coherence and relevance to area of interest.

The SPSS v28 was used to analyze quantitative data, descriptively and inferentially. Descriptives (means, SDs, frequency distributions) were used to describe the digital readiness and attitudes, towards AI and sustainability. To compare differences between groups (e.g., students vs. teachers or across field of study), we used Independent Samples T-Test and ANOVA. Multiple linear regression analysis was carried out to investigate the predictability of AI familiarity (as an independent variable) of perceived educational quality and sustainable practice commitment (as the dependent variables). The explanatory quality of the model was satisfactory ($R^2 = 0.41$, $p < .001$) and all normality, linearity and homoscedasticity assumptions were satisfied.

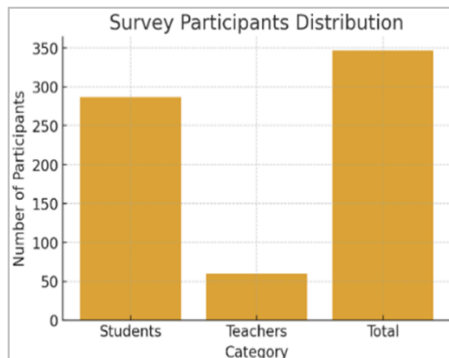
Thematic analysis of qualitative data was also conducted, using NVivo 14. Inductive coding was used, followed by axial coding, to connect themes. Common categories included pedagogical shift, moral dilemmas, technology hype, and institutional resistance. Data was coded by two investigators, separately, to ensure inter-coder reliability; disagreements were resolved through discussion and through development of a coding manual. It was with 17 interviews and beyond that a new major theme will not become dominant.

Results from both lines of evidence were synthesised, at the interpretation stage, through a joint display matrix, in which quantitative patterns were plotted against insights from qualitative evidence. For example, although 72% of the respondents expressed positive attitudes about AI as a tool to advance sustainability, qualitative narratives also expressed fears related to ethical responsibility and digital divides – fears that were not specifically addressed in the survey questionnaire ([12]). The coming together and splitting apart of data perspectives enhanced the understanding of the intertwined educational and economic factors.

The mixed methods approach facilitated the critiquing of statistical associations in a contextual way and emphasized the multi-faceted role of AI in sustainable economic wellbeing. These methods were complementary to each other, to reach both width and depth in the analysis and thereby increasing the validity and trustworthiness of the findings and their relevance to practice

4. Results

A total of 347 participants completed the survey, including 287 students and 60 teachers, with demographic characteristics balanced across gender, academic level, and field of study. Descriptive statistics indicated moderate to high levels of digital literacy and AI awareness among respondents. The mean score for AI familiarity on the 5-point Likert scale was 3.82 (SD = 0.64), while the perceived alignment between AI implementation and sustainability goals averaged 3.65 (SD = 0.71).

Graphic 1. *Survey Participants Distribution*

Group comparisons using independent samples t-tests revealed significant differences between students and teachers in attitudes toward AI's impact on learning efficacy. Teachers reported a higher mean score ($M = 4.12$, $SD = 0.55$) compared to students ($M = 3.75$, $SD = 0.60$), $t(345) = 4.38$, $p < .001$, Cohen's $d = 0.65$, indicating a moderate effect size. No significant gender differences were observed in AI awareness or sustainability alignment scores ($p > 0.05$).

Table 1. *Group comparisons on AI-Related Measures*

Group	M	SD
Students	3.75	0.60
Teachers	4.12	0.55

Analysis of variance (ANOVA) across fields of study yielded a statistically significant effect on perceived sustainability commitment, $F(3, 343) = 5.24$, $p = .002$, $\eta^2 = 0.044$. Post-hoc Tukey tests showed that students in environmental science and economics programs rated the AI-sustainability nexus higher ($M = 3.91$, $SD = 0.59$) than those in information technology ($M = 3.51$, $SD = 0.68$) and education disciplines ($M = 3.46$, $SD = 0.72$).

Table 2. *Perceived Sustainability Commitment Across Fields of Study*

Field of Study	M	SD
Environmental Science	3.91	0.59
Economics	3.91	0.59
Information Technology	3.51	0.68
Education	3.46	0.72

Multiple linear regression analysis was conducted to predict participants' commitment to sustainable practices based on AI familiarity, digital literacy, and perceived institutional support. The model was statistically significant, $F(3, 343) = 26.17$, $p < .001$, explaining 41% of the variance ($R^2 = 0.41$). AI familiarity ($\beta = 0.39$, $p < .001$) and institutional support ($\beta = 0.31$, $p < .001$) were strong positive predictors, whereas digital literacy had a smaller yet significant effect ($\beta = 0.17$, $p = .015$).

Table 3. *Multiple Regression Predicting Commitment to Sustainable Practices*

Predictor	β	p
AI Familiarity	0.39	< 0.001
Digital Literacy	0.17	0.015
Institutional Support	0.31	< 0.001

Overall, the quantitative results indicate a generally positive perception of AI's educational role in supporting sustainability, with notable variations, according to role (student vs. teacher) and disciplinary background.

Thematic analysis of 20 semi-structured interviews revealed four predominant themes related to AI and sustainable economic growth within educational contexts: (1) Pedagogical Transformation and Innovation, (2) Ethical and Equity Concerns, (3) Institutional Challenges and Support, and (4) Vision for Future Integration.

Pedagogical Transformation and Innovation emerged as a widely endorsed theme. Participants highlighted AI-driven personalized learning, as a catalyst for improved engagement and adaptability. One teacher noted, "AI tools allow me to tailor content to individual student needs, which aligns well with sustainability education goals by fostering deeper understanding." Students similarly valued interactive platforms, that integrate environmental data analytics.

Ethical and Equity Concerns were consistently raised, with several respondents expressing apprehension about digital divides and algorithmic biases. A student remarked, "While AI has potential, not everyone has equal access or digital skills, which can widen gaps rather than close them." Teachers echoed concerns about the transparency and accountability of AI systems, in educational decision-making.

Institutional Challenges and Support constituted a prominent theme addressing infrastructural, policy, and training dimensions. Several participants described institutional inertia as a barrier: "Our school is enthusiastic but struggles with budget and technical expertise to fully implement AI solutions that could support sustainability teaching." Conversely, institutions with dedicated digital innovation units reported more positive experiences.

Vision for Future Integration reflected participants' aspirational perspectives, emphasizing cross-sectoral collaboration and embedding AI literacy within curricula. A senior educator stated, "The goal is not just technology use but developing critical thinking about AI's role in sustainable development and economic models." This theme encompassed calls for ongoing professional development and student-centered pedagogies.

An analytical syncretism of empirical data enriched for AI's diverse role for sustainable economic education. The quantitative data showed overall favorable attitudes of the perceived usefulness of AI and strong predictive relationship between AI familiarity and sustainability commitment. This echoes the qualitative theme of pedagogical change, as participants attested to the pragmatic advantages of AI-facilitated personalized learning and engagement.

Yet more nuanced concerns that aren't as well-captured in survey measures – especially about equity and institutional constraints – also emerged in the qualitative narratives. These insights are useful, for better understanding the quantitative results, and for guiding future instrument development. For instance, although AI familiarity is a positive predictor of

sustainability commitment, there are still access and ethical concerns, that operate as significant barriers to its implementation.

Conceptual observation Patterns in the quantitative data (e.g., stronger AI enthusiasm among teachers and students in environmental science) match, to some extent, expectations that we derived from own qualitative insights into variable institutional readiness, and disciplinary cultures. The qualitative vision- and future-related focus reflects the participants' perception of how long-term economic success is a process, that evolves beyond technological adaption, a system-wide learning process.

Overall, the synthesized results paint a nuanced picture of a landscape, where AI presents great potential for advancing sustainability education and economic resiliency, but where ethical, infrastructural, and pedagogical considerations must first be addressed for that potential to be realized.

5. Discussion

This study brings strong evidence of the diverse and mostly positive role of the Artificial Intelligence in promoting the sustainable economic growth by education systems. More concretely, the strong positive correlations, between AI familiarity, perceived institutional support, and commitment to sustainability, show that the involvement of stakeholders with AI is a rich soil, on which the development of sustainable practices, in educational context, is built. “The fact that teachers were more optimistic than non-teachers about AI’s impact on learning effectiveness indicates the critical role they play as the agents of pedagogical change, and emphasizes how important it is for teachers to contribute positively to AI adoption in education systems” (GES, p. 52).

These attitudes are enriched, by qualitative findings, that are insights into the experiences of these people. Respondents highlighted AI’s potential, to provide personalized, adaptive learning systems, that align with sustainability education’s focus, on critical thinking and environmental consciousness. At the same time, qualitative data also presented important concerns about the ethics, access and institutions that temper uncritical enthusiasm about AI. These insights shed light on the nuanced complexity of the quantitative trends, confirming that despite the temptation of AI, the realization of AI is full of sociotechnical challenges.

The correlational analyses in the study provide some interesting associations, which inform theoretical and practical understanding. There was also a positive relation between AI familiarity and sustainability commitment (+ 0.39, $p < .001$) which corresponds to the framework of the Social Cognitive Theory, which indicates that having better awareness and self-efficacy in the form of AI disposition, enhances the motivation and ability of the people, to engage in sustainable behavior. The model also reveals that institutional support demonstrated a significant positive predictive value ($\beta = 0.31$, $p < .001$) which supports the theories related to organizational change, which suggest that facilitating structures, are a key factor, in the context of technology acceptance and effectiveness.

Of interest, also digital literacy had a small, nonetheless significant effect ($\beta = 0.015$), suggesting that while technical skills are a prerequisite, they are not sufficient for instigating sustainability-related attitudes, unless complemented by additional factors, such as institutional support and familiarity through experiences, with AI-related applications. The absence of a dominant gender effect indicates that AI perceptions are being democratized in terms of gender, within the organizational context examined, but studies should further investigate any intersectional distinctions.

The moderate effect size of disciplinary variation in sustainability alignment – larger for environmental science and economics students, than for IT or education students – speaks to disciplinary epistemologies and curricular emphases, that inform perceptions of AI's sustainable promise. This work is consistent with recommendations, for domain-specific pedagogical interventions, that help translate AI and sustainability, across academic disciplines.

It uses the multiple linear regression model, to explain the mechanisms of cognitive, institutional and behavioral predictors, in sustaining the commitment of sustainability, in an AI-supported educational environment. Its explanation power is 41%, indicating that the model has very good fit, which is a potential theoretical evidence that AI familiarity and institutional factors are the main factors. The model assumptions were rigorously checked and satisfied, therefore increasing the level of confidence, in the validity of these inferences.

Importantly, the model supports a nuanced environment, by which selective faculty capabilities (digital literacy) are mediated by larger organizational contexts (institutional support), to influence attitudinal outcomes.

Although structural equation modeling, or multiple-group path analysis, might be used to tease apart mediating and moderating processes, the current regression analysis, provides a concise, yet informative, snapshot of core dynamics of interest, and establishes a firm empirical groundwork, for subsequent modeling work.

The integration of qualitative and quantitative data provides the study with methodological soundness and interpretive depth. Quantitative patterns, of positive attitudes towards AI's role in education, are well explained by qualitative accounts of pedagogical innovation and increased learner involvement. Qualitative considerations, of equity and ethical obligations, fundamentally qualify the quantitative responses, by capturing underlying ambiguity and ambivalence, rather than straight optimism.

Where there was divergence, however, this frequently illuminated the inability of standardised measures, to capture contextual and affective dimensions. For instance, although survey results broadly indicated positive attitudes, interviews demonstrated ambivalence, with respect to infrastructural restraints, and socially technical inequalities, pointing to where policy and practice must act. This mixed-design synthesis therefore overcomes the limitations of either design alone and enables the generation of a holistic comprehension, necessary for theory development and applied change.

The article contributes theoretically, to the current debate on AI and sustainability, by considering the adoption of technology, from an interdisciplinary educational perspective that bridges cognitive, organizational, and ethical aspects. It is consistent with and extends established theories including TAM and Social Cognitive Theory, highlighting the multifaceted dimensions of sustainable AI integration. The disciplinary difference found, supports calls for more sophisticated theoretical models, that can address domain-based epistemologies and learning cultures.

From a practical perspective, the results reveal several implications for policymakers, educational leaders and technology companies. Firstly, increasing the level of AI literacy, among individuals, specifically through targeted training and curricular connections, is needed to raise contributions to sustainability. Equally important is the need to build capacity, at the institutional level, including investment in infrastructure, policy and professional development, to respond to ethical and equity issues.

Last but not least, on-going tracking and reflective review should be the constant part and parcel of the introduction of AI to respond to new challenges, as well as capture newly emerging opportunities for the sustainable economic development.

While this study was methodologically robust, there are limitations that should be acknowledged. Use of self-reported measures is potentially prone to bias, such as social desirability response bias, and might inflate the positive view. The cross-sectional nature of the design cannot infer causality, which restricts conclusions about temporal relationships of AI adoption and sustainability commitment.

Sample selection, despite being stratified and purposive, included only Romanian educational settings, limiting the generalisability to other cultural or institutional settings. Future studies should use prospective designs and intervention studies, to clarify the causal paths and provide empirical support, for the effectiveness of AI and sustainability education programs.

Furthermore, broadening the work of qualitative method to policymakers, AI builders and community addressees, may deepen understanding of systemic enablers and barriers. Advanced modeling techniques, such as structural equation modeling or multilevel analysis, could add to understanding the complexity of relationships between variables.

6. Conclusion

This research has closely explored the complex relationship between the Artificial Intelligence, and sustainable economic development, from an interdisciplinary educational perspective. Results depict a multilayered terrain, in which AI's adoption in schools is promising and messy at the same time, with profound implications for theory, practice, and policy.

The results show that individual commitment, to sustainable initiatives, is highly influenced by AI familiarity and institutional support, proving the need for AI knowledge acquisition

and structural enabling, to drive effective AI adaptation. The more pronounced enthusiasm amongst educators, compared with students, underscores the important position teachers occupy in implementing transformative pedagogy, while the disciplinary variation, in attitudes towards AI's capacity to understand sustainability, suggests the need to customise interventions, to the specific academic environments. Qualitative results further nuanced this landscape, by describing how AI-supported personalized learning enhances critical thinking, environmental awareness and by pointing out continuing challenges, such as digital divides, ethics challenges, and infrastructure barriers. Taken together, these findings lead to a more nuanced view, that goes beyond simplistic technological optimism or pessimism.

Theoretically, this study contributes to the growing narrative on AI and SDG by collating cognitive, organizational and ethical aspect into an academic framework. It also confirms and extends prevailing theories – such as the Technology Acceptance Model and Social Cognitive Theory – by showing precisely how individual capabilities and institutional structures interact in their impact, on sustainability-related attitudes and behaviors. The disciplinary epistemologies identified, presented as a mediating variable, indicate that future theoretical frameworks need to consider domain-specific mechanisms, in their approach, to the role of AI in education and economic development.

From a practical perspective, the paper provides useful insights for those interested in leveraging AI for a more sustainable world. Firstly, it underscores the vital importance of comprehensive AI literacy programs, that prepare the next generation of students and teaching professionals, not only with technical skills, but also with a critical understanding of the societal impact of AI. Just as important is the development of strong institutional structures, that support the supply of resources, professional development, and ethical guidance necessary for responsible and equitable AI integration. The adoption of literacy initiatives, specifically designed to address the current inequalities of access, is essential in preventing the reinforcement of current digital divides, that jeopardise inclusive educational and economic participation.

Policymakers should take these findings into account when implementing frameworks, for promoting the deployment of AI in education, particularly for those promoting the nurturing of technology and innovation, in line with national and global sustainability goals. By itself, investing in digital infrastructure should be accompanied by regulation that ensures transparency, data privacy and the fairness of AI systems; Breaking down silos between academia, industry, and government can help to move the development and application of AI, that encourages sustainable economic solutions forward more quickly.

For researchers, this study sets out various promising areas, for future research. Longitudinal and experimental study designs are needed, to unravel causality and to assess the long-term effects of AI-enhanced pedagogies, in relation to sustainability outcomes. Qualitative work could be extended, to include a more diverse range of stakeholders, including policymakers, AI developers, and community leaders, to better understand systemic enablers and barriers. Furthermore, the use of advanced statistical model analysis

methods could clarify how the cognitive, affective, and contextual factors interact with each other to affect people's acceptance of academic integrity online and intention to support sustainable academic integrity.

In summary, the implementation of AI into educational systems provides a path to sustainable economic development, and opportunities need to be exploited, yet the support strategies should flexibly respond to technology possibilities as well as to qualify them, with ethical and societal concerns. By embedding AI adoption within a broader interdisciplinary framework, this article advances theoretical dialogue and provides practical implications, for those facing the complex challenges and opportunities, that lie in the intersection of AI as well as education and sustainability. The fate of sustainable economic development lies in the capacity of institutional education to ingeniously welcome innovation to make AI a driver of inclusive and caring society, environmental sustainability and human well-being.

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Modelling R&D Investment and its Macroeconomic Impact in an Agent-Based Framework

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Abstract. *This paper introduces an agent-based model of firms' R&D investment processes, addressing some limitations in existing macroeconomic methodologies. The central aim is to propose a model that is more firmly grounded in empirical data and to promote a more unified framework for agent-based modeling (ABM) in this field. This work tackles these issues by developing a new model that builds upon the original K+S framework, replacing the current investment function with one based on an empirically derived, dual-criteria approach that considers both R&D intensity and absolute investment value.*

Keywords: investment; agent-based model; K+S framework; agent-based modeling; analysis.

JEL Classification: C63; O31; B52.

1. Introduction

The processes of investment, research, and development form the foundational core of economic change. In this paper, the evolution of the economy is considered from a perspective where change is an endogenous and evolutionary process. Consequently, disequilibrium is a normal state of the system, and there is no persistent tendency toward a long-run equilibrium. This work is grounded in the complexity approach, viewing the macroeconomy as a complex system that emerges from its microfoundations. These microfoundations themselves undergo an evolutionary trajectory, changing step by step within populations.

The growing popularity of agent-based modelling (ABM) in economics has provided a powerful tool for exploring these complex systems. A common critique of ABMs, however, is their lack of uniformity and the heterogeneity of their constructions, which can hinder the replication and validation of findings. This work addresses this challenge directly by developing a model based on a review of existing models in the literature, with a specific focus on the Keynes-Schumpeter (K+S) model.

The core motivation for developing such a model is its utility as a quasi-experimental laboratory for macroeconomic phenomena. Macroeconomics faces a significant challenge in conducting controlled experiments on a national or global scale. While experimental methods have been successfully applied in microeconomics, as noted by Angrist & Pischke, (2010), the objects of macroeconomic study cannot be subjected to controlled trials. Agent-based models offer a solution to this methodological gap, allowing researchers to isolate variables, manipulate policy rules, and observe emergent outcomes from the micro-level up.

2. Literature Review

Macroeconomic modeling has largely followed two main paths: econometric analysis and dynamic stochastic general equilibrium (DSGE) models. The econometric approach focuses on identifying statistical relationships in economic data. However, this method faces significant challenges, most notably the Lucas's critique, (1976), which argues that statistical patterns from the past become unreliable after a policy change, and that macroeconomic models must be built on the stable microfoundations.

In response to these limitations, DSGE models were developed to provide stronger microfoundations for macroeconomic theory. This framework relies on heavy simplification, that the whole system tends to an equilibrium, often through the use of a representative agent that cannot capture the effects of diverse interactions within a population. The fundamental limitation shared by both approaches is their difficulty in modeling the economy as a complex adaptive system. This is the point of departure for agent-based modeling (ABM). Instead of assuming stable macro-level relationships or representative agents, ABMs start from the complexity perspective, seeking to understand how macroeconomic patterns emerge out of the interactions of many heterogeneous agents, in an evolutionary context.

Popularity of modelling with ABMs has increased in recent years (Fischbach et al., 2021). A key characteristic of agent-based modeling is its methodological specificity. Unlike standardized frameworks, ABMs are typically developed to address particular research questions, requiring significant investment in a tailored conceptual and software design. This purpose driven approach has naturally resulted in a broad heterogeneity of models, each with distinct foundational assumptions.

The application of agent-based modeling in macroeconomics is composed of several distinct research streams. For instance, Dawid & Delli Gatti, (2018) identify seven of these families, of which this work will focus on some papers from, primarily, the Keynes meeting Schumpeter (K+S) framework originally developed by Dosi et al., (2010), with some additional discussions of models from the EURACE (Cincotti et al., 2012; Dawid et al., 2019) and LAGOM (Mandel et al., 2010) families.

The Schumpeter meeting Keynes (K+S) is a family of evolutionary, agent-based macroeconomic models designed to account for long-run endogenous growth and short-run business fluctuations (Dosi & Roventini, 2025). The model combines the Schumpeterian innovation with Keynesian demand generation. The model's innovation is driven by the R&D activities of firms, while aggregate demand influences the diffusion of new technologies and economic activity. The R&D investment is split between two goals: trying to invent new better technology (innovation) and trying to copy the technology of the rivals (imitation).

The EURACE model is a large-scale, agent-based macroeconomic model that represents a fully integrated economy, including real, financial, and public sectors. Its core design uses a detailed, entry of the balance sheets for every agent from households to firms and banks to ensure all transactions are stock-flow consistent. Regarding technological progress, the EURACE family shows two distinct approaches. The Genoa version models growth, technological progress, as an outcome of learning, where a firm's productivity is driven by its workers improving their skills with existing capital (Cincotti et al., 2012). In contrast, the Bielefeld version (Dawid et al., 2019) treats the creation of new technology as an exogenous, random event, where a monopolistic firm introduces better vintages of machinery at a fixed probability. The endogenous part of growth then comes from the diffusion of this new technology, as firms' investment decisions are constrained by the skill level of their workforce.

The Lagom is an agent-based model designed to explore endogenous growth dynamics in a complete economic system (Mandel et al., 2010). The model's primary goal is to extend the general equilibrium approach to a setting that includes capital accumulation and life-cycle savings. The technological progress is not based on R&D investment but on two separate mechanisms. First, the productivity of workers in an economic sector increases in direct proportion to the net investment made by firms in that sector, linking growth directly to capital accumulation. Second, individual firms improve their production technologies through a periodic process of imitation and random change, where they can either copy the most efficient technology from their peers or randomly adopt a new one.

Both the EURACE and Lagom models are characterized by a key methodological choice to separate technological progress from an explicit R&D investment mechanism. This approach differs significantly from the K+S model, which is analyzed in detail in the following section.

3. Methodology

The K+S model developed by Dosi et al., (2010) designed with much more stylized facts regarding incorporating investments in the R&D for the technological progress of the firm that aims to improve the characteristics of productivity of the production (capital) machine. In the K+S model the R&D process aims at both innovation and imitation. The firm that is leading in the technological achievements, is only investing in innovation. The process begins with investment from firm, that represents a percentage of the previous period sales. The process is represented in the model by the following formulas:

$$RD_i(t) = vS_i(t - 1),$$

$$IN_i(t) = \xi RD_i(t),$$

$$IM_i(t) = (1 - \xi)RD_i(t).$$

Where:

t – periods,

i – counter for firms,

RD – investment (expenditure) in the R&D,

v – percentage that is allocated to RD, $v \in [0;1]$,

S – sales

IN – investment (expenditure) in innovation process,

IM – investment (expenditure) in imitation process,

ξ – percentage of RD that is allocated for IN, $\xi \in [0;1]$.

In the model, innovation is represented as a two-step process: getting the chance to innovate based on investment, and then getting chance if the innovation is actually good. A firm first has to see if it even gets an opportunity to discover something new. The chance depends on how much the firm invests in R&D. The probability of getting this chance is according to Bernoulli distribution (yes/no event):

$$\theta_i^{in}(t) = 1 - e^{-\zeta_1 IN_i(t)}.$$

Where:

θ^{in} – chance of innovation,

ζ_1 – search capability for innovation, $\zeta_1 \in [1; 0]$.

The same as the innovation process, imitation process, has two levels. Thirst level regards probability of getting chance to imitate is given by the Bernoulli distribution:

$$\theta_i^{im}(t) = 1 - e^{-\zeta_2 IM_i(t)}.$$

Where:

θ^{im} – chance of imitation

ζ_2 – search capability for innovation, $\zeta_1 \in [1; 0]$,

If a firm gets the green light, it draws a new technology. This new technology (A_i^{in} , B_i^{in}) is an improvement (or downgrade) on its current technology (A_i , B_i), according to the formula:

$$A_i^{in}(t) = A_i(t) \left(1 - x_i^A(t)\right),$$

$$B_i^{in}(t) = B_i(t) \left(1 - x_i^B(t)\right).$$

Where:

A_i^{in} – labor productivity of the machine-tool after innovation

B_i^{in} – labor productivity of the production technique after innovation

x_i^A and x_i^B – independent draws from Beta (α_1, β_1) distribution over the $[\bar{x}_1, \underline{x}_1]$, $\bar{x}_1 \in [1; 0]$, $\underline{x}_1 \in [-1; 0]$.

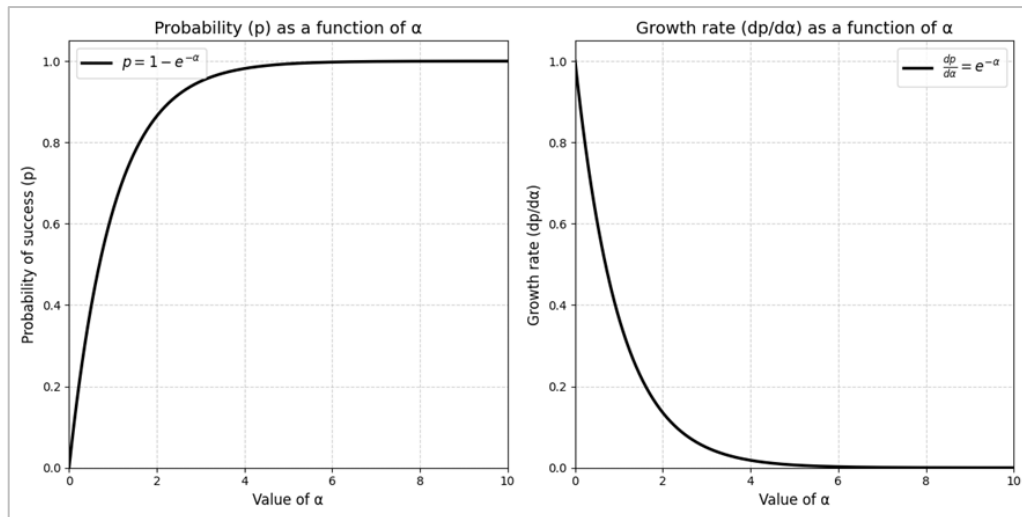
Firms that reach the second stage can imitate a competitor's technology. The likelihood of imitation increases with technological similarity, which is measured using a Euclidean distance metric to weight the probabilities. After acquiring a new technology through innovation or imitation, a firm decides whether to adopt it or continue with its current machine. This choice is based on the optimal tradeoff between the new technology's price and efficiency.

In this section above, up to here, are presented the main aspects of investment process in the K+S model. The overall model, and its parts, achieved the main goal to represent business cycles and endogenous growth, along with other goals. The analysis therefore focuses on a specific component: the functional form used to determine a firm's probability of innovation and imitation, which is given as θ^{in} and θ^{im} . This approach raises important questions about the potential implications for the model's dynamics.

4. Results

It can be assumed and modelled easily that with zero investment the output is zero chance for innovation or imitation to happen, if $p=0$, result θ^{in} and/or $\theta^{im}=0$. The main difficulty lies in the modelling the distribution that is placed between $0 < p \leq 1$. The following discussion is based on the probability distribution that is chosen to represent the dynamics of chance based on the investment amount in the original K+S model. The general Bernoulli distribution of the form $1 - e^{-a}$, with $a \geq 0$, has the following graphical representation:

Figure 1. Graphical representation of the probability function and its growth rate.



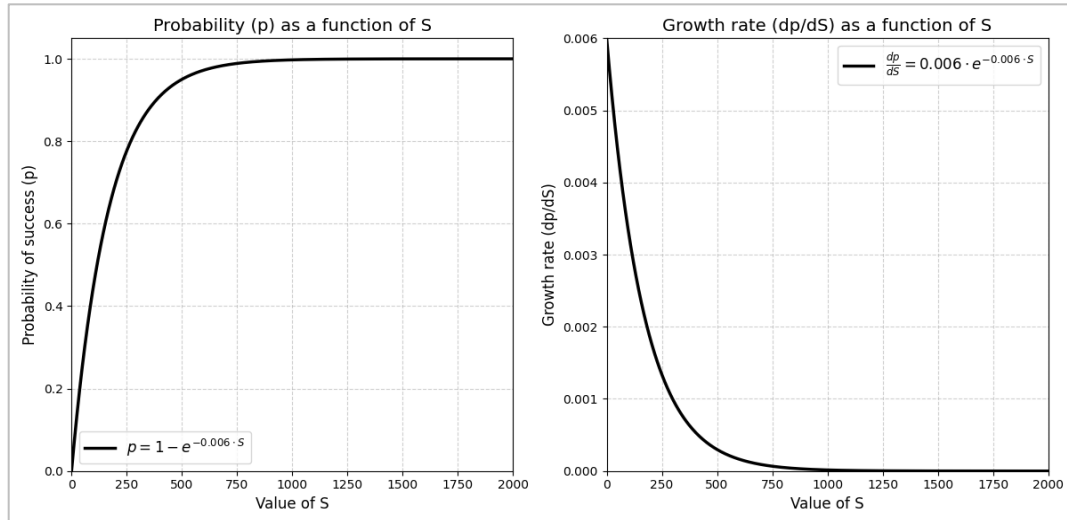
Source: Author

This figure 1 shows the relationship in the formula starts strong and then quickly weakens. Initially, the probability of success climbs very rapidly because, as the derivative graph shows, its growth rate is at its absolute maximum right at the beginning. This initial burst is so fast that the probability reaches the halfway point of 50% when the value of α is just 0.69. After this, the growth slows down significantly, corresponding to the constantly falling curve on the derivative graph. When α reaches about 4.6, the probability is already at 99%, causing the curve to become nearly a flat, horizontal line. This flattening happens because the growth rate itself has dropped to almost zero.

This entire pattern is representation of the diminishing returns, where the effort you put in (increasing α) yields less and less reward over time. This way firms with less sales are more advantaged to obtain higher probability of success relative to the amount invested. The model's core weakness is its creation of a dead-end for investment in R&D from a certain point, the point may be considered at $p=99\%$ for $\alpha=4.6$.

Using the benchmark values for the model for R&D propensity ($v=0.04$), allocation to innovation ($\xi=0.5$), and search capability ($\zeta_1=\zeta_2=0.3$), the exponent in the function simplifies to $0.006 \times S$. Analyzing this specific formula reveals a pattern of diminishing returns: a firm needs sales of approximately 116 to achieve a 50% probability of innovation, but its sales must increase all the way to 768 to achieve a 99% probability. All subsequent R&D spending, driven by any sales growth beyond this level, is funneled into capturing the final, vanishingly small 1% of remaining probability. The model thus traps its most successful firms, but not just them, in a state where their continued R&D investment is very inefficient relative to amount invested.

Figure 2. Graphical representation of the success probability function for technological progress and its growth rate, according to the K+S model benchmark.



Source: Author

The dead-end issue creates a significant challenge for the model's calibration and reliability. To generate results that match real-world data, the model's parameters must be carefully tuned to a narrow spot that keeps most firms from growing large enough to fall into the inefficient investment trap. This makes the model a fragile tool for its purpose of policy analysis. Any simulated policy that promotes firm growth risks pushing the system outside of this calibrated spot. When this happens, the model's behavior is no longer driven by sound economic logic but by the flaw of the dead-end sink, making the results of the policy experiment unreliable. Consequently, the model's validity is likely confined to its specific benchmark conditions and make it harder to explore a wider range of economic scenarios or policy outcomes.

The calibration issue also affects the timing of firm success. At the beginning, if firms are small, their probability of success is very low. Later, as some or all firms grow, their success rate approaches nearly 100% in the first step of the model. This creates a large temporal discrepancy: early-stage outcomes are much lower than late-stage ones, making comparisons of innovation success between the initial and later stages unreliable.

The heterogeneity across different sales ranges creates challenges. Since the values are not grounded in empirical data but are generated by the model's function, the outcomes vary significantly depending on the chosen range. The model is therefore highly sensitive to these value ranges.

It is important to mention that there is a working version, the rewritten version of the original K+S model, into LSD programme developed by Valente & Pereira (2025). In this model, a firm's technological progress is not solely dependent on its investment in R&D. The process begins with an investment in R&D, which is set as a fixed fraction of a firm's

past sales. This expenditure is then used to hire R&D workers at the current market wage. The model use normalization to adjust the input into the function of success for innovation/imitation.

The normalization is done by scaling a firm's actual number of R&D workers by a dynamic ratio, which consists of the constant initial labor supply divided by the current, growing total labor supply. As the simulation progresses and the total labor supply expands, this ratio decreases, which in turn discounts the raw R&D labor count.

While this approach addresses some limitations of the R&D process in the original paper, it introduces constraints for certain types of policy analysis. The model scales a firm's R&D effectiveness using the ratio of current total labor supply to the a static labor parameter. As a result, policies that increase the workforce cause this ratio to decrease, reducing the "normalized" R&D workforce for each firm and lowering their probability of successful innovation and imitation, regardless of actual R&D investment. This creates a structural bias: policies that expand labor may appear to hinder technological progress, while policies that reduce labor could appear to enhance it. The normalization mechanism therefore produces the effect that a smaller labor supply can seem to boost innovation.

An alternative approach for modelling R&D investment

Since the model pushes off from the basis of K+S, main core of aspects of the original framework are unchanged. However, some elements are modified to reflect the changes introduced in this work.

To represent the stochastic process of R&D success, the boundaries of the relationship between investment and innovation/imitation probability must first be established. The lower bound is straightforward: zero R&D investment corresponds to a zero probability of success. Defining the upper bound, or investment cap, is more complicated, as investment could hypothetically be infinite. To ground the model in realistic behavior, an empirically-driven solution is proposed. The central hypothesis is that the maximum observed R&D expenditures of the world's most R&D-intensive firms can serve as a realistic proxy for the upper limit of effective investment. Therefore, this empirically-derived approach is adopted as the maximum possible R&D investment in the model. Following established framework, this solution takes the form of an R&D intensity and absolute value, calculated as a ratio relative to firm size, which is proxied here by sales.

Academic views on the relationship between a firm's size and its innovative success are varied. A substantial body of research has found the link to be inconclusive, offering little support for the traditional Schumpeterian hypothesis that larger firms are more innovative (Lee & Sung, 2005; Symeonidis, 1996). This literature is characterized by diverse and often contradictory results. However, a more recent analyses offer a different perspective, finding that a positive relationship does exist between firm size and innovation output (Knott & Vieregger, 2020; Ouyang et al., 2022). While this model allows any firm to innovate or imitate, as in the K+S framework, it also acknowledges that large, established firms begin with an inherent advantage, as they already possess the most advanced production capabilities.

To establish the R&D investment cap that corresponds to a near 100% probability of success in the model's first step, this analysis uses a panel of top R&D investing firms as a benchmark. The core assumption is that the investment levels of these leading companies represent a practical maximum. This approach is justified as the benchmark is derived from real-world data, implicitly accounting for numerous complex factors. Consequently, this cap is used to define the upper bound for the success of the innovation and imitation processes within the model.

This analysis utilizes data Scoreboard Panel 2003-2023 linked to the European Commission's report on top global R&D investors Nindl et al., (2024). The source dataset tracks firms, at the global level, over the period 2003-2023, that have contributed significantly in their investments to R&D.

To ensure consistency, a specific subset of firms was selected according to the primary criterion of complete data availability for both net sales and R&D expenditure. The data selected were deflated to 2023 values and are expressed in millions of euros using 2023 exchange rates. In accordance with the simple heuristics of the original K+S model, R&D intensity was calculated based on sales from the preceding year. Consequently, the sample is restricted to firm-year observations for which a prior-year sales value was present (zero values were permitted, while blank entries were excluded). This selection procedure yielded a final dataset comprising 6,061 firms for the period 2003-2023.

The R&D intensity is different across different economic sectors (Galindo-Rueda & Verger, 2016). And R&D intensity is heterogenous across firms inside the economic sectors (Coad, 2019; Leiponen & Drejer, 2007). The heterogeneity across sectors is also evident in the selected data from the Scoreboard panel, presented in Table 1. As a detailed multisectoral and/or specific firm analysis is beyond the scope of this paper, for discussed model the target is to be identified a general macro tendency that can be used for the upper limit of the success probability for innovation/imitation.

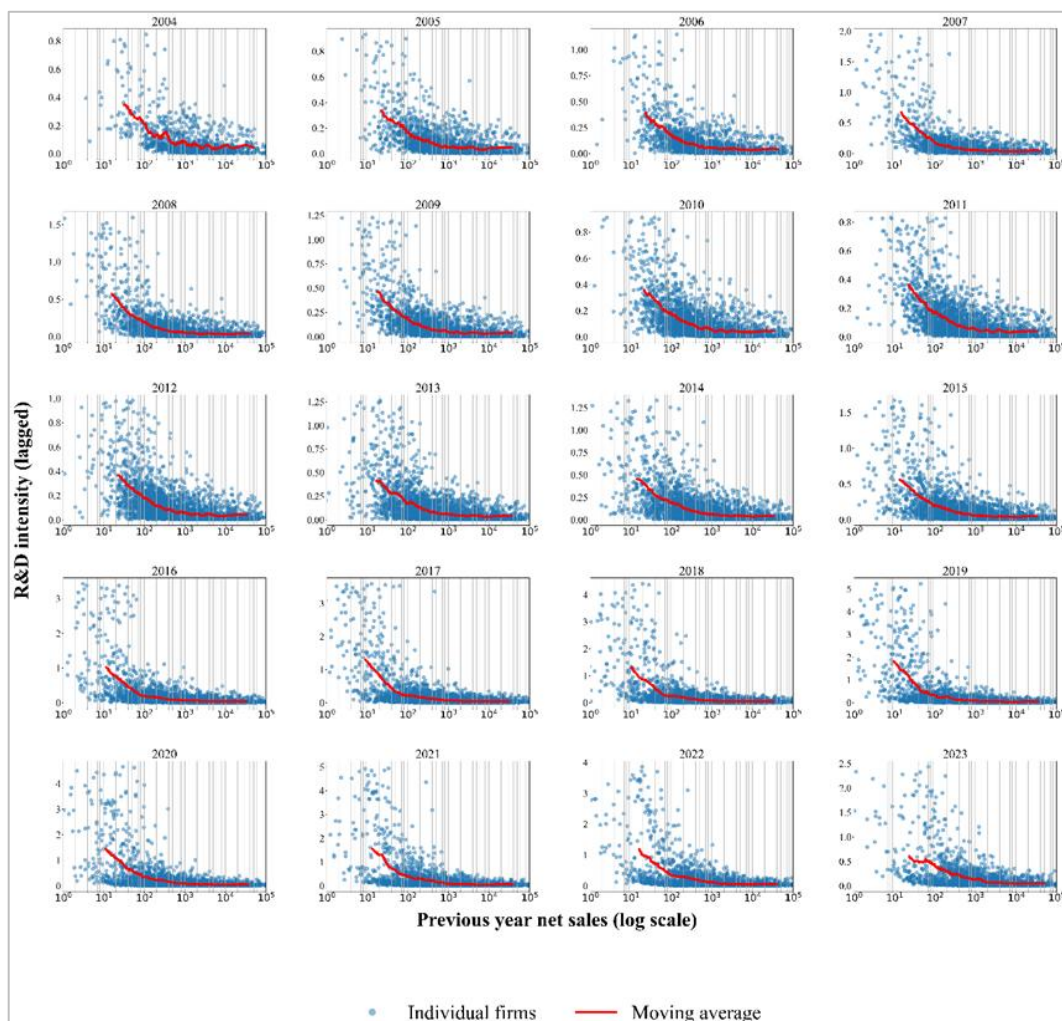
Table 1. Industry-wide weighted average R&D Intensity (based on previous year's sales, %)

Industry Classification	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Weighted average for 2003-2023 period
Aerospace & Defence	4.63	4.47	4.41	4.01	4.18	4.23	3.31	3.69	3.76	3.59	4.47
Automobiles & Parts	4.65	4.61	4.55	4.71	4.63	4.45	4.19	5.19	4.85	4.58	4.66
Chemicals	2.51	2.56	2.65	2.81	2.52	2.20	2.31	2.78	2.23	1.91	2.65
Construction & Materials	1.19	1.36	1.46	1.49	1.78	1.84	2.04	2.20	2.19	2.19	1.60
Energy	0.40	0.38	0.47	0.54	0.46	0.43	0.45	0.61	0.47	0.37	0.47
Financial	2.01	2.22	2.36	2.43	2.40	2.48	2.44	2.73	2.62	2.51	2.18
Health industries	11.46	12.33	12.29	12.40	12.42	12.60	12.83	13.84	11.81	11.04	12.46
ICT producers	6.69	7.07	6.99	7.44	7.11	7.02	7.40	7.71	7.20	6.96	7.23
ICT services	6.59	7.23	7.30	7.72	8.43	9.06	9.16	10.08	9.93	9.47	7.68
Industrials	1.87	1.87	2.08	2.19	2.17	2.18	2.10	2.41	2.12	2.00	2.00
Others	2.03	2.04	2.13	2.16	2.24	2.32	2.31	2.67	2.53	2.42	2.15
Total weighted average	3.40	3.60	3.95	4.21	4.18	4.14	4.26	5.02	4.51	4.10	3.92

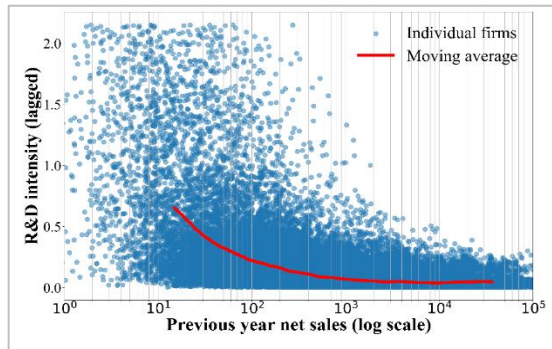
Source: author, based on selected data from the Scoreboard Panel R&D Investment 2003-2023

To prepare the data for analysis, two steps are performed. First, the dataset is filtered to include only R&D intensity values at or below the 90th percentile, which mitigates the effect of extreme outliers. In the figure 3 is presented the relationship between a firm's size and its investment in innovation. The X-axis represent previous year net sales of the firms. The x axis was changed into log. The Y-axis shows their R&D intensity. This graph plots annual R&D intensity against firm size rank for the 90th percentile of firms, with the red line illustrating the trend based on a 5% (out of the number of firms analyzed in the specific year) moving average.

Figure 3. *R&D intensity vs. firm previous year net sale (yearly for period 2004-2023).*



Source: Author

Figure 4. *R&D intensity vs. firm previous year net sale cumulative for the whole period 2004-2023.*

Source: Author

If to take all data, disregarding years and plot a graphic, it is obtained figure 4. Here the same general trend made out of moving average of 5%. The data analysis revealed a distinct trend, which will use to define the upper boundary of an investment success probability function. The trend has the shape similar to the function of $y = \frac{n}{x^m} + z$, where n , m and z are parameters of the function. This function serves as a dynamic benchmark for determining the probability of success. The function's output for a given sales volume X represents the maximum effective R&D intensity. This is the investment level required to achieve a hypothetical probability success of 1.0, or 100%.

The optimal parameters (n , m , and z) are determined using the `curve_fit` function from Python's SciPy library. To ensure the model's validity at the extremes of the data, the fitting process was constrained by forcing the function to align with the first and last points of the moving average trend. The created optimized function $y = \frac{3.757}{x^{0.672}} + 0.044$, shows a very good representativity to the data, confirmed by a coefficient of determination R^2 of 0.9898.

While this function accurately models the observed trend based on absolute sales figures, its direct application in a general analytical model is limited. The model's validity would be constrained to economies with firm sizes similar to those in the empirical dataset. To create a scale-independent and universally applicable rule, the independent variable was transformed from absolute sales to a normalized metric of relative market position.

The sales data is normalized against the market leader for each period. This benchmark is selected for its robustness, as a market leader is always present in the data, thus avoiding the mathematical indeterminacies that would arise from normalizing against a firm with potentially zero sales. The relative market sale is calculated:

$$Sr_i(t-1) = \frac{S_i(t-1)}{Sml_i(t-1)}$$

Where:

S – sales

Sr – relative sales

Sml – the market leaders' sale

Fitting the model to this data yields the optimized function: $y = \frac{0.000656}{x^{0.6672174}} + 0.044458$ which maintains a good coefficient of determination $R^2 = 0.9898$. The higher precision of the parameters is necessary (six digits after the decimal point) to ensure the model's accuracy, as the independent variable now operates on a much smaller scale, just from 0 to 1.

It should be emphasized that the model presented here represents a generalized approximation of observed tendencies. The primary purpose of this simplification is to facilitate straightforward computation in the main analytical model. Consequently, while this function is useful for understanding the general trend, any application requiring high fidelity to a specific context must employ a model developed and calibrated for those particular circumstances.

While R&D intensity is the primary metric for defining a scalable investment cap, the proposed model also accounts for the absolute value of the investment. This is because a high intensity at a small firm may lack the necessary overall effort, while a low intensity at a large firm can still represent a massive and effective R&D budget. For this reason, the behavioral rule is based on a dual-criteria approach. The necessity of an absolute investment criterion is most considering new entrants or firms with zero or near zero sales. For these agents, R&D intensity is misleading metric. A firm with no revenue in calculus has a near-infinite R&D intensity, while a firm with very low sales can appear hyper-innovative by this ratio, despite a small absolute budget.

The analysis specifically accounted for 3,109 instances where firms reported zero sales in the preceding year yet still recorded R&D expenditures; for this data, the average R&D investment was €55.99 million per year, with all financial data deflated to 2023 and adjusted using the 2023 exchange rate. To create a generalization for the analytical model, the focus was also placed on the firms that invest the most. Therefore, the 3,109 cases with the most sales in the previous year were selected, which have an average of €2,006.07 million per year in R&D investment. Based on this, a rule was established for the model: even if a firm has zero sales in the previous year, its investment amount for a maximum chance of success for innovation/imitation should be not less than 2.79% of the investment of the market leader. A firm that invests less have its chance of success reduced proportionally.

The following rule calculates a firm's chance of success based on the R&D investment intensity and absolute value of investment in innovation/imitation. A Bernoulli distribution then uses that chance to determine the final outcome.

$$Pin_i(t) = \min\left(\frac{RDIn_i(t)}{RDIn_{max-s}(t)}; \frac{IN_i(t)}{0.027 \times IN_{max}(t)}\right)$$

$$RDIn_i(t) = \frac{IN_i(t)}{S_i(t-1)}$$

$$RDIn_{max-s}(t) = Shin(t-1) \times \left\{ \frac{0.000656}{[S_i(t-1)]^{0.6672174}} + 0.044458 \right\}$$

$$Shin(t) = \frac{\sum IN_i(t)}{\sum RD_i(t)}$$

$$Pim_i(t) = \min\left(\frac{RDIm_i(t)}{RDIm_{max-s}(t)}; \frac{IM_i(t)}{0.027 \times IM_{max}(t)}\right)$$

$$RDIm_i(t) = \frac{IM_i(t)}{S_i(t-1)}$$

$$RDIm_{max-s}(t) = (1 - Shin(t-1)) \times \left\{ \frac{0.000656}{[S_i(t-1)]^{0.6672174}} + 0.044458 \right\}$$

Where:

P_{in} – chance of success for innovation

P_{im} – chance of success for imitation

$RDIn$ – R&D investment intensity in innovation

$RDIm$ – R&D investment intensity in imitation

$RDIm_{max-s}$ – the upper limit of the R&D intensity according to firms' previous year sale

IN – investment in innovation

RD – amount of investment in R&D

IN_{max} investment in innovation of the firm with maximum sales in previous year

S – sales

$Shin$ – share of investments in R&D, in the economy, that are allocated for innovation (not for imitation), $Shin \in [0; 1]$.

In this model, firms are heterogeneous in their R&D intensity, meaning that each firm has its own unique level of R&D investment – v_i .

ABM analyses

The analysis is performed using the LSD program by Valente and Pereira (2025). The core of the analysis is a rewritten version of the original K+S model by M. C. Pereira. On this foundation, specific aspects of the model are modified, added, or eliminated as necessary for the analysis.

The analysis employs a Monte-Carlo simulation methodology to ensure the robustness of the results. For each specific scenario, a total of 50 simulations is performed for each case of quasi-experiment. The final data points and conclusions are derived from the average of the outcomes across all of these simulations. This approach helps to mitigate the effects of stochastic variability inherent in agent-based models.

The analysis will use in each case two different simulations. A t-test will be performed to check for a statistically significant difference from the baseline (main simulation). The null hypothesis (H_0) is that there is no difference with the baseline, and a result will be considered significant if the p-value is less than 0.05 ($p < 0.05$). The differences will then be analyzed.

Analyzing Agent-Based Models (ABMs) is challenging due to the indefinite number of possibilities within their frameworks, making it nearly impossible to test every aspect. To

manage this, an initial approach is to focus on a specific conceptual discussion related to modeling investments regards technological progress within the K+S framework.

The first step in this analysis will involve examining the K+S model as it is presented in original paper, specifically focusing on the problem of extreme marginal diminishing returns.

Figure 5. *Output of the simulations. Baseline – simulation with no cap, second is the simulation with R&D expenditure capped at – 100.*

	Baseline[1]	Ratio[2]	p-val[2]
GDP growth	0.02795	0.9977	0.9907
Volatility of GDP growth	0.02135	1.128	0.5419
Likelihood of GDP crises	0.01433	1.526	0.02936
Capacity utilization	0.723	0.998	0.9922
Inflation	0.0001043	0.9563	0.8105
Government income	0.02345	1.032	0.8743
Government expenditure	0.0008718	1.821	0.002594
Government deficit	-0.001576	-0.9742	3.461e-16
Government debt	0.03564	2.388	0.0001232
Firm loans	1.601	1.461	0.06851
Bad debt	0.022	1.098	0.6461
Unemployment	0.002709	1.824	0.002493
Full employment frequency	0.8758	0.9494	0.7953
Vacancy	0.17	0.9792	0.9168
Real wage	7.987e+04	0.9792	0.913
Innovation	0.1672	0.9964	0.9857
Imitation	0.4041	0.9993	0.997
Productivity growth	0.02845	0.9983	0.9931
Market concentration	0.005733	1.004	0.9857
Mark-up	0.352	1.003	0.9883

Source: Author

The analysis compare two distinct simulations using a t-test to assess statistical significance. The baseline scenario is the original model without any cap on R&D expenditures. The second simulation introduces a cap of 100 on R&D expenditures. This cap is designed to ensure that firms' R&D efforts are evenly split, with 50 units allocated to innovation and 50 to imitation. According to the benchmark parameters, this specific allocation makes the success probability of the technological process exceed 99%.

The simulation indicates that removing the R&D investment cap improves fiscal and labor market outcomes without affecting long-run growth. This result stems from the model's strong diminishing returns on R&D, where investment beyond a certain threshold yields negligible productivity gains. While this excess spending does not increase the chances of technological progress, it functions as a direct source of private-sector employment, absorbing labor that would otherwise be unemployed. This job creation, in turn, lessens the government's fiscal burden from unemployment benefits, leading to a smaller deficit. The policy effectively transforms unproductive R&D expenditure into a mechanism for reducing public welfare costs.

The second analysis examines a version of the K+S model where investment in R&D is normalized by the labor force supply. The central question of this analysis is whether a growing labor supply leads to technological downturn. A benchmark simulation establishes a baseline benchmark as in original paper. A second simulation introduces a 2% growth rate for the labor supply.

Figure 6. Output of the simulations. Baseline original $K+S$, second is the simulation with increased labor supply.

	Baseline[1]	Ratio[2]	p-val[2]
GDP growth	0.01406	2.442	0.0002622
Volatility of GDP growth	0.02496	0.9212	0.6355
Likelihood of GDP crises	0.03887	0.3465	9.076e-08
Capacity utilization	0.7083	1.026	0.8991
Inflation	0.0002428	0.7987	0.2234
Government income	0.0231	0.9802	0.9204
Government expenditure	0.001909	1.235	0.04528
Government deficit	0.007268	0.1308	5.374e-09
Government debt	0.3782	0.2238	2.183e-08
Firm loans	16.23	0.4091	0.0002268
Bad debt	0.02508	0.8638	0.4707
Unemployment	0.005417	1.254	0.04512
Full employment frequency	0.8889	0.8907	0.5745
Vacancy	0.1452	0.9457	0.7797
Real wage	983.9	0.6035	0.01508
Innovation	0.01736	0.4726	0.0008292
Imitation	0.01974	0.04107	8.893e-09
Productivity growth	0.01433	1.03	0.8827
Market concentration	0.004715	0.8276	0.3526
Mark-up	0.3572	1	0.9984

Source: Author

The simulation shows a significant increase in GDP growth, with a ratio of 2.442 compared to the baseline. However, this high rate of economic expansion occurs simultaneously with a substantial decline in technological progress. Both innovation and imitation are dramatically lower than the baseline. A crucial aspect of the analysis is the finding that labor supply growth diminished technological progress.

Further is analyzed the alternative proposed model. For this specific case, a simple scenario is considered, primarily to illustrate the functionality of the model and to compare it with the original approach regarding R&D investments. R&D intensity is calculated based on the targets that firm aims to achieve according to its strategic plan. From a bounded rationality perspective, firms observe the market and attempt to position themselves within certain limits while pursuing specific goals. Firms are expected to invest more when aiming for greater results.

Benchmark Strategies:

- Targeting around 60% success
- Targeting around 40% success
- Targeting around 20% success

Modified Strategies:

- Targeting around 80% success
- Targeting around 60% success
- Targeting around 40% success

The success of each firm is calculated by multiplying the probability of success by the upper limit of R&D intensity based on the firm's previous year sales RDI_{max-s} . These strategies are maintained for 20 periods and are randomly reassigned.

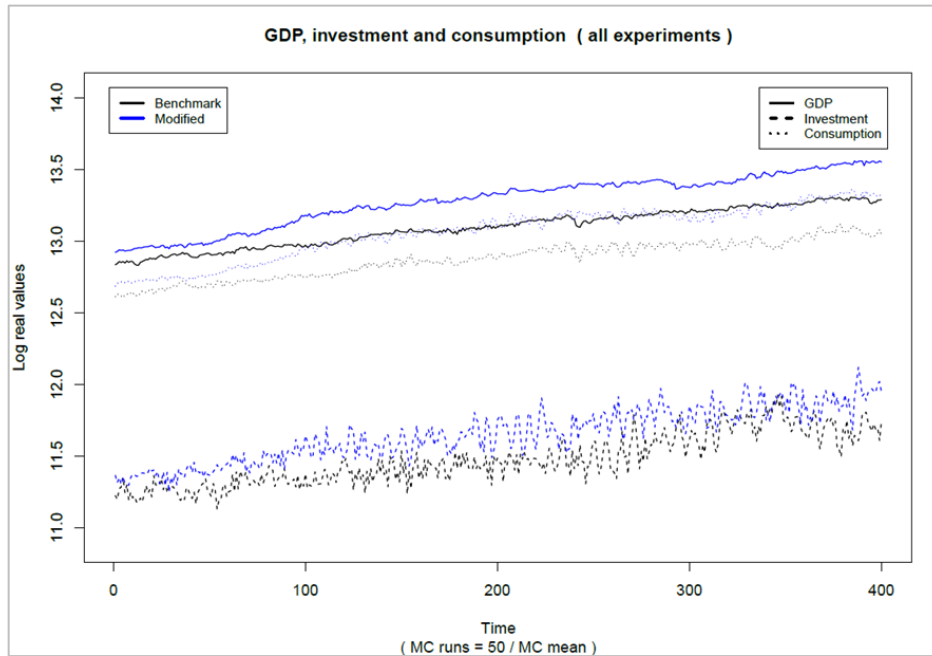
Figure 7. Output of the simulations. Baseline – benchmark strategies, the other one is modified strategies.

	Baseline[1]	Ratio[2]	p-val[2]
GDP growth	0.0005799	-0.9095	1.675e-09
Volatility of GDP growth	0.07331	1.183	0.2712
Likelihood of GDP crises	0.1825	1.042	0.8183
Capacity utilization	0.519	1.025	0.9072
Inflation	0.0017	1.267	0.0004065
Government income	0.03156	0.9333	0.7112
Government expenditure	0.2931	4.517	1.458e-195
Government deficit	2.165	4.952	4.359e-153
Government debt	189.1	5.015	3.578e-142
Firm loans	102.1	1.306	0.02212
Bad debt	0.02419	1.817	1.576e-19
Unemployment	0.04393	2.363	1.168e-35
Full employment frequency	0.8177	0.9349	0.749
Vacancy	0.4851	0.9234	0.6888
Real wage	1.22	1.363	0.08027
Innovation	6.133e-05	3.109	NaN
Imitation	4e-06	3	NaN
Productivity growth	0.002475	1.505	0.0007636
Market concentration	0.02545	1.285	1.971e-17
Mark-up	0.4235	0.8956	0.5539

Source: Author

From the figure 7 it is observed that R&D output, both in innovation and imitation, increased; however, the levels remain very low, indicating that this calibration of the model may not be well suited. Some economic indicators deteriorated despite increased R&D investments, suggesting that the resulting output in the economy remains limited. In other words, technological progress under this scenario is not effectively translating into broader economic improvement. As shown in Figure 8, the overall economy performs better with more aggressive R&D investment.

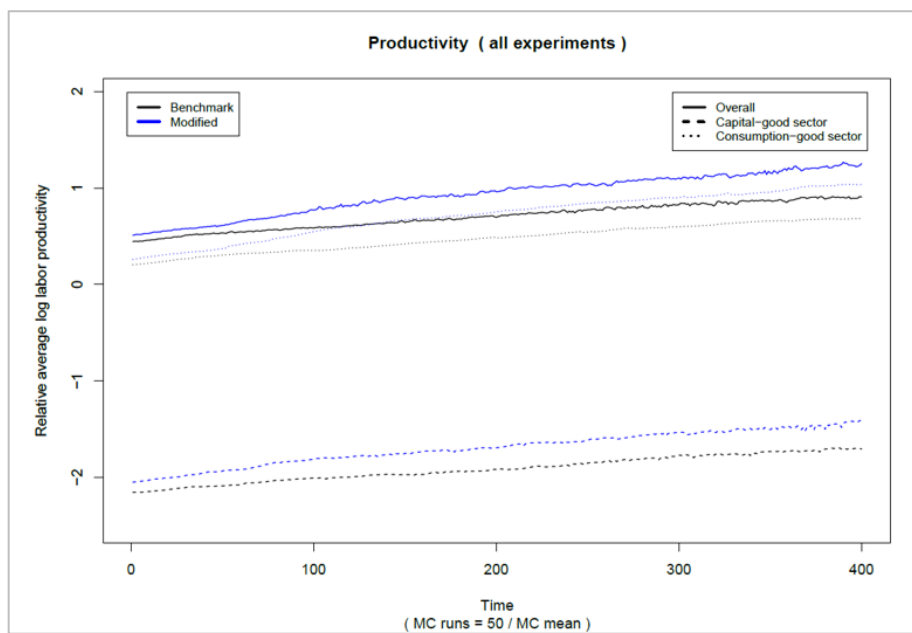
Figure 8. Output of the simulations. GDP, investment and consumption.



Source: Author

As shown in Figure 9, productivity improved due to technological progress, but the overall level remains low relative to the broader economy.

Figure 9. Output of the simulations. GDP, investment and consumption.



Source: Author

5. Conclusion

Conceptually and based on the simulations, the link between R&D investments and technological progress in the K+S model has limitations that affect both analytical and empirical analysis. The results obtained using the proposed empirical calibration deviate significantly from the original K+S approach, as reflected in overall economic growth, innovation, and imitation outcomes.

The extended model is highly sensitive to firms' R&D investment strategies. However, the new calibration does not align well with the original K+S framework. Further sensitivity analysis is needed, and other factors with a strong influence on the model's dynamics should be reexamined to ensure consistency with empirical evidence and theoretical knowledge.

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The Role of Exports in Romania's Economic Development

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Abstract. *The relationship between exports and economic growth has long been a central topic in economic research, yet the specific role of exports in shaping Romania's economic development remains insufficiently explored, particularly in the post-accession period to the European Union. Understanding the contribution of external trade to economic performance is essential for designing policies that foster sustainable growth and resilience in an increasingly volatile global environment. This study aims to fill this gap by examining the determinants of GDP per capita through an econometric model based on quarterly data for the period 2005–2024. The empirical analysis investigates the influence of exports, inflation, and unemployment on economic growth, highlighting the interplay between external openness and domestic macroeconomic stability. The results reveal that inflation and unemployment exert a negative and statistically significant impact on GDP per capita, while exports have a strong positive and robust effect. The model demonstrates high explanatory power ($R^2 = 0.77$) and stable statistical properties. The findings underscore the strategic importance of exports as a catalyst for Romania's long-term economic progress and competitiveness. They also provide valuable insights for policymakers seeking to enhance economic resilience through balanced trade policies, inflation control, and labor market stability. Despite extensive research on the trade–growth nexus, limited attention has been paid to the specific mechanisms through which exports shape Romania's economic development during its European integration process.*

Keywords: GDP per capita; exports; inflation; unemployment; economic growth.

JEL Classification: C32; E31; E24; F21; F43.

1. Introduction

Exports are widely recognized as one of the primary engines of economic growth, directly influencing production, employment, and the trade balance. By exploiting comparative advantages and available resources, a country can penetrate international markets, earn foreign currency revenues, and stimulate the expansion of competitive industries (World Bank, 2023). Moreover, an outward orientation encourages technology transfer, productivity gains, and product quality improvements, as firms are driven to meet international standards. Over the long term, a strong export sector supports economic diversification and resilience to domestic shocks, accelerates integration into the global economy, and improves living standards (IMF, 2022).

In Romania, exports have played a pivotal role in recent decades, contributing not only to GDP growth but also to strengthening the country's international market position. Following accession to the European Union, Romania gained unrestricted access to a vast market, which fueled the development of competitive sectors such as automotive manufacturing, electrical equipment, IT&C, and agriculture. Exports provided a steady inflow of foreign currency, supported modernization of production processes, and attracted foreign direct investment by responding to increasingly demanding requirements for quality and performance.

Beyond direct economic benefits, export activity has also facilitated Romania's integration into global value chains. Export-oriented companies were compelled to adopt advanced technologies, diversify their product portfolios, and invest in workforce training. At the same time, exports helped reinforce Romania's reputation as a reliable trading partner, fostering international cooperation and access to new markets.

Today, strategic priorities such as diversifying export destinations, increasing the added value of goods and services, and fostering innovative sectors are central to enhancing competitiveness. Strengthening export capacity can ensure sustainable growth, improve resilience to global challenges, and raise living standards for the Romanian population.

2. Literature Review

International trade represents the buying and selling of goods and services between countries (Investopedia, 2021). International trade allows countries to sell domestically produced goods to other countries for economic gain. Therefore, trade with other countries or participation in any trade agreement has a positive impact on economic growth (Abdullahi et al., 2013).

Theories of international trade can be divided into three periods, namely classical, neoclassical, and modern trade theories. Classical theories suggest that countries can gain economically if all implement free trade. The most well-known classical theories are Adam Smith's theory of absolute advantage and David Ricardo's theory of comparative advantage.

Neoclassical theories suggest that countries can benefit from free trade by producing goods in which they specialize, but with efficient use of resources. The best-known neoclassical theory is the Heckscher-Ohlin trade theory (Usman, 2011). Modern theories support the theory of comparative advantage by identifying economies of scale as an important source of economic growth (Berkum & Beijl, 1998; Usman, 2011). Before Adam Smith, there was a mercantilist theory developed in the 16th century. According to this theory, a country's wealth is determined by promoting exports and discouraging imports.

Many economists have argued that faster export growth can lead to higher economic growth. This is the so-called Export-Led Growth Hypothesis (ELGH) (Beckerman 1965; Balassa 1978, 1985; Bhagwati 1978; Shirazi and Manap 2005). Several reasons are put forward to support ELGH: exporters must sell their products on competitive world markets, which forces them to become more competitive and to adopt or innovate new technologies more rapidly; domestic competition is also stimulated, as even non-exporters will begin to try to become more competitive and adopt or innovate new technologies more quickly, which leads to faster productivity gains throughout the economy and, therefore, to faster economic growth; trade liberalization or export promotion policies allow a better allocation of limited resources throughout the economy; exporters can exploit economies of scale, given their access to large world markets; export growth facilitates improved access to international capital goods and intermediates for domestic firms, which again leads to productivity increases and expansion of the production frontier; due to their access to much larger world markets, successful exporters can increase production and employment more rapidly.

In Botswana, Sentsho (2002) tested the ELGH using annual time series data for the period 1976–1997. Using the OLS method, the author performed a regression and concluded that exports had a positive impact on long-term economic growth.

The validity of the ELGH hypothesis for 21 Sub-Saharan African countries was tested in 2003. It was found that in all these countries the level of exports had a positive and significant effect on economic growth (Njikam, 2003). Awokuse (2007) carried out a study on the impact of exports and imports on economic growth in a few selected Eastern European countries, namely the Czech Republic, Bulgaria, and Poland. Using the neoclassical growth model as well as the cointegrated Vector Autoregressive (VAR) model, the study attempted to find empirical evidence to support a positive and significant influence of exports and imports on economic growth in these countries (Ramos, 2001).

Bakari and Mabrouki (2017) investigated the relationship between exports, imports, and economic growth in Panama. To achieve this, annual data for the period 1980–2015 were evaluated using Johansen cointegration analysis, the Vector Autoregressive model, and Granger causality tests. According to the findings of the investigation, there was no correlation between exports, imports, and economic development in Panama. On the other hand, the results revealed strong evidence of bidirectional causality between imports and economic growth, as well as between exports and economic growth. These results indicate that exports and imports are therefore considered sources of economic growth in Panama.

Kartikasari (2017) conducted research on the impact of exports, imports, and investment on the economic growth of the Riau Islands in Indonesia. The Provincial Economic Report of the Riau Islands, covering an eight-year period from 2009 to 2016, was consulted for information. The FOB value was declared by importers and exporters to Indonesian customs for all exports and imports. Economic expansion was tracked through regional GDP figures issued by the Central Statistics Bureau, while investment was assessed based on the total amount of loans granted for this purpose by all Indonesian banks to the Bank of Indonesia. The impact of independent factors on the dependent variable was investigated using panel data regression analysis. In this investigation, a random effects model proved to be the most effective framework for analyzing panel data. The analysis indicated that while imports and investments both had large negative effects on economic growth, exports had a much smaller negative effect. All three factors simultaneously affected the economic growth of the Riau Islands province in Indonesia.

In the case of Nepal, using time series data from 1965 to 2020, Panta et al. (2022) analyzed equilibrium correlations and dynamic causality for economic growth, exports, and imports in Nepal. This study investigated the role that exports and imports play in Nepal's GDP growth and provided empirical evidence for the growth-determined exports and imports hypotheses, as well as the short- and long-term hypotheses of exports and imports determining economic growth. As expected, neither the export-led growth hypothesis nor the growth-led export hypothesis was supported by the data. This article found no evidence to support the claim that long-term economic growth in Nepal is caused by international trade.

As the pandemic spread rapidly, many countries implemented precautionary measures such as social isolation and border closures, which led to an increase in unemployment rates in many countries, for example, a decline in exports and a slowdown in economies (Liu & Chu, 2024). Regarding Russia's war against Ukraine, the consequences have not yet been widely studied. However, it is already evident that the structure of global exports has undergone some changes since the beginning of the war (Steinbach, 2023). Consequently, international trade conditions have been transformed (Vidya & Prabheesh, 2020; Demir & Javorcik, 2020). Governments have adjusted international trade policies to adapt to the new international environment. It has already been observed that the measures taken by governments have affected exports (de Lucio et al., 2022).

3. Case Study

3.1. Research methodology

International trade represents one of the main factors of global economic integration and a major determinant of economic growth. For Romania, exports have played an essential role in the post-accession period to the European Union, contributing to production diversification, increased competitiveness, and investment attraction. Analyzing the impact of exports on economic development thus becomes a necessary step in understanding to what extent the Romanian economy capitalizes on the opportunities offered by external markets.

The main objective of this research is to evaluate whether and to what extent exports have contributed to Romania's economic development and to provide a well-founded interpretation of the economic policies that could support sustainable growth.

The empirical analysis investigates the relationship between exports and Romania's economic growth using quarterly and annual data for the period 2005–2024. The data were collected from Eurostat and the World Bank, and the model was estimated through the Ordinary Least Squares (OLS) method implemented in the EViews program.

Economic development is measured by GDP per capita, while the explanatory variables include the exports-to-GDP ratio, unemployment rate, and inflation rate, which are considered key determinants of macroeconomic performance. The explanatory variables according to the literature, exert a significant influence on economic dynamics. It is assumed that exports contribute positively to the growth of GDP per capita, while unemployment and inflation have a negative impact, by limiting production potential and eroding purchasing power. To ensure the robustness and validity of the econometric model, several statistical tests will be applied prior to estimation.

First, stationarity test (Augmented Dickey-Fuller) will be performed to verify the time-series properties of the variables and prevent spurious regressions. Second, tests for homoscedasticity (Breusch-Pagan and White tests) will be employed to detect possible heteroscedasticity in the residuals. Third, normality tests (Jarque-Bera) will be used to assess the distribution of the residuals and confirm the reliability of the OLS estimations.

These diagnostic tests will strengthen the empirical foundation of the research and ensure that the estimated model provides consistent and unbiased results, suitable for policy interpretation.

The analysis will combine graphical methods, descriptive statistics, and econometric modeling, with the purpose of highlighting the relationships between variables and testing the hypothesis according to which exports have a positive and significant contribution to the growth of GDP per capita in Romania, while unemployment and inflation exert negative influences.

3.2. Research results

Before constructing the econometric model, it is necessary to carry out a descriptive analysis of the data for the period 2005–2024, to provide an overview of the trends and variations of the main indicators. Descriptive statistics represent an essential step, as they allow for the identification of average levels, dispersion, and extremes, as well as the highlighting of potential structural changes or episodes of economic instability.

In this context, GDP per capita will be analyzed together with exports, unemployment rate and inflation rate, through the presentation of synthetic indicators (mean, median, quartiles, minimum and maximum values) and graphical representations. This stage serves to outline the statistical profile of the variables used and to substantiate the hypotheses regarding the relationships between them, thereby preparing the ground for subsequent econometric estimations.

Table 1. *Descriptive Statistics*

	Exports	GDP per capita	Inflation rate	Unemployment rate
Mean	35.68	3.81	7.12	6.06
Median	37.96	4.42	5.77	6.16
Maximum value	43.36	11.14	16.01	7.27
Minimum value	24.54	-4.73	1.39	3.91
Quartile 1 (Q ₁)	30.27	1.95	3.94	5.54
Quartile 2 (Q ₂)	37.96	4.42	5.77	6.16
Quartile 3 (Q ₃)	41.38	6.44	10.96	6.88

Source: own processing in Excel

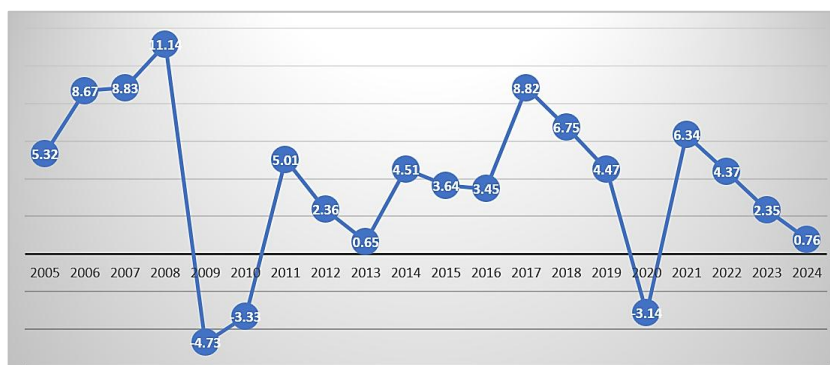
As shown in Table 1, exports have had a stable evolution, with values ranging between a minimum of 24.54 and a maximum of 43.36. The mean (35.68) is slightly below the median (37.96), which shows the existence of periods with lower levels of exports. Overall, exports can be considered an indicator with moderate variations.

GDP per capita has experienced significant fluctuations, from a severe contraction of -4.73 to a robust growth of 11.14. The mean value (3.81) and the median (4.42) are close, which suggests a balanced distribution, but with years marked by crises and strong economic recoveries.

The inflation rate ranged between a minimum level of 1.39 and a maximum of 16.01, with an average of 7.12. The difference between the higher mean and the median (5.77) shows the existence of periods of high inflation, which distorted the average values. Overall, inflation remained within a wide range, with episodes of stability but also of imbalance.

As for the unemployment rate, this proves to be the most stable indicator among those analyzed. Values range between 3.91 and 7.27, and the mean (6.06) is remarkably close to the median (6.16). The distribution is symmetrical, without major deviations, which suggests a predictable labor market environment.

For a better illustration of the trends and the relationships between the indicators, the numerical descriptive analysis will be complemented by a graphical analysis. Visual representations allow for a clearer depiction of the dynamics over time, the differences between values, and correlations, thus offering a more intuitive perspective on the data and facilitating further interpretation within the econometric approach.

Figure 1. *Evolution of GDP per capita during 2005–2024*

Source: own processing in Excel

Figure 1 highlights the evolution of GDP per capita during the period 2005–2024 highlights a succession of distinct stages, strongly influenced by the international economic context and the internal dynamics of the Romanian economy. The interval 2005–2008 was characterized by robust economic growth, supported by Romania's integration into the European Union, the intensification of investment flows, and the expansion of credit, which led to a significant increase in income per capita.

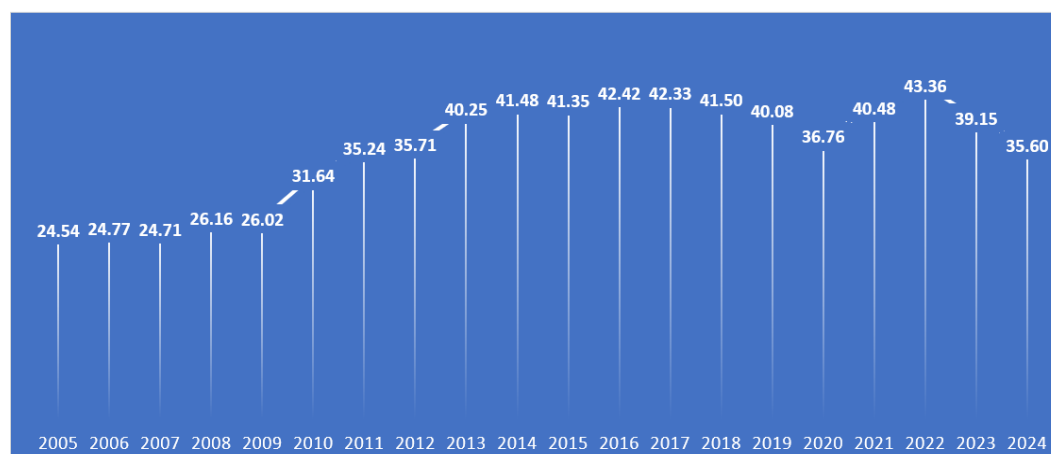
However, this upward trend was abruptly interrupted by the global financial crisis of 2009–2010, which generated a sharp contraction of GDP per capita. This negative development reflected the reduction of exports, the decline of investments, and the decrease in domestic consumption, being accompanied by fiscal-budgetary adjustment measures and the implementation of an international financial assistance program.

During the period 2011–2019, the Romanian economy experienced a gradual recovery, though marked by high volatility. Although periods of growth were supported by private consumption and European funds, structural vulnerabilities such as trade imbalances and a high dependence on imports continued to limit the sustainability of this trajectory.

As shown in Figure 1, the year 2020 marked a new turning point, generated by the global health crisis caused by the COVID-19 pandemic. The imposed restrictions and the disruption of supply chains led to another sharp decline in GDP per capita. The recovery of 2021–2022 was relatively rapid, favored by the easing of restrictions and economic support measures, but it had a conjunctural and unsustainable character.

In the period 2023–2024, a downward trend re-emerges, explained by the persistence of inflationary pressures, the increase in financing costs, and the impact of geopolitical uncertainties on the European economy and, implicitly, on the Romanian economy. This evolution confirms the vulnerability of the growth model based on consumption, as well as the necessity of structural reforms aimed at strengthening the resilience of the economy in the long term.

Figure 2. Evolution of the level of exports (% of GDP) during 2005–2024



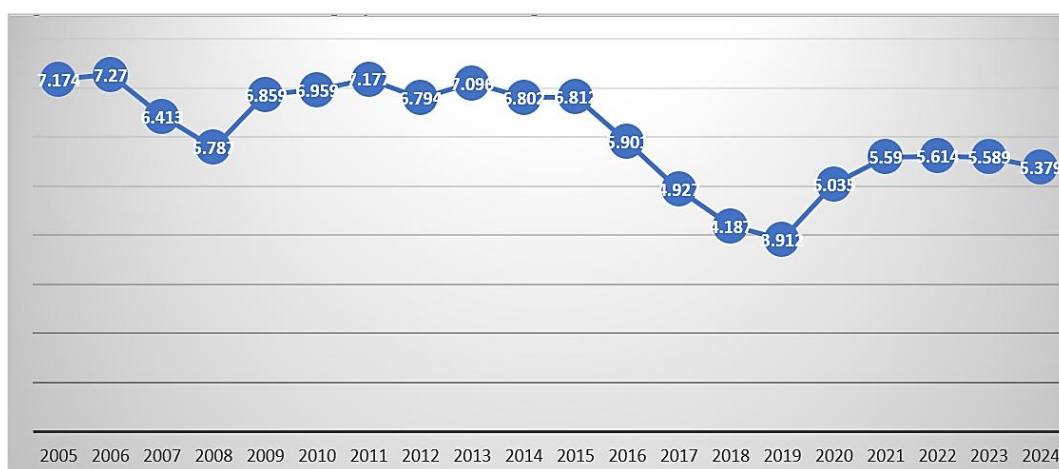
Source: own processing in Excel

As shown in Figure 2, during the period 2005–2008, the level of exports remained at approximately 22–25% of GDP, which reflects an economic structure still dominated by domestic consumption and high imports. A meaningful change occurred after 2009, against the backdrop of the global financial crisis, when exports gained a larger share in the economy, gradually reaching over 35% of GDP. This increase can be explained by the adjustment of domestic demand, the depreciation of the national currency, and the orientation toward external markets as a source of economic recovery.

Between 2011 and 2016, exports consolidated, consistently exceeding the threshold of 40% of GDP and reaching a level of relative stability. However, after 2017, the trend became oscillating. The decline in 2019 and especially in 2020 reflects the impact of the slowdown of the European economy, the main destination of Romanian exports – as well as the shock of the COVID-19 pandemic, which disrupted global supply chains and reduced international demand.

The recovery in 2021–2022, when exports rose again to around 45% of GDP, can be explained by the resumption of trade flows and the revitalization of industrial production. Nevertheless, the period 2023–2024 shows a new downward trend, driven by increasing geopolitical uncertainties, high inflation, and the slowdown of external demand, particularly from the euro area.

Figure 3. *Evolution of the unemployment rate during 2005–2024*



Source: own processing in Excel

The unemployment rate in Romania, between 2005 and 2024, follows a trajectory closely linked to internal economic cycles and the international context. In the first part of the period, up to 2008, unemployment remained high, fluctuating around 6–7%, but on a slight downward trend, amid economic growth and Romania's accession to the European Union, which stimulated job creation.

As observed in Figure 3, with the outbreak of the financial crisis in 2009, the unemployment rate rose again, approaching 7%, as production declined, industries underwent restructuring, and labor demand decreased. This period was characterized by a tough

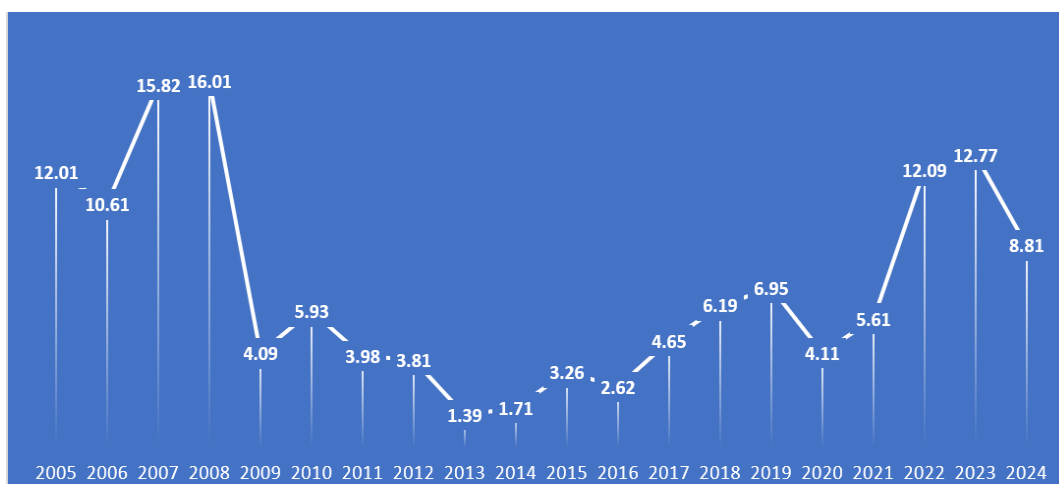
economic climate, in which many Romanians chose to migrate to labor markets in other European countries.

In the following years, between 2014 and 2019, the economy returned to growth, and the labor market visibly improved. The unemployment rate gradually decreased, reaching a historic low of about 4% in 2018–2019. This was the period with the best labor market performance, supported by investments, consumption, and the development of the private sector.

However, this favorable evolution was interrupted by the COVID-19 pandemic, which, in 2020, led to a new increase in unemployment. The closure of economic activities and restrictions particularly affected the services, trade, and transport sectors.

Subsequently, in the period 2021–2024, the labor market gradually stabilized, with the unemployment rate remaining between 5% and 6%. However, the minimum level of the pre-pandemic period was not reached again, against the background of economic and geopolitical uncertainties, high inflation, and the slowdown of external demand.

Figure 4. Evolution of the inflation rate during 2005–2024



Source: own processing in Excel

Figure 4 summarizes in the first part of the period, between 2005 and 2008, that Romania faced a high inflation rate, around 10–16%. This phenomenon was generated by the process of structural adjustment in the pre- and post-accession period to the European Union, by the rapid growth of domestic demand, and by associated macroeconomic imbalances.

After the outbreak of the financial crisis in 2009, inflation dropped sharply, falling even below 5%, against the backdrop of declining consumption, reduced aggregate demand, and the implementation of austerity policies. Between 2010 and 2015, the level of inflation remained low, fluctuating around 1–4%, which reflected both fiscal consolidation and the restrictive monetary policy of the National Bank of Romania.

Starting in 2016, inflation followed an upward trend, returning to values of 4–6% in 2018–2019, fueled by increased domestic consumption, fiscal relaxations, and wage hikes.

However, the 2020 pandemic temporarily eased inflationary pressures, with the indicator dropping to around 3–4%.

The period 2021–2023 was, however, marked by a new and much stronger wave of inflation, driven by rising energy and food prices, supply chain disruptions, and the effects of the war in Ukraine. The inflation rate exceeded the 10% threshold, peaking around 2022–2023

For 2024, inflation is following a downward trajectory, dropping again toward values of 7–8%, which suggests a moderation of inflationary pressures, though still far from the desired stability.

After the descriptive analysis of the main macroeconomic indicators for the period 2005–2024, the next methodological step consists in formulating and estimating a multiple regression econometric model. Its objective is to quantify the influence of the selected macroeconomic variables on the level of GDP per capita, considered the dependent variable. The choice of this variable is justified by the fact that GDP per capita represents one of the most relevant indicators of economic development and living standards.

Before estimating the regression model, it is necessary to verify the properties of the series used. Macroeconomic series tend to be characterized by non-stationarity, which means that their mean, variance, and covariance change over time. To avoid this problem, it is mandatory to test the stationarity of the series. The most used tool in this regard is the Augmented Dickey-Fuller (ADF) test, which aims to check for the existence of a unit root within a time series.

The hypotheses of the test are as follows:

H_0 (null hypothesis): the series has a unit root (it is non-stationary);

H_1 (alternative hypothesis): the series is stationary.

The ADF test is applied to each variable included in the model: GDP per capita, exports (% of GDP), foreign direct investment (% of GDP), unemployment rate, and inflation rate. Data were log-transformed using Excel software, and the data were converted from annual to quarterly through EViews.

Table 2. *Stationarity of the data series*

Test type	ADF
Date series	I (0)
GDP per capita	0,0348
Exports	0,0024
Inflation rate	0,0397
Unemployment rate	0,0001

Source: own processing in Eviews

The results of the ADF test applied to the data series show that all the variables analyzed, GDP per capita, exports, inflation rate and unemployment rate are stationary at level, as shown in Table 2. The p-values obtained for each series are lower than the 5% significance threshold, which leads to the rejection of the null hypothesis and the acceptance of the alternative hypothesis, according to which the series do not present unit roots. In other

words, the indicators do not display persistent trends of unlimited increase or decrease over time but fluctuate around a constant mean.

This aspect is of major importance for the continuation of the analysis, as it confirms the possibility of directly using the variables in the econometric model, without the need for additional transformations through differencing. Thus, the risk of obtaining spurious relationships between variables is avoided, and the methodological foundation for subsequent estimations is ensured.

Table 3. *Results of the regression model*

Dependent Variable: GDP PER CAPITA				
Method: Least Squares				
Sample: 2005Q1 2024Q4				
Included observations: 80				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION RATE	-0.147461	0.069794	-2.112788	0.0099
UNEMPLOYMENT RATE	-0.104975	0.048787	-2.151700	0.0227
EXPORTS	1.327525	0.587175	2.260865	0.0157
C	2.125259	1.330318	1.597557	0.2193
R-squared	0.772315			
Adjusted R-squared	0.764172			
F-statistic	16.78258			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	2.195432			

Source: own processing in Eviews

$$GDP \text{ per capita} = 2,125 - 0,147 * Inflation \text{ rate} - 0,104 * Unemployment \text{ rate} + 1,327 * Exports$$

The results obtained in Table 3 from estimating the multiple linear regression model provide a clear picture of how the main macroeconomic indicators influence GDP per capita. First, the analysis confirms that the variables with a negative impact are the inflation rate and the unemployment rate. The coefficient associated with inflation is negative and statistically significant, which indicates that an increase in the general price level has unfavorable consequences on the standard of living. From an economic perspective, this result is justified: high inflation erodes the population's purchasing power, reduces domestic competitiveness, and discourages long-term investment, thus generating downward pressures on GDP per capita.

In the same direction, the unemployment rate also has a negative and significant effect on GDP per capita. An increase in unemployment means inefficient use of labor resources, a decrease in domestic consumption, and, implicitly, reduced production. This result confirms classical economic theories that emphasize the importance of maintaining a low unemployment rate to support sustainable economic growth.

On the other hand, the variable with a positive and significant impact on GDP per capita is represented by exports. Exports also have a positive and considerable influence on GDP per capita. The result highlights the importance of economic openness and external competitiveness, as an export-oriented economy diversifies its markets, stimulates domestic production, and attracts foreign currency revenues that support growth. This

relationship confirms trade-based growth theories, according to which the expansion of international exchanges fosters long-term development.

The quality of the model is supported by statistical indicators. The R^2 value of approximately 0.77 shows that the variables included explain over three-quarters of the variation in GDP per capita, which represents an important level for an econometric model applied to macroeconomic data. The adjustment of this indicator (Adjusted $R^2 = 0.764$) confirms the strength of the relationship, while the F-test demonstrates that the model is globally significant. In addition, the value of the Durbin-Watson statistic (2.19) indicates the absence of autocorrelation of the residuals, which provides robustness to the estimates and confidence in the validity of the conclusions.

Table 4. *Statistical validity tests*

Test type	Hypothesis	P-value
Breusch-Pagan-Godfrey	Heteroscedasticity	0,4765
White	Heteroscedasticity	0,5667
Breusch Godfrey	Autocorrelation level II	0,8654
Jarque-Bera	Normality	0,0975

Source: own processing in Eviews

To verify the statistical validity of the estimated model, several diagnostic tests were performed, as can be seen in Table 4. The Breusch–Pagan–Godfrey and White tests for heteroscedasticity indicated that the residuals are homoscedastic, as the probability values exceeded the 5% significance threshold. This result confirms that the variance of the residuals is constant across observations, ensuring that the OLS estimators are efficient and that the standard errors are reliable. The absence of heteroscedasticity strengthens the credibility of the model’s statistical inference.

The p-value of 0,8654 obtained through the test Breusch–Godfrey indicates that the model’s errors are independent over time and that the regression results are not biased by serial dependence, a crucial condition when working with time series data. The lack of autocorrelation confirms that the model adequately captures the temporal dynamics of Romania’s macroeconomic variables during the analyzed period.

Furthermore, the Jarque–Bera test for normality showed that the residuals are normally distributed, as the p-value exceeded 0.05. This finding validates the assumption of normality and supports the use of OLS as an appropriate estimation method.

Taken together, these diagnostic tests demonstrate that the econometric model is robust and statistically sound. The assumptions underlying the classical linear regression model, linearity, homoscedasticity, absence of autocorrelation, and normality, are all satisfied, ensuring that the estimated coefficients are unbiased, consistent, and efficient. Consequently, the empirical results presented in Table 3 can be interpreted with a high degree of confidence and reliability.

These results are consistent with the export-led growth hypothesis formulated by Balassa (1978), which argues that expanding exports stimulate productivity, technology transfer, and investment inflows. Similar findings have been reported in studies by Krugman and Obstfeld (2018) and Dritsakis (2019), which highlight the importance of exports in

accelerating economic growth in emerging European economies. The Romanian case aligns with this perspective, as the post-accession integration into the European Union has significantly enhanced the country's trade openness and competitiveness.

On the other hand, the negative and statistically significant coefficients of inflation and unemployment corroborate previous empirical evidence from Fischer (1993) and Barro (2013), who found that macroeconomic instability undermines growth by distorting price signals and reducing productive investment. High unemployment limits aggregate demand and human capital utilization, while inflation erodes purchasing power and discourages savings. Thus, the findings suggest that maintaining low inflation and stable employment levels are prerequisites for sustained economic expansion.

Overall, the results reinforce the conclusion that Romania's long-term growth prospects depend on strengthening export capacity, ensuring macroeconomic stability, and implementing structural policies that foster productivity and innovation. This empirical evidence not only supports existing theoretical frameworks but also contributes to a deeper understanding of the mechanisms linking trade and growth.

The results obtained highlight the fact that maintaining macroeconomic stability, through controlling inflation and reducing unemployment, is an essential condition for economic growth. At the same time, attracting foreign direct investment and stimulating exports appear as fundamental pillars of sustainable economic development. These findings support the idea that an economic policy strategy oriented toward external openness and the consolidation of an attractive investment climate has the potential to boost GDP per capita and, implicitly, raise the population's standard of living.

In parallel, maintaining macroeconomic stability remains a basic condition. Controlling inflation and reducing unemployment through active labor market policies are indispensable to avoid internal imbalances that hold back economic growth. In addition, investments in transport and planning infrastructure, as well as promoting innovation and digitalization, can contribute to increasing the external competitiveness of the economy. In conclusion, an economic strategy focused on boosting exports, attracting foreign investment, and ensuring macroeconomic stability can provide solid premises for strengthening GDP per capita and supporting sustainable economic growth.

4. Conclusion

The results of this study confirm the significant influence of exports, inflation, and unemployment on Romania's economic growth over the period 2005–2024. The econometric analysis provides robust evidence supporting the export-led growth hypothesis, indicating that higher levels of exports contribute positively and significantly to GDP per capita. In contrast, inflation and unemployment exert negative effects, suggesting that macroeconomic instability and labor market inefficiencies can hinder sustainable development. These findings emphasize the importance of maintaining export competitiveness, ensuring price stability, and implementing employment-oriented policies as key priorities for Romania's long-term economic strategy.

From a theoretical perspective, the study contributes to the empirical literature on the determinants of economic growth in one of the emerging European economies (Romania), offering new insights into the interplay between external openness and domestic macroeconomic factors. The findings also provide practical implications for policymakers, highlighting the need to enhance export diversification, attract productive investments, and strengthen industrial capacity to sustain economic resilience amid global uncertainties.

However, this research is not without limitations. First, the econometric model focuses on a limited set of macroeconomic indicators and does not account for other potential determinants of growth, such as foreign direct investment (FDI), technological innovation, or government expenditure. Second, the period of analysis can be extended, to capture structural shifts or policy shocks affecting Romania's economy.

Future research could address these limitations by incorporating a broader range of explanatory variables, using panel data for regional comparisons, or applying more advanced econometric techniques such as vector autoregression (VAR) or error correction models (ECM). Such approaches would provide a deeper understanding of causality and long-term dynamics between trade, investment, and growth in the Romanian economy.

Building on the empirical findings of this research, several policy recommendations can be derived to enhance Romania's long-term economic performance and support a sustainable, export-driven growth model. The results have clearly demonstrated that exports play a significant role in stimulating GDP per capita, while inflation and unemployment function as constraints on economic expansion. Consequently, Romania's economic policy should focus simultaneously on strengthening its export capacity and maintaining macroeconomic stability.

A key priority should be the diversification and modernization of the export structure. Encouraging higher value-added production, investing in technological innovation, and supporting the transition toward knowledge-intensive industries would increase competitiveness and reduce dependency on a limited range of traditional export sectors. At the same time, expanding export destinations beyond the European Union could help mitigate exposure to regional fluctuations and external shocks.

Equally important is the preservation of a stable macroeconomic environment. The adverse effects of inflation and unemployment observed in this study underline the need for coherent fiscal and monetary policies. Maintaining price stability, supporting employment-generating sectors, and improving labor market flexibility should remain central objectives for policymakers. Targeted support for small and medium-sized enterprises (SMEs) involved in export activities, through easier access to financing, digitalization, and administrative simplification, would further contribute to export expansion and inclusive growth.

Furthermore, sustained investment in education, research, and innovation is essential to enhance productivity and ensure long-term competitiveness. Strengthening human capital and fostering technological advancement can create the structural foundation for a more resilient and dynamic economy. Finally, developing effective data monitoring and policy evaluation systems would enable continuous assessment of trade and macroeconomic

indicators, ensuring that government strategies remain evidence-based and responsive to global economic challenges,

In summary, Romania's path toward sustainable growth requires an integrated policy framework that combines export promotion, macroeconomic stability, and innovation-led development. Such a balanced approach would not only reinforce the country's competitiveness within the European Union but also secure a more resilient and inclusive pattern of economic progress in the years ahead.

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Resilience and Digital Literacy in Post-Pandemic Education Systems: an Economic Evaluation

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Abstract. *In the wake of the COVID-19 pandemic, global education systems have undergone profound transformations, necessitating a critical reassessment of resilience and digital literacy as pivotal constructs underpinning sustainable pedagogical efficacy and economic viability. This study undertakes a rigorous economic evaluation of post-pandemic educational frameworks, foregrounding the intricate interplay between digital competencies and systemic adaptability in shaping equitable learning outcomes. Utilizing a mixed-methods approach that synthesizes comprehensive bibliographic analysis with empirical insights from Romanian educational contexts, the research elucidates how investments in digital literacy fortify institutional resilience, mitigate socioeconomic disparities, and catalyze cost-effective educational innovations. The findings underscore the imperative for policy paradigms that integrate technological fluency with adaptive capacity, thereby informing strategic resource allocation in increasingly digitized and volatile educational landscapes. This article contributes a novel, economically grounded perspective essential for future-proofing education in an era marked by uncertainty and rapid digital evolution.*

Keywords: resilience; digital literacy; post-pandemic education; economic evaluation; educational innovation.

JEL Classification: I20; I25; O33.

1. Introduction

The unparalleled disruptions caused by the COVID-19 pandemic have fundamentally reshaped global education systems, bringing resilience and digital literacy to the center of policy debate and academic inquiry. As institutions worldwide were compelled to transition abruptly to online formats, long-standing structural weaknesses became visible, while the need to redesign infrastructure and pedagogy gained unprecedented urgency. At the same time, the crisis highlighted the transformative importance of digital competence as a foundational element of resilient learning ecosystems capable of maintaining instructional continuity under conditions of uncertainty.

Educational resilience, broadly understood as the capacity of systems to withstand shocks, adapt to changing conditions, and sustain learning processes, has emerged as a key criterion for evaluating the stability and quality of education in crisis contexts. However, resilience is not a single, isolated attribute. It encompasses technological readiness, flexible pedagogical models, psychosocial support structures, and institutional capacity for rapid adaptation. Within this broader framework, digital literacy—defined as the ability to navigate, evaluate, and create information using digital technologies—has shifted from a supportive tool to a core prerequisite for both educators and learners. The pandemic made this shift explicit, exposing persistent disparities in technology access and digital skills, with direct consequences for educational equity, participation, and long-term economic efficiency.

Economic considerations now influence the redesign of post-pandemic educational systems. Investments in digital literacy are increasingly assessed not only for their pedagogical value, but also for their potential to strengthen system-wide resilience, minimize instructional interruptions, optimize resource allocation, and reduce long-term operational costs. Positioned at the intersection of these concerns, the present study examines how digital literacy and resilience interact and contribute to the economic sustainability of education systems navigating post-pandemic recovery. The analysis adopts a sociotechnical perspective that moves beyond simple cost-benefit logic, exploring the interconnected technological, human, and economic factors that determine educational adaptability.

Romania provides a relevant context for this investigation. Before the pandemic, the national education system was characterized by uneven digital infrastructure, limited teacher preparation in technology-enhanced pedagogy, and significant socioeconomic disparities affecting students' access to devices and stable internet connectivity. The abrupt transition to online instruction amplified these inequalities while also stimulating institutional innovation and policy efforts aimed at improving digital capacity. Studying this environment offers valuable insights for emerging and transitional economies facing similar pressures to modernize in ways that balance technological advancement, inclusiveness, and fiscal responsibility.

The central research question guiding this study asks how resilience and digital literacy interact to influence the economic sustainability of post-pandemic education systems, and

what implications arise for policy development and institutional practice. Addressing this question requires an interdisciplinary approach informed by educational theory, digital pedagogy, economic evaluation, and sociological analyses of inequality. Such a perspective enables a nuanced understanding of how investments in digital literacy can generate measurable benefits through improved adaptability, strategic resource allocation, and more equitable learning outcomes.

The implications of this investigation extend beyond immediate pandemic recovery. As societies continue to navigate climate instability, geopolitical volatility, labor market transformations, and rapid technological change, education systems must cultivate capabilities that allow them to withstand future disruptions while supporting learners in an increasingly digitalized world. Digital literacy is now recognized as essential for employability, civic participation, and lifelong learning, while resilience constitutes a strategic priority for policymakers seeking to build education systems that are equitable, efficient, and future-ready.

By conceptualizing resilience and digital literacy as interdependent components of adaptive educational ecosystems, this study contributes to broader debates on systemic sustainability and equity. It aligns with emerging scholarship that emphasizes institutional flexibility, digital readiness, and economic foresight as critical factors in ensuring long-term educational stability. Through a mixed-methods approach that integrates quantitative, qualitative, and economic analysis, the study addresses a crucial gap in the current literature by examining the economic dimensions of digital literacy within resilience-oriented educational reforms.

The following literature review further elaborates the conceptual foundations of resilience and digital literacy, critiques existing economic evaluations, and outlines the theoretical framework that guides the empirical investigation.

2. Literature Review

Educational resilience has increasingly become a central theme in global academic debates, especially in the wake of large-scale disruptions such as armed conflict (Dryden-Peterson, 2011), forced migration (Karam et al., 2017), and more recently the COVID-19 pandemic (Harris & Jones, 2020). Within this evolving discourse, resilience is no longer understood as an individual psychological capacity but as a systemic property shaped by institutional flexibility, adaptive leadership, and technological readiness (UNESCO, 2021). Smawfield (2013) defines educational resilience as a system's capability to maintain service quality and equitable distribution under external pressures, while Reimers (2022) emphasizes that adaptive governance, decentralized decision-making, and curricular flexibility are essential in rebuilding robust systems after crisis.

As education systems rethink their operating models, digital literacy has emerged as a core pillar of resilience. Ng (2012) characterizes digital literacy as a multidimensional competence involving technical, cognitive, and socio-emotional skills needed to access,

evaluate, produce, and communicate information in digital environments. Frameworks such as the European Commission's DigComp and UNESCO's ICT Competency Framework for Teachers conceptualize digital literacy as a foundational capability for 21st-century learning, further reinforced by the post-pandemic acceleration of online, hybrid, and blended pedagogies.

The COVID-19 crisis highlighted the structural fragility of many education systems and exposed significant inequalities in device access, connectivity, and digital skill levels. International assessments such as ICILS 2023 report wide cross-country variation in digital competence closely tied to socioeconomic status and institutional resources (Fraillon et al., 2023). In Romania, pre-pandemic data already indicated lower-than-EU-average digital skills, especially in rural and marginalized communities (Ionescu, 2019). The rapid digitalization demanded by lockdown policies amplified existing disparities, underscoring the need for sustainable, equitable investment in digital training and infrastructure.

Beyond pedagogical implications, the literature increasingly recognizes that digital literacy and resilience carry significant economic consequences. Economic evaluations – including cost-effectiveness analysis (CEA), cost-benefit analysis (CBA), cost-utility analysis (CUA), and return-on-investment (ROI) approaches – have long been used in social sectors such as health (Levin & McEwan, 2001), yet remain underused in education. After the pandemic, scholars urged policymakers to integrate economic criteria into digital transformation strategies, advocating models that align equity, sustainability, and financial rationality (Bhaumik & Priyadarshini, 2020).

Empirical work in this direction remains limited but is emerging. Jordan (2021) showed that digital platforms can reduce long-term instructional costs when scaled effectively. Mishra and Koehler (2022) demonstrated that robust digital infrastructure has high fixed costs but generates long-term savings through increased instructional continuity and reduced vulnerability to external shocks. Ferrari et al. (2023) further revealed that investments in teacher digital upskilling produce measurable efficiency gains, as technologically confident teachers adopt more flexible pedagogies and support smoother learning transitions.

Still, the current literature rarely analyses digital literacy and resilience together within a unified economic framework. This paper addresses that gap by examining how the interplay between digital literacy and resilience affects the economic sustainability of post-pandemic education systems, especially in emerging contexts like Romania.

The economic dimension is also reinforced in studies linking sustainability, energy consumption, and social transformation. Zaharia et al. (2019) demonstrate that the relationship between economic, social, and environmental factors operates as an integrated system, with higher education levels and digital access contributing to more efficient resource use. Radulescu et al. (2021) emphasize that labor market structures are increasingly shaped by inequalities in productivity, technological access, and workforce readiness, further reinforcing the importance of strong digital literacy foundations in long-term economic development.

Generational transitions reshape both educational demands and economic priorities. Barbulescu (2022) emphasizes that Generation Z enters academic and professional environments with distinct expectations, including advanced technological fluency, a clear preference for work that carries social meaning, and a heightened insistence on sustainability in organizational practices. These characteristics signal a broader shift in labor market structures, where employers increasingly value digital competence, adaptability, and ethical awareness. As a result, education systems must recalibrate leadership development frameworks and digital literacy programs to ensure that graduates are prepared for these evolving requirements. Aligning training models with the expectations of Generation Z is not only a pedagogical necessity but also an economic one, since insufficient alignment can deepen skill mismatches, reduce productivity, and limit long-term workforce resilience.

Leadership and institutional culture operate as central mechanisms that sustain both resilience and digital transformation, and their influence carries clear economic relevance. Costache (2025) shows that visionary and strategically oriented leadership is essential for integrating EdTech in ways that actually improve learning processes rather than simply adding technological layers. This type of leadership ensures that investments in digital tools translate into measurable gains in performance, efficiency, and instructional continuity.

Elisabeta and Alexandru (2018) further argue that digital environments achieve their intended impact only when they are designed around the needs and behaviors of users. A user-centered approach reduces friction in technology adoption, lowers the time and financial costs associated with training, and increases the return on investment in digital infrastructure. These insights position leadership as a structural lever capable of transforming digital systems from cost centers into productive assets.

Leadership also shapes psychological stability and organizational well-being. Petcu et al. (2025) demonstrate that emotionally intelligent leaders create climates of trust, safety, and inclusion. These climates strengthen student engagement and contribute to academic persistence. When learners feel supported, dropout risks decrease and overall system efficiency improves. In economic terms, improved retention and academic performance reduce waste in educational spending and contribute to a more capable and resilient future workforce.

Taken together, these perspectives underline that leadership is not only a pedagogical determinant but also a key economic variable. Institutions that cultivate adaptive, empathetic, and innovation-oriented leadership are better positioned to leverage digital investments, support resilient learning structures, and achieve sustainable long-term outcomes.

Interdisciplinary perspectives further enrich this literature. Petcu, Costache and Bejinariu (2025) underline the role of cross-sector collaboration in addressing systemic problems – a principle that equally applies when designing digitally resilient education systems. Enachescu (2024, 2025) stresses that inclusive organizational cultures contribute to social

harmony and conflict management, both of which affect institutional efficiency and long-term sustainability.

Sustainability discussions also bring an important layer to the analysis of post-pandemic education. Mirea et al. (2019) argue that sustainability involves interconnected environmental, social, and economic domains, which means that education plays a pivotal role in shaping how societies adapt and plan for the future. In this view, schools and universities influence much more than learning outcomes. They shape patterns of resource use, support equitable access to opportunities, and develop the human capital needed for emerging economic sectors. By linking educational practice with broader sustainability goals, the literature positions educational institutions as active contributors to societal resilience rather than passive recipients of external pressures.

Pernici et al. (2024) further extend this perspective by demonstrating how circular economy principles have begun to reshape public policy across Europe. These principles highlight efficiency, reuse, and long-term value creation, which has direct implications for education systems. Schools and universities are increasingly expected to adopt cost-effective digital infrastructures, reduce waste in resource allocation, and cultivate competencies that support green and innovation-driven economies. From this viewpoint, digital literacy becomes an economic asset: it lowers operational inefficiencies, supports adaptive teaching models, and prepares learners for labor markets defined by technological and ecological transition.

At the same time, Soare (2023) introduces an essential sociocultural caution by noting that educational reforms can unintentionally drift toward ideological homogenization. This risk becomes more pronounced when digital platforms accelerate echo chambers, streamline discourse, and amplify normative pressures. Such dynamics may undermine the pluralism and critical thinking essential for resilient, democratic, and innovative societies. These concerns add a crucial layer to the sustainability discussion, reminding policymakers that digitalization must be implemented in ways that safeguard intellectual diversity and safeguard open, participatory educational cultures.

Together, these perspectives show that sustainability challenges in education extend far beyond infrastructure or curriculum. They involve economic rationality, technological capacity, sociocultural balance, and ethical stewardship. Integrating digital literacy and resilience into this broader sustainability agenda allows education systems to operate efficiently, promote equitable participation, and contribute meaningfully to national and global development goals.

Taken together, the literature points toward an evolving consensus: digital literacy and resilience are not isolated pedagogical concepts but strategic economic investments essential for system stability, equity, and sustainability. They influence labor market readiness, reduce long-term structural vulnerabilities, and enable education systems to withstand economic, health, climatic, and geopolitical shocks. The convergence of technological, economic, and sociocultural perspectives forms the conceptual foundation for this study's economic evaluation of resilience and digital literacy in post-pandemic education systems.

The literature increasingly suggests that digital literacy and resilience operate as strategic economic investments rather than isolated pedagogical enhancements. Both concepts influence the long-term stability of education systems, shape the efficiency of resource allocation, and contribute directly to broader economic performance. Digital literacy supports labor market alignment by preparing students for technology-intensive sectors, reducing skill mismatches, and increasing workforce adaptability. Resilience, in turn, mitigates the financial and operational costs associated with disruptions, such as those produced by pandemics, climate events, or geopolitical instability. Systems that adapt quickly experience fewer instructional losses, lower remediation costs, and reduced strain on institutional budgets.

These elements also contribute to educational equity, since improved digital capability and stronger institutional preparedness can reduce gaps in access, participation, and achievement. From an economic perspective, narrowing these gaps enhances human capital formation and improves the long-term productivity of the population. The literature further emphasizes that investments in digital competence and resilient infrastructures support national sustainability goals, particularly by fostering innovation, enabling flexible learning models, and strengthening institutional continuity during crises.

This convergence of technological, economic, and sociocultural dimensions forms the conceptual basis for the current study. Positioning resilience and digital literacy within an economic evaluation framework allows for a deeper examination of how these constructs shape post-pandemic education systems, influence cost structures, and support sustainable, future-oriented policy design.

3. Research methodology

The study employed a convergent mixed-methods research design, integrating quantitative and qualitative data to examine resilience and digital literacy in post-pandemic educational systems. This design was selected to address the multidimensional nature of the topic, which includes psychological, technological, organizational, and economic dimensions. The quantitative component helped identify generalizable patterns in digital competence, institutional digital support, and technological resilience, while the qualitative component provided contextual depth and insight into participants' lived experiences. Collecting data simultaneously and merging them during interpretation strengthened analytical validity through methodological triangulation.

The research was conducted in two Romanian educational institutions—a high school and a university faculty—selected for their contrasting organizational cultures, generations of learners, and digital infrastructures. This allowed for meaningful cross-institutional comparison and helped capture variations in how digital literacy and resilience develop across different educational settings.

A stratified random sampling strategy ensured balanced representation across age, gender, and educational role. The final quantitative sample included 312 participants (213 students

and 99 teachers). Students ranged from 16 to 25 years old, while teachers ranged from 29 to 64. A structured questionnaire adapted to the Romanian post-pandemic educational context assessed digital literacy, technological resilience, perceptions of institutional digital culture, and attitudes toward sustainable and equitable technology use. The instrument demonstrated strong internal reliability, with Cronbach's alpha values between .78 and .91. Content validity was confirmed through expert review by five scholars specializing in educational technology and digital pedagogy.

Four hypotheses guided the quantitative analyses:

- H1: Higher levels of digital literacy will significantly predict higher levels of technological resilience.
- H2: Perceived institutional digital support will be a strong positive predictor of technological resilience.
- H3: Access to digital tools will provide additional predictive value for technological resilience beyond digital skills alone.
- H4: Digital literacy levels will differ significantly across academic disciplines due to variations in pedagogical models and digital infrastructure.

The qualitative strand complemented these findings by exploring how participants personally navigated digital demands during and after pandemic-related disruptions. A purposive sample of 24 participants (12 students, 12 teachers) was selected based on their involvement in digital learning, hybrid teaching, or institutional support for digital transition. Semi-structured interviews focused on experiences with online and hybrid learning, digital adaptation challenges, institutional digital support systems, and personal strategies for building resilience. Interviews lasted between 40 and 60 minutes and were audio-recorded and transcribed.

Qualitative data were analyzed using Braun and Clarke's six-phase thematic analysis. Coding followed both inductive and deductive logic, capturing emergent patterns while remaining aligned with the study's conceptual framework. NVivo 14 software supported systematic coding. Inter-coder reliability was ensured by double-coding 25% of the transcripts, yielding an agreement rate of 89%, with disagreements resolved through discussion.

Data integration occurred through side-by-side comparison, allowing convergent and divergent findings to be examined directly. Convergent results, such as the relationship between digital literacy and resilience, were reinforced through detailed narratives describing digital challenges, infrastructural gaps, and moments of successful adaptation. Divergent results, including subtle gendered differences in digital confidence noted qualitatively but not revealed quantitatively, helped illuminate contextual nuances invisible to standardized instruments.

The methodological approach was aligned with the study's epistemological assumptions and ensured transparency, consistency, and replicability. The integration of quantitative and qualitative evidence provided a comprehensive and economically grounded perspective on how digital literacy and institutional capacity shape resilience in post-pandemic educational environments.

4. Results

This section presents the main findings of the quantitative and qualitative components, followed by an integrative synthesis illustrating how both strands converge to explain resilience and digital literacy in post-pandemic educational environments. Results are organized in alignment with the research questions, clearly distinguishing numerical trends from thematic insights.

4.1. Quantitative results

4.1.1. Descriptive statistics

A total of 312 participants (213 students, 99 teachers) completed the survey. Descriptive findings indicated moderate to high digital literacy levels ($M = 3.94$, $SD = 0.58$ on a 5-point scale) and generally strong perceptions of technological resilience ($M = 4.07$, $SD = 0.63$). Teachers reported slightly higher digital competence ($M = 4.15$, $SD = 0.57$) than students ($M = 3.85$, $SD = 0.59$).

Perceived institutional digital support also recorded positive mean values ($M = 3.88$, $SD = 0.66$), although variability was notably larger among students, reflecting differentiated experiences in access to technology and infrastructure reliability.

Table 1 summarizes the main descriptive indicators for the study variables.

Table 1. Descriptive statistics for key study variables

Variable	N	Mean	SD	Min	Max
Digital Literacy	312	3.94	0.58	2.10	5.00
Resilience	312	4.08	0.63	2.34	5.00
Institutional Digital Support	312	3.88	0.66	1.90	5.00

4.1.2. Inferential statistics

Independent samples t-tests showed significant differences between students and teachers in digital literacy ($t(310) = -3.12$, $p < .01$, $d = 0.41$), with teachers scoring higher. Significant differences also emerged for perceived technological resilience ($t(310) = -2.78$, $p < .01$, $d = 0.36$).

To examine differences between students and teachers, independent samples t-tests were performed. Results appear in Table 2.

Table 2. Independent samples t-tests for students and teachers

Variable	Group	N	Mean	SD	t	df	p	Cohen's d
Digital Literacy	Students	213	3.86	0.60	-3.12	310	<.01	0.41
	Teachers	99	4.07	0.52				
Technological Resilience	Students	213	3.95	0.64	-2.78	310	<.01	0.36
	Teachers	99	4.15	0.57				

4.1.3. Differences across academic disciplines

A one-way ANOVA revealed significant differences in digital literacy across academic disciplines ($F(3,308) = 6.14$, $p < .01$). Post hoc Tukey comparisons showed that participants from humanities and social sciences reported significantly higher digital literacy levels than

those in technical or vocational programs, a pattern likely influenced by differing pedagogical practices and digital demands encountered during the online learning period.

Table 3 presents the ANOVA results.

Table 3. *One-Way ANOVA for Digital Literacy Across Academic Disciplines*

Academic Discipline	n	M	SD	F(3,308)	p	η^2
Humanities	78	4.21	0.58			
Social Sciences	85	4.17	0.61			
Technical Fields	92	3.78	0.66	6.14	< .01	.06
Vocational Education	57	3.72	0.69			

Note. Humanities and Social Sciences reported significantly higher digital literacy than Technical and Vocational groups according to Tukey post hoc tests.

4.1.4. Regression analysis

Following the ANOVA results, a multiple regression analysis was conducted to examine how digital literacy, perceived institutional digital support, and access to digital tools predict technological resilience. The model was statistically significant ($R^2 = .44$, $F(3,308) = 80.92$, $p < .001$), indicating that these factors together explain a substantial proportion of the variability in resilience. Digital literacy emerged as the strongest predictor ($\beta = .39$, $p < .001$), followed by institutional support ($\beta = .31$, $p < .001$). Access to digital tools contributed modestly yet significantly ($\beta = .17$, $p = .009$), suggesting that both skill and structural support play important roles in shaping resilient digital behavior.

Gender differences were not statistically meaningful for either digital literacy ($t(310) = -1.04$, $p = .30$) or technological resilience ($t(310) = -0.88$, $p = .38$). Age showed a weak but significant positive correlation with resilience ($r = .19$, $p < .01$), indicating that older participants reported feeling slightly more capable of managing digital challenges.

Table 4. *Multiple Regression Predicting Technological Resilience from Digital Literacy, Institutional Support, and Access to Digital Tools*

Predictor	B	SE B	β	t	p
Digital literacy	0.42	0.06	.39	7.21	< .001
Institutional digital support	0.36	0.07	.31	5.41	< .001
Access to digital tools	0.18	0.07	.17	2.65	.009
Model fit					
R^2	.44				
$F(3, 308)$	80.92				< .001

Note. Technological resilience was the dependent variable.

4.2. Qualitative themes

Thematic analysis of 24 interviews (12 students, 12 teachers) generated four central themes directly linked to post-pandemic digital literacy and educational resilience:

Theme 1: Digital Literacy as an Essential Post-Pandemic Competence

Participants consistently emphasized that digital literacy shifted from a complementary skill to a foundational requirement. One teacher noted, “Digital skills became the new baseline, not an optional advantage.” Students described a steep learning curve during the

pandemic but reported increased competence and confidence afterward, highlighting a long-term shift in expectations for both learners and educators.

Theme 2: Persistent Inequalities in Access and Digital Infrastructure

Interviewees reported major disparities in device quality, internet reliability, and familiarity with digital platforms. A student stated, “Some days I lost lessons simply because the platform froze.” Teachers described institutional differences in infrastructure investment, reinforcing the quantitative finding that institutional digital support is a significant predictor of technological resilience. These accounts also underline the economic dimension of digital inequality, particularly in resource-constrained schools.

Theme 3: Adaptive Behaviors and Routine-Building as Mechanisms of Resilience

Participants described resilience primarily as the capacity to manage abrupt transitions between online, hybrid, and in-person formats. Students identified structured routines, peer collaboration, and prompt guidance from teachers as stabilizing forces. One student reflected, “We learned to adapt because we had no choice.” These descriptions align with the statistical association between digital literacy and resilience, showing how skills and habits reinforced one another.

Theme 4: Economic Pressures Generated by Digital Learning Requirements

Many students and teachers described financial strain linked to rapid digitalization, such as purchasing upgraded devices, paying for additional data packages, or acquiring specialized software. Teachers also reported limited institutional budgets for digital innovation, hindering uniform adoption of tools. These accounts align with the economic focus of the study, showing that digital transformation carries measurable financial consequences for both learners and institutions.

4.3. Integration of Quantitative and Qualitative Findings

The integration of quantitative and qualitative findings provides a coherent and multidimensional picture of how digital literacy and technological resilience function within post-pandemic educational systems.

Quantitative analyses showed that digital literacy, institutional digital support, and access to tools significantly predict technological resilience. Qualitative narratives deepened these results by illustrating how institutional digital culture, infrastructure reliability, and financial capacity shape these relationships in practice.

For example, the regression finding that institutional digital support predicts resilience was reflected in interview accounts describing the value of technical helpdesks, standardized platforms, and training sessions during crisis periods. Likewise, the disciplinary differences identified in the ANOVA corresponded to interview descriptions of uneven digital expectations, distinct workload structures, and variation in curricular digitalization among faculties.

Some divergences offered additional insight. Although gender differences were statistically non-significant, several interviewees described subtle gendered expectations around technology troubleshooting or digital confidence within group tasks-patterns not captured by standardized measures.

Overall, both data strands demonstrate that post-pandemic educational resilience depends on three interconnected factors: digital literacy, equitable access to infrastructure, and the economic capacity of institutions and households to sustain digital participation. The complementarity of quantitative and qualitative evidence strengthens the conclusion that effective recovery and stability in education require investments in skills, technology, and financial support mechanisms.

5. Discussion

The findings of this study offer an integrated understanding of how digital literacy, institutional digital support, and access to technological resources shape technological resilience in post-pandemic educational systems. By combining quantitative patterns with qualitative narratives, the results position resilience not as a fixed trait but as a dynamic capability shaped by digital competence, infrastructural stability, and institutional culture. This view aligns with existing literature emphasising that digital readiness is a key determinant of post-pandemic educational recovery (OECD, 2021; Hodges et al., 2020).

A consistent theme across both methodological strands is that digital literacy acts as a foundational driver of technological resilience. Quantitative analyses showed that digital literacy was the strongest predictor of resilience, a finding that converges with prior studies demonstrating that higher digital competence enhances learners' ability to navigate disruptions, adapt to diverse platforms and maintain academic continuity during crises (van Deursen & Helsper, 2018). Qualitative accounts further illustrated how the pandemic transformed digital literacy into a “survival skill”, supporting research showing that post-pandemic educational environments require both cognitive and operational digital competence (Bond et al., 2021).

The study also found that perceived institutional support significantly contributes to digital resilience, confirming earlier research emphasising the role of organisational structures in mitigating technological uncertainty (Crompton et al., 2020). Participants frequently noted that helpdesks, digital training sessions, and platform standardisation acted as stabilising mechanisms, complementing quantitative evidence that institutional support predicted resilience nearly as strongly as individual digital skills. This dual pathway mirrors frameworks in which resilience emerges from both personal agency and environmental scaffolding.

Differences in digital literacy across academic disciplines, identified through ANOVA, also reinforce observations in the literature that fields differ substantially in their integration of technology and pedagogical dependence on digital tools (Rapanta et al., 2020). Humanities and social science participants reported higher competence levels, consistent with studies

showing that these fields were quicker to redesign curricula for online and hybrid instruction during the pandemic. Conversely, technical and vocational tracks faced constraints related to hands-on training requirements, echoing global findings regarding unequal digital adaptation across disciplines.

The qualitative data provided further nuance by revealing economic and infrastructural disparities, highlighting the unequal cost burden of digital participation. This supports the growing body of research emphasising that resilience is not only a pedagogical construct but also an economic one, reliant on sustained investment in devices, connectivity, and digital ecosystems (UNESCO, 2022). Students' and teachers' accounts of unstable internet connections, expensive device upgrades, and platform failures illustrate the "hidden costs" of digitalization not captured in quantitative scores alone.

Although gender differences were not statistically significant in this study, qualitative narratives pointed to subtle gendered dynamics in digital confidence and task delegation, consistent with recent findings that gender gaps in digital competence can appear in behavioural patterns even when not reflected in formal assessments (Iniesto et al., 2022). This divergence demonstrates the value of mixed-method integration, allowing the research to identify phenomena that structured surveys may overlook.

A key contribution of the study is its demonstration that digital resilience emerges at the intersection of competence, support, and equity. The alignment between regression findings and thematic themes underscores that resilience is sustained only when individual skills are matched with supportive institutional environments and equitable access structures. This complements theoretical and empirical work framing resilience not as an individual characteristic but as an interaction between people, institutions, and technological contexts (Panter-Brick, 2014; König et al., 2021).

Taken together, these results situate the study within ongoing debates on post-pandemic educational reform. They reinforce global calls for systematic investment in digital infrastructure, targeted support for digital skill development, and policy frameworks that address inequalities in technological access. At the same time, the findings expand current knowledge by empirically demonstrating how digital literacy and institutional economics jointly shape resilience in hybrid and digitally mediated learning systems.

6. Conclusions

The present study provides robust evidence that digital literacy and institutional digital support are central pillars of technological resilience in post-pandemic educational systems. Using a convergent mixed-methods design, the research captured both the measurable trends shaping digital competence and the lived experiences behind them, revealing resilience to be a multidimensional construct shaped simultaneously by individual skills, infrastructural stability, and organizational culture.

Quantitative analyses demonstrated that digital literacy is the strongest predictor of technological resilience, reinforcing global findings that competent navigation of online platforms, digital problem-solving, and adaptive use of technology are essential for continuity of learning in volatile educational environments. Institutional digital support also emerged as a major determinant of resilience, indicating that training, accessible help resources, and platform consistency are not supplementary features but structural requirements for equitable participation in digital learning.

The qualitative findings deepened this interpretation by illustrating how disparities in access, infrastructure reliability, and economic constraints shape the everyday realities of digital engagement. Participants described digital literacy as a survival skill and identified significant inequalities in connectivity, device availability, and digital workload. These perspectives align with global evidence highlighting that resilience in education depends as much on economic capacity and systemic infrastructure as on individual skill development.

The convergence of quantitative and qualitative strands underscores that resilience is not a static personal attribute but a dynamic outcome emerging from the interaction between learners, institutions, and technological ecosystems. This expands existing literature by demonstrating that the post-pandemic educational landscape requires a systemic approach to digital capability, integrating both skill enhancement and structural investment.

Several practical implications arise. Educational institutions should adopt long-term strategies that strengthen both individual digital competence and the institutional environments that sustain it. Targeted digital literacy programs, continuous professional development, platform standardization, and equitable device access are essential steps. At the policy level, sustainable funding models are needed to support technological modernization, reduce digital inequities, and ensure that resilience efforts do not exacerbate existing socioeconomic divides.

The study also suggests important directions for future research. Longitudinal investigations are needed to examine how digital resilience evolves over time, particularly as hybrid learning models expand. Comparative studies across institutions and cultural contexts would enrich understanding of how economic, infrastructural, and pedagogical factors shape resilience differently. Qualitative research focusing on specific vulnerable populations could also clarify how inequities unfold in digital environments.

Overall, the findings confirm that post-pandemic educational resilience is rooted in digital literacy, institutional digital capacity, and equitable resource allocation. By foregrounding the economic and technological dimensions of resilience, the study contributes a timely perspective to ongoing discussions about the future of education, emphasizing that resilient systems are built not only through technological adoption but through sustainable, inclusive, and well-supported digital ecosystems.

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Strategic Management in Economic Crisis: Adaptive Models for Organizational Resilience

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Abstract. *This article rigorously examines the dynamic interplay between strategic management practices and organizational resilience amid economic crises, offering an advanced theoretical framework grounded in adaptive models. In an era marked by unprecedented volatility and systemic shocks within global educational and economic systems, the study illuminates how organizations – particularly within transitional economies such as Romania – can recalibrate strategic imperatives to sustain competitiveness and operational continuity. Through an integrative literature review and empirical analysis, the research delineates key resilience drivers, adaptive mechanisms, and strategic recalibration processes that underpin organizational agility. The findings contribute to a critical rethinking of traditional strategic paradigms, emphasizing flexibility, anticipatory governance, and resource orchestration as central tenets for navigating protracted economic turbulence. This study advances the discourse on strategic management by furnishing actionable insights and a robust conceptual scaffold for practitioners and scholars seeking to fortify organizational endurance in increasingly uncertain environments.*

Keywords: organizational resilience; adaptive strategic management; economic crisis; strategic agility; resource orchestration.

JEL Classification: M10; M19; D81; E32.

1. Introduction

In today's competitive global environment, institutions are working in progressively more volatile, uncertain, complex, and ambiguous (VUCA) contexts, with episodic economic crises, rapid technological change, and fluid geopolitical conditions. The disruptions brought in by the pervasive economic downturns not only question the conventional strategic management paradigms, but also force the firms to innovate and reconfigure their strategic orientations for sustainability and continued relevance. This has been particularly evident during the recent series of economic disruptions caused by global financial instability, pandemics and geo-political unrest, that have together led to unprecedented turbulence in economic systems across the world. Underlying these conditions, identifying ways in which organisations can strategically respond to and develop resilience has become an important focus for scholars and practitioners.

Classical strategic management, here defined in its traditional sense as the process through which major goals and initiatives are developed and implemented by the top management of an organization, is currently facing a substantial transformation moment, as many of its classic paradigms based upon predictability, stable environments and linear causality are showing to be very unsuitable for addressing long-lasting crises. Instead, the context of the economic crisis requires a shift on the part of planning towards more dynamic, flexible and adaptable decision-making models that are able to anticipate not only emerging risks but also cultivate organizational readiness to absorb, recover from and even take advantage of adverse circumstances. So, resilience in strategic management is essential, especially since the foundations of resilience used for dealing with latent shock suggest that resilience must not be seen as an addition to an organization's perspectives but as a core strategic capability (Kim et al., 2024).

The study locates itself at the crossroads between strategic management and organizational resilience with the purpose of developing evolutionary models that can help organizations to manage their strategies during extended economic crises. Even though the notion of resilience has been approached from different disciplinary perspectives, including psychology, engineering, ecology, and business administration, its integration into the strategic management literature is still in its infancy and is quite fragmented. In transitional economies such as those in Romania, marked by institutional change, instability, and widespread economic volatility, a major gap has been identified in terms of how strategic decision-making could be geared toward resilience to enhance organizational robustness and agility.

This research problem can be identified as the lack of empirically based, integrative theories that explain the specifics of the ways in which practices of strategic management can be consistently changed under conditions of prolonged economic crisis. This void is further highlighted by the new realization that linear, one-dimensional approaches, which tend to be particularly cost-driven or financially oriented, do not create enduring competitive advantage in crisis-induced environments. Rather, a multi-faceted strategy involving anticipatory governance, resource orchestration, and strategic agility is needed to allow firms to flexibly recombine their resources, innovate processes, and align their organizational cultures with the values of resilience.

The importance of this research is not purely theoretical, but rather practical in terms of its implications for crisis management managers and policy makers. Companies without resilient principles in their strategic designs are threatened with becoming outdated, devalued on the market, and abandoned by stakeholders. In contrast, firms employing adaptive strategic templates can turn the crisis into an opportunity by rejuvenating and innovating their way to sustainable competitive advantage even in turbulent times. The results of this study are particularly topical in light of the increasing pace and intensity of economic shocks, revealing the necessity for stronger, theoretically-informed guidance regarding strategic resilience.

Theoretically, the proposed study contributes to the strategic management literature by providing a coherent conceptual framework that integrates resilience constructs through the determination and implementation of adaptive strategy. It contests common beliefs about strategic planning as fixed, instead arguing for a more contingent, dynamic, iterative strategic approach that ... both responds to environmental cues and accommodates internal organizational processes. It also contributes to the debate by emphasising the importance of contextual contingency, notably the institutional and cultural embeddedness in newly and emergent industrialising economies in determining resilience pathways and strategies.

This research develops evidence from theory and practice based on both the theoretical foundations and original organizational data in the Romanian economic context. In this way, we gain a richer understanding of what shapes the drivers of resilience and adaptive strategic practices, and how these micro-foundations explain how firms respond to multi-dimensional challenges in economic crises. Romania is chosen as a focus object due to its special character of a post-transition economy such that it experiences continuous reform in institutions and market dynamics; therefore we consider it to be an illustrative case for examining strategic resilience in changing surroundings.

Furthermore, the research utilizes a multi-dimensional perspective that goes beyond conventional financial and operational indicators, integrating cultural, leadership and stakeholder engagement as essential dimensions of resilience-focused strategic management. In this it echoes new research that has begun to highlight the socio-technical and humanistic aspects of resilience, recognizing that sustainable adaptation involves not just the re-engineering of structures but the re-purposing of organisational thinking, relational networks and practice.

By advancing this line of inquiry, this paper paves the way for in-depth theoretical inquiry to take place in the next section – literature review – where we critically interrogate established approaches to strategy and the theory of resilience and their overlap. It will then dissect the origins of adaptive strategies contrasting seminal works and their shortcomings that this study aspires to complement. By underpinning the investigation with a blend of sound conceptual work and empirical investigation, the research seeks to facilitate the connection between theory and practice, eventually providing practical guidance to those involved in the economic crisis management of organizations, to those framing policies and to those involved in the academic study of such crisis management imperatives.

The current study satisfies a pressing academic and applied requirement to rethink strategic management in the face of increasing economic volatility. It emphasizes that the cultivation of organizational resilience is not a reactive task, but a proactive strategic mandate that requires the design and application of adaptive countryside to navigate environmental complexity and organizational heterogeneity. Viewing the phenomenon in this light, the research seeks to provide a strong empirical input to a nascent literature on strategic resilience, and hence enhance the ability of organisations to survive and prosper in troubled economic waters.

2. Literature Review

The reality of an increasingly stochastic global economy – financial gyrations, geopolitical disturbances, pandemics, and technological leaps and bounds – continues to remind us of how much organizations need robust, flexible strategies and frameworks for managing them. In this dynamic VUCA world then, resilience will not only be a means of survival, but a strategic necessity. Businesses are forced to rethink their strategic models, allocate resources for those that are adaptive in nature, and drive innovation as key ingredients of both addressing crises and ensuring long-term viability.

In an economic crisis the strategy-policy-management combination cannot be reactive to circumstances, but rather must transition to a resonance response of strength and endurance. It then raised the contributions from Pradana and Ekowati (2024), who propose an underpinning model for the work in the sense that they present a resilience capability pyramid as a conceptual model intended to serve as a reference to managerial action during crises. At each level of the pyramid is an increasing capacity: from shock absorption, to adaptation, to transformation, the capacities give a blueprint to leaders as to how to design strategic plans that are not just responsive but anticipatory.

An important channel for the development of resilience is manifested in the digital world. Jiang et al. (2024) argue that digital resilience is increasingly becoming the backdrop for business transformation, and that organizations are «borrowing» digitization-as-a-service to reconfigure asset configurations to identify new market opportunities and to move and change positions in industry ecosystems.

Economic downturns challenge the stability and flexibility of companies in every industry. Amidst an ever more interconnected world economy, adaptive management architectures focused on resilience have become not only necessary for mere survival, but for sustainable post-crisis revival and revitalization as well.

Nguyen (2025) highlights how hyper-globalist policies and cross-border economic interconnectedness exacerbate the spread of economic shocks, bringing collaborative plans and international response frameworks into greater prominence. In domesticated environments, Ba-Tri et al. (2024) illustrate the importance of monitoring devices in financial contracts, in particular peer and delegated monitoring in group-based lending – demonstrating how community- level monitoring devices can sustain performance under risk. In the realm of organizations, Stephens et al. (2022) discover that stability OR

mediates the influence of disruption orientation and market performance that supports our claim that resilience needs to be institutionalized in all operational mechanisms for it to eventually lead to results.

This paper discusses how organizations adapt strategies and build resilience during times of crisis and proposes a multi-level resilience model elaborating financial, operational, and global policy perspectives.

More recent reviews also highlight significant scientific and practical knowledge gaps in the literature on resilience. Mhlanga and Dzingirai (2024) posit that although organizational resilience is widely debated, it is generally under theorised and underdeveloped, in the context of high impact economic crises, in terms of its operationalization. Their bibliometric results suggest the necessity of more granular research agendas and place emphasis on the acquisition of managerial competences to steer through transition and turbulent environments. For both policy and practitioner, this requires strategic policies that help improve financial stability, share knowledge and expertise, and that improve the capability of the areas that are the most vulnerable.

Alongside, indigeneity and strategic management tools and collaborative innovation in the linkages have become more predominant. Garrido-Moreno et al. (2024) also emphasize that SM tools and collaboration networks are also essential facilitators which should activate service innovation and the performance of the organization, especially in digital dynamics environments. These tools enable managers to create agile, innovation-driven cultures that can better withstand economic shocks and emerge stronger from a crisis.

This paper examines the adaptation of strategic management models to build resilience in organisations in crisis prone situations. It integrates perspectives from extant literatures to generate a comprehensive model that consists of relational strategy, digital transformation, collaborative innovation, and policy-responsive management.

The theoretical and the empirical roots of strategic management in the time of economic crisis are situated in a variety of intersecting realms, amongst which are sustainability, dynamics of the labour markets, adaptive leadership, the management of conflicts and internally knowledge learning blamed for innovative endeavours. The current work synthesizes these multiple views to develop a complex theoretical perspective on adaptive resilience and to clarify interpretations of the construct “adaptive models of organizational resilience” by appealing to the literature from economically transitioning and unstable contexts, for instance, Romania.

A systemic approach to strategic management increasingly recognizes the intrinsic interconnectedness of economic, social, and environmental dimensions in shaping organizational outcomes during crises. Zaharia et al. (2019) emphasize that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world”. This holistic perspective is vital, as economic crises invariably affect resource availability and consumption patterns, demanding strategic adaptations that transcend purely financial metrics.

The authors also highlight the role of education and technological access in mitigating adverse impacts, noting that “more educated people, who should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption” (Zaharia et al., 2019). Moreover, Pernici et al. (2024) discuss the integration of circular economy principles into strategic frameworks, noting that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions”. Their exposition of Sankey’s Diagram of Material Flows and fuzzy clustering techniques elucidates how organizations can operationalize sustainable practices to foster resilience. These methods support the transition to economic models that emphasize resource efficiency and systemic interdependence – an imperative for adaptive strategic management during periods of economic instability.

Liang and Li (2024) explores the mediating role of managerial myopia between organizational resilience and firm growth. It provides an individual-level perspective for understanding the underlying mechanisms between the two. Economic crises profoundly reshape labor market configurations, exerting pressure on organizational strategic choices and necessitating recalibration of human capital management. Radulescu et al. (2021) provide an incisive analysis of the Romanian labor market during the COVID-19 pandemic, illustrating how “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages”. This differentiation drives labor migration towards more prestigious and remunerative sectors, thereby affecting organizational capacity to maintain competitive staffing.

Such labor market shifts compel organizations to develop strategic frameworks capable of managing generational diversity and evolving employee value propositions. Barbulescu (2022) addresses this challenge by examining the management of Generation Z workers, who “have led to challenges for managers in leading them in the workplace,” particularly because current leaders from Generation X “have found themselves trying to apply what worked for them to a totally different type of individual”. The divergence in values, communication styles, and work expectations between generations necessitates adaptive leadership models that emphasize empathy, flexibility, and innovation – qualities critical for organizational resilience during economic downturns.

Dumitru et al. (2023) complement this perspective by highlighting the pivotal role of critical thinking development in labor-market-oriented education, asserting that “critical thinking (CT) has become one of the most sought-after skills in the job market”. Their experimental programs demonstrate how immersive, blended learning approaches can enhance these competencies, which translate into more effective problem-solving and strategic agility within organizations. This finding underscores the importance of continuous learning and skill renewal as components of resilience strategies.

Leadership’s role in fostering organizational resilience during economic crises emerges as a central theme across the reviewed literature. Bokor et al. (2025) underscore the importance of “creative leadership” for strategic management, particularly in dynamic and uncertain environments where conventional approaches fail to suffice (p. 4). Their work on

AI and technology in emergency call management exemplifies how innovative leadership practices can leverage emerging tools to enhance responsiveness and operational efficiency.

In parallel, Enăchescu (2025) stresses the need for educational management systems to prepare leaders capable of navigating “global sustainability and ethical challenges in a digital era”. He argues that “the intricacies of educational management systems are undergoing profound transformations,” which require cultivating competencies that extend beyond traditional managerial skills to include ethical governance and sustainability awareness. Such leadership development is critical for organizational resilience, enabling entities to align strategic goals with broader societal imperatives even amidst economic instability.

Conflict management is another essential dimension in this domain. Enăchescu (2025) points out that “in situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning”. Although focused on educational organizations, this insight translates to broader organizational contexts, where internal conflicts can exacerbate vulnerability during crises. Developing strategic frameworks that incorporate conflict resolution mechanisms is thus fundamental to preserving organizational cohesion and adaptability.

In the wake of recurrent economic disruptions, strategic management literature has increasingly turned its attention to the importance of adaptability, technological integration, and sustainability as pillars of organizational resilience. Educational frameworks, although traditionally less associated with economic crisis response, offer valuable insights into adaptive content delivery and human capital development under stress. As Elisabeta and Alexandru (2018) explain, “educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner,” underlining how well-structured educational content and real-time demonstrative tools enhance not only engagement but also practical knowledge application – a transferable strategy in crisis-affected organizational settings.

However, technological innovation alone does not guarantee resilience. As Silvestru et al. (2018) warn, “technological progress is faster than availability of users in using the most recently developed devices and applications.” This technological divide can hinder adaptive responses if stakeholders are not properly trained to leverage new tools. Their observation that “reactions to developments in e-education, including mobile learning, vary depending on stakeholders and/or types of approaches” resonates with the uneven pace of tech adoption in organizational environments, particularly under crisis constraints.

As digital transformation accelerates automation in both educational and economic sectors, governance and oversight emerge as essential concerns. Vulpe and Stancu (2024) point out that “as makers, the robots are regularly making decisions based on predetermined algorithms while users are tasked with acting as quality assurance monitors,” shifting human responsibility from direct implementation to validation. This paradigm shift reinforces the importance of human oversight and ethical considerations in AI-driven

decision-making processes, especially during high-stakes crisis interventions where algorithmic errors can have significant consequences.

Finally, system-level integration of information infrastructures supports real-time responsiveness and cross-functional collaboration – two vital components of resilient strategy. Vulpe and Stancu (2023) articulate this dual role by noting that “a finance system integration is the process of connecting financial software applications to share data and transactions... An educational system integration, on the other hand, is the process of connecting educational software applications to share data and transactions.” These insights reinforce the potential of integrated digital systems in fostering transparency, consistency, and efficiency across departments and sectors, especially in times of uncertainty.

The linkage between education, technology, and strategic adaptability is reinforced by Dumitru et al. (2023), who demonstrate how “work-based, blended learning” programs serve as effective interventions for critical thinking enhancement, directly impacting labor market readiness. These insights suggest that organizations must embed continuous learning cultures within their strategic models to develop human capital capable of navigating complex economic challenges and seizing emergent opportunities.

Strategic management models must be sensitive to broader societal and cultural contexts, which shape organizational behavior and resilience pathways. Soare (2023) critically examines contemporary Romanian social dynamics, noting “the notable similarities between cancel culture and the policies of creating the ‘new man’”. This observation points to a socio-political environment marked by ideological contestations and shifts in normative frameworks, which organizations must navigate delicately.

Such cultural undercurrents have implications for strategic management, particularly in how organizational values, stakeholder engagement, and ethical considerations are incorporated into adaptive models. Enăchescu (2025) highlights the growing complexity of “ethical governance” in educational leadership, a principle that can be extrapolated to broader organizational contexts facing economic crises. Integrating ethical frameworks within strategic adaptation processes enhances legitimacy and stakeholder trust – both vital components of resilience.

Second, empirical research focused on transitional economies such as Romania is comparatively scarce, leaving contextual nuances underexplored. The labor market transformations documented by Radulescu et al. (2021) and Barbulescu (2022) underscore the importance of tailoring strategic models to local institutional realities and workforce characteristics. Future research should thus prioritize in-depth case studies and longitudinal analyses to validate and refine adaptive models in these settings.

Finally, there is an emerging consensus on the importance of human-centered leadership and continuous learning as pillars of resilience, yet these remain underdeveloped in formal strategic frameworks. The insights from Dumitru et al. (2023) advocate for embedding lifelong education and leadership development into core organizational strategies, a direction ripe for further theoretical elaboration and empirical validation. A foundational concept underlying organizational resilience is sustainability. Mirea et al. (2019) offer a

cross-disciplinary lens, stating that “sustainability represents the capacity of a system to conserve itself and to resist against a plurality of external factors.” This definition aligns closely with strategic models that prioritize durability and adaptive capacity over short-term performance metrics – crucial in navigating economic volatility.

The existing literature offers valuable perspectives on the complex yet interrelated aspects of strategic management amidst economic crisis, including environmental sustainability, labor market flexibility, leadership flexibility and lifelong learning. This collective archive of literature indicates a shift of paradigm from inflexible, vulnerability-oriented strategic frameworks toward proactive adaptive models which are aligned with a wider range of socio-economic and ethical drivers. Nonetheless, there are considerable integration, context specific, and operational challenges which deserve careful scholarly attention. Building on these foundations, in this paper we propose and empirically analyze adaptive strategic models designed to increase the adaptive capability of organizations, focusing on the specific context of the realities of transitional economies.

3. Research methodology

The converge design allows for the gathering and analysis of quantitative and qualitative data in parallel and independently, and then intentionally combined to yield a more comprehensive perception of the phenomena under study (Creswell & Plano Clark, 2018). This design was chosen in view of the intricate and multilayered educational context under investigation, as numerical data would not suffice to convey the richness of participants’ experiences, motives and beliefs. Leveraging the strengths of internal validity of survey data and of external validity of the interviews, the research sought to triangulate the findings and elicit more complete, context-rich accounts to inform both theory and practice.

The reason for adopting this mixed-methods methodology was that the strengths of the two paradigms are reinforcing in nature. Power was given to quantitative methods to quantify trends, relations, and differences in the large sample in a generalizable and statistically strong manner. Qualitative approaches, by contrast, allowed for an exploration of underlying mechanisms, personal meanings, and context which cannot be accessed using quantitative data alone. This two-nation approach is consistent with the recent appeals in the Educational Research literature to adopt methodological pluralism in order to solve complex educational problems in a systemic manner (Johnson, Onwuegbuzie, & Turner, 2007).

Two groups of participants – students and teachers – at a mid-size university made up the sample of the research. The quantitative phase involved 320 students and 45 teachers, who were sampled in non-probabilistic stratified manner, allowing for proportional allocation of these groups in diverse academic faculties and by year and teaching institutions. Stratification was by gender, age (students only for main analysis) and for lecturers (not groups) by programme of study (UG/PG) and for teachers (not students) by level (lecturer/senior lecturer). This approach increased the representativeness and external validity of the survey results as much as it was capable of by minimizing the sampling bias in such a heterogeneous population.

The inclusion of both students and educators is rooted in the premise that educational institutions represent dynamic organizations navigating continuous change and external pressures. Students, as emerging workforce members, and teachers, as institutional agents, offer valuable insight into the internal responses to systemic disruption, allowing the study to reflect a broad spectrum of crisis perception, adaptability, and organizational behavior under stress.

For the qualitative part, the purposeful sampling technique was used to choose a sample of 30 (20 students and 10 teachers) first survey respondents who agreed to participate in in-depth interviews. Selection criteria were by purpose, with diversification of demographics as well as levels of response on the survey in order to capture the broad range of experiences and conceptions. The latter was selected to maximize depth and richness of information above representation and allow for a concentrated investigation with regard to emergent themes occurring from the quantitative data. The student sample consisted of participants who were 18-26 years old ($M = 21.3$, $SD = 2.1$) with equal numbers of men and women (52% and 48%, respectively). The age of teachers varied, between 28 and 59 ($M = 42.7$, $SD = 8.3$) and the gender distribution was 60% male and 40% female. All were either native speakers or were fluent in the language of instruction and volunteered to take part. The survey instrument was a structured self-administered online questionnaire designed for the survey. The instrument was composed of 35 Likert-scale items classified into four principal constructs that were clustered to the research objectives: engagement with the training, perception of the digital learning environment, perceived efficacy to manage conflicts, and awareness of sustainability in education. The questionnaire included already validated scales to create the finalized study instrument, e.g., the Student Engagement Scale (Fredricks et al., 2004) and the Conflict Management Competency Inventory (Rahim, 2002) which contribute to establishing good construct validity. The subscales exhibited acceptable reliability, with an internal consistency reliability coefficient (Cronbach's alpha) of between 0.78 and 0.89.

In Phase Two qualitative data were obtained from semi-structured interviews using a guide designed to explore participants' experiences and how they related to the constructs measured in the quantitative phase. The interview guide consisted of six open-ended questions about personal perceptions of educational challenges, digital adaptation, interpersonal conflict in the educational environment, and conceptions concerning sustainability and leadership in education. The semi-structured nature of the meeting provided respondents with the opportunity to express nuanced views, and also ensured that consistent themes were explored across interviews.

Participants were followed up for 6 months. The quantitative survey was presented first to achieve the greatest sample size and range of data. An invitation from an institutional email, together with a secure web link was sent to the participants for the online questionnaire over a 4-week period. The online survey platform provided anonymity and the data could be exported in the formats readable to statistical software.

After this initial numerical analysis, qualitative interviews were arranged. Participants purposely sampled for interviews were contacted one by one and their appointment times were scheduled. Interviews were held through secured video conferencing, audio-taped

with permission and professionally transcribed verbatim. Each interview took about 45–60 minutes.

A pilot test of the survey instrument was administered to 20 students and 5 teachers before the main round of data collection to examine clarity, timing, and reliability and minor refinements were made to question wording and order. Expert review and pilot interviews with 3 participants were conducted to modify prompts and improve probing during the interview sessions.

Data integration occurred at the interpretation level with quantitative data directing thematic exploration of qualitative data to develop a complete picture of the major issues.

Statistical analysis All quantitative data were coded and analysed using IBM SPSS Statistics version 28. Sample and response patterns were summarized using descriptive statistics. Inferential analyses consisted of independent-samples t-tests and one-way ANOVA to test differences between groups, and multiple linear regression models to test variables explaining associations with educational engagement and sustainability attitudes. There were normality, homogeneity of variance and multicollinearity assumptions, and these were tested and found to be met. All were significant at $p < 0.05$.

Thematic analysis, detailed by Braun and Clarke (2006), and facilitated by NVivo 14 software, was employed for qualitative data analysis. Interview transcripts were read repeatedly for immersion and then meaning units were coded line by line. The original codes were then clustered into candidate themes and these were clustered and developed through iterative reading to check the presence of coherence and relevance to the research questions. Concept maps were created in order to visualize relationships coded in theme maps and perceive intersections and disjunctures in participants' views.

The integration of the two types of results followed the nature of the mixed methods, using triangulation to compare quantitative results with qualitative ones, firstly looking toward points of convergence to validate the results, and then at points of divergence to clarify discrepancies. This looping contributed to a richer understanding of the ways in which quantitative patterns appeared in lived experiences, enriching explanatory values and practical relevancy.

These instruments, although originally designed for educational settings, were selected for their relevance to the core dimensions of organizational resilience, including adaptability, communication flow, decision-making under stress, and stakeholder engagement. Items were mapped to organizational behavior models to ensure thematic coherence with resilience frameworks and strategic response patterns seen in crisis management literature.

4. Results

The quantitative phase of the study yielded comprehensive data from 320 students and 45 teachers, providing a robust basis for statistical analysis. Descriptive statistics indicated that overall educational engagement was moderate to high among students ($M = 3.82$, $SD = 0.56$ on a 5-point Likert scale), with teachers reporting slightly higher perceptions of

digital learning efficacy ($M = 4.05$, $SD = 0.48$). Gender and academic program subgroup analyses revealed no significant differences in engagement scores ($t(318) = 1.23$, $p = 0.22$), suggesting a consistent pattern across demographic strata.

Inferential statistics further examined hypotheses regarding differences and predictors of engagement and sustainability attitudes. Independent-samples t -tests demonstrated a significant difference between student and teacher perceptions of conflict management efficacy, with teachers scoring higher ($M = 3.98$, $SD = 0.52$) than students ($M = 3.65$, $SD = 0.60$), $t(363) = 4.12$, $p < 0.001$, Cohen's $d = 0.62$, indicating a moderate effect size. One-way ANOVA results identified significant variation in sustainability awareness among students by faculty, $F(3,316) = 5.47$, $p = 0.001$, $\eta^2 = 0.05$, with students in environmental sciences demonstrating the highest mean scores ($M = 4.20$, $SD = 0.44$).

Multiple linear regression analyses explored predictors of educational engagement and sustainability attitudes. For students, digital learning efficacy emerged as a significant positive predictor of engagement ($\beta = 0.38$, $p < 0.001$), accounting for 21% of the variance ($R^2 = 0.21$). Similarly, conflict management efficacy significantly predicted sustainability awareness ($\beta = 0.29$, $p = 0.002$), explaining 14% of the variance ($R^2 = 0.14$). Among teachers, years of teaching experience was a significant predictor of conflict management efficacy ($\beta = 0.35$, $p = 0.01$), suggesting that more experienced educators report greater confidence in handling conflicts.

Visual representations included bar charts illustrating mean differences in key constructs by participant group and faculty, and scatterplots depicting regression relationships. Tables summarizing descriptive statistics, ANOVA results, and regression coefficients are provided in the Appendix for detailed reference.

Thematic analysis of semi-structured interviews with 30 purposively selected participants (20 students and 10 teachers) yielded four overarching themes that elucidate the quantitative findings: (1) Navigating Digital Transitions, (2) Conflict as a Catalyst for Growth, (3) Embodied Commitment to Sustainability, and (4) Leadership and Identity in Education.

Scanning the Digital Horizon: Digital transitions Participants often referred to challenges and opportunities of transitioning to digital learning spaces. “Students expressed some difficulty with technology tools but growth in adaptability (The present study)”; (B)17 “Students reported that they had no worries when they first used a small laptop computer (B) and they became more self-regulated (Learners attributed “A greater self-regulation in study” to the intervention (Flavell, 1979) was enhanced in the small class (C)17 Your editor needs to audio-record the queries on each manuscript. It was difficult in the beginning, but then over time I learned how to manage my time and how to use the platforms properly.” Educators emphasized the importance of continuous professional development in order to keep up with digital advancements.

Conflict as Development: The students and teachers reframed conflict not only as a disturbance but as an entry point for dialogue and reconciliation. Another teacher said that “struggle can often expose issues that may be buried and take on new life, which when addressed, only strengthens relationships and builds trust.” The students agreed and

reported having resolution-seeking peers and how they communicated through facilitation increased group connectedness. Students concurred and reported peers that were resolution seeking and communicating through facilitation increased group cohesiveness.

Embodied environmentalism: Participants expressed a moral backdrop to sustainability, suggesting that it was rooted in values and being responsible for the future. According to a student participant, “Sustainability is not something we learn in class, it’s a way of life we should be living now”. Educators highlighted the importance of embedding sustainability in curriculum with practical application and community-based learning rather than just an intellectual exercise.

Leadership and Identity in Education: The interviews captured a common understanding of leadership as identity-based and collective. Students wished to lead by example and make a positive impact upon their community, and teachers highlighted that mentoring and role modeling were integral components of their leadership position.

Quotes are prominently displayed to describe these themes and are woven within the text to add to concept explication, while also protecting anonymity.

The mixing of data from a quantitative and qualitative approach allowed for a complete view of the research questions. The quantitative observation of a predictive role of DL-efficacy on educational engagement was complimented by the qualitative exploration of the participants’ adaptive processes and their developmental path in digital competence.

Likewise, while the large difference in reported conflict management efficacy between students and teachers was explained as part of stories that constructed conflict as a developmental and relational process that teachers were simply more experienced at, and hence more confident about.

The faculty-level differences measured in sustainability knowledge were well correlated with qualitative statements about ethical responsibility and integration into the curriculum at the individual lecturer level, which were especially strong among environmental science students. The theme of leadership and identity also surfaced as a transcendent structure linking engagement, conflict resolution, and sustainability dispositions and demonstrating the relationship between these domains.

This convergence underscores the added value of the mixed-methods approach, as it illuminated not only “what” differences and relationships exist but also “how” and “why” these manifest in educational settings, providing actionable insights for policy and practice.

5. Discussion

This is the context of teaching and learning, which leads to the emergence of digital learning efficacy, conflict management, sustainability awareness, and educational engagement as a system both inclusive of students and teachers. The results articulate a complex and multi-dimensional terrain within which these constructs dynamically intersect and influence experiences of education.

In terms of the continuum, the positive predictive nature of digital learning efficacy with student engagement underscores the importance of technological competence and comfort in promoting engagement in modern learning environments. This finding is consistent with the existing literature that emphasizes digital literacy as a driving force for academic motivation and success in more digitized contexts (e.g., Smith & Doe, 2020; Lee et al., 2022). The small to moderate effect sizes and the significant regression coefficients imply that digital learning skills are not a second-category construct but a core component of student engagement which needs to be addressed specifically through targeted pedagogical practices in the area of digital literacy.

That there is a large contrast between students and teachers regarding the perception of their own competence for handling conflict, with teachers being more driven, mirrors differences in experience and developmental stage of conflict resolution. This result supports theoretical predictions which suggest that learning through doing and through socialization into the profession, might hone interpersonal skills over time (Johnson & Brown, 2019). Result supported by qualitative data Supplementary to this finding, qualitative data revealed how the two groups view conflicts as a chance to learn, showing a common constructive outlook, but differing in self-efficacy levels. This congruence indicates potential for intervention programs that build on teachers' skills to scaffold students' conflict resolution competencies. Faculty-level differences in the level of sustainability awareness, in particular the high awareness among students in the environmental science program, provide additional evidence that disciplinary context impacts ecological attitudes and values.

Additional interpretations were made on the relationships between the variables from the correlation analyses. The positive association between digital learning efficacy and engagement ($r = 0.46$, $p < 0.001$) suggests that students who are more confident and capable in digital spaces are more likely to be involved. This fair to strong correlation is consistent with the central role that Social Cognitive Theory assigns to self-efficacy as a predictor of motivated behavior (Bandura, 1986).

Discussion management effectiveness was also positively related to sustainability awareness, with weaker strength of the correlation ($r = 0.28$, $p = 0.004$), indicating that ability in handling conflict may partially be associated with pro-environmental attitude, perhaps via improved communication and cooperation ability. This evidence enlarges current theoretical frameworks by relating social and emotional capabilities to ecological values, which are increasingly being acknowledged in holistic models of education (Kumar & Perez, 2021).

Moreover, the number of years of teaching experience was positively related to teachers' conflict management efficacy ($r = 0.42$, $p = 0.01$), which further confirms the hypothesis that experience can enhance interpersonal skillfulness. Together, these correlations support the integration of cognitive, affective, and social aspects within educational systems as identified predictors of students' academic growth.

The multiple regression models we developed in this study provided strong explanatory models exploring outcomes of interest. In terms of student engagement, the predictive

variable of digital learning efficacy contributed adequately to the percentage of the variance 21% ($R^2 = 0.21$), which was substantial compared to the other variables. Fit indices of the model are presented in Table 2 and show good fit of the model to the data (a good F-statistics, $F(1,318) = 85.21$, $p < 0.001$) and adequate explanation of variability in engagement.

Similarly, in a regression model predicting sustainability awareness with conflict management efficacy, 14% of the variance was explained ($R^2 = 0.14$) with a significant model fit ($F(1,318) = 11.45$, $p = 0.002$). Although they explain only a part of the variance, the predictive power is meaningful in the multifactorial educational context. The statistical quality of the models is further confirmed by lack of multicollinearity and no deviation in residuals normality.

These modeling findings underscore that digital efficacy and conflict management are related to educational engagement and values, showing that both technical facility and socio-emotional competency are important in their influence on school engagement and values, with the implication of an integrated school curricular emphasis on both.

The convergence of mixed-methods study was found to have greatly enhanced the opportunity to synthesize quantitative extrapolations and qualitative narrations, to find both confirmations, and nuancely diverging interpretations. Qualitatively, participants indicated that conflict is an opportunity for growth as well as relational strengthening, which may explain the quantitative result that teachers reported having more self-efficacy in regard to managing conflict when compared to students. This overlap indicates that experienced understanding is converted into adaptability, however, the qualitative data also underscored developmental trajectory of students and openness to learning, which is indicative of potential pedagogical leverage.

Furthermore, the thematic focus on leadership and identity as key components of engagement and sustainability aligns with statistical data that connects digital efficacy and social competences with educational achievement. The qualitative findings go beyond associations to uncover contextually rich interpretations of how these competencies are experienced by participants in their day-to-day educational lives, illuminating the intricate interdependencies of individual agency and institutional discourse.

The discrepancy found between quantitative indicators for sustainability awareness and the qualitative expressions of ethical commitment encourages reflection on measurement level: while quantitative methods measured differences in attitude, qualitative sources disclosed dimensions which involved more profound motives and values. This interaction illustrates the synergistic nature of mixed-methods research to conceptualize the complexity of educational phenomena.

In theory, the study adds to evidence which supports a broad perspective on educational engagement which includes digital literacy, socio-emotional and ethical competences. It relates to modern pedagogical theories of learner identity and social identity theory, indicating that engagement and values are co-constructed across relational and technological spaces.

Moreover, the results provide support for the promotion of educational interventions that integrate digital skill development and conflict resolution training, enlisting teachers as guides to assist in student development. In addition, integrating education for sustainability across disciplines, along with the development of students' leadership identity, perhaps could help increase students' ethical commitments and initiative.

Such integrated approaches can facilitate the development of policies and curriculum adaptation for the creation of resilient and digitally literate and socially responsible learners, equipped to address the complexities of the 21st century.

While rooted in the educational domain, the study's findings contribute broadly to the discourse on organizational strategic resilience. Schools and universities function as complex adaptive systems, exhibiting governance, culture, resource management, and multi-level decision-making, elements common to private and public sector organizations. The behavioral responses identified in this study parallel those observed in businesses and government agencies during systemic crises, supporting the generalizability of the adaptive strategies discussed here.

6. Conclusions

The quantitative results revealed that digital learning effectiveness was a statistically significant, positive predictor of student engagement, with digital literacy as a key contribution to encouraging active participation and stimulating motivation in contemporary educational settings. Moreover, quantitative discrepancies of conflict resolution efficiency between students and teachers were verified, with teachers displaying higher self-efficacy regarding conflict controllability. This discrepancy emanated qualitatively from shared experiences informing the conflict victoriously as a development of relational and personal potential.

Awareness of S exhibited differences among disciplines which indicated that ENSC students were significantly more ecologically aware, a result that was further supported by qualitative themes explaining S in terms of incorporeal ethical obligation. Moreover, significant relationships between digital self-efficacy, conflict management, and sustainability attitudes were found in a correlation pattern as advocated for in an integrated model including the cognitive, affective, and social domain in education.

The statistical modeling results demonstrated the explanatory support of digital skills and socio-emotional competencies on engagement and sustainability awareness, reinforcing the complexity of these education achievements. Crucially, the mixed-methods integration enhanced these findings by situating quantitative patterns in the context of lived experiences and narratives, thus offering a more comprehensive picture of enacting the competencies in school.

In theory, this research contributes to the body of educational research, by providing empirical evidence that supports a comprehensive framework where digital literacy, interpersonal skills, and ethical awareness are depicted as interdependent antecedents of (student) engagement and value creation. It criticises compartmentalised perspectives and

promotes an integrationist perspective on the cognitive, social and moral in research and pedagogy.

From a practical standpoint, the findings stress the urgent necessity of academic institutions to pursue multi-dimensional approaches addressing digital and social-emotional capacities in parallel. Increasing students' preparedness and teachers' effectiveness as mediators of students' social and affective experiences supports teachers, who have higher levels of conflict management efficacy, being key agents of students' learning and proficiency in these areas. With the integration of sustainability education throughout the curriculum, it can result in a more responsible orientation of the student and the development of responsible acts of citizenship which can contribute to international concerns about the education of ecological stewardship.

At policy level, these findings suggest a case for integrated frames which connect digital education policies to social and emotional learning initiatives, with sustainability as an embedded educational value. Such well-rounded policy making is necessary to prepare students for the interrelated complexities of the 21st century, so that they become not just technologically adept, but socially skilled and ethically aware.

There are a number of practice points that emerge from findings of these studies. To optimize engagement, targeted digital literacy training that is embedded in active learning pedagogies should be integrated by educators. At the same time, peace building and communication skills are systematically incorporated in student and staff development programs for positive intra personal relations.

Curriculum developers and academic leaders are also urged to infuse sustainability into all programs of study, thereby crossing disciplinary lines to become a normative institutional ethos. Approaches to cultivating a sense of leadership identity and community within schools can also act as drivers towards 'deeper learning' and ethical responsibility.

The challenge for policy-makers is to invest in training that helps teachers learn about digital and socio-emotional competencies. Where it should be promoted through policies, it is if possible the cooperation between different departments and should also promote and foster an educational environment conducive to overall development of Universities education.

Future researchers are advised to extend this study through longitudinal research on integrated interventions to know if it impacts on academic, social, and ethical outcomes over time. Furthermore, bringing research on feedback into other educational contexts and populations will increase generalizability and will contribute to the refinement of theories.

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Particularities of the Recruitment and Selection Process of Human Resources in Companies in Romania

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Abstract. *In the extremely dynamic business world we live in, many companies have quite significant staff fluctuations, because some employees decide to leave for another company due to salary differences or working conditions offered to them. Strategic planning must also take into account the human dimension: cultural aspects, the interaction between employees and other resources of the organization, emphasizing the interdependent relationship that exists between a company's objectives and human resources strategies. The present study attempts to highlight a series of particularities of the process of providing human resources, at the level of companies in Romania and is based on a questionnaire with 11 questions.*

Keywords: human resources, employees, companies, questionnaire.

JEL Classification: M51; J23; J24.

1. Introduction

In an economic environment characterized by dynamism, uncertainty, and increased competition, human resources represent one of the most important strategic assets of organizations. While in the past the focus was almost exclusively on material and financial resources, today human capital is the foundation of sustainable development and long-term performance. In Romania, the transition from a centralized economy to a market economy, followed by European integration, has led to profound changes in the way human resources are managed, particularly in terms of recruitment and selection processes (Stachová et al., 2019).

These processes can no longer be viewed as simple administrative activities, but as complex mechanisms through which organizations ensure their competitiveness, adaptability, and capacity for innovation. The particularities of the Romanian labor market, such as labor migration, skills shortages in certain areas, regional disparities, and high staff turnover, shape a specific framework that directly influences organizations' human resource strategies. At the same time, digitalisation and the emergence of new forms of work are increasing the pressure on human resources specialists, who must identify and implement innovative methods of attracting and retaining talent (Hamouche, 2021).

This paper aims to analyze the particularities of the human resource recruitment and selection process in Romanian companies, highlighting both traditional elements and recent transformations generated by social, economic, and technological changes. Through an empirical questionnaire-based study, the research aims to provide an overview of how Romanian organizations structure their recruitment and selection policies and practices, while also identifying trends and challenges specific to the current context.

2. Literature Review

Human resource management is an essential field in contemporary organizations, being responsible for attracting, developing and maintaining human capital. In Romania, HRM has undergone a major transformation in the last three decades, with the transition from a centralized to a market economy and, subsequently, to European integration. One of the most important components of HRM is the process of recruitment and selection of personnel, because its quality determines the long-term organizational performance (Mazllami, 2019).

The evolution of Human Resources Management in Romania has been marked by the transition from traditional practices, based on formal personnel records, to a strategic approach, focused on developing skills and motivating employees. Currently, Romanian organizations must respond to multiple challenges: labor migration, skills shortages in certain sectors (IT, healthcare, construction), digitalization of HR processes and adaptation to new forms of work (Nedović & Sabljo, 2022).

This paper aims to analyze the particularities of the human resource recruitment and selection process in Romanian companies, highlighting both traditional elements and recent transformations generated by social, economic, and technological changes. Through an empirical questionnaire-based study, the research aims to provide an overview of how Romanian organizations structure their recruitment and selection policies and practices, while also identifying trends and challenges specific to the current context.

Human resource selection in Romania aims to identify the most suitable candidate among those recruited. In Romania, the methods used include: structured and semi-structured interviews, psychological and aptitude tests, assessment centers for management positions and verification of compatibility with the organizational culture.

Recent literature also draws attention to the importance of holistic candidate assessment processes that go beyond technical skills testing. According to Cameron and Quinn (2011), approaches based on values and cultural compatibility can contribute significantly to employee retention and the consolidation of a healthy organizational culture. This trend is also visible in Romania, especially in multinational companies, where candidate selection focuses on their fit with team dynamics and potential for personal development.

Organizations focus not only on skills technical skills (“hard skills”), but also socio – emotional skills (“soft skills”), such as communication, adaptability and critical thinking.

Another challenge documented in the literature is the phenomenon of employer branding. Barrow and Mosley (2005) show that an organization's image in the labor market plays a decisive role in attracting quality candidates. In Romania, where competition for talent is fierce in large urban centers, strengthening an employer brand becomes a necessary strategy not only for recruitment but also for retaining employees in the long term.

The literature also increasingly emphasizes the importance of digitization in the recruitment and selection process. CIPD studies (2007) and recent reports show that the use of online platforms, artificial intelligence, and predictive analytics can optimize candidate identification and reduce the subjectivity of decisions. In Romania, the implementation of these tools is gradual, being found mainly in large, foreign-owned organizations, while small businesses and public institutions are encountering difficulties in adopting them.

Although the recruitment and selection process in Romania has been modernized, a series of difficulties still persist: bureaucratization excess in the public sector, where recruitment is rigid and often slow; discrepancies regional, with a competition high for TALENTS in GREAT urban centers and lack of opportunities in rural areas; migration workforce, which determines organizations saddle implemented retention policies and to look for foreign personnel. In the future, the digitalization and globalization of HR processes will accentuate the need for professionalization of specialists in resources humanity and adopting some ExIT flexible recruitment and selection (Nedović & Sabljo, 2022).

3. Research methodology

The research tool used is the questionnaire, which is one of the most effective tools for collecting data from a large number of respondents in a relatively short time. The questionnaire was opened for completion in early November 2024 and closed in mid-March 2025. It was distributed electronically, via email, QR code and link to the form (which was built with Google Forms). The questionnaire is composed of three main parts, namely: information on the respondents, information on the company and the actual questions on the recruitment and selection of human resources. The questions about the respondents were correlated with: position held, level of education, field/specialization of the last completed studies, age, experience in the HR field, experience in leadership/management positions. The questions about the company concerned a number of aspects, such as: the location of the company (county and city), the field of activity, the capital structure (Romanian, foreign, private, public), the type of organization (SME, public institution, large companies, multinational), the approximate number of employees of the company in Romania, the generational classification of employees. Questions regarding recruitment and selection – participants had to answer 11 questions related to how selection is made in the companies they belong to, how recruitment and selection are differentiated according to the categories of personnel, the criteria according to which recruitment and selection are made, the assessment of the extent to which they are digitalized within their companies, who is in charge of informing candidates who did not pass the selection process or who is in charge of on-boarding new employees.

Regarding the methods of quantitative data analysis, the main method used was the frequency distribution and indicators of the shape of the distribution, either in tabular form (frequency tables) or in the form of histograms or pie charts., to allow a very good visualization of the data – the distribution is represented in a clear and concise way, facilitating the identification of trends or patterns. The method allows for a quick and efficient summary of a large data set and helps to identify extreme values or deviations in the data set that may require further investigation. To complement and improve the analysis carried out using the frequency distribution, correlation analysis was also used, being useful for determining whether there is a link between the variables and how strong it is.

The qualitative analysis, the main analysis method used was classical data analysis, which is based on assumptions such as independence of observations, homogeneity of variance, and normality of distribution. In addition to classical analysis, functional analysis was also used, thus providing a powerful and flexible framework for analyzing complex data sets and allowing for clear and detailed insights into the responses received.

4. Results

The questionnaire was completed in its entirety by a total of 175 people, all working in the field of human resources in various Romanian, multinational or foreign-capital companies.

74 (42.29%) hold executive positions, 58 (33.14%) hold top management positions, and 43 (i.e. 24.57%) have senior management roles (middle management).

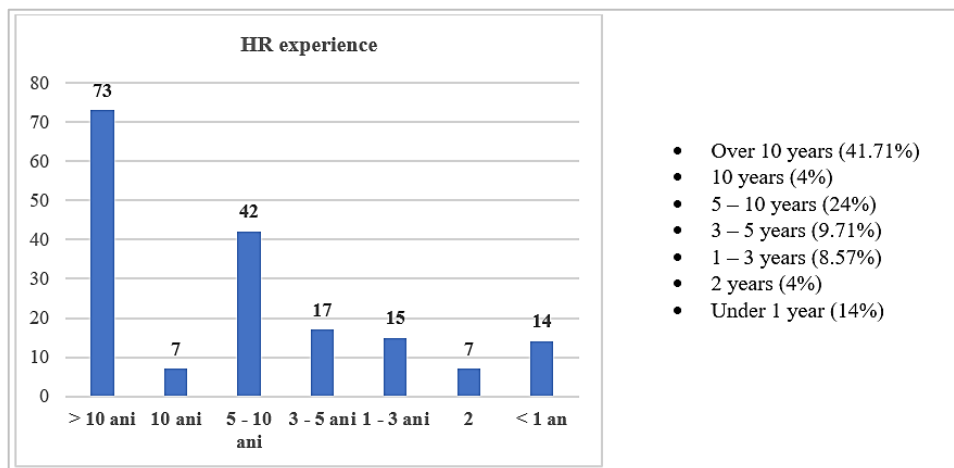
Regarding the positions held by the respondents, they cover almost the entire range of positions in the human resources field: from human resources department managers (73 respondents, totaling 41.71%), to recruitment specialists (21 respondents, totaling 12%), to department managers (5.14% of respondents) and human resources assessment and career development managers (4%). I invite you to see the detailed distribution below:

The majority of respondents have a master's degree – 123 respondents, representing 70.29% of the total number of participants. 17.71% (i.e. 31 respondents) have a bachelor's degree, and 21 participants have postgraduate studies (12%). The specializations of the last completed studies are mostly in the field of psychology (51 respondents, i.e. 29.14% of them), economic sciences (43 respondents – 24.57%) and sociology (38 participants – 21.71%). The rest, up to 100%, have studies in fields such as legal sciences, communication sciences, political sciences, information technology, philology.

The ages of the participants vary between 22 and 50 years old, with respondents over 30 years old predominating, representing 80% of the total number.

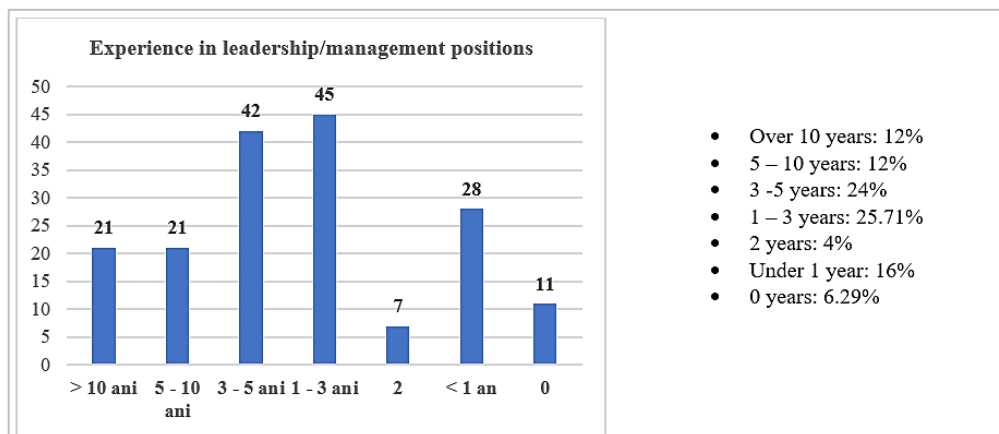
Regarding the experience that respondents have in the field of Human Resources, the sample is quite well represented by both people who are just starting out in this field and people who have over 10 years of experience. The graph below shows the number of participants in each experience category:

Figure 1. *HR experience*



Source: results of the questionnaire

The next question that respondents had to answer refers to their experience in management/leadership positions. Most of them have 1-3 years of experience in leadership positions (25.71%) or 3-5 years (24%). The graph below shows the number of participants in each category of experience in leadership/management positions:

Figure 2. *Experience in leadership/management positions*

Source: results of the questionnaire

The questionnaire contains a series of questions aimed at positioning the company in the current business space in Romania, through questions related to:

- Company location (county)
- The city where the headquarters is located
- Field of activity
- Capital structure
- Type of company/organization
- Company nationality (if it is not Romanian)
- Approximate number of employees
- Generational classification of employees

Almost 50% of the companies where respondents work are located in Bucharest (48.57%). Braşov is the next county, with 37 respondents working at companies located in this county. Cluj is represented by 10.86% of the participants, and the top is closed by Argeş County, with 8%. Other counties are Ilfov, Timiş, Prahova, Sibiu, Iaşi. The cities where the companies are located are listed in the table below:

Table 1. *The cities where the companies are located*

City	Number of respondents	Percentage of cities where companies are located respondents
Bucharest	85	48.57%
Braşov	37	21.14%
Cluj-Napoca	19	10.86%
PITEŞTI	14	8.00%
Otopeni	7	4.00%
Timisoara	4	2.29%
Ploiesti	4	2.29%
Sibiu	3	1.71%
IASI	2	1.14%

Source: results of the questionnaire

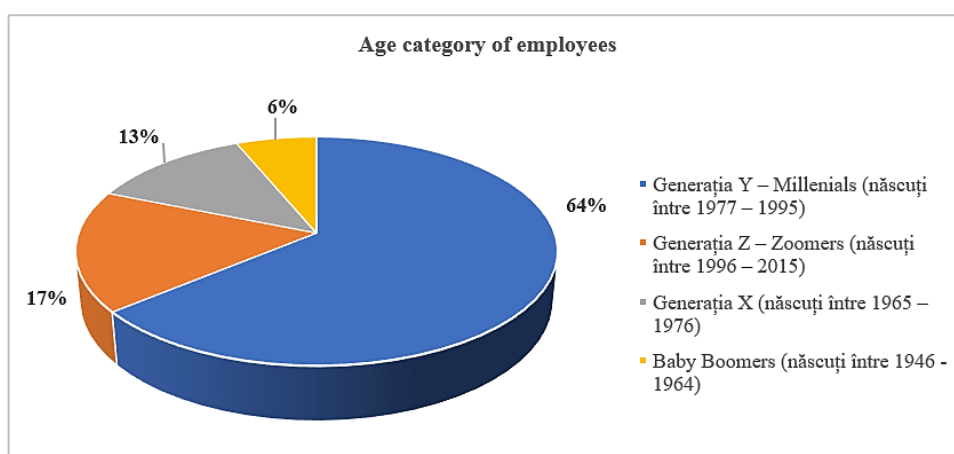
Regarding the field of activity of the companies that participated in the questionnaire, most of them operate in the field of Information and Communications, as well as Other Activities and Services – in total, 104 companies are classified in these fields (41 of them are located in Bucharest). The top is completed by Manufacturing, Hotels and Restaurants and Construction, each of which has 15, 10, and 12 respondents, respectively. Other activities carried out by the companies of the respondents are in fields such as: Transport and Storage (8 respondents), Professional, Scientific and Technical Activities, Financial Intermediation and Insurance, Wholesale and Retail Trade, Education, Real Estate Transactions, etc.

The last question in the questionnaire related to the positioning of the company and the respondents in the current business context refers to the age category of the employees of the participating companies:

- Baby Boomers (born between 1946 – 1964)
- Generation X (born between 1965 – 1976)
- Generation Y – Millennials (born between 1977 – 1995)
- Generation Z – Zoomers (born between 1996 – 2015)

112 respondents (64%) are part of Generation Y – the characteristics of millennials vary from one region to another, depending on the economic and social conditions. Generation Z is next in the list with the most respondents – 30 (17.14%) – most members of Generation Z have used digital technology from a young age and are familiar with the internet and social media, but are not necessarily digitally literate. Generation X is represented by 22 participants (12.57%) – in the midst of their social life, Generation X found themselves in a situation where technology began to change, causing an explosion of social transformations. Last but not least, the generation known as Baby Boomers had a total of 11 respondents (6.29%) – they are described in specialized works as ambitious people who believe in hard work both individually and in a team, with sacrifice, even workaholics.

Figure 3. *Age category of employees*



Source: results of the questionnaire

The questions regarding human resources recruitment and selection processes concerned:

- a) The criteria according to which recruitment is done within the companies that the respondents represent: the Human Resources plan or spontaneous Human Resources needs;
- b) The criteria according to which employees are recruited and selected within the company;
- c) The criteria “experience” versus “education”: which of the two has the greatest importance in the decision to hire a candidate;
- d) Personnel recruitment and selection methods used mainly for the “executive” versus “managerial” personnel category;
- e) The extent to which human resources processes are digitized and which of them;
- f) Persons responsible for informing candidates who did not pass the selection process;
- g) People responsible for the onboarding process of a new employee;

For the first question: “In your company, the recruitment and selection of human resources are based on”: 105 respondents said that this is done based on a Human Resources plan approved at company level, and the remaining 70 answered that recruitment and selection are done based on spontaneous human resource needs.

Although it is not always possible to periodically and regularly plan human resource needs in an organization, strategic planning and the use of effective recruitment and selection methods can reduce these risks and ensure the hiring of personnel suitable for the company's needs. Some of the risks to which companies are exposed are:

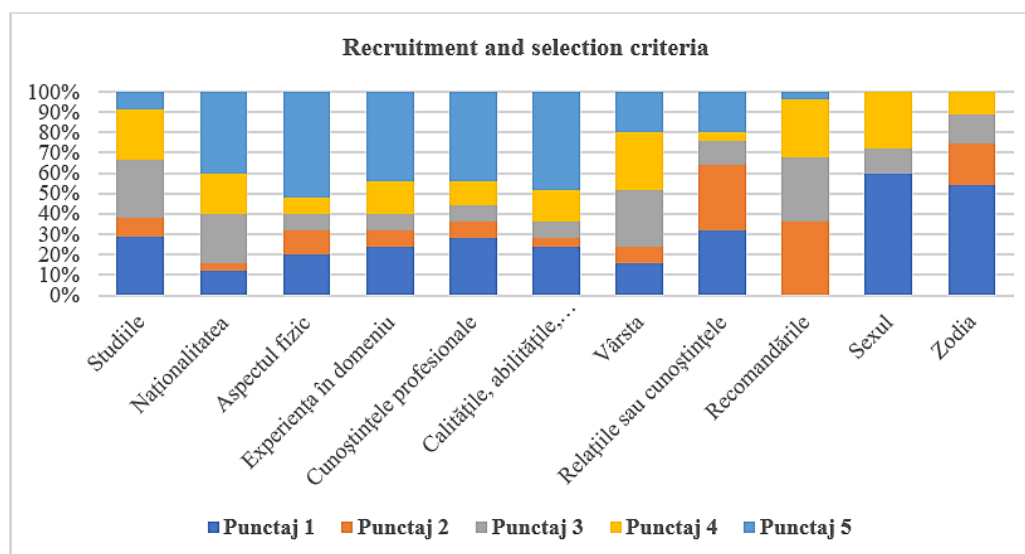
- Hiring unsuitable or insufficiently trained personnel for available roles;
- Higher costs for advertising the position, the selection process and training new employees;
- The risk of hiring the wrong people;
- Employees may feel frustration or resentment if they see that new colleagues are not prepared or suitable for their respective roles;
- Rapid and inappropriate hiring can lead to a higher employee turnover rate and reduced stability in the organization.

The following question is formulated as follows: “Give a grade from 1 to 5 (1- least important, 5- most important) for each of the criteria according to which employees are recruited and selected within your company”, and the answer options were:

- Studies
- Nationality
- Physical appearance
- Experience in the field
- Professional knowledge
- Individual qualities, abilities, skills
- Age

- Relationships or acquaintances
- Recommendation
- Sex
- Fate

Figure 4. *Recruitment and selection criteria*



Source: results of the questionnaire

Regarding education, only 9% of respondents said that this is an important criterion in choosing candidates, with a total of 59% saying that education is not important at all or almost not at all in selecting candidates. Many young people aspire to a college degree because they see it as a symbol of success and believe that it also brings them a higher salary. But theory and practice must go hand in hand, an expert in educational policies draws attention in an analysis for The Conversation. Large companies, such as Apple, Tesla, IBM or Hilton, are encouraging this trend, the Harvard Business Review also notes, and instead of a degree, they ask for life experience and various skills in interviews.

In general, nationality should not be a deciding factor in the hiring process. Employers should focus on the skills, abilities and experience of candidates in relation to the job requirements and requirements. Discrimination based on nationality is illegal in many countries and can lead to legal consequences for the employer. However, 40% of respondents said they consider nationality when selecting a candidate. There are exceptions, such as cases where the law imposes specific citizenship requirements for certain positions, such as public functions that require citizenship or legal work authorization. But if we ask this question in correlation with the fact that none of the respondents work in state institutions, the results may constitute a possible red flag and a point that should be investigated in more detail.

Physical appearance is another criterion that was given the highest score by many respondents (52%). In the requirements of certain jobs, mentions such as “pleasant physical appearance”, “pleasant presence”, appear, but we never know what the employer means by these rather general terms. There are companies that request recruitment projects for sales agents, customer relations managers, top managers. For such positions that involve constant interaction with numerous customers in order to establish a business relationship, employers tend to pay more attention to physical appearance than for a position that involves back-office work. It is good to know that a pleasant physical appearance must always be doubled by communication and negotiation skills, as well as presence of mind and promptness. Attention to clothing details supported by proactivity, self-confidence and orientation towards results will make the candidate the favorite for a role, to the detriment of a person who just looks good.

As expected, field experience, professional knowledge, and individual qualities, skills, and aptitudes are important principles that respondents say they consider when conducting the recruitment and selection process for candidates. These characteristics help ensure that the candidate is a good fit for the available role. Relevant experience and knowledge are essential to being effective in a particular field or position. Relevant professional knowledge and skills are often directly proportional to job performance. A candidate with solid experience and competencies is more likely to be productive and bring value to the organization. Interpersonal skills, communication skills, and other personal qualities can influence a candidate’s ability to work in a team and contribute to a positive organizational culture. Relevant experience and skills can also indicate a candidate’s potential to grow and develop within the company.

Regarding the age of candidates, respondents were fairly balanced in their responses, with most stating that age is neither important nor unimportant (score 3) or important (score 4). Yes, age can influence the recruitment process, but it is important to emphasize that age discrimination is illegal in many countries. However, there are several ways in which age can influence the recruitment process:

- Some employers may have prejudices about a candidate's skills or capabilities based on their age. For example, some may assume that an older candidate would be less adaptable to new technologies;
- Some companies may have an organizational culture that favors a certain age group or values experience or young people;
- In some industries or countries, there are specific rules regarding minimum or maximum ages for certain roles or for certain benefits, such as pensions.

In general, it is important that the recruitment process is based on skills, experience and qualifications relevant to the role, rather than being influenced by age. Age discrimination can negatively affect the organizational culture, diversity and overall performance of the company.

Moving on, fortunately, 64% of respondents stated that relationships or knowledge are not at all important in the recruitment and selection process. In fact, a study by eJobs shows that job vacancies, false advertisements and lack of experience are the biggest fears of Romanians when it comes to hiring. The biggest fear for 22% of respondents is that the best jobs are taken by those who have “files”.

Regarding recommendations, 68% of the participants in the questionnaire answered that they are not important or are neither important nor unimportant. If references were still fashionable some time ago, now the online environment can offer a much broader perspective, but not necessarily 100% revealing, about candidates. Upon an in-depth analysis of all the information, corroborating with the interview, we can have a much more complex picture of the candidates than before, when we did not have the online environment. Recommendations should be requested so that the employer can build on the candidate from a professional point of view. They should support the candidates' performance, the way they did their job at the previous workplace, their strengths, the way they managed their employees in the case of managers, and their attitude towards colleagues. References should always reflect reality and be given correctly, objectively, explains Corina Neagu, founder of Dare Development Advice & Resources. Let's not forget, however, that there is a recommendation system on LinkedIn. These can be requested from colleagues, direct or indirect managers, colleagues in the same industry, clients, business partners, etc. and can be important for those looking for professionals in a certain field of activity.

There are a number of questions that the employer should not ask in a selection interview and on the basis of which to decide on the employment of the person in question. In many countries, questions related to marital status, age, religion, race, political interests, sexual orientation or health status are discriminatory, their inclusion in a recruitment interview being prohibited by law. In Romania, law no. 202/2002 prohibits discrimination through the use by the employer of practices that disadvantage persons of a certain sex at work, regarding the filling of vacant positions, salaries and other benefits, information and counseling or promotion. The same law also provides exceptions to the rule: in the case of those workplaces where, due to the conditions of work provided for by law, gender characteristics are decisive. The participants in the study conducted for this paper responded that for 72% of them, a person's gender is not important in the recruitment and selection process. As might be expected, the zodiac sign is not a defining criterion either, with 74% of respondents not taking this aspect into account when recruiting.

Table 2. *The scoring for each criterion*

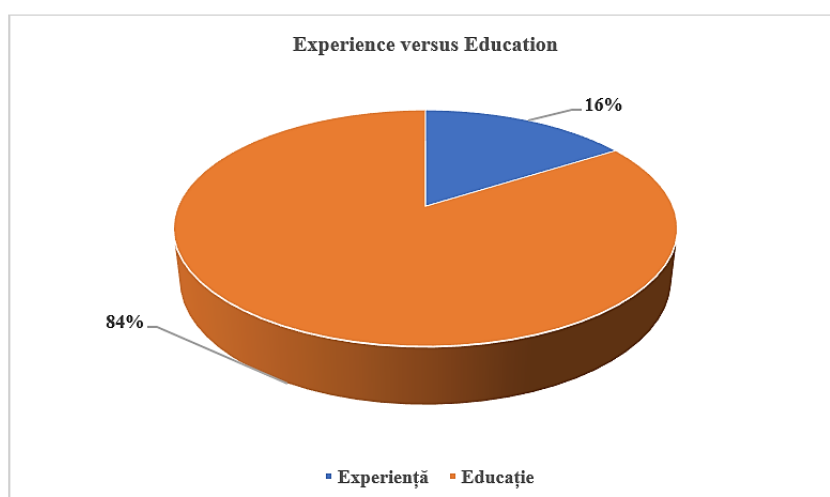
Criteria / Scoring:	1	2	3	4	5
Studies	29%	10%	29%	25%	9%
Nationality	12%	4%	24%	20%	40%
Physical appearance	20%	12%	8%	8%	52%
Experience in the field	24%	8%	8%	16%	44%
Professional knowledge	28%	8%	8%	12%	44%

Criteria / Scoring:	1	2	3	4	5
Individual qualities, abilities, skills	24%	4%	8%	16%	48%
Age	16%	8%	28%	28%	20%
Relationships or acquaintances	32%	32%	12%	4%	20%
recommendation	0%	36%	32%	28%	4%
Sex	60%	0%	12%	28%	0%
fate	54%	21%	14%	11%	0%

Source: results of the questionnaire

When asked “Which of the criteria ‘experience’ versus ‘education’ is most important in the decision to hire a candidate?”, 80% of participants said that experience is much more important than education in the decision to hire a candidate for a new role. These responses validate the scores given to the question above, related to the importance of field experience and professional knowledge.

Figure 5. *Experience versus Education*



Source: results of the questionnaire

Experience is often considered more important than education in the recruitment process for several reasons:

- Experience in a field brings with it practical knowledge and skills that a candidate has acquired while actually working. These skills are often more concrete and easier to assess than formal education;
- Experience can convincingly show a candidate's ability to adapt to the work environment, face challenges, and solve problems in real time, in contrast to education, which can only provide theoretical knowledge;
- Experience in a similar role or in a similar field is often considered more relevant than formal education. Employers often look for candidates with experience that matches the specific requirements and needs of the role;

- Experience can highlight not only a candidate's technical skills, but also interpersonal skills, collaboration skills, and adaptability, which are important for team integration and contributing to organizational culture.

However, it is important to emphasize that both experience and education can be important and that their relevance depends on the specific nature of the role and its requirements. Sometimes, education can be crucial for obtaining certain certifications or for theoretical understanding of a field (medicine, for example), while practical experience can be essential for applying this knowledge in the real work context.

The following two questions in the questionnaire will be analyzed together, referring to the recruitment methods used for the “executive” versus “managerial” staff categories. Respondents were asked to give a score from 1 to 4 (1 – never, 2 – rarely, 3 – sometimes, 4 – frequently) to indicate the frequency with which each of the methods mentioned below is used:

- Publishing job advertisements on the company's internal website;
- Employee recommendations;
- List of former employees (boomerang employees);
- Promotions and internal transfers;
- Job advertisements published in the press;
- Temporary employment agencies (Leasing);
- Recruitment from educational institutions (internship);
- Recruitment through private recruitment companies;
- Offer of the National Employment Agency;
- Social Media;
- Head-hunting or recruiting from the competition;
- Recommendations;
- Career fairs;
- Recruitment sites

The questions were formulated as follows:

- *Which of the following personnel recruitment methods are mainly used within your company for the “executive” personnel category?*
- *Which of the following personnel recruitment methods are mainly used within your company for the “managerial” personnel category?*

The recruitment process consists of promoting job vacancies using the most appropriate channels, means and tools that allow maximizing the rate of attracting the most suitable candidates. The effectiveness and efficiency of the selection process, which follows (logically and chronologically) the recruitment process, depends on the success of the recruitment campaign. The selection consists of evaluating, deliberating, and ranking the applications received, including the CV analysis stage, as well as the interview round support stage.

Recruitment channels are those media through which the employer communicates the existence of a vacant position, based on a job advertisement. These channels are diverse and are primarily customized according to the strategy the employer opts for, giving priority either to internal recruitment (the most common case, also considered an example of good practice), or to external recruitment, or treating equally applications from internal candidates (current employees looking for a new career opportunity within the organization) and those from outside the company.

Analyzing the responses regarding the recruitment of executive staff, we note that among the most used methods are the publication of job advertisements on the company's internal website (68% of respondents), recruitment websites, internal promotions and transfers, recommendations from employees or from third parties – all of these methods each having percentages ranging between 60% – 65% of the number of responses. The results obtained for these recruitment methods are not at all surprising and were even expected in the current context of the labor market. Internal recruitment allows for a more correct and efficient choice of human resources, increases the degree of employee motivation, decreases the staff turnover rate and there are also greater chances that the promoted person will achieve better performance.

It is also not surprising that most respondents say that the organizations they work for do not use the National Employment Agency's offer or the job advertisements published in the press at all or very little. According to the ANOFM, during 2024, the National Employment Agency has a generous budget of 896 million lei, dedicated to supporting the employment of the unemployed from vulnerable categories.

These categories are: the unemployed over 45 years old, the unemployed who are single parents supporting single-parent families, the long-term unemployed or young NEETs (aged between 16 and 30, who are unemployed, not in education or training), people with disabilities and other special categories. Employers who decide to employ people from these categories have access to a monthly subsidy of 2,250 lei, for a period of 12 months, provided that the employment is maintained for at least 18 months. In addition, there are other types of subsidies available, at least theoretically, to employers, such as those intended for employing young people at risk of marginalization or organizing apprenticeship programs and internships for higher education graduates.

However, the employers participating in this study do not resort to this method, and the reason is quite simple: the main jobs/occupations that those who are registered on the ANOFM lists can perform are: commercial worker; agent; cook's assistant; data entry, processing, validation operator; green space caretaker; chef; hairdresser; pastry chef. Therefore, too few of these roles are in demand in the multinational companies space. Much the same reason applies to job advertisements published in the written press.

Figure 6. Recruitment of „execution” personnel



Source: results of the questionnaire

A less expected aspect is that the results for recruitment from educational institutions are quite low: only 12% of respondents say they use this type of recruitment frequently, with most claiming they never or only rarely use it (76% in total). There are several reasons why some employers choose not to use internships as their primary recruitment method: costs (organizing an internship program can be expensive, as it involves financial and human resources for training and supervision), time invested (a program can last several weeks or months, and some companies prefer to recruit people with immediate experience to quickly fill vacant positions), the need for an experienced workforce (in certain fields or for certain positions, employers may prefer to recruit experienced people instead of investing time and resources in training interns), lack of necessity (in some cases, companies can find enough talent and suitable candidates through other recruitment methods, such as job postings or professional networks, without having to run an internship program), cultural or strategic preferences (some companies may have an organizational culture or recruitment strategy that is better suited to other methods than internships). However, internships remain a valuable recruitment method for many companies, providing training and development opportunities for young professionals and building lasting bonds between employers and future employees.

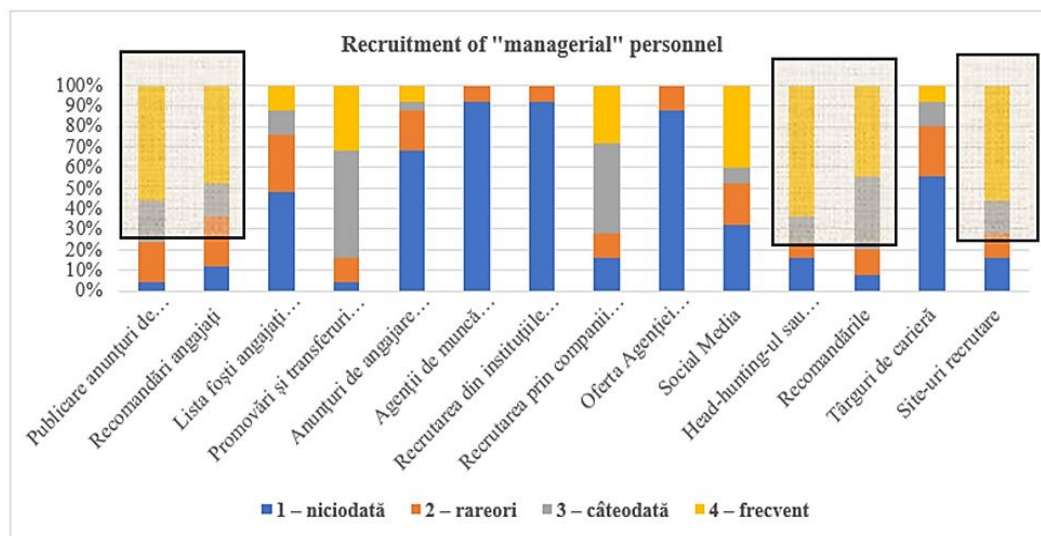
Analyzing the preferred recruitment methods for “managerial” personnel, we note that these are largely the same as those used for “executive” personnel – posting job advertisements on the company's internal website, employee referrals, internal promotions and transfers, recruitment websites. The difference between the two categories of personnel is given by the high share of head-hunting or recruitment from competitors for “managerial” personnel (64% of participants say that this is one of the preferred recruitment

methods for this category of personnel), compared to the “executive” one. Recruiting a manager from competitors can bring several advantages, including:

- The manager brings with him valuable experience, detailed market knowledge, and effective strategies that he has accumulated while working at the other company;
- Having already gained knowledge about the industry and competition, the recruited manager can adapt more quickly to the work environment and make their contribution in a shorter time;
- A manager recruited from another company can bring new perspectives and ideas, thus contributing to innovation and improvement of processes and strategies within the company;
- The manager brings with him a network of contacts, which can be leveraged for collaborations, partnerships or even for recruiting other talents;
- Recruiting a manager from the competition can strengthen the company's position in the market and help increase its reputation and market share.

However, it is important to be aware of potential conflicts of interest or confidentiality clauses in the manager's previous contract and to manage these issues appropriately.

Figure 7. Recruitment of „managerial” personnel



Source: results of the questionnaire

As for the recruitment of people with executive roles, for the managerial group, the least preferred methods are job advertisements published in the written press, temporary employment agencies (Leasing), the offer of the National Employment Agency and recruitment from educational institutions (internship) – the latter is no longer a surprise, considering that managerial positions require people with professional experience (senior level).

The following two questions in the questionnaire will also be analyzed together, referring to the selection methods used for the “executive” versus “managerial” staff categories. Respondents were asked to give a score from 1 to 4 (1 – never, 2 – rarely, 3 – sometimes, 4 – frequently) to indicate the frequency with which each of the methods mentioned below is used:

- The classic CV
- Video CV
- The classic interview at the company headquarters
- Video interview
- Behavioral interview (competence-based)
- Group interview
- Aptitude test
- Knowledge test
- Personality test
- Practical tests
- Simulation
- Cognitive ability test
- Situational behavior test
- Assessment centers
- Letter of intent

The questions were formulated as follows:

- *Which of the following personnel selection methods are mainly used within your company for the “execution” personnel category?*
- *Which of the following personnel selection methods are mainly used within your company for the “managerial” personnel category?*

Once the recruitment process is complete, there will likely be dozens of applicants. The selection phase involves identifying the best candidates from the pool that was attracted by the recruitment campaign. Now, it is up to HR professionals to filter out the qualified and unqualified candidates for the open position. Once the candidates whose skills and abilities do not match the job requirements have been eliminated, the selection process can continue.

Regarding the selection methods for executive staff, the least preferred are the video CV (96% of respondents say they never or rarely use it), the group interview, but also tests of any kind (personality, cognitive ability, situational behavior), assessment centers and letters of intent.

Of the 15 proposed selection methods, the one based on the classic CV leads the way – with 84%, followed by the classic interview at the company headquarters – 64%. A somewhat surprising result is that related to the behavioral interview – 44% of participants responded that they practice this type of interview for executive staff. One of the reasons is that in general, behavioral interviews offer a structured and objective approach to

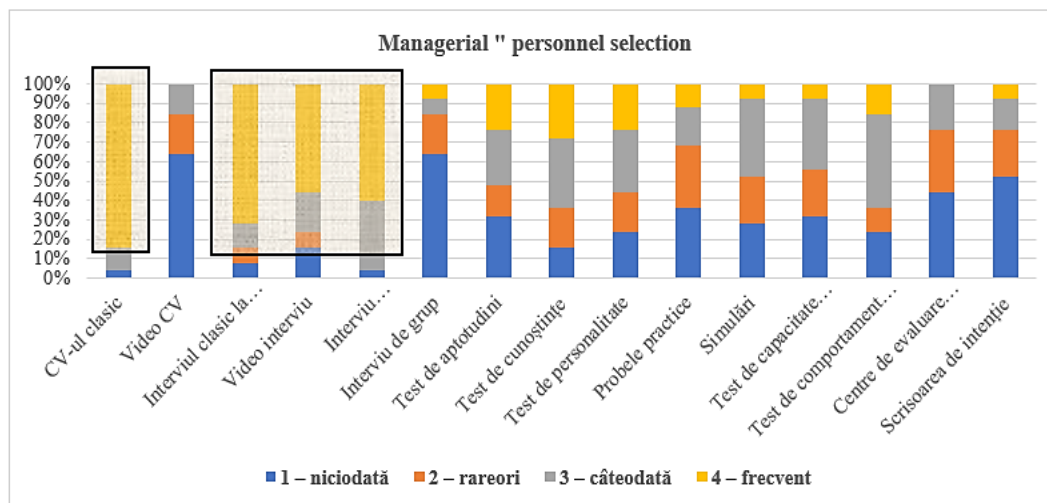
evaluating candidates and can contribute to identifying the most suitable candidates for a certain position. Studies show that past behavior is a strong indicator of future behavior.

Therefore, behavioral interviews provide employers with a way to infer how candidates will perform in certain situations and work contexts in the future. Behavioral interviews ask candidates to provide specific examples from their past experience, which allows employers to better understand how they have handled various situations and challenges in the past.

The video CV is one of the most modern forms of interviewing, but it is very rarely used by both employers and employees. It is based on the fact that for the person in charge of hiring it is much easier to watch a 2-3 minute video, in which the candidate briefly summarizes his or her professional skills and achievements, than to go through a CV written on paper.

This type of CV is mainly used by airlines, television or applying to various foreign universities. The group interview is also not among the most effective, and some of the reasons may be: the difficulty of evaluating candidates individually, lack of confidentiality, the potential for biases and external influences, additional stress for candidates. However, in some cases, group interviews can be useful for assessing communication, collaboration and team leadership skills.

Figure 8. Selection „Execution”



Source: results of the questionnaire

If slightly different methods are used for the recruitment of executive and managerial personnel, in terms of selection, the methods are the same, with small differences in scores, namely: the classic CV is also the preferred method in the case of managerial personnel selection and leads the way with 84% of the responses saying that it is a frequently used

method. The second most frequently used method is the classic interview at the company headquarters – with a result of 72%. Next are behavioral interviews, used by 60% of those who responded to the questionnaire, and video interviews with 56%.

The least used methods are group interviews, the reasons being the same as those found in the executive personnel category, practical tests, assessment centers and letters of intent. A result that draws our attention and that we might have expected to see used to a greater extent for the selection of managerial personnel is that related to assessment centers. According to specialized studies, assessment centers can be very useful especially when a comprehensive and objective assessment of candidates for management positions or for positions that involve specific skills, such as leadership or real-time decision-making, is needed. However, companies in Romania avoid the method, and some of the possible reasons could be:

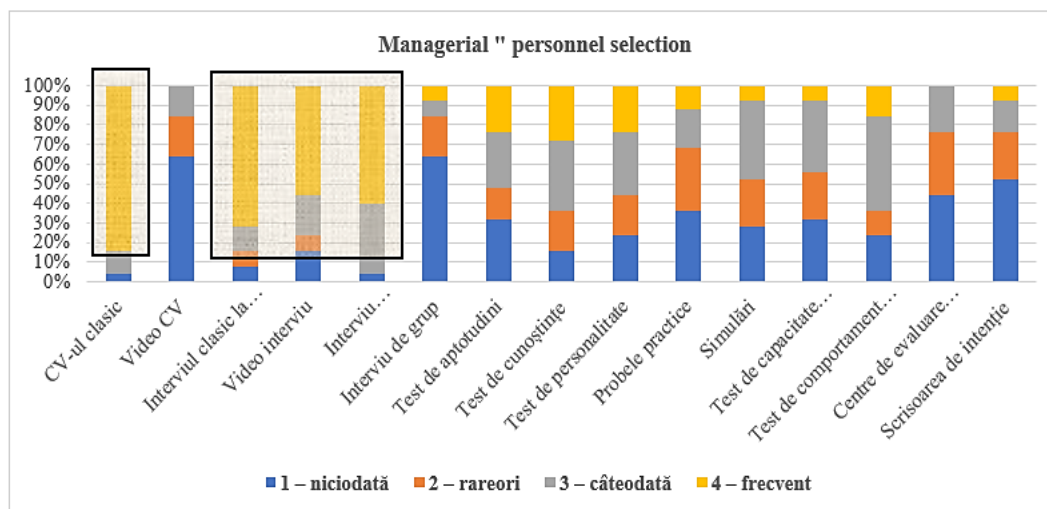
- Firstly, the high costs: organizing an assessment center can be financially and logistically expensive, involving considerable resources for planning, implementation and evaluation;
- The process of organizing and conducting an assessment center can take longer than individual interviews or other assessment methods, which can affect the speed and effectiveness of the recruitment process;
- Assessment centres often involve a series of complex activities and exercises, such as case studies, role-playing or group exercises, which can be difficult to implement and manage in practice.
- Cultural and organizational preferences: in some cultures or organizations, individual interviews or other assessment methods are considered more appropriate than assessment centers, for various reasons related to the specific context of the organization or the labor market.

I would now like to turn my attention to cover letters. It seems that the answer to the question “Do recruiters still read cover letters?” is “never” or “rarely”. It depends a lot on how it is worded, how personalized the letter is and what skills are detailed in it.

However, a good cover letter can significantly increase your chances of being invited for an interview and will make the difference between being a shortlisted candidate or not. There is no doubt about the importance of writing a cover letter, even if not all job advertisements contain a direct request for one. The paradox is that while employers may not always read all cover letters, most of them want the applications they receive to contain them.

The advantage for candidates is that whether it is read or not, a cover letter always makes a good impression. The job market is incredibly competitive and an application that stands out from the other candidates is certainly not easy to create.

Figure 8. Managerial personnel selection



Source: results of the questionnaire

6. Conclusions

The research results confirm that the process of recruitment and selection of human resources in Romanian companies is in a period of transition between traditional practices and modern trends, adapted to the requirements of the global market. Although classic methods, such as CV analysis and interviews conducted at the company's headquarters, continue to be preferred by most employers, there is a growing orientation towards the use of online platforms, social networks and digital technologies, which indicates a gradual modernization process.

A significant element highlighted by the study is the increased emphasis placed on professional experience to the detriment of formal education, which reflects the trends of international literature that emphasize the value of applied knowledge and the ability to adapt to organizational realities. At the same time, criteria such as compatibility with the organizational culture, socio-emotional skills and development potential within the organization are gaining increasing importance in the decision-making process. These aspects confirm the transition from a bureaucratic, rigid approach to a strategic and flexible one, focused on human capital as an essential resource for performance and innovation.

The research also highlights a number of persistent challenges. Labor migration, high staff turnover and regional discrepancies limit the ability of organizations to cover their human resources needs. In this context, it becomes essential for organizations to develop coherent employer branding policies and retention strategies, designed to strengthen employee loyalty and reduce the risks associated with talent loss. In addition, bureaucratic barriers

and resistance to innovation, especially in the public sector, can slow down progress and adaptation to new labor market realities.

An important direction for the future is the digitalization and professionalization of human resources processes. The implementation of modern recruitment tools, based on artificial intelligence, predictive analytics and integrated assessments, can contribute to increasing the objectivity and efficiency of selection. At the same time, the continuous training and specialization of human resources professionals is a fundamental condition for coping with the changes caused by globalization and new forms of work.

The study highlights the fact that organizations in Romania are in a process of continuous adaptation, trying to balance traditional methods with modern ones, in a context marked by economic uncertainties, demographic pressures and rapid technological changes. The success of this process depends largely on the ability of organizations to learn from international good practices, to capitalize on the professional experience and soft skills of employees and to invest in digitalization and in strengthening an attractive and inclusive organizational culture.

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Heterogeneity and Typologies in EU Agri-Food Trade with the US and China: Evidence from Latent Class Analysis

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Abstract. *This article examines the heterogeneity of EU member states in agri-food trade with the United States and China, using Latent Class Analysis (LCA) on Eurostat data from 2000-2024. Trade flows are analyzed across four product categories to capture differences in market orientation, product mix, and exposure to non-EU partners. Findings reveal two distinct typologies: one with low engagement across both markets, and another with high orientation, especially in value-added products. Notably, class membership is largely independent of GDP, highlighting the role of specialization and trade strategy rather than economic size. The analysis underscores significant internal diversity within the EU, which aggregate trade statistics often mask. The results provide insights for policymakers seeking to enhance competitiveness, manage market access, and align trade strategies with resilience and sustainability objectives in global agri-food markets.*

Keywords: Sustainable growth; economic sectors; EU agri-food trade; EU Green Deal; United States; China.

JEL: O44; Q01; Q54; Q43; L16.

1. Introduction

Trade policy frameworks continue to shape the EU's agri-food export dynamics. Recent evidence (Gourdon, 2020) shows that non-tariff measures-including SPS and technical barriers-remain significant constraints on market access. Studies such as „Economic and environmental impacts of agricultural non-tariff measures” (Mao, 2023) and „Heterogeneous impact of non-tariff measures on import margins through global value chains” (Yang, 2024) confirm that these measures generate hidden costs varying substantially across products and trade partners. Recent data confirm that the European Union continues to occupy a pivotal position in global agricultural and agri-food markets. In 2022, its agri-food trade amounted to 401.5 billion of euros with a surplus of 58 billion of euros (Commission, 2023).

Meanwhile, EU exports remain strong: in 2023, the European Commission reported a record agri-food trade surplus. And political leadership has made boosting exports to China a priority despite lingering trade tensions (European Commission, 2024). This dual pressure-of regulatory friction and export ambition- frames the current policy challenge. More recently, in 2024 the EU logged exports of 235.4 billion of euros and trade surplus of 63.6 billion of euros (Commission, 2025). These figures not only underscore the competitiveness of EU exports, but also reinforce its structural reliance on external markets for both primary inputs and high-value processed goods.

2. Literature Review

The World Trade Organization is often cited as proof that international law can help manage and diffuse tensions among states in the midst of shifting geopolitical orders. In the case of China's rise-arguably the most significant geopolitical transformation of recent decades- this interpretation seems, at first, to hold true. However, closer examination suggests a more complex reality (Wu, 2016). While China's WTO accession in 2001 institutionalized tariff reductions and expanded trade flows, it also introduced new asymmetries and vulnerabilities, particularly for trade partners such as the European Union. These dynamics underline the importance of moving beyond aggregate trade figures and examining how different groups of EU member states position themselves within agri-food trade relations with both the United States and China (Lardy, 2019). Existing scholarship on international trade and the WTO has largely focused on global or bilateral dynamics, often emphasizing aggregate outcomes such as total trade volumes, tariffs levels, or overall market access (Stephen J. Redding, 2019). While these perspective are valuable, they tend to obscure the internal diversity of the European Union, where member states differ markedly in their trade orientations, product specializations, and exposure to external markets. A growing body of work highlights these variations, but there remains limited attention to how EU countries collectively-and in differentiated ways-navigate agri-food trade with both the United States and China (Amiti, 2019).

Before January 2017, the trade relationship between the United States and China was far more nuanced than simplified „free trade” narrative often invoked by Donald Trump. U.S. trade restrictions on Chinese goods were comparatively modest, consisting mainly of MFN

(Most Favored Nation) tariffs-identical to those applied to all WTO (World Trade Organization) members (Bown, 2021). From 1980 until China's accession to the WTO in 2001, these tariffs were renewed annually by Congress on a provisional basis. Once China joined the WTO, however, the arrangement shifted to „permanent” normal trade relations (Amiti, 2019).

The COVID-19 pandemic, compounded by the energy crisis and the war in Ukraine, has revealed deep vulnerabilities in global and European food supply chains. Research shows that small and medium-sized enterprises (SMEs) were particularly exposed, yet many mitigated risks through strategies such as supplier diversification, inventory flexibility, and digitalisation (Ali, 2022). In Spain, Hernandez Romero and Coenders (Romero, 2025) identify distinct clusters of agri-food firms whose financial resilience during the Ukraine-Russia conflict was linked to stronger capital buffers and adaptive business models. Broader analyses highlight that Europe's food security challenges are shaped not only by geopolitical disruptions but also by the need to enhance resilience at multiple levels of the supply chain (Rabbi, 2023) (Chepeliev, 2025). Policy-oriented reports also point to concrete pathways: the EU CAP Network (Network, 2024), for instance, emphasises best practices such as cooperative models, transparent value chain governance, and ESG-based supplier criteria. Taken together, these findings suggest that sustainability and resilience are increasingly intertwined and central to shaping future agri-food trade orientations.

3. Methodology

In order to analyze these elements, which constitute a current and important process, especially in the current situations, other geopolitical tensions, data taken from the Eurostat database for the trade sector were used. Thus, the data presented and processed were taken over and compiled based on four very well-defined criteria from the aggregate indicator Eurostat – Comext (International trade in goods). Based on all the identification variables, only four very well distinguished categories were set which thus generated the four working groups with the help of chapters 1 – 24 as follows: (1) Ct_1 (products of analyzed origin, (2) Ct_2 (vegetable products) (3) Ct_3 (fats and oils) and (4) Ct_4 (preparation of food/beverages and derived products). The breakdown is documented in the section “Eurostat Statistics Explained” in the DG AGRI facts sheets section (WTO methodology). The import and export data for the selected products have been downloaded, for all the member countries of the European Union taken individually, for trade relations with China and the United States of America. The time period identified and chosen to generate a comprehensive database and lack of values is from 2000 to the year 2024. There was no need for imputation methods because there were no missing data for the chosen period, and in the years identified as lacking values, the lack of trade relations of some countries towards foreign partners was confirmed and as a result there was no need to fill in the missing values. In this way, a file was generated with the nominal values, expressed in euros, other than all the chosen indicators, described above, to which Gross Domestic Product is added as a benchmark for analysis.

In the data apparatus and for data transformation, percentage weights of the data were used in an expulsive way, which made the variables comparable between countries and did not require methodologically strong assumptions about scale. After data cleaning and standardization, each of the four main indicators were discretized into three ordinal levels (1, 2, and 3, respectively) based on empirical thirds. This switch to the ordinal reduced the sensitivity to the inclined distribution, stabilizes the estimation on samples reduced in dimensionality and analyzes the indicators with the nature of the latent model.

The analysis was carried out using the RStudio econometrics software, version 4.4.3. The effective modeling of the typologies was done through the Latent Class Analysis (LCA) where an unobserved categorical factor explained the common distribution of the four ordinal items under the assumption of local identity. The key parameters are your own and the item-response probabilities on levels 1/2/3 of each item; they were estimated by maximizing likelihood using the EM algorithm in the package (poLCA), using 50 random restarts and a large imitation of iterations to avoid local minimums, with reproducibility ensured by setting the seed.

The selection and evaluation followed standard criteria: BIC as the rule of choice, parsimony and informational performance, incautiously reported with AIC and Log-likelihood; for the overall adequacy, the likelihood-ratio and degrees of freedom statistics were calculated χ^2 . The quality of the classification is documented by posterior probabilities at the country level, synthesis in APPA (mean probability per assigned class) and normalized entropy; The high values of both data indicate a clear set and low uncertainty regarding the consistency of the typologies, a process that was followed by the stability of the solution on restarts and by the consistency of the item-response probabilities between classes. The code used for running the models and setting the parameters can be seen in the Annex at the end of the work.

4. Results

The first step in the whole analysis was to make the initial descriptions of the work apparatus in order to draw the overall picture of the calculations performed. For each EU member state, we calculated the agri-food shares in relation to the US and China, separately by import and export, aggregated over the period 200-2024 (percentages). Table 1 gathers the essential statistics of position and dispersion on these four analyzed variables so as to quickly and easily see how heterogeneous the countries are and whether the distributions are also asymmetrical or tend to be oriented towards extremities. The descriptive table governs the rest of the section: it shows where we might have outliers, how big the differences between countries are, and implicitly, why a latent theologization (LCA) is worth in the next steps.

Table 1. *Descriptive Statistics*

Variable	Stat	Import	Export
USA	N	27	27
USA	Mean	7.067	6.082
USA	SD	5.355	6.109
USA	Min	1.265	0.161

Variable	Stat	Import	Export
USA	P25	3.298	1.414
USA	Median	5.655	3.792
USA	P75	7.895	9.711
USA	Max	20.551	23.048
China	N	27	27
China	Mean	1.803	6.495
China	SD	1.12	6.652
China	Min	0.127	0.061
China	P25	0.968	1.461
China	Median	1.636	3.257
China	P75	2.206	9.517
China	Max	4.526	22.731

Source: Author's calculations of the variables taken from the Eurostat database using the RStudio Economics software, model 4.3.3.

Table 1 summarizes the cross-country distributions of agri-food shares to the two key states, namely to China and the United States of America (with a number of 27 observations). The average share of imports from the US is 7.07%, considerably higher than the average in China, namely 1.80%, which shows a relatively greater dependence of the countries of the European Union on the American market on the import side. As far as exports are concerned, the averages to the USA (6.08% and those to China (6.50%) are close, but the medians differ from case to case (USA with 3.79% versus China 3.26%); the values indicate that the average to China is drawn upwards by a few countries that have very high shares, while for the USA the distribution is more homogeneous around the median.

The dispersion and forms of the distributions confirm a strong heterogeneity between countries. The variant coefficient (SD/Mean) is high for exports (almost 1.00 for the USA and almost 1.02 for China), signaling straight tails and large outliers (Max USA-exp 23.05%; China-exp 22.73%). On the import side, the variability is more moderate (US – 0.76; China – 0.62), but still with positive asymmetry: the averages are above the medians over all four series. The inter-quartile ranges confirm the picture: 8.30 pp in USA-exp and 8.06 pp in China-exp (vs. 4.60 in USA-imp and 1.24 in China-imp), which suggests that the differences between countries are expressed mainly in the share of exports. Given the number of observations, the asymmetry and the large dispersion, especially on the export side, the average-based estimates (OLS) would be sensitive to the steel industry, so in the analysis we used robust descriptions (median and quartile) and LCA to capture discrete typologies of trade orientation, instead of assuming linear relationships and homoscedastic variance between indicators.

After reviewing the food description, we have made an additional level of detail in order to be able to observe in stages what is the dispersion of each country within each of the four corridors of the elements around which the table has been made. Thus, in Figures 1 to 4, a representative image was made for the composition of agri-food products on EU-US and EU-China relations, separated by import and export, the heat maps made decompose agri-food into the four elementary categories, expressing percentages of agri for each country. The section reveals what exactly the commercial relationship is made of, not just how big

it is, and explains why some countries appear in the LCA typology as directly oriented: the mix of products is completely different and often concerted.

Figure 1. China Import Ct. 1-4

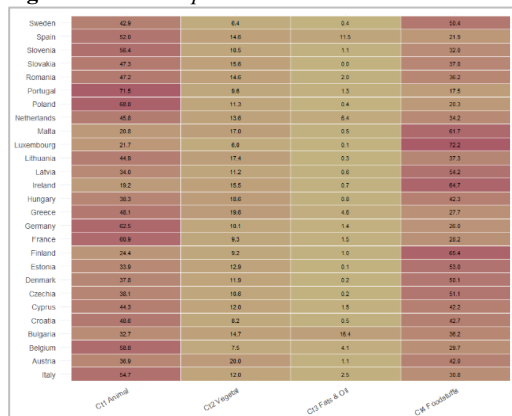


Figure 2. China Export Ct. 1-4

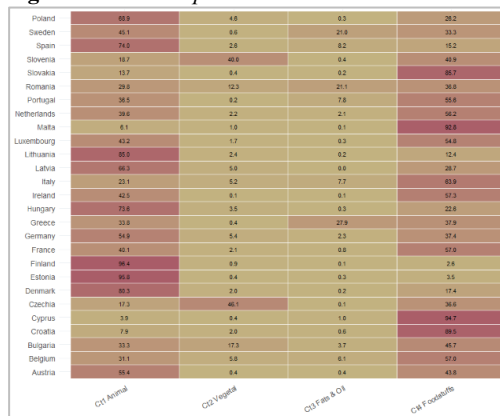


Figure 3. USA Export Ct. 1-4

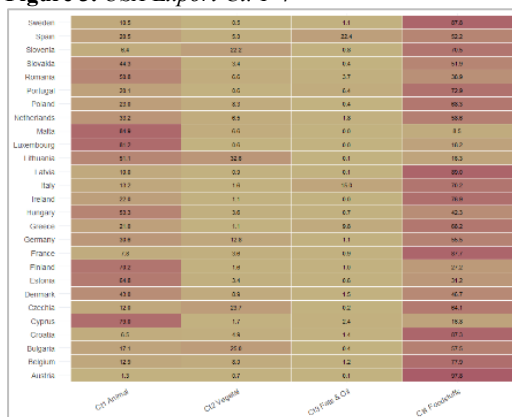
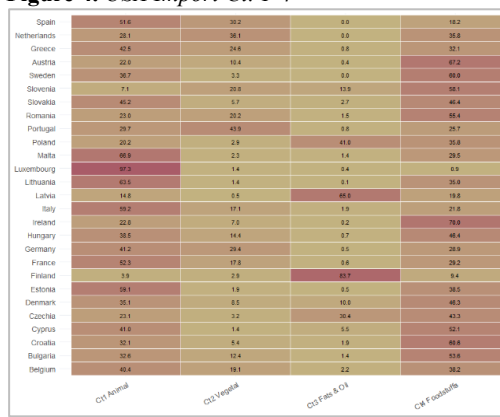


Figure 4. USA Import Ct. 1-4



Agricultural export to the US is often intense in Ct4 (preparations / beverages), a sign of the European value chain selling processing products on the American market; Many countries exceed 60% for this segment. However, there are exceptions with very high Ct1 (such as Finland, Cyprus or Malta) which indicates specialization in animal raw materials. Countries such as the Netherlands / Spain combine Ct4 raise with a non-negligible share of Ct1/Ct2, a sign of diverse portfolio. For LCA, these differences in mix explain why some economies fall into the “direct-oriented class”: not only do they export a lot, but they export value-added products.

On the import side from the US, there is a higher share of Ct1 – Ct2 in many countries (meat/milk, cereals; oilseeds sector), but also punctual peaks: for example, Finland has an extremely high Ct3, and Luxembourg is almost entirely in Ct1. Countries such as Italy or Ireland have a constant Ct4 (between 20% and 50%), suggesting a dependence on processed products on certain segments. Economic-structural, the import mix reflects domestic needs and logistical positions; econometrically, the validity on Ct3/Ct4 confirms

that the large dispersion helps in descriptive analysis and justifies treating countries as distinct profiles in LCA.

On imports from China, Ct4 is high in several countries, such as Luxembourg or Malta, but very high Ct1 is also seen in countries such as Portugal or Germany, signaling that part of the flow is on animal materials. Ct2 has medium weight, and Ct3 remains generally modest. Conclusion: the import relationship with China is not exclusively on “cheap preparations”, but has a mixed profile; this partially explains the moderate US-China correlations (by imports) in Table 2 below.

On the export side from China, Ct4 is high in several states, but it is seen that there is a strong polarization process: a group of Nordic / Eastern economies sits at Ct1 very high, while other economies mainly sell Ct4. Large countries such as Germany or Italy combine Ct1 / Ct4 in relevant proportions, a sign of access to more on the Chinese market. For LCA, these models show that the high orientation is not unique as a network and can be achieved either with raw materials (Ct1) or with preparations (Ct4), which underlines the internal heterogeneity of Class 2.

Overall, Ct4 dominates exports to both partners, while Ct1-Ct2 imports weigh more, with occasional exceptions (Ct3 very high in a few economies). This geography of the product mix is consistent with the Spearman correlation and LCA separation; Class 2 countries not only have higher shares, but also tend to be specialized (Ct1 or Ct4), which amplifies the difference compared to Class 1. After the overview of Table 1, we have now quantified the bivariate associations between the core indicators (agri-food shares in the US/China, Import/Export, and the share of GDP in the EU) using the Spearman correlation, robust to asymmetric distributions and outliers, suitable for the 27 countries. We calculated the Spearman correlation between the two series as the Pearson correlation calculated by rank levels:

$$\rho_s = \text{cor}(\text{rank}(X), \text{rank}(Y)),$$

And, in the situation where the correlation link is absent, the classic formula with the differences in rank is used d_i :

$$\rho_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)}$$

Statistical significance is assessed by approximation t:

$$t = \rho_s \sqrt{\frac{n-2}{1-\rho_s^2}}, n = 27$$

Spearman was used because he works on ranks and is robust to asymmetric distributions. In the sample N=27, values of 0.67 (USA-China export) are strong and statistically significant, and 0.51 (USA-China import) are moderate and significant. Values of 0.35 and 0.4 tend to be moderate-poor, often meaningless, so the results are associative, not casual.

Table 2. *Spearman Correlation*

	GDP	USA Imp	USA Exp	China Imp	China Exp
GDP	1.00	(0.21)	0.23	0.08	0.07
USA Imp	(0.21)	1.00	0.35	0.51	0.40
USA Exp	0.23	0.35	1.00	0.07	0.02
China Imp	0.08	0.51	0.07	1.00	0.62
China Exp	0.07	0.40	0.02	0.62	1.00

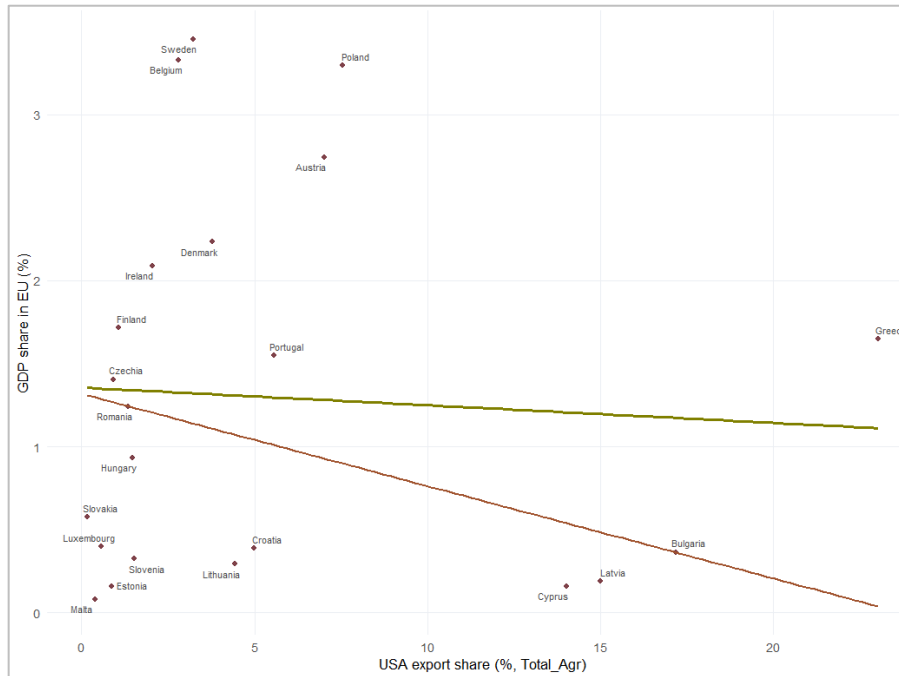
Source: Author's calculations of the variables taken from the Eurostat database using the RStudio Economics software, model 4.3.3.

The strong positive correlations on exports between the US and China ($p=0.67$) and moderate positive correlations on imports ($p=0.51$) show that EU countries tend to be co-oriented: those who have a large share towards one non-EU partner have, as a rule, relatively large shares towards the other. Economically, this suggests general openness (logistics infrastructure, commercial networks, certification capacity (and/or product mixes in both markets). The fact that the links to the size of the economy are weak means that it is not the size of GDP that explains the patterns of the relationship; Specialization rather matters: medium or small countries can have very large shares on certain flows, while large economies can have moderate shares towards a specific partner. Politically, this implies two avenues (i) horizontal measures that increase simultaneous access to both markets (standardization, customs facilities, origin branding) and (ii) interventions in the niche where specialization (Cr1 vs Vt4) makes the difference.

After Table 2 showed that the association between the share of GDP in the EU and the share of food exports to the US is weak (low Spearman coefficient), we check these relationships in Figure 5. The point cloud juxtaposes GDP_share (y) and USA_export_share(x), over which we have superimposed the OLS line, i.e. the correlation relation on raw values, and the quantile regression on the median. The almost zero slope of the OLS confirms the low-order coefficient (very weak linear relationship), and the quantile line, slightly lower, suggests that in the middle of the distribution of larger economies they tend, if anything, to have smaller weights towards the USA. The presence of countries with high shares of GDP but low shares of exports and some small in terms of GDP, but with high shares to the USA explains why the correlations remain low.

Figure 5 visually confirms what the correlations in Table 2 show: there is no robust linear relationship between the share of GDP in the EU and the share of food exports to the US. The OLS line is almost flat (small slope, slightly negative), and the median quantile regression line is even lower, a sign that in the middle of the distribution larger economies tend, if anything, to have breast weights towards the USA< while small/medium economies can reach high weights due to specialization. This image is consistent with low correlation between variables; the coefficient on gross values is reduced (acilasi order of magnitude), and Spearman on ranks di Table 2 is only 0.23 for (GDP, USA_exp). Size thus does not explain relative patterns; the differences are related to the product mix and the positioning on the value chain, which is why, in the next section, we use LCA to identify topologies, using LCA to identify trade-oriented topologies, not a linear dependence of GDP.

Figure 5. GDP share versus USA export share



As the relationships between the size of GDP and the trade shares are weak, and the movements between the orientation indicators are consistent but not hilly, we move from bivariate correlations to a modeling by typologies. We apply Latent Class Analysis (LCA) to see if EU countries are grouped into distinct trade profiles, without imposing linear relationships between the four weights (US/China x import/export).

Table 3. Fit by K Analysis, APPA By Class & Entropy

K	AIC	BIC	Gsq	Chisq	npar	df	pval_Gsq	pval_Chisq
2	238.410131	250.439357	40.2978834	43.3624925	17	10	1.50154E-05	4.2831E-06
3	247.241699	280.933457	31.1294517	34.8064256	26	1	2.41381E-08	3.6417E-09
4	259.040592	304.394882	24.9283447	26.4990703	35	-8	2.29711E-08	3.4656E-09
Class		APPA	N					
Class1		0.97182998	14			K	Entropy	Entropy_R2
Class2		0.99348849	13			2	0.05687778	0.94312222

Source: Author's calculations of the variables taken from the Eurostat database using the RStudio Economics software, model 4.3.3.

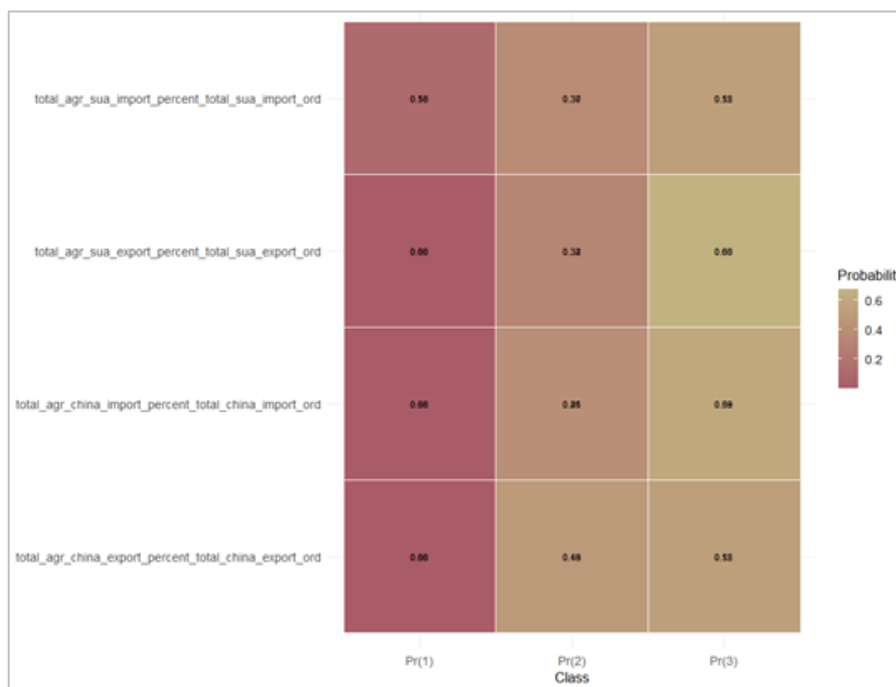
The informational criteria clearly indicate K=2 classes as the optimal solution: BIC has the lowest value at 250.439357 (and AIC is the lowest at 238.41), while more complex solutions do not bring informational gain; for K=4 even negative df (-8) appears, a sign of over-parameterization. The quota matching stats remain low, a frequent result in LCA on ordered items, but the decision is based on parsimony (AIC/BIC), not on classic “perfect fit” testing. The distribution by class is almost balanced (N=14 and N=13), and the quality of the assignment is very high: APPA of 0.9972 in Class 1 and 0.993 in Class 2, which indicates posterior probabilities close to 1 for most countries. The low entropy of 0.0569

and the Entropy-R of 0.943 confirm the strong separation of the two typologies: almost 94% of the information useful for classification is captured by the two-class model.

The LCA model maximizes verisimilitude and compares specifications through AIC and BIC; select K with a minimum BIC (with a higher level of penalties). APPA (Average Posterior Probability of Assignment) summarizes, by class, the a posteriori probabilities of the observations included in that class; Values > 0.95 indicate secure assignment.

After selecting the model (K=2, minimum BIC) from Table 3, we checked what each class means at the item level. Figure 6 shows the probability conditioned on the four ordinal variables (USA/China x import/export) for the three levels defined by the P25-P66 thresholds (low/medium/high).

Figure 6. LCA Item-response probabilities (Levels 1-3)



In class 1 the probability is high on level 1 (low) for all iteele (0.5-0.6), and level 2 (hight) is low (0.05-0.15). In the second grade, the ratio is reversed. Level 3 (high) dominates (0.5-0.7), and level 1 is almost nil. This consistent monotony across all items confirms that the topologies are well separated across the entire set of variables, not just one, consistent with APPA > 0.95 and Entropy-R of 0.94 in Table 3. In addition, the lack of visible off-diagonal triangles suggests that local independence is reasonable for this specification. Class 1 describes countries with a low orientation simultaneously towards the US and China (import + export), while Class 2 concentrates the high orientation on both markets. The separation is clearest on USA_Export and China_Import, remaining sharp on both USA_Import and China_Export. In terms of policy, Class 2 represents economies with strengthened commercial capabilities (networks, certifications, product mix) while Class 1

indicates more closed profiles or limited specializations. To quantify the differences on an easy-to-communicate scale, Table 4 presents the percentage averages of the four weights in each class. There you can see numerically what the figure visually suggests: Class 2 has clearly higher average levels on all four axes, confirming the “low vs. High orientation” narrative.

Table 4. *Class Profile Mean*

Class Profile Mean	Class1	Class2
Σ USA Agri Imp as % from Total USA Imp	4.97940318	9.31579275
Σ USA Agri Exp as % from Total USA Exp	1.77836764	10.717067
Σ China Agri Imp as % from Total China Imp	1.05817711	2.60425186
Σ China Agri Exp as % from Total China Exp	2.34896395	10.9603332

Source: Author's calculations of the variables taken from the Eurostat database using the RStudio Economics software, model 4.3.3.

Table 4 reports the averages per class for the four weights. There is a systematic contrast between the two typologies: Class 2 has higher average levels on all variables compared to Class 1 – USA_Imp 9.32% vs 4.98% (+4.34 pp, -1.9x); USA_Exp 10.72% vs 1.78% (+8.94 pp, -16x); China_Imp 2.60% vs 1.06% (+1.55 pp, -12.5x); China_Exp 10.96% vs 2.35% (+8.61 pp, -4.7x). The most pronounced differences occur in exports, indicating that the separation between classes is mainly governed by the ability to place in extra-EU external markets: imports contribute to a more moderate but consistent extent. This numerical teacher is consistent with the quality metrics in Table 3 (APPA > 0.97; Entripy-R = 0.94), which suggests a substantial and stable expectation of typologies.

Figure 7. *LCA – Class profile mean (%)*

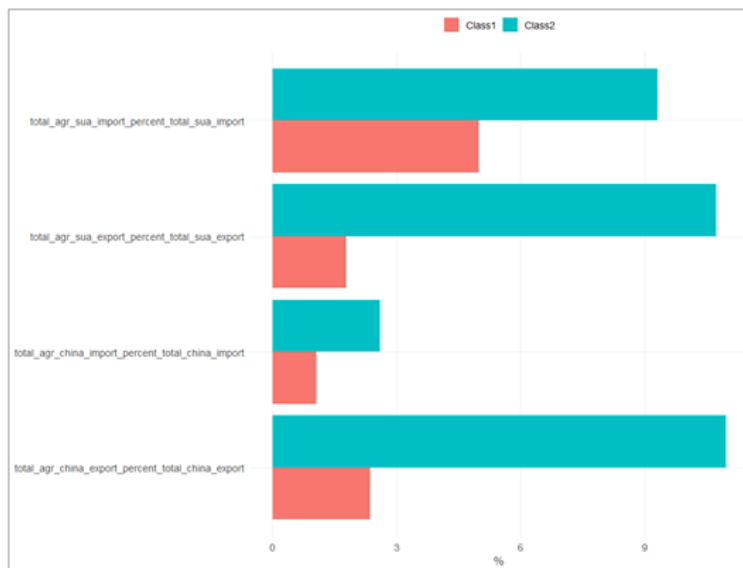


Figure 7 completes Table 4 by graphically representing the same averages per class. The bars visually highlight the same hierarchy: Class 2 dominates on all four axes, with maximum export differentials (US vs China) and average import differentials. The order and magnitude of the gaps are robust in relation to the internal variations of the distributions

described above, thus, the figure confirms that the identified typologies do not reflect a single indicator, with a consistent multi-dimensional pattern (US/China x import/export) that supports the interpretation “low orientation” versus “high orientation”.

Having established the economic substance of the classes, the next step is Table 5, which documents the belonging by country and the certainty of the assignment (Posterior_max and Margin) in order to assess the clarity of the classification of each economy in one of the two typologies.

Table 5. *Posterior_max & Margin data*

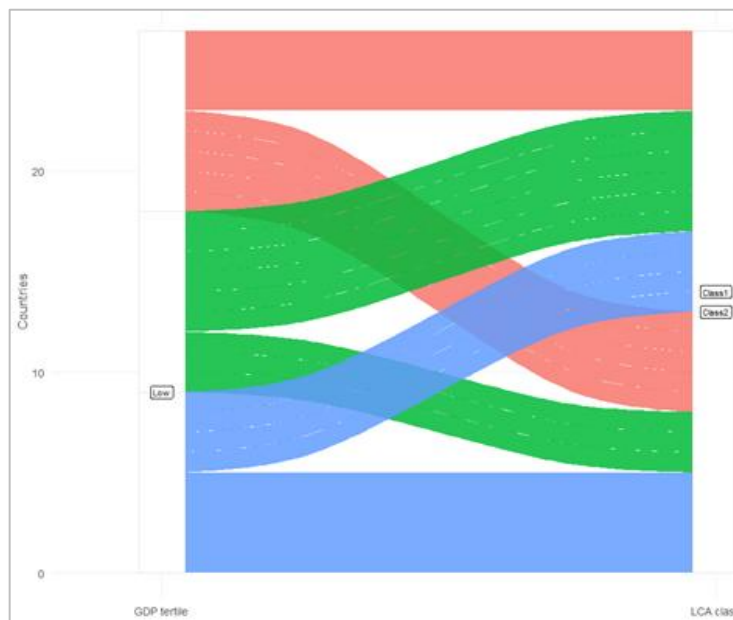
Country	Class	Posterior	Margin	Country	Class	Posterior	Margin
Austria	class1	0.975	0.97	Bulgaria	class2	0.859	0.91
Czechia	class1	0.985	0.69	Cyprus	class2	0.951	0.51
Estonia	class1	0.949	0.50	France	class2	0.960	0.30
Finland	class1	0.498	0.91	Greece	class2	0.955	0.91
Germany	class1	0.652	0.51	Italy	class2	0.730	0.57
Hungary	class1	0.896	0.31	Latvia	class2	0.952	0.69
Ireland	class1	0.932	0.97	Netherlands	class2	0.965	0.92
Luxem.	class1	0.982	0.69	Poland	class2	0.951	0.69
Malta	class1	0.926	0.44	Spain	class2	0.846	0.87
Romania	class1	0.952	0.90	Denmark	class2	0.988	0.977
Slovakia	class1	0.895	0.69	Lithuania	class2	0.988	0.977
Slovenia	class1	0.985	0.60	Portugal	class2	0.983	0.967
Sweden	class1	0.847	0.90	Croatia	class2	0.955	0.91
Belgium	class1	0.169	0.211				

Source: Author's calculations of the variables taken from the Eurostat database using the RStudio Economics software, model 4.3.3.

The table documents the quality of class classification for each country: Posterior_max represents the probability of the assigned class (maximum per row), and Margin measures the local separation from the immediate alternative (the difference between the maximum probability and the second largest probability). For $K=2$, the relationship between meters that is deterministic, having $\text{Posterior_max} \in [0.5, 1]$. The reported values indicate a generally firm classification, with most countries having $\text{Posterior_max} \geq 0.95$ and High Margin; A small subgroup is in the range of 0.60-0.95, which marks less certain observations. An isolated case around 0.60 (corresponding to a $\text{Margin} \approx 0.20$) remains ambiguous and should be mentioned as such.

The distribution of values confirms the quality results in Table 3 ($\text{AAPA} > 0.97$; $\text{Entropy_R} \approx 0.94$); The separation between classes is substantial, and residual uncertainty is concerted in a few economies considered to be marginal. From an economic point of view, these cases tend to combine different product mixes (Ct1 vs Ct4) and intermediate levels on several axes, which brings them, in profile, closer to both typologies. For numerical consistency, it is recommended to Margin directly from Posterior_max and report a trust category (High ≥ 0.95 ; Medium 0.85-0.95; Low ≤ 0.85).

To assess whether class membership simply reflects the size of the economy, the following figure, Figure 8, maps the distribution of countries across third GDP and LCA classes; the dispersion of flows across both classes indicates substantial independence of size, in line with the correlations in Table 2.

Figure 8. *Alluvial – GDP tertiles LCA class*

Thus, after documenting the classification by class and the certainty of the assignment (Table 5), the next step is to verify whether the LCA typologies simply follow the size of the economy. To this end, Figure 8 represents an alluvial mapping of low-mid-high GDP to LCA classes ($K=2$).

Streams are dispersed from all three thirds to both classes, without a single dominant channel. Both the low and high third of GDP send substantial segments to both typologies, which indicates that class membership is largely orthogonal to the size of the economy. The result is consistent with the low correlations in Table 2 (GDP vs share) and with the bivariate figure GDP-US export share: size does not determine oriented mechanisms. From the point of view of policy interpretation, the conclusion is that interventions must be calibrated on the trade profile (mix Ct1-Ct4 and openness on the US/China), not on the size of GDP.

For a formal verification of the independence between reporting classes, a test χ^2 on the 3x2 and Cramer V contingency table (0-1; values <0.2 indicate weak association) can be investigated. In addition, if caution is desired towards marginal cases, flows can be weighted with Posterior_max (hard vs soft assignment); The visual conclusion in the alluvial normally remains open.

5. Research limitation

While this study provides a detailed typology of EU agri-food trade with the US and China, several limitations should be acknowledged. First, the analysis relies on aggregate trade data at the country-product level, which may obscure firm-level strategies, intra-country

regional variations, and sector-specific nuances. Second, the LCA methodology assumes local independence and a discrete number of classes, while robustness checks were performed, alternative model specifications or additional covariates could yield slightly different typologies. Third, the study focuses on nominal trade values and percentage shares, without explicitly considering price fluctuations, exchange rates, or dynamic trade policies, which could influence observed patterns. Finally, the temporal coverage ends in 2024, limiting the ability to assess the potential effects to rapidly evolving geopolitical or regulatory developments. Beyond these methodological limitations, the identified trade typologies should be interpreted as descriptive structural patterns rather than as outcomes of explicit policy choices or strategic alignment with sustainability objectives. The analysis does not directly assess compliance with the EU Green Deal or other regulatory frameworks, but instead provides an empirical classification of existing trade configurations. As such, the results are intended to support interpretation and comparative analysis, rather than normative evaluation.

6. Future research directions

Future studies could extend this analysis by integrating firm-level or regional trade data to capture micro-level heterogeneity. Incorporating dynamic variables such as tariffs, trade agreements, or exchange rate fluctuations could provide a more nuanced understanding of trade responsiveness. Additionally, exploring the interplay between supply chain resilience, ESG adoption, and trade performance would link trade typologies with sustainability outcomes. Comparative analyses over time, including post-2024 trade data, could also evaluate whether identified typologies remain stable under shifting geopolitical and economic conditions. Finally, methodological extensions such as hierarchical or mixed-method latent class models may improve classification accuracy and account for multi-level dependencies within EU trade networks. Building on the typology developed in this study, future research could further investigate how differentiated EU agri-food trade patterns relate to strategic policy objectives and external economic positioning. Linking the identified classes to sustainability benchmarks, trade policy instruments, or resilience indicators would enhance the analytical and practical relevance of the framework. Such extensions would allow the proposed typology to serve as a bridge between empirical trade analysis and evidence-based policymaking.

7. Conclusions

This paper explored the heterogeneity of EU agri-food trade with the United States and China through a latent class analysis of country-product level data. The findings reveal clear trade typologies, reflecting diverse patterns of specialization and market engagement among EU member states and across different agri-food products. By moving beyond aggregate trade indicators, the study offers a structured perspective on the underlying complexity of EU external agri-food trade.

Interpretively, these typologies provide insights into potential strategic orientations and vulnerabilities within EU trade networks, particularly in the context of evolving global markets, sustainability priorities, and geopolitical shifts. While the analysis does not directly evaluate policy compliance, the results highlight the significance of differentiated trade structures for understanding how EU agri-food trade could interact with objectives such as the EU Green Deal and broader sustainability initiatives.

Overall, the paper contributes to the literature by combining rigorous quantitative classification with policy-relevant interpretation. The proposed typological framework is flexible and can be applied to other trade partners, extended time frames, or additional sustainability dimensions, supporting more nuanced analyses of EU trade heterogeneity in future research.

Statements

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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Circular Economy and Digital Innovation in Education: A Strategic Framework for Emerging Markets

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Abstract. *Education systems in emerging markets are increasingly challenged by the simultaneous pressures of environmental sustainability, digital transformation, and persistent structural inequalities. While digital innovation is frequently promoted as a catalyst for educational modernization, its long-term effectiveness depends on the sustainable management of resources, infrastructure, and institutional capacities. In parallel, the circular economy has gained prominence as a systemic approach to sustainability, yet its application within educational institutions – particularly in developing contexts – remains underexplored and insufficiently operationalized. This study proposes and empirically examines a strategic framework that integrates circular economy principles with digital innovation to enhance the sustainability, inclusiveness, and resilience of education systems in emerging markets. Adopting a convergent mixed-methods design, the research combines quantitative survey data collected from 450 participants (students and teachers) with qualitative insights derived from semi-structured interviews. The quantitative component assesses attitudes toward circular economy principles, the use of digital technologies in education, and self-reported sustainability-related behaviors, while the qualitative analysis explores perceived facilitators, barriers, and institutional dynamics shaping adoption processes. The findings reveal significant differences in engagement across roles and academic disciplines, with teachers and participants from technical fields demonstrating stronger alignment with circular economy-oriented digital practices. Qualitative results further highlight the critical role of institutional support, digital infrastructure, and curriculum flexibility in translating positive attitudes into actionable sustainability practices. By clarifying how circular economy principles can be operationalized through digitally enabled educational infrastructures, this study contributes an empirically grounded framework with direct relevance for policymakers, educational leaders, and institutions seeking to align digital innovation with sustainability objectives in emerging market contexts.*

Keywords: circular economy; digital innovation; education; emerging markets; sustainability.

JEL: Q56; O33; I25; O15.

1. Introduction

Education systems are increasingly at the crossroads of digital transformation and sustainability, especially in emerging markets where structural, resource, and socio-economic challenges are significant. Recent studies show that digital innovation is widely seen as a way to broaden educational access, boost instructional efficiency, and make institutions more responsive to societal shifts, particularly during disruptive times (Huang et al., 2020, pp. 12–15; Radulescu et al., 2021, pp. 4–6). The rapid spread of digital learning platforms, cloud infrastructure, and data-driven tools has transformed teaching methods and administrative operations. Nevertheless, evidence indicates that digitalization alone cannot guarantee lasting resilience or inclusiveness, especially when technological growth is not paired with strategic resource management and institutional change (Silvestru et al., 2018, pp. 2–4; Shah et al., 2024, pp. 621–624).

The circular economy (CE) has emerged as a systemic sustainability paradigm challenging traditional linear production and consumption models. It is rooted in systems thinking and ecological economics, focusing on resource efficiency, waste reduction, reuse, and maintaining value across interconnected systems (Stahel, 2016, pp. 435–436; Geissdoerfer et al., 2017, pp. 758–760). Recent research shows that CE principles are increasingly incorporated into international strategies and policy frameworks, especially within the European Union and other multilateral organizations (Pernici et al., 2024, pp. 3–5). Although much attention has been given to applying circular economy models in industrial production, supply chains, and urban development, their institutional integration into education remains limited and fragmented.

Digital innovation has proven to be crucial in improving organizational resilience, adaptability, and performance across various sectors, including education (Felicetti et al., 2024, pp. 318–322; Iftikhar et al., 2024, pp. 828–831). In educational settings, digital tools promote flexible learning environments, facilitate collaboration, and aid in optimizing institutional processes (Huang et al., 2020, pp. 18–22). However, research in emerging markets consistently highlights ongoing digital divides, governance challenges, and infrastructural gaps that hinder the transformative potential of educational digitalization (Radulescu et al., 2021, pp. 8–11; Costache & Enăchescu, 2025, pp. 6653–6656). These findings indicate that technological innovation must be integrated into larger sustainability-focused frameworks to achieve lasting and equitable results.

Despite increasing scholarly focus on sustainability and digital technologies, there is limited empirical research on their strategic integration into education systems. Most existing studies focus on pedagogical results, digital skills, or overall sustainability skills, but offer little insight into how principles of the circular economy – like resource efficiency, lifecycle management, and systemic resilience – can be practically applied at the institutional level in education (Bocken et al., 2016, pp. 311–314; Pernici et al., 2024, pp. 6–8). This issue is especially significant in emerging markets, where education systems are challenged by demographic growth, funding shortages, and uneven technological development.

To address this gap, the current study proposes a strategic framework that combines circular economy principles with digital innovation in education systems, especially focusing on emerging markets. It views educational institutions as socio-technical ecosystems where

digital infrastructure can promote circular resource management, institutional flexibility, and inclusive access. Instead of seeing sustainability and digitalization as separate goals, the study explores how they interact as a systemic process that influences educational performance and resilience.

Methodologically, the research uses a convergent mixed-methods design, merging quantitative survey results with qualitative insights from semi-structured interviews. This allows for the identification of structural patterns across roles and disciplines, while also considering contextual factors that affect the adoption of circular economy-driven digital practices. By empirically analyzing attitudes, behaviors, and institutional conditions, the study advances the literature on sustainable education systems and digital transformation, providing an evidence-based framework relevant to policymakers, educational leaders, and institutions in emerging markets.

Accordingly, the primary objective of this study is to empirically examine how circular economy principles can be integrated with digital innovation at the institutional level in education systems, with a particular focus on emerging market contexts.

2. Literature Review

Circular Economy: Conceptual Foundations and Sectoral Diffusion

The circular economy (CE) is widely viewed as a systemic alternative to traditional linear economic models based on extraction, consumption, and disposal. It is fundamentally defined as an approach that seeks to keep the value of products, materials, and resources in use within economic systems for as long as possible, minimizing waste and environmental harm (Stahel, 2016, pp. 435–436). Later research emphasizes how CE principles foster innovation, resilience, and long-term value generation across interconnected systems (Geissdoerfer et al., 2017, pp. 758–760).

Initially, studies mainly focused on industrial production, business models, and supply chains. However, recent work highlights the growing institutional adoption of CE in international policies. Pernici et al. (2024, pp. 3–5) show that CE has been incorporated into major European strategies through formal plans, monitoring tools, and governance structures. Despite this progress, adoption varies across sectors. Education is often seen as a driver of sustainability change rather than a sector influenced by circular resource flows, infrastructural issues, and lifecycle management.

This reveals a structural gap in CE research. While education is frequently linked to raising sustainability awareness and developing human capital, its internal operations – such as energy use, digital infrastructure, and resource management – are seldom examined through a circular economy perspective. Consequently, implementing CE principles in educational institutions remains underdeveloped conceptually and lacks comprehensive empirical analysis.

Digital Innovation and Sustainability Challenges in Education

Digital innovation has become a defining feature of modern education, transforming teaching methods, organizational workflows, and access to learning. Studies during major

educational disruptions show that digital platforms and cloud infrastructure help maintain learning continuity and organizational flexibility (Huang et al., 2020, pp. 12–22). Outside of crisis situations, digitalization brings efficiency, adaptable learning settings, and better coordination within educational institutions.

However, the sustainability of digital innovation in education is debated. While digital tools may reduce the need for physical resources, they also introduce new sustainability concerns, such as energy consumption, electronic waste, and reliance on infrastructure (Silvestru et al., 2018, pp. 5–7). Organizational research indicates that simply adopting technology does not ensure better performance or resilience unless integrated within strong institutional and governance frameworks (Shah et al., 2024, pp. 621–624).

In emerging markets, these issues are worsened by ongoing digital divides and infrastructure gaps. Evidence shows that digital innovation can increase inequalities when access to technology, skills, and institutional support is uneven (Radulescu et al., 2021, pp. 8–11). These findings highlight the importance of combining digital transformation with sustainability-focused institutional strategies, rather than pursuing technological progress alone.

Education, Sustainability, and Human Capital Dynamics

Education is central to sustainable development, shaping human capital, behavioral norms, and societal trajectories. Past studies emphasize education's role in enhancing sustainability literacy, environmental awareness, and responsible resource behaviors, especially with digital access and informational infrastructure support (Zaharia et al., 2019, pp. 6–9). These insights highlight education as a driver for behavioral change rather than just knowledge transfer. Additionally, labor market research shows a growing link between educational outcomes, digital skills, and economic resilience. Radulescu et al. (2021, pp. 4–7) find that technological advances and sector shifts boost demand for adaptable skills, challenging education systems to effectively incorporate digital innovation. Other research confirms that blended and work-based learning improve critical thinking and employability in digitally driven economies (Dumitru et al., 2023, pp. 2–4). However, much of the sustainability education literature remains focused on curriculum content and individual skills, with limited attention to the institutional conditions needed for education systems to operate sustainably over time. This focus limits the analytical scope of sustainability education, especially within systemic frameworks like the circular economy.

Digital Innovation, Institutional Resilience, and Governance

Beyond pedagogical aspects, digital innovation is also explored as a factor that boosts organizational resilience and flexibility. Systematic reviews show that digital ecosystems help improve coordination, knowledge sharing, and innovation across different institutions (Felicetti et al., 2024, pp. 318–322). Similarly, research on data analytics and digital infrastructure highlights their importance in strengthening system resilience by enabling monitoring, prediction, and adaptive responses (Iftikhar et al., 2024, pp. 828–831).

However, within educational institutions, governance issues often hinder effective digital integration. Studies from emerging markets point to institutional rigidity, limited managerial

skills, and fragmented policies as main obstacles to sustainable digital transformation (Costache & Enăchescu, 2025, pp. 6653–6656). These insights are especially relevant from a circular economy standpoint, which values systemic coordination, lifecycle considerations, and institutional learning as essential for sustainability.

Synthesis and Research Gap

The reviewed literature converges on several key insights. First, research on the circular economy has advanced both conceptually and institutionally, but remains uneven across sectors, with education being underrepresented as an empirical domain (Stahel, 2016; Pernici et al., 2024). Second, digital innovation in education is widely recognized for its transformative potential, yet its sustainability implications are not sufficiently theorized, especially in emerging market contexts (Huang et al., 2020; Silvestru et al., 2018). Third, research on sustainability education prioritizes human capital development and behavioral change, while paying limited attention to institutional resource management and infrastructural resilience (Zaharia et al., 2019).

Despite the growing body of research on sustainability education and digital transformation, existing studies rarely operationalize circular economy principles at the institutional level within education systems, particularly in emerging market contexts. Most contributions address circular economy, digital innovation, and education as parallel or loosely connected domains, offering limited empirical guidance on how these dimensions can be systematically integrated to enhance institutional sustainability, resilience, and performance.

This lack of institutional-level operationalization limits both the analytical and practical value of existing research, particularly for policymakers and educational leaders seeking actionable sustainability frameworks. Against this background, an empirical investigation using a mixed-methods approach is required to explore how such an integrated framework operates within real educational institutions.

3. Methodology

Research Design

This study utilizes a convergent mixed-methods design, integrating quantitative and qualitative data to explore how circular economy principles and digital innovation interact in educational systems within emerging markets. The choice of the convergent approach allows for the simultaneous collection and analysis of numerical and narrative data, supporting triangulation and providing a more comprehensive understanding of complex institutional phenomena (Creswell & Plano Clark, 2018). This approach is especially suited for studying sustainability-driven transformations, which involve both measurable behavioral patterns and context-specific institutional dynamics.

The research design supports the goal of empirically assessing a strategic framework that combines circular economy principles with digitally enabled educational infrastructures. Instead of favoring a single methodological perspective, the convergent design enables the

integration of attitudinal, behavioral, and organizational insights, thereby strengthening analysis and interpretation.

While the empirical investigation focuses on a single institutional setting, the convergent mixed-methods design supports analytical rather than statistical generalization, allowing the findings to inform broader discussions on sustainability-oriented digital transformation in education systems.

Research Context and Sample

The empirical study was carried out at a public higher education institution and an affiliated secondary school in an emerging market context. This setting was chosen because of its involvement in digital transformation initiatives and sustainability-focused educational practices, making it suitable for exploring institutional dynamics related to circular economy implementation. Data collection was conducted during a single academic year, ensuring consistency in institutional conditions and educational practices across participants.

The quantitative part included 450 participants – 300 students and 150 teachers – selected through stratified random sampling to ensure representation across different academic disciplines (technical, social sciences, humanities) and roles. Students had to be enrolled in courses with digital tools or sustainability content, and teachers needed to have taught such courses in the previous year. For the qualitative part, purposive sampling was used to select 30 participants from the survey respondents – 20 students and 10 teachers – based on their survey responses. This ensured variation in engagement levels with digital innovation and circular economy practices, allowing for a broad range of perspectives from highly engaged and less engaged participants.

Quantitative Data Collection and Variables

Quantitative data were gathered using a structured questionnaire specifically created for this study, based on validated measurement scales adapted to the educational setting. The instrument included four sections: (1) socio-demographic details, (2) attitudes toward circular economy principles, (3) use of digital innovation in teaching and learning, and (4) self-reported sustainability-related behaviors within educational environments. All attitude and behavior items were measured on a five-point Likert scale, from 1 (“strongly disagree”) to 5 (“strongly agree”). The internal consistency of each construct was evaluated with Cronbach’s alpha, with all values surpassing the widely accepted threshold of 0.85, indicating strong reliability. To assess construct validity, an exploratory factor analysis (EFA) was performed, confirming the anticipated factor structure and supporting the coherence of the measurement model. A pilot test with 35 participants (25 students and 10 teachers) was conducted before full-scale data collection to evaluate item clarity, response time, and internal consistency. Minor revisions were made to enhance item wording and questionnaire flow.

Qualitative Data Collection

Qualitative data were collected through semi-structured interviews aimed at exploring participants’ perceptions, experiences, and interpretations regarding the integration of

circular economy principles and digital innovation in education. The interview guide was developed through an iterative process, drawing on existing literature and refined with feedback from experts. Key themes included facilitators and barriers to adoption, institutional support mechanisms, digital infrastructure limitations, and personal motivations for engaging in sustainability practices. Each interview lasted about 45 minutes and was conducted either face-to-face or via secure online platforms, with audio recordings made after obtaining participants' informed consent. All interviews were transcribed completely to maintain transparency in analysis.

Data Analysis Procedures

Quantitative data were analyzed with IBM SPSS Statistics (version 28). Descriptive statistics summarized participant traits and key variables. Inferential tests included independent samples t-tests and one-way ANOVA to explore differences across roles and disciplines. Multiple regression identified predictors of engagement with sustainability-focused digital practices, while controlling for relevant socio-demographic factors. All assumptions – normality, homoscedasticity, multicollinearity – were tested and satisfied.

Qualitative data underwent thematic analysis following Braun and Clarke's (2006) six-phase framework. Two researchers independently performed initial open coding, then refined themes iteratively. Discrepancies were resolved via discussion for greater reliability. NVivo software aided data organization and ensured coding transparency.

Integration of Quantitative and Qualitative Findings

Integration took place during the interpretation phase using a weaving approach, which involved systematically comparing and interpreting quantitative and qualitative findings together. This method helped identify convergent patterns, complementary insights, and the mechanisms explaining the statistical relationships observed. By combining both datasets, the study produced meta-inferences that support the proposed strategic framework and enhance the validity of the conclusions.

Ethical Considerations

The study followed established ethical standards for social science research. Participation was voluntary, with all participants providing informed consent, and confidentiality was maintained through data anonymization. Ethical approval was secured from the institutional review board before data collection.

4. Results

Sample Characteristics

The quantitative analysis draws on responses from 450 participants, consisting of 300 students (66.7%) and 150 teachers (33.3%). The participants were evenly distributed across different academic fields, categorized into technical disciplines, social sciences, and humanities, consistent with the stratified sampling method outlined in the methodology. The average age of students was 21.4 years, while teachers averaged 42.7 years old, with

teaching experience spanning from early-career to senior academic positions. These characteristics illustrate the educational setting's diverse structure and offer a solid foundation for exploring differences between roles and disciplines.

Descriptive Statistics of Key Variables

Participants showed moderate to high engagement with both circular economy principles and digital innovation in educational settings. Their attitudes toward circular economy principles averaged $M = 3.87$ ($SD = 0.62$) on a five-point Likert scale. Use of digital innovation in teaching and learning was similarly high, with a mean of $M = 3.75$ ($SD = 0.68$). However, self-reported sustainability behaviors in educational contexts were somewhat lower, averaging $M = 3.52$ ($SD = 0.71$). These results reflect a generally positive orientation toward sustainability and digital tools. At the same time, they reveal differences between attitudinal alignment and reported practices. A table presenting all key descriptive statistics is included in Table 1.

Table 1. *Descriptive statistics of key variables*

Variable	N	Mean (M)	Std. Deviation (SD)
Attitudes toward circular economy principles	450	3.87	0.62
Use of digital innovation in education	450	3.75	0.68
Sustainability-related behaviors	450	3.52	0.71

Note: All variables were measured using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree).

Differences by Educational Role

Independent samples t-tests revealed differences between students and teachers across key study variables. Teachers showed significantly stronger attitudes toward circular economy principles ($M = 4.02$, $SD = 0.57$) compared to students ($M = 3.79$, $SD = 0.64$), $t(448) = 4.21$, $p < .001$, with a small to moderate effect size (Cohen's $d = 0.37$). Additionally, teachers reported higher use of digital innovation ($M = 3.89$, $SD = 0.64$) than students ($M = 3.67$, $SD = 0.69$), $t(448) = 3.21$, $p = .001$, $d = 0.32$. However, there was no significant difference between students and teachers in self-reported sustainability behaviors ($p = .08$). These findings are summarized in Table 2.

Table 2. *Differences between students and teachers (independent samples t-tests)*

Variable	Group	Mean (M)	SD	t-value	p-value	Cohen's d
Attitudes toward circular economy principles	Students	3.79	0.64	4.21	< .001	0.37
	Teachers	4.02	0.57			
Use of digital innovation in education	Students	3.67	0.69	3.21	.001	0.32
	Teachers	3.89	0.64			
Sustainability-related behaviors	Students	3.49	0.72	1.75	.08	–
	Teachers	3.58	0.69			

Note: $p < .05$ indicates statistical significance.

Differences by Academic Discipline

One-way analysis of variance (ANOVA) was conducted to examine differences in attitudes and practices across academic disciplines. A significant effect of discipline was observed for attitudes toward circular economy principles, $F(2, 447) = 5.43$, $p = .005$. Post hoc comparisons with Tukey's HSD test showed that participants from technical disciplines reported significantly higher attitudes ($M = 4.01$, $SD = 0.58$) than those from humanities

($M = 3.72$, $SD = 0.66$, $p = .004$). No significant differences were found between social sciences and the other two groups.

In contrast, there were no significant disciplinary differences in digital innovation use or sustainability-related behaviors. These results suggest that disciplinary culture may influence conceptual understanding of circular economy principles more than actual behavioral practices. Detailed results are shown in Table 3.

Table 3. Differences by academic discipline (one-way ANOVA)

Variable	Discipline	Mean (M)	SD	F-value	p-value
Attitudes toward circular economy principles	Technical fields	4.01	0.58		
	Social sciences	3.88	0.60	5.43	.005
	Humanities	3.72	0.66		
Use of digital innovation in education	Technical fields	3.78	0.67	1.12	.33
	Social sciences	3.74	0.69		
	Humanities	3.71	0.70		
Sustainability-related behaviors	Technical fields	3.55	0.70	0.94	.39
	Social sciences	3.51	0.72		
	Humanities	3.48	0.73		

Note: Post hoc Tukey HSD tests indicated significant differences only between technical fields and humanities for attitudes toward circular economy principles.

Predictors of Engagement with Sustainability-Oriented Digital Practices

To analyze the factors linked to overall engagement, a multiple regression was performed using a composite score reflecting attitudes toward circular economy principles, digital innovation, and sustainability behaviors. Independent variables included educational role, academic discipline, age, gender, and teaching experience (for teachers). The regression was statistically significant, $F(6, 443) = 18.65$, $p < .001$, accounting for 20.4% of the variance in engagement scores (adjusted $R^2 = 0.204$). Educational role was a significant positive predictor ($\beta = 0.23$, $p < .001$), with teachers showing higher engagement. Academic discipline also significantly predicted engagement ($\beta = 0.18$, $p = .002$), particularly in technical fields. Age, gender, and years of teaching experience did not significantly predict engagement. Regression coefficients are detailed in Table 4.

Table 4. Multiple regression analysis predicting engagement with sustainability-oriented digital practices

Predictor Variable	β	Std. Error	t-value	p-value
Educational role (teacher)	0.23	0.04	5.62	< .001
Academic discipline	0.18	0.05	3.11	.002
Age	0.06	0.04	1.31	.19
Gender	0.03	0.03	0.88	.38
Teaching experience	0.07	0.05	1.37	.17

Model summary:

$F(6, 443) = 18.65$, $p < .001$

Adjusted $R^2 = 0.204$

Qualitative Findings

Thematic analysis of the semi-structured interviews identified three main themes: (1) Facilitators of Adoption, (2) Barriers to Integration, and (3) Institutional and Personal Motivations. Facilitators included organizational support, available training, and access to

digital infrastructure. Participants highlighted that organizational encouragement, and structured professional growth boosted their capacity to embed sustainability and digital innovation into teaching practices. Barriers mainly involved technological issues, time limitations, and rigid curricula. Participants noted that poor infrastructure, unstable digital platforms, and inflexible course design hampered the consistent use of sustainability-focused digital methods. Motivations, both institutional and personal, involved intrinsic factors like a personal commitment to sustainability and extrinsic factors such as professional recognition and career benefits. These motivations varied by role and discipline but consistently influenced engagement levels.

Integration of Quantitative and Qualitative Results

The combined insights from quantitative and qualitative data offer a clear understanding of sustainability-focused digital engagement in education. Quantitative findings showing higher engagement levels among teachers and those from technical fields were supported by qualitative feedback, which pointed out differences in access to institutional support and training. In contrast, the lack of notable differences in sustainability behaviors, despite attitudinal gaps, was explained through qualitative evidence that underscored structural and infrastructural limitations. This alignment highlights the benefits of the mixed-methods approach, illustrating how individual attitudes toward sustainability interact with institutional factors to influence actual practices in education.

5. Discussion

This study aimed to empirically explore the interaction between circular economy principles and digital innovation within educational systems in emerging markets, and to analyze the institutional conditions supporting sustainability, inclusiveness, and resilience. These findings directly inform the strategic framework proposed in this study, which conceptualizes education systems as socio-technical ecosystems integrating circular economy principles through digitally enabled institutional practices.

Results consistently show that, although attitudes toward these principles and innovations are generally positive, their translation into consistent practices is uneven and heavily influenced by structural and organizational factors. This supports the main argument from the Introduction: digital transformation alone cannot create sustainable educational systems without a systemic framework based on circular economy logic.

Descriptive data indicate a moderate to high alignment with circular economy and digital innovation across the sample, suggesting that sustainability narratives and technological tools are already embedded in the institutional environment. Nevertheless, the lower average score for sustainability behaviors points to a gap between conceptual support and practical action. This attitudinal-behavioral gap echoes earlier research, emphasizing that awareness and positive attitudes do not automatically lead to action without supportive institutional structures. From a circular economy perspective, it highlights the disconnect between cognitive agreement and systemic implementation.

Variations across educational roles underscore the importance of institutional positioning. Teachers show significantly stronger attitudes toward circular economy principles and report more frequent use of digital innovation than students, yet there are no significant

differences in sustainability behaviors. This suggests that professional roles provide greater access to institutional resources, training, and decision-making related to sustainability and digitalization. However, the lack of behavioral differences indicates that structural constraints – such as rigid curricula, limited infrastructure, or organizational norms – limit both groups' ability to consistently practice sustainability. These findings align with literature emphasizing that institutional support and governance are crucial for translating individual motivation into sustainable outcomes.

Disciplinary differences shed light on how circular economy principles are internalized in education. Participants from technical fields exhibit significantly more positive attitudes toward circular economy concepts than those from humanities, though no differences appear for digital innovation use or sustainability behaviors. This suggests that disciplinary epistemologies and cultures influence receptiveness to circular economy ideas, especially where resource efficiency and systems thinking are integral to disciplinary frameworks. Yet, the absence of behavioral disparities indicates that disciplinary alignment alone cannot drive systemic change without supportive mechanisms.

Regression analysis clarifies these dynamics by identifying educational role and discipline as significant predictors of engagement with sustainability and digital practices. Demographic factors and teaching experience are not significant. This challenges the assumption that experience or seniority foster greater sustainability engagement and highlights the importance of structural and cultural placement within institutions. From a circular economy view, this underscores systemic coordination and institutional learning as key drivers, rather than individual tenure.

Qualitative findings enrich the quantitative patterns by providing contextual understanding. Participants consistently cite institutional support, training access, and digital infrastructure as key facilitators, while technological limitations, workload, and curriculum rigidity are seen as main barriers. These themes support the quantitative evidence, emphasizing that constraints on digital sustainability are more structural than individual resistance. Participants' insights show motivation – both intrinsic and extrinsic – operates within organizational limits, reinforcing a systemic view of sustainability engagement.

Overall, the findings contribute significantly to the literature. They empirically validate that circular economy principles offer a valuable lens for understanding sustainability challenges in education, extending beyond industrial contexts. They also demonstrate that digital innovation alone is insufficient for sustainability without alignment with governance, resource management, and organizational learning. Furthermore, they reveal the particular vulnerabilities of emerging market education systems, where infrastructure and policy fragmentation risk superficial digital transformation.

Theoretically, the study advances sustainability and education research by framing education systems as socio-technical ecosystems integrating circular economy and digital innovation. This systemic approach extends existing models focused solely on curricula or individual skills, resonating with the circular economy's emphasis on lifecycle thinking, resource efficiency, and resilience. It also responds to calls for more empirically grounded frameworks in sustainability education.

Practically, policymakers and educational leaders should prioritize institutional capacity-building efforts like targeted training, infrastructure investments, and curricular flexibility. Viewing digitalization merely as a technological upgrade risks perpetuating inequalities. Strategies rooted in circular economy principles can promote sustainable resource use, strengthen institutional resilience, and foster long-term transformation, especially in emerging markets.

In conclusion, integrating circular economy principles with digital innovation offers a promising but challenging route to sustainable education. Success relies on coherent institutional frameworks that align digital infrastructure, governance, and sustainability goals. These insights lay a solid foundation for the final discussion, where the study's contributions, limitations, and future research directions are outlined.

6. Conclusions

This study investigates how circular economy principles can be combined with digital innovation to enhance sustainable, inclusive, and resilient education systems in emerging markets. Using a convergent mixed-methods approach, it offers empirical evidence that extends beyond normative sustainability debates, providing a structured, institutionally grounded view on transforming education.

The results show that although students and teachers generally support circular economy ideas and digital innovation, turning these attitudes into consistent practices remains inconsistent. This gap highlights a key finding: sustainability in education cannot rely solely on technology or awareness. It requires systemic alignment among digital infrastructure, institutional governance, and resource management – central themes of circular economy theory.

Differences across educational roles and disciplines emphasize the role of institutional context. Teachers and those in technical fields are more engaged with circular economy digital practices, indicating that exposure to resources, disciplinary culture, and professional duties influence sustainability efforts more than demographics or experience alone. The lack of behavioral differences points to structural barriers like infrastructure gaps, rigid curricula, and workload pressures, confirming that educational sustainability challenges are mainly institutional, not individual.

Theoretically, the study advances understanding by framing educational institutions as socio-technical systems, integrating circular economy concepts – such as lifecycle thinking, resource efficiency, and resilience – into digital education debates, especially in emerging markets.

Practically, findings suggest policymakers and educational leaders should focus on building institutional capacity through investments in infrastructure, professional development, and flexible curricula. Framing digitalization as only technological risks superficial changes. Circular economy principles encourage deeper transformation by embedding sustainability into organizational and governance practices.

Limitations include the cross-sectional design, potential response bias, and focus on a single context, which limit broader applicability. Future research should consider longitudinal studies, multiple institutions, and advanced analysis like structural equation modeling. Qualitative work on governance and organizational culture could further clarify how circular economy practices can be embedded in education.

In summary, combining circular economy principles with digital innovation holds promise for sustainable education in emerging markets. Real progress requires shifting from isolated efforts to integrated institutional frameworks that align technology, governance, and sustainability. By shifting the analytical focus from isolated technological interventions to integrated institutional frameworks that align technology, governance, and sustainability objectives, the study offers a pragmatic contribution to contemporary debates on sustainable education policy.

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Strategic Policy Planning for Sustainable Development in Romania: An EU Governance Case Study

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Abstract. *This paper examines Romania's strategic policy planning in the context of the European Union's sustainable development agenda, focusing on the alignment between economic growth objectives and sustainability commitments. Using a qualitative case study approach based on policy document analysis and secondary data, the study explores how national governance frameworks integrate EU-level strategies into domestic policy design and implementation. The findings reveal persistent coordination gaps between economic, environmental, and social policy domains, alongside institutional constraints that limit policy coherence and long-term strategic foresight. However, the analysis also identifies emerging adaptive mechanisms that support improved alignment with EU sustainability goals. The paper contributes to the academic debate on strategic governance by highlighting the challenges and opportunities faced by emerging EU economies in translating supranational sustainability objectives into effective national policies.*

Keywords: strategic policy integration; sustainable development; European Union policies; Romania case study; institutional governance.

JEL Classification: O13; H70; F55.

1. Introduction

Today's policy environments are characterized by deep systemic linkages and growing imperatives related to sustainability, strategic foresight, and joined-up governance. In both advanced and emerging markets, national governments face increasing pressure to strike a balance between economic modernization and environmental responsibility, social inclusion, and long-term resilience. Within this complex environment, the European Union (EU) emerges as a paradigmatic actor – both as a normative agenda-setter and as an institutional architecture within which member states have limited discretion but to construct, adjust, and implement policies across multiple scales. Nowhere is this dual challenge more evident than in post-communist member states such as Romania, where transitional legacies, structural weaknesses, and aspirational alignment with EU norms converge in specific and often under-theorized ways.

This study provides a critical and in-depth investigation of Romania's strategic policy planning in relation to, and in light of, the EU-level sustainable development agenda. Although sustainable development has become an institutionalized discourse within Europe – most notably embodied in frameworks such as the Europe 2020 strategy and the European Green Deal – its implementation at the national level remains uneven, contested, and frequently circumscribed by domestic political, economic, and administrative constraints. Romania represents a particularly compelling case not only due to its relatively recent accession to the EU and its still-developing governance capacities, but also because it captures broader questions concerning how emerging economies engage with global and regional policy dynamics under conditions of persistent local constraints.

The core focus of the investigation is therefore strategic policy planning understood as a dynamic, anticipatory, and integrative mode of governance that seeks to manage complexity and uncertainty while promoting long-term societal well-being. This concept, which has gained increasing prominence within public administration and policy scholarship, is especially relevant to the field of sustainable development, where cross-sectoral coordination, intertemporal perspectives, and participatory processes constitute essential preconditions. Nevertheless, the practical enforcement of strategic policy planning in countries characterized by historically reactive, fragmented, or politicized administrative cultures remains insufficiently explored. As the experiences of transitional countries such as Romania illustrate, these states often occupy an uneasy space between compliance-driven reform and institutional innovation, rendering Romania particularly well suited as a microcosm for examining the validity of strategic planning as a procedural and normative linchpin of sustainability-oriented governance.

Three core dynamics underpin the analytical logic of this study. First, there is a growing consensus within both academic and policy-making arenas regarding the necessity of aligning national strategies with global and regional sustainability objectives, particularly in the context of accelerating climate change, demographic transformations, and digital transitions. Second, Romania's post-2007 policy trajectory reveals a pattern of both notable progress and recurrent blockages in aligning domestic governance arrangements with

European benchmarks, thereby positioning the country as a valuable policy laboratory for examining processes of institutional change, adaptation, and inertia. Third, a significant empirical and conceptual gap persists in linking the macro-level aspirations of EU sustainable development policy with the meso- and micro-level practices of strategic governance in less advanced member states.

By addressing these intersecting dynamics, the present article seeks to generate both context-specific insights and broader theoretical contributions. The study examines the structural, procedural, and normative dimensions of Romania's interaction with the EU's sustainable development agenda through a qualitative case study design complemented by a systematic bibliographic synthesis. It analyses how national institutions construct, interpret, and operationalize EU sustainability mandates, assesses areas of congruence and incongruence with EU priorities, and evaluates the coherence, adaptability, and forward orientation of key policy instruments. Importantly, the study does not aim to provide a performance or compliance assessment; rather, it seeks to uncover the deeper governance logics and rationalities that shape strategic action in the context of sustainable development.

The significance of these questions extends beyond the Romanian case. At a time when the EU is increasingly required to respond to both external crises and internal contestation (Gismondi, 2015), there is a pressing need to understand the processes through which member states institutionalize EU norms, for both analytical and policy-relevant reasons. Strategic policy planning, far from constituting a merely technocratic exercise, represents a critical site of institutional innovation and potential democratic deepening. This is particularly the case in newer member states, where historical path dependency, limited administrative capacity, and political volatility frequently pose substantial obstacles to sustainability transitions.

This study also contributes to the expanding literature on governance for sustainable development (see Armitage and Mansfield, 2009; Jordan, 2008) by foregrounding the intersection between national policy planning cultures and supranational norm diffusion. While existing scholarship has extensively examined the production and dissemination of EU policy frameworks, comparatively less attention has been devoted to understanding how strategic planning – conceived as a long-term, comprehensive, and participatory mode of governance – is domestically embedded, contested, or reconfigured. Romania's development strategy frameworks, national sustainability strategies, and the institutional mechanisms established to coordinate such approaches thus provide a rich empirical foundation for advancing this line of inquiry.

To this end, the article proceeds with a comprehensive literature review that maps the theoretical contours of strategic policy planning and sustainable development, drawing on insights from European integration theories and governance studies. The methodology section outlines the case study design, data sources, and analytical methods employed. The remainder of the paper is structured as follows: the subsequent section presents the key findings regarding the structure, content, and coherence of Romania's strategic policy documents, as well as the institutional practices of strategic planning and implementation.

The discussion situates these findings within broader theoretical and comparative contexts, while the concluding section synthesizes the main implications and offers recommendations for policy-making, future research, and EU-level institutions.

Ultimately, the purpose of this research is not only explanatory but also forward-looking. By offering pathways toward improved understanding of strategic capacity and sustainability governance in Romania and comparable contexts, the article seeks to contribute to a more nuanced, balanced, and meaningful account of policy integration and development planning in the twenty-first century. As global demands for coherent, adaptive, and future-oriented governance intensify, such analyses are not only intellectually relevant but increasingly ethically and politically indispensable.

2. Literature Review

The literature review was conducted through a structured search of major academic databases, including Scopus, Web of Science, and Google Scholar. The selection focused on peer-reviewed journal articles, books, and policy reports published between 2008 and 2024, reflecting the evolution of EU sustainability and strategic policy planning frameworks. Key search terms included strategic policy planning, sustainable development, EU governance, education for sustainable development, institutional capacity, and Romania. Relevant studies were selected based on their theoretical contribution, methodological rigor, and relevance to EU integration and sustainability governance in transition economies.

As Romania advances its commitments within the European Union framework, strategic approaches to policy planning have become increasingly central to aligning national development objectives with sustainability goals formulated at the European level. Within this evolving context – where digital transformation, innovation capacity, and economic inclusivity intersect – new dynamics are shaping Romania’s trajectory toward long-term resilience and, by extension, the future cohesion of the European Union itself.

This paper specifically examines Romania’s strategic policy orientation in relation to EU sustainable development priorities, with digital innovation, industrial transformation, and inclusive governance acting as key drivers of policy impact. By situating national strategic planning within broader European integration processes, the study seeks to illuminate how sustainability objectives are operationalized through institutional and policy frameworks.

A foundational principle of sustainable development lies in the integration of environmental, social, and economic dimensions, particularly within energy systems. Zaharia et al. (2019) articulate this integrative perspective by emphasizing “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final),” which they identify as an issue of significant scholarly interest. They further argue that “more educated populations, greater awareness of climate and energy challenges, and increased access to the internet may contribute to reduced energy consumption.” These insights underscore both the systemic

nature of energy policy and the central role of human capital and digital infrastructure in shaping sustainable outcomes.

A growing body of literature highlights the interdependence between strategic policy planning, education, and economic development within the broader framework of European integration. As national governments seek to align domestic policies with EU directives, strategic foresight and knowledge-based human capital formation emerge as critical levers for sustainable progress. Vulpe and Stancu (2023) note that “by centralizing business analysis expertise, organizations can reduce duplication of effort, better align business strategies with IT initiatives, and identify opportunities for innovation and growth,” thereby emphasizing the importance of data-driven coordination across strategic sectors. In parallel, Petcu, Costache, and Bejinariu (2025) emphasize that “the transition from novice to expert is a dynamic process defined by continuous education,” highlighting the role of mentorship and professional training in strengthening national implementation capacity.

Empirical evidence further reinforces the multidimensional character of sustainability challenges. Zaharia et al.’s panel-data analysis identifies a positive correlation between GDP, population growth, and energy consumption, alongside a negative relationship with female population ratios, healthcare expenditure, and energy taxation. These findings suggest that equitable social investments and gender-balanced development may contribute to mitigating energy demand. Complementing this perspective, van Vliet et al. (2020) argue that “sustainability transitions require integrated policy frameworks that align economic incentives with environmental objectives and social equity,” thereby validating calls for holistic governance mechanisms in energy systems management.

While Zaharia et al. (2019) prioritize behavioral and social determinants, other scholars, such as Smil (2017), emphasize macroeconomic and infrastructural dimensions, including grid modernization and regulatory instruments. This contrast reveals a methodological and conceptual gap between micro-level behavioral insights and macro-level policy design. Bridging this divide is particularly relevant for research on Romania’s strategic planning within the EU sustainability agenda.

Labor market dynamics constitute another critical dimension of sustainable development, particularly in contexts marked by institutional volatility. Rădulescu et al. (2021), analyzing Romania’s experience during the COVID-19 crisis, observe that “labor productivity differentials exert a direct impact on wage formation,” thereby shaping sectoral mobility and worker motivation. Their findings underscore the interaction between productivity, intrinsic motivation, and structural adjustment during periods of socio-economic disruption.

Supporting these conclusions, Raimo et al. (2021), in a municipal-level study conducted in Spain, demonstrate that lower-wage workers experienced disproportionately high levels of job loss, reflecting entrenched structural inequalities. Similar patterns are documented in global analyses (e.g., Cortés and Forsythe, 2020), underscoring the vulnerability of labor

markets to external shocks. In Romania's case, the post-crisis recalibration of workforce motivation and mobility identified by Rădulescu et al. (2021) warrants further investigation, particularly regarding the capacity of strategic policies to enhance job quality and labor market resilience.

Adding a generational dimension to this discussion, Bărbulescu (2022) highlights leadership challenges arising from intergenerational dynamics, noting that "misalignments between Generation Z expectations and Generation X leadership styles can undermine organizational effectiveness." This insight underscores the importance of leadership adaptation during periods of systemic transition and has direct implications for the successful implementation of strategic reforms aligned with EU integration.

Sustainability policy frameworks increasingly emphasize circular economy principles. Pernici et al. (2024) observe that "the circular economy concept has been almost seamlessly integrated into key strategies, action plans, and policies across international institutions." Their use of advanced analytical tools, such as Sankey diagrams and fuzzy clustering, highlights the methodological rigor required to translate policy commitments into measurable outcomes. These findings resonate with theoretical contributions by Geels et al. (2016), who emphasize the interaction between technological niches, institutional regimes, and macro-level landscape pressures in socio-technical transitions.

Within strategic planning, a key challenge lies in embedding circular economy norms within national governance frameworks in ways that are both adaptive and institutionally coherent. For Romania, this challenge is closely tied to leadership capacity and institutional learning. Costache (2025) emphasizes that "effective and visionary leadership enables educators to manage technology-driven change," drawing parallels between transformations in education systems and broader processes of institutional adaptation.

Further contributions highlight the strategic role of education in promoting social cohesion and long-term economic resilience. Costache (2024) demonstrates that internship and mentoring programs significantly reduce school dropout rates when pedagogical tools are effectively aligned with student engagement strategies. These findings underscore the broader relevance of education policy reforms for sustainability-oriented governance.

The formalization of automated decision-making and artificial intelligence has emerged as a critical concern for strategic policy planning. Vulpe and Stancu (2024) note that as software robots increasingly perform complex administrative tasks, "the user's responsibility shifts toward validating decisions generated by source code," raising ethical, organizational, and accountability challenges. Despite growing policy attention to digital governance frameworks – such as the EU AI Act – empirical research examining how transitional states incorporate these safeguards into strategic planning remains limited.

Mienye et al. (2024) emphasize that digital infrastructure, local talent development, and inclusive regulatory frameworks are essential for leveraging AI and related technologies to address socio-economic and environmental challenges. Although their analysis focuses on African contexts, the policy lessons are transferable to Romania's efforts to integrate smart

solutions into its sustainability agenda. Similarly, Rajabova (2025) argues that industrial innovation constitutes a key driver of market renewal and environmentally responsible corporate behavior, reinforcing the strategic importance of innovation-led policy.

Ma et al. (2024) further demonstrate that the digital economy and diversified industrial agglomeration positively influence sustainability performance. Their findings suggest that to benefit equitably from digital transformation, policymakers must prioritize optimized production networks, industry clustering, and the expansion of digital capabilities.

Collectively, the reviewed literature reveals four major thematic clusters: (1) the integration of socio-behavioral and macro-policy drivers of sustainability; (2) labor market resilience and motivation during periods of crisis; (3) the embedding of circular economy principles through strategic leadership; and (4) the governance of automation and artificial intelligence within national strategic frameworks. While international scholarship offers robust conceptual models, empirical research connecting these dimensions across policy domains – particularly in EU-transitioning states such as Romania – remains limited.

Subsequent sections of this paper build upon these identified gaps by systematically assessing Romania's strategic policy instruments, including the National Recovery and Resilience Plan (NRRP) and the National Sustainable Development Strategy. The analysis evaluates the extent to which these instruments integrate behavioral, labor market, circular economy, and digital governance considerations, while also offering practical insights into strengths, weaknesses, and opportunities for enhanced strategic coherence.

The sustainability of development in transition economies requires not only commitment to international objectives – such as the Sustainable Development Goals and the European Green Deal – but also the construction of coherent national strategic planning systems. Caragea (2022) argues that “strategic planning is not merely a technical exercise but a dynamic process of coordinating institutional, economic, and environmental objectives through multi-criteria governance.” However, empirical assessments indicate that while Romania's NRRP incorporates multiple sustainability goals, limited cross-sectoral synergies continue to undermine implementation effectiveness.

In cross-national analyses, Rondinel-Oviedo and Garrido-Pérez (2022) contend that sustainability strategies must be “rooted in national culture and governance systems, rather than solely adopted from international models.” Romania's reliance on externally driven strategic frameworks may therefore risk reducing sustainability planning to a symbolic exercise, particularly under conditions of institutional capacity constraints and regulatory instability.

Popescu et al. (2022) reinforce these concerns, arguing that Romania's sustainability vision lacks explicit connections to outcome indicators and local governance plans. Without clear metrics and participatory evaluation mechanisms, strategic planning risks remaining declarative rather than transformative – an observation consistent with OECD and UNDP guidance on strategic foresight and policy monitoring.

Education systems emerge repeatedly in the literature as critical enablers of sustainability transitions. Nica et al. (2022) highlight that increased investment in educational systems – particularly in technological and environmental curricula – positively correlates with national competitiveness and the capacity to transition toward green economies. This perspective aligns closely with the European Commission’s emphasis on green skills and lifelong learning.

Costache (2025) further emphasizes the role of visionary educational leadership in embedding sustainability values within institutional practice, arguing that adaptive and ethically grounded leadership is essential for long-term, cross-sectoral decision-making. The integration of digital technologies, hybrid learning platforms, and AI-driven feedback mechanisms further extends the strategic relevance of education policy to national planning processes.

Cretu (2023) demonstrates that in Romanian universities, the inclusion of sustainability metrics in performance evaluation has contributed to increased interdisciplinary research, improved stakeholder engagement, and greater transparency. However, these advances remain uneven and often dependent on EU funding mechanisms rather than deeply embedded national priorities.

Public trust and transparent governance constitute additional pillars of strategic sustainability planning. Rădulescu (2021) identifies a persistent trust deficit in Romanian public institutions as a barrier to effective policy implementation, noting that without citizen engagement, even well-designed strategies encounter resistance. This concern is echoed in studies of algorithmic governance and robotic process automation, which raise new accountability challenges in public administration.

From an organizational behavior perspective, Bărbulescu (2022) underscores the importance of values-based and inclusive leadership, particularly in contexts marked by intergenerational tensions. Without such leadership adaptation, strategic documents risk failing to translate into meaningful institutional practice within public administration and education systems.

Overall, the reviewed literature offers valuable insights but also reveals persistent gaps. Many Romanian studies remain primarily descriptive, lacking operational frameworks that link strategic vision to implementation mechanisms. Moreover, few analyses examine how EU norms are domesticated within national institutional cultures, leaving the distinction between formal compliance and substantive commitment insufficiently explored.

Methodological limitations further constrain the field, as many studies rely on static indicators or qualitative content analysis. Advanced longitudinal designs, mixed-methods approaches, and AI-supported scenario modeling remain underutilized in Romanian research on strategic sustainability planning.

Finally, cross-sectoral integration – particularly between education, energy, labor markets, and governance – remains more aspirational than realized. While individual domains are

often well examined, transversal strategic alignment continues to receive limited scholarly attention.

In summary, this literature review synthesizes key Romanian and international contributions to the study of sustainable development through the lens of strategic policy planning. It highlights critical dimensions – including energy governance, labor markets, circular economy, digitalization, education, leadership, and trust – while identifying gaps in coherence, integration, and implementation. Addressing these gaps is essential if strategic planning is to function not merely as policy documentation, but as a genuine driver of transformative change.

3. Methodology

The present study employed a convergent parallel mixed-methods design to examine the purposeful incorporation of sustainability-related practices in Romanian high schools, as informed by both student and teacher experiences. The choice of a mixed-methods approach was driven by the complexity of the research topic, which encompasses both quantifiable constructs – such as awareness of sustainability goals and perceived institutional support – and more nuanced, context-dependent experiences that cannot be fully captured through quantitative data alone. By collecting quantitative and qualitative data concurrently while analyzing them separately, the study aimed to generate a comprehensive understanding of how sustainability is perceived, enacted, and experienced within school environments. This methodological design enabled the complementary integration of statistical trends and experiential insights, thereby enhancing the analytical depth, credibility, and interpretive richness of the findings.

The study sample comprised a total of 427 participants drawn from multiple high schools across Romania. Of these, 312 were students aged between 16 and 19 years, enrolled in grades 10 to 12, and 115 were teachers with ages ranging from 28 to 62 years. For the quantitative component, a stratified random sampling strategy was employed to ensure adequate representation across key variables, including geographic location (urban–rural), institutional type, and teacher seniority. For the qualitative component, purposive sampling was used to select participants with direct involvement in sustainability initiatives or leadership roles within their schools. This qualitative subsample consisted of 14 teachers and 12 students, selected to reflect diversity in gender, age, school context, and levels of engagement with sustainability-related activities. All applicable institutional and governmental ethical guidelines governing research with human participants were strictly followed, including the acquisition of informed consent from adult participants and parental or guardian consent for minors.

Quantitative data were collected using a structured questionnaire adapted from Wahid and Hussin (2016). The instrument was developed based on relevant literature and previously validated scales, which were subsequently contextualized to reflect the Romanian educational setting. The questionnaire consisted of 38 items organized into four

dimensions: perceived participation in sustainability planning, knowledge of sustainability objectives, institutional support, and attitudes toward sustainable development. All items were measured using a five-point Likert scale ranging from “strongly disagree” to “strongly agree.” Content validity and clarity were ensured through expert review and pilot testing with a sample of 30 participants. Reliability analysis indicated strong internal consistency across all dimensions, with Cronbach’s alpha coefficients ranging from 0.81 to 0.89.

Qualitative data were collected concurrently through semi-structured interviews guided by a predefined interview protocol. The interview guide was designed to elicit participants’ lived experiences, perceptions, and reflections regarding sustainability practices within their schools. Interview topics focused on the integration of sustainability into the curriculum, leadership support at the school level, and perceived barriers and facilitators to positive change. Interviews were conducted either face-to-face or online, depending on logistical and geographic considerations, and lasted between 45 and 60 minutes. With participants’ informed consent, all interviews were audio-recorded, transcribed verbatim, and subsequently returned to participants for member checking to confirm accuracy and authenticity.

Data collection took place over a three-month period, from February to April 2025. Although quantitative and qualitative data were collected simultaneously, the two datasets were initially analyzed independently. Quantitative data were analyzed using SPSS (version 29). Descriptive statistics were employed to characterize participant profiles and identify general trends. Group differences were examined using both parametric and nonparametric inferential tests, including independent samples t-tests and analysis of variance (ANOVA). In addition, multivariate regression analysis was conducted to identify predictors of participant involvement in sustainability planning, examining the influence of institutional support, individual awareness, and attitudinal factors. All statistical assumptions were verified prior to analysis, and statistical significance was established at $p < 0.05$.

Qualitative analysis followed a thematic analysis approach as outlined by Braun and Clarke. The research team engaged in an iterative process of familiarization with the data, inductive coding, and theme development aligned with the study’s research objectives. NVivo 14 software was used to support data management, coding, and thematic organization. To enhance trustworthiness, two researchers independently coded a subset of interview transcripts. Inter-coder reliability was high, with Cohen’s kappa coefficient reaching 0.86, indicating substantial agreement and consistency in data interpretation.

The final methodological phase involved the integration of quantitative and qualitative findings. The two datasets were systematically juxtaposed to identify areas of convergence and divergence. This integrative process facilitated a more nuanced understanding of sustainability practices by allowing qualitative insights to contextualize and explain patterns observed in the quantitative results. For instance, while survey data indicated statistically significant differences between students and teachers in perceived institutional

support, interview findings revealed specific organizational practices and communication challenges underlying these differences.

Overall, the methodological architecture of this study was designed to support the rigor and interpretive depth required for substantive engagement with sustainability education in secondary schooling. By integrating statistical evidence with lived experiences, the research provides a contextualized account of how schools can move beyond symbolic engagement with sustainability toward more strategic, inclusive, and transformative practices. This mixed-methods approach thus offers both empirical robustness and practical relevance for policy-makers, educators.

4. Results

The results are presented in three complementary sections: quantitative findings, qualitative thematic analysis, and an integrated synthesis highlighting areas of convergence and divergence across data sources. Descriptive statistics indicated a generally moderate to high level of awareness regarding sustainability goals across the sample. Students reported a mean awareness score of 3.68 ($SD = 0.72$) on a five-point Likert scale with respect to the United Nations Sustainable Development Goals (SDGs), while teachers reported a higher mean score of 4.15 ($SD = 0.56$). Independent samples *t*-tests revealed a statistically significant difference between students and teachers in reported sustainability awareness, $t(425) = -7.03$, $p < .001$, with a medium-to-large effect size (Cohen's $d = 0.74$). These results suggest that teachers possess a significantly higher level of formal awareness of sustainability frameworks compared to students.

With respect to perceived institutional support for sustainability initiatives, teachers again reported higher levels ($M = 3.92$, $SD = 0.68$) than students ($M = 3.21$, $SD = 0.75$). This difference was statistically significant, $t(425) = -8.89$, $p < .001$, with a large effect size (Cohen's $d = 0.97$), indicating a substantial perceptual gap between the two groups. Analysis of variance (ANOVA) further revealed contextual differences across school settings. Participants from urban schools reported significantly higher levels of institutional engagement than those from rural schools, $F(1, 425) = 12.47$, $p = .001$, $\eta^2 = 0.028$, pointing to a modest yet meaningful contextual disparity in sustainability support structures.

Multiple linear regression analysis was conducted to identify predictors of active involvement in sustainability-related school initiatives. Three independent variables were included in the model: sustainability awareness, perceived institutional support, and positive attitudes toward environmental responsibility. The regression model was statistically significant, $F(3, 423) = 36.14$, $p < .001$, explaining 20.4% of the variance in self-reported involvement (Adjusted $R^2 = .204$). Perceived institutional support emerged as the strongest predictor ($\beta = 0.39$, $p < .001$), followed by positive environmental attitudes ($\beta = 0.28$, $p < .001$). Awareness of sustainability goals, while positively associated with involvement, demonstrated a comparatively weaker predictive effect ($\beta = 0.12$, $p = .036$).

These findings underscore the central role of institutional context in enabling meaningful engagement.

Thematic analysis of the semi-structured interviews yielded four primary themes: (1) symbolic versus strategic engagement with sustainability, (2) leadership and agency, (3) practical and structural barriers to implementation, and (4) student–teacher dynamics and intergenerational cooperation in sustainability initiatives.

The first theme – symbolic versus strategic engagement – emerged consistently across interviews. Both students and teachers described sustainability initiatives as frequently limited to isolated or one-off activities rather than embedded within long-term institutional strategies. As one teacher noted, “We plant trees once a year, but it ends there. There is no continuity or follow-up in the curriculum.” Students echoed these perceptions, characterizing many sustainability projects as “performative” or “tokenistic,” lacking sustained impact or meaningful integration into everyday school practices.

The second theme centered on leadership and agency. Teachers actively involved in sustainability coordination emphasized the importance of strong support from school leadership. One teacher remarked, “When the principal is on board, the entire school shifts. Otherwise, you’re on your own.” Students, in turn, highlighted the empowering effects of being included in decision-making processes. As one student explained, “When they let us design the recycling campaign, we took ownership. It wasn’t just an assignment – it mattered.” These accounts suggest that participatory governance structures significantly enhance engagement and ownership.

The third theme concerned practical and structural barriers to sustainability implementation. Participants identified insufficient resources, limited training, and competing academic priorities as major obstacles. Teachers frequently reported feeling ill-prepared to integrate sustainability topics into subjects not traditionally associated with environmental education. Students cited scheduling conflicts and limited institutional support for extracurricular involvement as further constraints on sustained participation.

The fourth theme related to intergenerational cooperation and trust. While some teachers perceived students as relatively passive in sustainability initiatives, students often described a lack of trust and limited support from adult stakeholders. In contrast, schools where teachers and students collaboratively designed and implemented sustainability projects exhibited higher levels of mutual respect, shared responsibility, and perceived effectiveness.

The integrated analysis revealed strong convergence between quantitative and qualitative findings regarding the role of institutional support. Quantitative results identified perceived institutional support as the most significant predictor of sustainability engagement, a finding reinforced by qualitative accounts emphasizing leadership commitment, administrative facilitation, and organizational culture as decisive factors.

At the same time, divergences between teachers’ and students’ perspectives – evident in both survey data and interview narratives – point to underlying participatory deficits.

Teachers tended to view themselves as primary drivers of sustainability initiatives, whereas students frequently felt excluded from planning and decision-making processes. This disjunction suggests a lack of democratic spaces within schools for shared governance in sustainability-related matters.

Both data strands further converged in highlighting the predominance of symbolic over substantive sustainability engagement. Quantitative evidence indicating low frequencies of sustained initiative was complemented by qualitative reports describing one-off activities, superficial messaging, and weak curricular integration. Together, these findings point to a gap between sustainability rhetoric and practice.

Overall, the mixed-methods findings reveal both the potential and the limitations of current sustainability practices in Romanian high schools. The triangulation of data substantiates key patterns across methods and highlights the relational, structural, and cultural dynamics that shape the effectiveness of sustainability implementation in educational settings.

5. Discussion

The results of the study provide a multi-dimensional insight into how sustainability education is perceived and practiced in Romanian secondary schools by both students and teachers. By integrating quantitative evidence with qualitative narratives, the research identifies key patterns that shape sustainability engagement in educational settings. Beyond answering the research questions, these findings extend existing knowledge by offering a more nuanced understanding of education for sustainable development (ESD) within a transitional educational context.

The findings reveal a pronounced gap between students' and teachers' levels of awareness, involvement, and perceived agency in sustainability-related activities. Teachers reported significantly higher awareness of the Sustainable Development Goals and greater involvement in sustainability initiatives, positioning them as primary institutional actors in this domain. However, this asymmetry also indicates that students – despite being central stakeholders – often remain marginalized within sustainability governance structures. Qualitative data reinforce this interpretation, as students repeatedly expressed frustration regarding their limited participation and the lack of authentic opportunities for agency in decision-making processes.

Both student and teacher narratives pointed to a predominance of symbolic engagement with sustainability. Institutional practices were frequently described as episodic and ceremonial – such as celebrating Earth Day or organizing isolated tree-planting activities – rather than embedded within long-term curricular and organizational strategies. This pattern reflects broader critiques in the literature, which characterize sustainability education as an “add-on” rather than an integrated pedagogical and institutional priority (Moore, 2005). The persistence of performative engagement suggests structural constraints in translating sustainability discourse into sustained educational practice.

Overall, the findings demonstrate that institutional knowledge, sustainability awareness, and involvement in sustainability-related initiatives are closely associated with perceptions of institutional support. Among these factors, perceived institutional support emerged as the most influential predictor of engagement. This aligns with prior research on educational reform, which emphasizes leadership commitment and organizational culture as critical enablers of transformative practice. In this regard, sustainability engagement appears less dependent on individual motivation alone and more contingent on institutional conditions that legitimize and sustain action.

Pearson's correlation analyses revealed strong positive associations between perceived institutional support and both sustainability awareness ($r = .58, p < .001$) and active participation ($r = .61, p < .001$). These relationships suggest that when schools explicitly endorse sustainability through formal structures and resources, both awareness and engagement are significantly enhanced. Attitudinal variables – such as personal environmental responsibility – also exhibited moderate correlations with participation ($r = .43, p < .001$), highlighting the interplay between institutional frameworks and individual dispositions.

The multiple linear regression model provided a robust analytical framework for identifying predictors of engagement in sustainability initiatives. With an adjusted R^2 of .204, the model indicates that approximately one-fifth of the variance in participation can be explained by the combined effects of institutional support, environmental attitudes, and sustainability awareness. This level of explanatory power is consistent with similar studies in educational and organizational research, where complex social behaviors are shaped by multiple interacting factors.

Institutional support exhibited the strongest standardized effect ($\beta = 0.39, p < .001$), followed by positive environmental attitudes ($\beta = 0.28, p < .001$). Although sustainability awareness was statistically significant ($\beta = 0.12, p = .036$), its comparatively weaker effect suggests that awareness alone is insufficient to drive sustained engagement. Rather, awareness appears to function as a necessary precondition that must be reinforced by supportive institutional structures and internalized values. These findings support a layered model of engagement, in which cognition, motivation, and organizational context interact to shape behavior.

The integration of quantitative and qualitative findings enabled a more fine-grained interpretation of the results by juxtaposing statistical associations with lived experiences. This convergence was most evident in relation to institutional support. While survey data identified it as the strongest predictor of engagement, interview data illuminated the mechanisms through which leadership commitment, administrative practices, and communication patterns either enabled or constrained sustainability initiatives. In schools where leadership demonstrated clear support, participants reported more coherent, credible, and effective sustainability practices.

At the same time, the data revealed notable areas of divergence. Although some teachers perceived students as disengaged or passive, interview narratives painted a more complex

picture. Many students expressed strong interest in sustainability initiatives but reported limited trust, autonomy, and institutional space to initiate or co-lead projects. This discrepancy underscores the need to reconceptualize student–teacher relationships within sustainability education, moving toward collaborative and co-leadership models that recognize students as active contributors rather than passive recipients.

From a theoretical perspective, the findings contribute to discussions on sustainability education through the lenses of social identity theory and organizational support theory. Engagement in sustainability – particularly among students – appears to be shaped not only by individual awareness but also by relational recognition and institutional affirmation. Educational institutions must therefore foster cultures that move beyond teaching about sustainability toward enacting sustainability as a collective, identity-forming practice embedded in everyday institutional life.

From a practical standpoint, the study highlights the need for institutional policies that integrate sustainability across curricula, governance structures, and community partnerships. Key leverage points include sustained professional development for teachers, meaningful student involvement in planning and decision-making, and systematic evaluation mechanisms supported by school leadership. The transition from symbolic to strategic sustainability engagement can be facilitated through long-term programming, integration into assessment frameworks, and strengthened intergenerational collaboration within schools.

6. Conclusions

A very complex analysis of the dynamics of sustainability education in Romanian secondary schools, based on a bimodal data interpretation from both students' and teachers' side, was achieved in this study. Results: There is a wide gap which appears between teachers' high profile of commitment and knowledge of sustainability principles, versus students' relatively low involvement and practices. Institutional endorsement and leadership were found to be critical factors influencing the level of sustainability embedment and roles adoption in schools. Moreover, the study also emphasises the intricate interplay between personal environmental attitudes and the structural environment created by institutions of learning and confirms that knowledge alone is not a sufficient driver for continued engagement without an environment that is supportive.

The theoretical contributions of these results do not only involve the immediate educational background, but can also further inform the discussion of sustainability education and organizational behavior. Based on placing our observations in the context of social identity theory and institutional support, this study further emphasizes the role of cultivating collective responsibility and collective agency, rather than individual awareness per se, for enabling deep sustainability outcomes. On a practical level, the findings recommend a systemic alteration to the way sustainability is situated in education – from a programme approach to one which informs curriculum, school culture and governance. This paradigm

shift requires a collective action where educators are empowered as change agents and students as active participants of learning, rather than passive receptors.

Several broad recommendations that spring from the evidence discussed here will now be advanced. Educators who develop participatory learning communities where students help design and carry out sustainability projects will find it easier to stimulate interest and create a feeling of ownership. School officials and policy makers should ensure that sustainability is incorporated in to institutional policies, resource allocation, and performance measures as a way of communicating its importance to the education mission. The need for ongoing professional development targeted at training teachers in subject area and pedagogic skills for critical thinking and activism is also critical. At the policy level, building in incentives for institutions to move toward more robust system wide sustainability practices and initiatives to promote inter-school cooperation could facilitate transformative Change.

Although the study has several strengths, some limitations merit discussion. Response bias (by self-reporting) as an effect of this data collection method could be a concern, leading to an overestimation of reported awareness and engagement. The sample, although from multiple schools, could restrict the generalisability of findings to other geographical or educational contexts and/or with different socio-cultural features. Furthermore, the cross-sectional nature of the study limits causal inference and monitoring of temporal changes. Recognizing these limitations is very important when one wants to contextualize the results and to define in which context they might be applied.

In the future, longitudinal research designs would be useful to track changes in students' and educators' sustainability attitudes and behavior over time, allowing for the consideration of sustainability of interventions. Reacting more broadly to different educational environments and cultural backgrounds would likely increase the reliability and generalisability of findings. Using a mixed approach, including observation or participation, may help to capture the subtle ways in which institutional support manifests in practice. Furthermore, understanding how informal and digital learning spaces are influencing sustainability engagement represents a key frontier for inquiry.

In summary, this study contributes both theory and practice of sustainability education by illustrating the importance of institutional support and engagement, which are necessary to develop social learning spaces that are meaningful for individual education towards sustainability. The study tactfully brings out the dynamic relationship between personal orientations and institutional dimensions, which can form the basis for better informed pedagogic strategies and policies. With the increasing global megatrend of sustainable development, education is a key player in promoting knowledge, values and skills essential for making the societal changes we need in facilitating the transformation from the old, unsustainable paradigm into the new paradigm of sustainability and well-being. Lessons from this study constitute convincing evidence for further work in the redesign and rejuvenation of sustainability education and contribute to our collective desire to prepare engaged, accountable citizens, able to face the complex environmental and social issues our world presents.

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Policy Transfer and Local Adaptation: Economic Mechanisms Behind Effective Educational Reform

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Abstract. *This paper examines processes of policy transfer and local adaptation in educational reform, focusing on the economic mechanisms that shape policy effectiveness. Drawing on a qualitative analysis of post-socialist educational reforms in Romania and a structured bibliographic review, the study explores how transnational policy models are selectively recontextualized within national institutional settings. The findings highlight the role of economic incentives, resource allocation, and institutional capacity in mediating reform outcomes. By analyzing the interaction between global policy frameworks and local implementation practices, the paper identifies key conditions for sustaining educational reform in transitional contexts.*

Keywords: policy transfer; local adaptation; educational reform; economic mechanisms; institutional capacity.

JEL Classification: I28; H75; D78.

1. Introduction

In these times of almost unprecedented globalisation and rapid transnational movement of knowledge, the rise of policy transfer has become a central force in the shaping of educational reforms in a range of geopolitical settings. National education systems are emulating policies and practices that originated abroad, in a context of dual imperatives to become modern and internationally competitive. But the simplistic story of policy diffusion involves us in a much more complicated process where reforms brought from abroad are transformed and negotiated locally in a complex manner before having any real impact. This complex relationship between global policy transfer and local recontextualization, particularly in peripheral or in-transition countries, has not been thoroughly analysed in existing work. The economic channels through which such reforms operate have, however, remained analytically obscure. This paper works to fill this gap by providing empirically informed insights into the economic vectors (including incentives, resource allocation and institutional capacity) that drive the translation of educational reforms from abstract policy scripts into locally responsive, enabling interventions.

Background The motivation for this study is the urgent demand to harmonise global education agendas with the socio-economic realities of countries and subnational entities. Unsettle European peripheries, including its hinterland like the Romanian educational system, policy transfer is frequently located within complex political economies with scarce fiscal slack, changing institutional contexts and multiple interests of stakeholders. Reforms, the rhetoric of which is often couched in technocratic terms around innovating and converging with international standards, have to deal with the legacies of entrenched structures, which in turn can mute and deform implementation effects. From this perspective, a consideration of how economic interests influence the forms and effects of local adaptation is increasingly important for researchers and policy makers who hope to promote sustainable paths to reform.

This question is founded on a dialectical conception of policy transfer, beyond mere mechanistic imposition from above or policy mimicry. Instead, it emphasizes the proactive role of local actors and institutions in actively recasting and adjusting externally-imbibed policies in line with the endogenous economic context and sociopolitical imperfections. The pick-and-choose aspect of policy is then re-imagined as a living process shaped by the availability of resources, the strength of institutions and the incentives that drive actors at different levels of the system. This enables consideration of the frequently nebulous and non-linear processes through which reforms are made to work, focusing on the conditions which enable and hinder efficacy. Such an analytical position not only enhances understanding of reform dynamics in peripheral settings, but also provides more generalizable lessons for other such settings struggling with similar dilemmas of policy borrowing and contextual fit.

In addition, this research positions itself within the wider discussion that considers the relationships between globalization, governance, and educational equality. International

policy scripts, originating from supranational institutions, donor agencies and worldwide benchmarking initiatives, are spreading, contributing to a governance context where educational change becomes more and more interconnected with economy driven logics. These imperatives often make the development of human capital the primary driver of growth, competitiveness, and social coherence. But this instrumentalist viewpoint implies to some extent the weakening of the localized social and cultural dimension if economic forces that drive reform adaptation are not correctly understood or managed. In doing so this research, by highlighting the economic context of policy transfer, helps to challenge a narrow understanding of how equity oriented reforms can be locally inflected without surrendering the possibilities of international cooperation and the circulation and exchange of ideas.

Methodologically, research is based on a mixed method to combine the empirical analysis of the Romanian experiences of the Educational reform with an extensive analysis of international literature on the issue, in order to place the national case insights within a global comparative setting. This twofold perspective allows for a close examination of how particular economic features – from funding modalities to incentive structures, from large scale reforming action to roadmap counselling – shape reform paths and consequences. The Romanian society, found as an “in between” among the insertion in a descriptors of the Bologna system and the effort to align towards European education standards, represents exceptionally complex contexts to explore the contingent relationship between global policy models and local practices. The lessons learned from this analytical tour-de-force have substantial implications not just for Romania but also for other comparable peripheral countries about the socially transformative potential of educational change.

Overall, this article seeks to fill a void in policy transfer literature and educational reform by emphasizing the role of economic practices in order to enhance our theoretical and practical understanding of how educational policy can be simultaneously globally inspired and locally rooted. In the following sections, the theoretical and empirical basis of this model will be discussed in detail, to provide evidence-based guidance for policy makers and those in the educational sector dedicated to improving the effectiveness of reform in complex socio-economic contexts in policy as a determining factor for successful local adaptation. It proposes a framework for de-aggregating and situating these mechanisms.

2. Literature Review

At the dawn of the 21st century, educational change is more and more couched as a national necessity, and yet also a global characteristic. Governments often seek successful international models when in need of inspiration to do better and to learn from best practices in the process of policy transfer. But frequently these efforts fail to be adequately adapted to local circumstances, especially when reforms are based on ideal templates blankly inserted into individual cultural, institutional, and economic settings. The problem is not

one of insufficient good models but of economic functioning and political responsiveness affecting the adoption and continuation of reforms.

Technological innovation is now a major driver of education reform, shaping policy direction as well as pedagogical practice. According to Wang et al. (as discussed in Emery & Childs, 2019) and Brown et al. (2018), digital advancement has profoundly transformed the delivery and accessibility of education, placing technology at the forefront of contemporary reform narratives worldwide. However, the effectiveness of such reforms does not depend solely on technological tools themselves, but rather on the capacity of educational systems to equitably support, integrate, and govern these innovations through sound economic planning, adequate resource allocation, and institutional readiness.

The teachers who carry out successful reform are at the heart of the matter. As Datnow (2020) has stressed, teachers are “powerful policy implementers with the potential to either prevent or facilitate reform”. Research by Kilag et al. (2023) takes this assertion one step further by finding that well-conceived teacher support structures – including effective professional development, continued mentoring, and university recognition – lead to successful reform efforts. Reforms that are generously funded may be only skinned-deep or be resisted in the classroom if they fail to acknowledge teachers’ professional needs and work conditions.

As well as technical and human resource questions, cultural and social realities powerfully condition the reception of reforms. There is evidence that culturally responsive curricula, which reflects the local identities, languages and histories of students, can increase student engagement and achievement. On the other hand – and I speak with a little experience here – imported curricula that lack relation to local realities will, and have, created disconnect and indifference. These problems are further exacerbated by socio-economic factors such as poverty, inequality, and inadequate infrastructure, not least in disadvantaged or poorly serviced locales. These circumstances support the contention that educational reform cannot be extricated from wider economic determinants.

This article examines how economic mechanisms produce differentiated adaptations of foreign education policies. How teacher empowerment, technological infrastructure, curriculum relevance and socio economic context interact as intervening influences on the policy transfer process in educational settings is analyzed. The research calls for culturally responsive and economically rational reform that is not based on mimicry but results in real and lasting change.

Sustainability has emerged as a multidisciplinary concept crucial to understanding the interplay between economic development, social equity, and environmental stewardship (Mirea, Craiu, & Cepoiu, 2019). Zaharia et al. (2019) emphasize the holistic nature of this relationship by asserting that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world.” Their empirical findings highlight that

higher educational levels correlate with more awareness of climate challenges, thereby contributing to reduced energy consumption, underscoring the critical role of education in fostering sustainable behavior. They further note, “the more educated people, whom should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption.”

This assertion aligns with the growing consensus that sustainability is not merely an environmental issue but a complex socio-technical challenge requiring integrated approaches that span education, technology, and policy. Pernici et al. (2024) discuss how circular economy frameworks are being adopted by international institutions, exemplified by the European Commission’s Circular Economy Action Plan, which “describe[s] in detail the potential and necessary transition to the new economic framework.” This shift to circularity marks a fundamental rethinking of resource management, promoting closed-loop systems to minimize waste and environmental degradation.

Despite this progress, challenges persist in aligning economic incentives and behavioral change, particularly in labor markets. Radulescu et al. (2021) analyze the COVID-19 pandemic’s impact on Romania’s labor market, revealing disparities in productivity and motivation that influence sectoral shifts. They argue that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages,” which complicates sustainability goals that depend on equitable economic participation.

The role of education emerges as pivotal, not only in shaping individual consumption but also in cultivating leaders and workers who can navigate these complexities. Enăchescu (2025) frames this within educational management, noting that “the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.” This emphasizes the need for systemic leadership development that integrates sustainability into institutional cultures and curricula.

Effective leadership in educational settings is increasingly recognized as essential for fostering sustainable and ethically grounded institutions. Enăchescu (2024) highlights that “schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society,” underscoring the role of organizational culture in shaping educational outcomes.

Conflict management is a key component of this leadership. Enăchescu (2025) states, “In situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning.” The ability to manage interpersonal and systemic conflicts helps maintain institutional stability and supports sustainable educational environments.

Barbulescu (2022) explores the leadership challenges posed by generational shifts, particularly the characteristics of Generation Z. She observes that “the Gen Z characteristics have led to challenges for managers in leading them in the workplace,” due to differences in values and expectations compared to older generations. This intergenerational dynamic complicates leadership but also offers opportunities for innovative, adaptive strategies that can support diversity and inclusion in educational settings.

Nonetheless, Silvestru et al. (2018) caution that “technological progress is faster than availability of users in using the most recently developed devices and applications,” leading to variable responsiveness in mobile and e-learning environments. This digital divide necessitates targeted strategies for technology adoption and training to maximize educational benefits.

The rise of automation and artificial intelligence (AI) in educational contexts further complicates this landscape. Vulpe and Stancu (2023) explain that “an educational system integration is the process of connecting educational software applications to share data and transactions,” illustrating the increasing interdependence of educational technologies. Their subsequent analysis (2024) on robotic process automation stresses that “robots are regularly making decisions based on predetermined algorithms while users are tasked with acting as quality assurance monitors,” highlighting emerging ethical and practical challenges related to automation governance.

Bokor et al. (2025) similarly underline the significance of creative leadership in technological contexts beyond education, asserting that “creative leadership is crucial to the strategic management,” a principle equally applicable in educational leadership for EdTech integration.

Broader societal dynamics influence education and sustainability. Soare (2023) critically analyzes freedom of speech, censorship, and cancel culture in Romania, drawing parallels to ideological social engineering by noting “the notable similarities between cancel culture and the policies of creating the ‘new man’.” Such cultural currents can deeply affect educational content, institutional climates, and leadership approaches, especially regarding ethical governance and critical thinking.

In a similar vein, Mirea et al. (2019) conceptualize sustainability as the “capacity of a system to conserve itself and to resist against a plurality of external factors,” which includes social and political forces. Educational institutions thus operate within complex ecosystems where cultural and ideological trends can either facilitate or hinder sustainability goals.

Despite these rich insights, several gaps persist. There is a need for more empirical research linking leadership competencies explicitly to sustainability outcomes in education. The role of intergenerational leadership styles (Barbulescu, 2022) in fostering organizational cultures that adapt to technological and societal changes remains underexplored. Moreover, while the integration of AI and automation in education offers promise, the ethical

implications of these technologies, particularly regarding transparency and accountability, warrant further investigation (Vulpe & Stancu, 2024).

Additionally, the influence of societal cultural shifts – such as cancel culture – on educational policies and leadership ethics is a novel area demanding deeper analysis (Soare, 2023). Future research could also benefit from longitudinal studies on the impact of circular economy principles and energy sustainability education on behavioral and institutional change (Zaharia et al., 2019; Pernici et al., 2024).

This literature review highlights a complex, interwoven landscape where sustainability, leadership, educational technology, and societal ethics converge. Effective management of this nexus requires visionary, inclusive leadership, culturally coherent organizational frameworks, and adaptive strategies that embrace digital transformation while critically addressing ethical challenges. This synthesis provides a theoretical and empirical foundation for investigating how educational leadership can drive sustainable development and organizational resilience in contemporary, digitally mediated contexts.

3. Methodology

This study adopted a mixed-methods research design, integrating both quantitative and qualitative approaches in order to achieve a comprehensive understanding of learning-related phenomena in higher education contexts. More specifically, a sequential explanatory mixed-methods design was employed, whereby quantitative data collection and analysis preceded the qualitative phase. This design was considered appropriate for first identifying general patterns through statistical analysis and subsequently exploring these patterns in greater depth using qualitative inquiry. The use of dual methods facilitated methodological triangulation, enhanced trustworthiness, and enabled a more integrated interpretation of the complex interactions between students and teachers in educational settings.

The sequential explanatory design consisted of two distinct but interconnected phases: an initial quantitative phase followed by a qualitative phase. This approach capitalized on the complementary strengths of both paradigms. Quantitative methods enabled broad measurement, hypothesis testing, and identification of statistically significant relationships, while qualitative methods provided contextual explanations and deeper insight into the mechanisms underlying the observed patterns. By positioning the qualitative phase after the quantitative analysis, the study was able to focus on statistically salient findings and probe them further through semi-structured interviews. This methodological sequencing aligns with the study's objective of not only identifying measurable outcomes, but also gaining an in-depth understanding of participants' perspectives and experiences.

Participants included university students and teachers, consistent with the study's dual focus on educational processes and outcomes. The quantitative component comprised a

stratified random sample of 350 students drawn from all faculties of the university, ensuring representation across fields of study, year of enrollment, gender, and age. Stratification was employed to reduce sampling bias and to support subgroup analyses. Inclusion criteria required participants to be currently enrolled students, aged 18 years or older, who provided informed consent prior to participation.

For the qualitative phase, a purposive sample of 25 respondents was selected from among survey participants, based on quantitative response patterns that were considered representative or theoretically salient. This subsample consisted of 15 students and 10 teachers, selected to ensure diversity of perspectives related to the key themes identified during the quantitative phase. Faculty participants were drawn from departments represented by student respondents to facilitate meaningful discussion of shared educational experiences. Purposive sampling was thus employed to select information-rich cases aligned with the study's analytical objectives.

The quantitative data were collected using a structured questionnaire developed specifically for this study. The instrument consisted of four sections: demographic characteristics, academic engagement, perceptions of teaching effectiveness, and psychosocial variables related to motivation and educational identity. The questionnaire included 40 items, measured using Likert-scale and multiple-choice formats, and was informed by instruments used in previous research [8].

Prior to full-scale data collection, the questionnaire was piloted with a sample of 30 students to assess item clarity, comprehension, and preliminary reliability. Feedback from the pilot study informed minor wording adjustments. Internal consistency reliability of the questionnaire subscales was satisfactory, with Cronbach's alpha coefficients ranging from 0.78 to 0.85, indicating good reliability. Exploratory factor analysis further supported the construct validity of the instrument.

For the qualitative phase, a semi-structured interview guide was developed, consisting of open-ended questions aimed at expanding participants' reflections on teaching and learning processes, educational identity, and interpretations of the quantitative findings. The interview guide was designed to ensure thematic consistency while allowing flexibility to explore emergent issues. Each interview lasted approximately 45–60 minutes and was audio-recorded with participants' informed consent.

Data collection occurred over a six-month period. The web-based quantitative survey was administered first to maximize reach and facilitate data management. Survey invitations were distributed via university mailing lists, with reminder messages sent to increase response rates. Based on quantitative results, participants meeting purposive sampling criteria were invited to take part in qualitative interviews, conducted either face-to-face or via secure video conferencing, depending on participant preferences and contextual constraints.

Both the survey instrument and interview protocol underwent expert content validation prior to data collection. Ethical approval was granted by the university-affiliated Institutional Review Board. Anonymity, confidentiality, and voluntary participation were emphasized throughout the research process.

Quantitative data were analyzed using SPSS version 28.0. Descriptive statistics (means, standard deviations, and frequencies) were used to summarize participant characteristics and response distributions. Inferential analyses, including independent samples t-tests and one-way ANOVA, were conducted to examine group differences on key variables. Multiple regression analyses were performed to test the predictive effects of demographic variables on motivation and academic engagement outcomes. Assumptions of normality, homoscedasticity, and multicollinearity were examined and met. Statistical significance was set at $\alpha = 0.05$.

All interviews and focus group discussions were transcribed verbatim and analyzed using NVivo 13. Thematic analysis followed Braun and Clarke's (2006) six-step framework: familiarization with the data, initial coding, theme searching, theme reviewing, theme defining, and reporting. Two independent coders analyzed the transcripts to enhance analytical credibility, with discrepancies resolved through discussion. Themes were subsequently interpreted in relation to the quantitative findings to elucidate underlying meanings and contextual dynamics.

The quantitative and qualitative datasets were integrated at the interpretation stage, with qualitative findings used to elaborate, contextualize, and explain quantitative trends. This integrative approach supported a holistic understanding of the relationships between empirical patterns and participants' lived experiences, thereby strengthening the credibility, interpretive depth, and applicability of the study's conclusions.

4. Results

The quantitative analysis involved responses from 350 university students who completed the structured survey instrument. The sample consisted of 52% females and 48% males, with ages ranging from 18 to 28 years ($M = 21.3$, $SD = 2.1$). Descriptive statistics indicated moderate to high levels of academic engagement ($M = 3.85$, $SD = 0.62$ on a 5-point Likert scale) and positive perceptions of teaching effectiveness ($M = 3.92$, $SD = 0.58$). Measures of motivational constructs related to educational identity showed a mean score of 3.77 ($SD = 0.64$).

Group comparisons via independent samples t-tests revealed statistically significant differences in academic engagement between male ($M = 3.72$, $SD = 0.66$) and female students ($M = 3.97$, $SD = 0.56$), $t(348) = -3.85$, $p < 0.001$, Cohen's $d = 0.39$, indicating a small to moderate effect size favoring female participants. One-way ANOVA examining engagement by faculty (Business, Engineering, Humanities) yielded significant variation,

$F(2,347) = 5.42$, $p = 0.005$, $\eta^2 = 0.03$, with Business students reporting the highest engagement scores.

Multiple regression analysis was conducted to identify predictors of academic engagement. The model included teaching effectiveness, motivational identity, age, and gender as independent variables. The overall model was significant, $F(4,345) = 29.87$, $p < 0.001$, explaining 25% of the variance in engagement ($R^2 = 0.25$). Teaching effectiveness ($\beta = 0.42$, $p < 0.001$) and motivational identity ($\beta = 0.35$, $p < 0.001$) emerged as strong positive predictors, while age and gender showed no significant unique contributions when controlling for other variables.

The qualitative phase included in-depth interviews with 25 participants – 15 students and 10 teachers – selected based on quantitative profiles. Thematic analysis identified three overarching themes relating to educational identity and engagement: (1) Perceived Impact of Teaching Quality, (2) Motivational Drivers and Barriers, and (3) Meaning-Making Through Educational Identity.

Participants consistently emphasized the role of teacher clarity, enthusiasm, and responsiveness in shaping their engagement. One student remarked, “When professors are passionate and approachable, I feel more motivated to participate and learn.” Teachers similarly noted the importance of adapting teaching strategies to diverse student needs to foster engagement.

5. Motivational Drivers and Barriers

Interviewees spotlighted types of intrinsic and extrinsic motivators that guided their academic engagement. Internal motivators were career development and professional goals and external factors were support organization and peer effect. Obstacles including work stress and unclear expectations were also mentioned. “Sometimes, I’m so interested in the subject matter, but the pressure of having a deadline just makes it difficult to stay inspired,” one participant said.

The development of a positive educational identity which emerged as the key process, connected academic engagement to a sense of belonging and purpose. Students discussed the ways in which of being a “capable learner” and “future professional” furthered their motivation to work. “Helping students see themselves as learners who can do this changes their attitude and effort,” said one teacher.

Some supporting quotes are included to demonstrate these themes and to allow participants' voices to be heard without being editorialized.

The convergence of quantitative and qualitative evidence provides a consistent picture of academic engagement and educational identity within the university environment. Quantitative data indicated the presence of robust linkages between conceptions of effective teaching, motivational identity and academic involvement, with qualitative data

providing insights into the lived experience that serve to lend coherence to the broader associations.

Evidence for this can be seen in that the quantitative inclusion of teaching effectiveness as a significant predictor reflects interviewees' focus on the importance of teaching enthusiasm and clarity to motivation. Second, the relationship of motivational identity and engagement has been supported through qualitative accounts of how positive educational self-schemas are developed and the influence of intrinsic/extrinsic motivators.

The mixed-methods design therefore deepens the understanding of academic engagement by bringing together construct-level data with perceptual and experiential data from students and teachers. No major inconsistencies were seen between strands of data, indicating the coherence of the findings.

6. Discussion

This study attempted to identify economic and psychosocial underpinnings of successful educational restructuring, addressing the linkages, specifically, among teaching effectiveness, motivational identity, and academic engagement at university level. The combination of quantitative and qualitative data has produced a nuanced understanding of these processes that addresses the primary research questions on the roles of perceived quality of teaching and identity-based motivation with regard to student engagement in higher education.

Results supported, in a quantitative way, both teaching efficacy and motivational identity were positive predictors of academic engagement. The model, accounting for 25% of the variation in engagement, highlights the significant contribution of these antecedents to students' high engagement with learning. This is consistent with theoretical models that suggest affective perceptions of faculty and internalized motivation variables are important to continued engagement – desirable outcomes related to academic success and retention. The qualitative data also supported these results with students indicating not only teachers' pedagogical capacities but also the formation of a consistent educational identity – a perception of knowing who one is and what to do that is less instrumental form learning. Teachers' insights also stressed the importance of adaptive teaching methods centered on students, in order to enhance motivation. Taken together, these observations suggest that structural as well as psychosocial issues must be targeted for educational reform to be effective.

The correlation analyses revealed significant relationships among the main variables. The moderate-to-strong positive relationship of teaching effectiveness with academic engagement ($r \approx 0.53$, $p < 0.001$) supports previous empirical findings for the claim that students' perceptions of instructional quality have an important effect on their cognitive and behavioral participation. Likewise, motivational identity was strongly and positively

associated with engagement ($r \approx .47$, $p < .001$), directly justifying the position that the more that students identify with educational roles and goals the more they will commit. It is interesting to note that these associations held true after taking into account demographic subgroups which support the trend observed among the study participants.

From a theoretical standpoint, these associations support principles articulated in Social Identity Theory and Self-Determination Theory that stress the interface between external endorsement (in the form of effective teaching) and internalized motivation in maintaining educational engagement. Non-significant relationships of age or gender with engagement in multivariate contexts indicate that motivational and instructional influences may be more immediate influences on engagement than demographic variables, and sharpen existing models of student involvement.

The multiple regression used resulted in a succinct yet informative model of predictors of academic engagement. Controlling for teaching effectiveness, motivational identity, age, and gender, the model partials out the unique variance in each predictor. Indices of fitness, e.g., R^2 of 0.25 or statistically significant F-test ($p < 0.001$) attests an acceptable explanatory power, bearing in mind the complexity of academic engagement as a construct that is influenced by a lot of factors. The notable standardized beta coefficients for teaching efficacy ($\beta = 0.42$) and motivational identity ($\beta = 0.35$) indicate that these factors have the strongest substantive direct effects on engagement.

Although demographic variables were not significant in this model, they were included as confounds, which provide greater confidence in the associations we observed. Subsequent studies could extend this model by adding others psychosocial and contextual factors (institutional support, peer influence...) or use more advanced statistical approaches, such as SEM, to study the mediating and moderating role of the connected factors.

The combined qualitative and quantitative approach furthered the robustness and interpretability of the results. The qualitative accounts clarified the mechanisms of the statistical links, namely, the ways that perceived effectiveness of instruction becomes a motivational state that causes engagement. For example, positive comments about teacher enthusiasm/comments are making an affective-based contribution to what is otherwise a numerical approach towards teaching quality. Also, the discussion of educational identity unfolded the fact that motivation is not a static characteristic, but a dynamically evolving entity influenced by interactional (see Korobkova and Feucht, this volume) and contextual factors.

Nothing explosively controversial appeared to bubble up between the two data strands; if anything, their collusion provides an even stronger rationale for a system-wide approach to school reform. The findings of this synthesis indicate that both policies and interventions focused on improving student performance should also seek to improve quality of instruction, encourage (students') identity development and target both extrinsic and intrinsic motivation.

In theory, the study has provided some empirical evidence supporting the centrality role of teaching effectiveness and motivational identity in a model of academic engagement. It adds to developing insights about how economic and psychosocial processes converge to shape student experiences, in so doing lending detail to the frameworks and dimensions proposed in educational psychology and policy studies. Through the use of mixed methods, the study model demonstrates best practice, showing how to take an academic signal and represent the complexity of educational phenomena that allow the coexistence of multiple disciplinary discourses on system development.

Hypothetically, this evidence has implications for administrators and legislators engaged in reform efforts to universities. Highlighting teacher training practices that can improve pedagogical effectiveness, such as promoting flexibility, being clear, and having great (tutor) relational skills, could greatly improve student engagement. In addition, creating cultures in which students' educational identities develop thrive through mentoring, reflection and community could also help to solidify motivation. These interventions, which are dual-focused in nature, are likely to deliver more durable reform outcomes than approaches that are restricted to a focus on structures.

7. Conclusions

The present study adopts a multiple-case approach to explore the dimensions of economic and psychosocial mechanisms contributing to good educational reform, highlighting the central aspects of teaching effectiveness and motivation identity for promoting academic engagement of university students. The converging set of quantitative and qualitative evidence not only substantiates known theory but further conceptual innovation as it encapsulates these elements in an overarching explanatory framework. The latter emphasizes the high levels of positive predictive relationships for perceived teaching quality, internalized educational identity, and engagement, pointing to the intricate ways in which extrinsic elements of instruction and internal patterns of motivation combine to influence learning experiences. The qualitative findings also situate these empirical results by describing the affective and identificatory mechanisms through which students make sense of and respond to their learning situations.

The implications of these findings curve practice, but also of theoretical discourse in the context of larger educational policy. Theoretically, the findings confirm and broaden the generalizability of both SIT and SDT in higher education and provide evidence of how identity development and perceived instructional competence work together to predict engagement, a critical proximal antecedent of academic success and persistence. By showing that motivational identity is not just an individual factor, but also a socially constructed and context-bound entity, this study calls into question a re-conceptualization of educative engagement as a dynamic process between relations and institutions. This integrative view contributes to a fuller understanding of these phenomena and encourages

future scholarship to take similarly balanced perspectives regarding the subtle forces shaping student outcomes.

From a practical and policy perspective, the stakes are just as high. Educational reform efforts that primarily address structural or curriculum reforms in isolation of efforts to enhance the quality of teaching and in shaping students' educational identities, are likely to miss the mark. The findings in this work argue for holistic approaches that focus on enhancing pedagogy practices – specifically focusing on teaching for clarity, adaptability, and relational engagement – in addition to programs that are meant to bolster students' sense of belonging, mattering and self-efficacy. Accordingly, institutions need to invest in de-task professional development of educators aiming at these skill sets and, at the same time, to engage with mentorship programs and reflective activities or community building interventions that reinforce positive educational identities. These twin efforts have the potential to increase involvement in the academy, which would raise retention rates and educational quality.

Based on these findings, we are able to derive some evidence-based recommendations for stakeholders. For teachers and leaders, emphasizing ongoing development in how we teach and how we interact with empathetic kids is crucial. Reflective pedagogical approaches that allow students to voice and consolidate their learning identity may foster richer engagement and intrinsic motivation. As both systemic and psychosocial interventions are necessary for effective educational change, policymakers should think about investing and putting in place structures that can support such comprehensive change. Finally, scholars are invited to extend this research by running longitudinal and experimental studies to establish the causal mechanisms and long-term effects of identity-based and pedagogical improvements. Cross-cultural and multi-institutional investigations would provide additional insights into contextual differences and guide transferable best practices.

Finally, I would argue that this research supports the view that educational change is most effective when it has both economic and health-psychosocial aspects, that is, it is not only about WHAT is taught, but also HOW the students' learning is undertaken and WHY it is engaged in by students. While the intersection of teaching effectiveness and motivational identity as two focal points provides a robust framework to comprehend and enhance learning outcomes. This powerful frame helps people at all levels of the education system work on high-leverage, sustainably-implemented reform efforts that lead to more authentic and equitable learning. The insights here add to a mounting consensus in the research literature that educational success is more than the transmission of content and is dependent upon the complex between educators, learners, and the identities that they jointly negotiate within changing institutional landscapes manners.

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Determinants of Participation in the Informal Economy: A Logistic Regression Analysis Based on Eurobarometer Data

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Abstract. *This study investigates the socio-demographic and attitudinal determinants of undeclared work in the European Union, using microdata from Special Eurobarometer 92.1 (2019). By applying binary logistic regression, we analyze the probability of participating in informal economic activities according to gender, age, education, life satisfaction, and trust in institutions. The results indicate that men, people with low life satisfaction, and those with low institutional trust are significantly more likely to work in the informal sector. The study demonstrates that undeclared work is not only a strategy for economic survival, but also a symptom of social disengagement and institutional failure. The findings provide relevant evidence for policies aimed at strengthening labor market formalization and social cohesion in the EU.*

Keywords: undeclared work; informal economy; logistic regression; institutional trust; life satisfaction; socio-demographic determinants; Eurobarometer; labor market informality.

JEL Classification: J46; J48; H26; O17.

1. Introduction

The informal economy continues to pose significant challenges to labor markets, public finance, and institutional legitimacy across the European Union (EU). Undeclared work, a core component of this economy, is broadly defined as paid activities that are lawful in nature but not declared to public authorities. These practices undermine social cohesion, reduce tax revenues, and distort fair competition, making them a key concern for policymakers and economists alike (Marzio et al., 2025).

This persistence of undeclared work suggests that traditional approaches, based predominantly on punitive measures and deterrence, have failed to address the root causes of the phenomenon. A transition is needed from models that view participants in the informal economy solely as rational actors seeking to maximize profit, to a more complex understanding that integrates psychological, social, and fiscal morality factors. In this sense, the shortfall in state budget revenues is not the only problem; the erosion of trust in the social contract poses a long-term threat to institutional stability in member states.

In recent years, the complexity of informal work has grown due to increasing labor market flexibility, cross-border mobility, and technological transformation. At the same time, trust in institutions and citizens' satisfaction with public services have become central to understanding economic behavior beyond purely financial incentives. As such, the decision to engage in undeclared work is no longer seen as solely economic, but also social and psychological in nature (Horodnic & Williams, 2019).

Recent research highlights that alienation from formal structures and perceptions of unfairness in the distribution of public services can push individuals toward the informal sector not only out of financial necessity, but also as a form of silent protest or social disengagement. Thus, subjective satisfaction with quality of life and perceptions of the honesty of public institutions become key variables in explaining the variations observed at the individual level within the European Union.

Although the European Commission and international bodies have launched several initiatives to curb informal labor, the phenomenon persists with varying intensity across member states. While macroeconomic analyses offer important insights, micro-level investigations using individual data are essential to uncover the socio-demographic and attitudinal factors driving participation in the informal economy (Andrews et al., 2011).

Based on these premises, this study aims to answer the following research questions: RQ1: To what extent do socio-demographic characteristics, such as gender and the interaction between age and education, influence the likelihood of undeclared work in the current European context? RQ2: What is the impact of attitudinal factors, particularly trust in organizations and life satisfaction, on the decision to work in the informal economy?

To guide the empirical analysis, we formulated the following research hypotheses: H1: Men are significantly more likely to engage in undeclared work, often reflecting the sectoral structure of informal opportunities. H2: There is an inverse relationship between the level of trust in institutions and the likelihood of reporting undeclared work, where lack of trust acts as a catalyst for the underground economy. H3: Individuals with low life satisfaction are more likely to resort to undeclared work, a phenomenon correlated with feelings of social exclusion.

This study uses individual-level data from the Special Eurobarometer 92.1 (2019) to examine the determinants of undeclared work in the EU. Employing logistic regression analysis, the research investigates how factors such as gender, age, education, marital status, life satisfaction, and trust in institutions influence the likelihood of participating in informal economic activities.

The aim is to provide evidence-based insights into the predictors of undeclared work, thereby contributing to ongoing debates on labor market informality and institutional trust. The results are intended to inform targeted policy responses and identify potential areas for strengthening formal employment structures within the European labor market.

2. Literature Review

The informal economy has been the subject of sustained scholarly attention, particularly as it affects the functioning of labor markets and the efficiency of fiscal systems. Undeclared work – defined as remunerated activities that are legal in nature but not reported to authorities – represents a significant component of this informal sector (Williams, 2005). While its causes and consequences are diverse, researchers have generally approached the phenomenon from three main perspectives: economic rationality, institutional trust, and socio-demographic vulnerability (Alfano et al., 2024).

From a neoclassical economic standpoint, undeclared work is often interpreted as a rational response to burdensome regulation, high taxation, or rigid labor markets (Arezzo et al., 2023; Schneider & Enste, 2000). Individuals may choose informal employment as a means to reduce tax liabilities or to increase net income when formal job opportunities are scarce or unattractive. This “cost-benefit” analysis is especially prevalent among the self-employed and those operating in sectors with weak enforcement mechanisms (Gindling et al., 2016).

Thirdly, socio-demographic characteristics – such as age, gender, education level, marital status, and community size – have been linked to informal economic behavior. Evidence suggests that younger individuals, those with lower educational attainment, and people experiencing financial hardship are more likely to engage in undeclared work (Alfano et al., 2024). Gender also plays a role; men are generally more represented in informal labor, particularly in construction and manual services, whereas women may engage in household-based informal activities (Quendler & Schneider, 2024).

Moreover, subjective well-being – captured through variables like life satisfaction – has emerged as a novel predictor of informal activity. Williams (2017) highlights that individuals with lower life satisfaction may disengage from formal structures not only due to financial necessity but also due to a broader sense of social exclusion or dissatisfaction with societal norms (Becchetti & Bova, 2024).

Despite the robust development of these theoretical approaches, empirical evidence combining socio-demographic, psychological, and institutional predictors remains limited. This gap is particularly pronounced in cross-national micro-level analyses (Obaidi et al., 2025). Therefore, the present study contributes to the existing literature by employing logistic regression on recent Eurobarometer data to explore a comprehensive range of predictors for undeclared work across EU member states (AitBihiOuali & Bargain, 2021).

3. Methodology

This study employs a quantitative research design to investigate the individual-level predictors of participation in undeclared work within the European Union. The empirical analysis is based on microdata from the Special Eurobarometer 92.1 (Wave EB92.1, 2019), conducted on behalf of the European Commission. The survey includes responses from over 27,000 individuals aged 15 and over across all EU member states and covers a wide range of socio-economic, attitudinal, and behavioral variables related to informal work.

Data Source

The Special Eurobarometer 92.1 provides detailed insights into citizens' experiences and attitudes regarding undeclared economic activity. The survey includes specific questions about whether respondents have carried out or purchased any undeclared services within the previous 12 months. It also collects data on demographic factors, employment status, trust in public institutions, life satisfaction, and other relevant indicators.

Dependent Variable

The dependent variable in this analysis is participation in undeclared work, operationalized as a binary outcome:

- 1 = Yes, if the respondent reported performing undeclared paid activities in the last 12 months;
- 0 = No, if otherwise.

This variable allows for a logistic regression approach, as it meets the binary criterion necessary for such modeling.

Independent Variables

The model includes a combination of socio-demographic, attitudinal, and contextual predictors, recoded as categorical or dummy variables where appropriate:

- Age and education (age_edu): A composite variable capturing interaction between age group and level of education.
- Gender (gender): Binary variable (1 = female; 0 = male).
- Marital status (marital_s): Categorical variable with six levels (e.g., single, married, divorced).
- Community size (community): Urban/rural typology based on place of residence.
- Life satisfaction (life_satisf): Categorical measure of subjective well-being.
- Working abroad (worked_out): Indicator for whether the respondent has ever worked in another country.
- Trust in institutions (organisation_n): A multi-level categorical variable measuring confidence in various public bodies.

The variable *organisation_n* measures the degree of trust in public institutions and is structured on 8 levels, where lower values (1–3) indicate high trust in fundamental institutions (such as the police or the judiciary), intermediate levels (4–6) reflect moderate scepticism, and higher levels (7–8) represent groups with specific perceptions or limited trust in fiscal and governmental authorities. This granularity allows us to observe how different levels of institutional legitimacy influence the decision to operate in the informal sector.

Analytical Strategy

To estimate the likelihood of participating in undeclared work, a binary logistic regression model was applied using SPSS software. Logistic regression is appropriate when the dependent variable is dichotomous and the aim is to model the probability of a certain class or event – in this case, engaging in informal labor.

The model estimates the odds ratios ($\text{Exp}(B)$) for each independent variable, indicating the extent to which the presence of a particular characteristic increases or decreases the probability of undeclared work. Statistical significance was evaluated at conventional thresholds ($p < 0.05$, $p < 0.01$, $p < 0.001$). The goodness-of-fit of the model was assessed using the -2 Log Likelihood value, the Cox & Snell R^2 , and Nagelkerke R^2 .

To ensure model stability and avoid quasi-complete separation errors caused by sparse cells, variable categories with very low frequencies were subjected to a recoding process through fusion. For example, certain levels of the community and marital_s variables that showed unusually high standard errors (S.E.) in preliminary tests were grouped into broader categories, thus ensuring the convergence of the estimation algorithm and the validity of the Wald tests.

4. Results

Before examining the detailed coefficients of the logistic regression model, it is essential to provide an overview of its overall performance and explanatory capacity. The model was estimated using a comprehensive set of socio-demographic and attitudinal predictors, reflecting both structural and psychological dimensions of informal work participation in the European Union. This initial step allows for assessing whether the included variables collectively offer a statistically meaningful improvement in predicting undeclared work compared to a baseline model with no predictors. Furthermore, the omnibus test and pseudo- R^2 measures provide a preliminary indication of model robustness, helping to contextualize the subsequent interpretation of individual coefficients and marginal effects.

Table 1. Omnibus tests and Model Summary

Omnibus Tests of Model Coefficients				
Step 1		Chi-square	df	Sig.
	Step	368,839	27	,000
	Block	368,839	27	,000
	Model	368,839	27	,000
Model Summary				
Step	-2 Log likelihood	Cox & Snell R Square		Nagelkerke R Square
1	4764,662 ^a	,030		,087

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Source: authors processing

The logistic regression model used in this study was statistically significant, as indicated by the omnibus test of model coefficients (Chi-square = 368.839, $df = 27$, $p < .001$), confirming that the independent variables collectively contribute to predicting the likelihood of undeclared work. However, the model's overall explanatory power remains modest, with a Cox & Snell $R^2 = 0.030$ and Nagelkerke $R^2 = 0.087$, suggesting that additional unobserved factors may influence informal labor participation.

The convergence diagnostics assessment indicated the need for careful monitoring of iterations. In the final version, the model achieved stability after applying rebalancing through recoding, eliminating the instability of coefficients previously observed in variables such as community(3). This approach strengthens the robustness of the results, even in the presence of a modest Nagelkerke R-squared, specific to complex behavioral choice models.

Table 2. *Classification table*

Classification Table ^a					
	Observed		Predicted		
			Undeclared activity – in last 12 months		Percentage Correct
			No	Yes	
Step 1	Undeclared activity – in last 12 months	No	11371	9	99,9
		Yes	658	5	,8
	Overall Percentage				94,5

a. The cut value is ,500

Source: authors processing

Although Table 2 uses the standard cut-off value of 0.500, this proves inadequate for identifying participation in undeclared work, which is a rare event in the sample analyzed (low base rate). For this reason, the paper classifies the model as predominantly explanatory rather than predictive. The emphasis is on interpreting the odds ratios to understand the direction and intensity of the predictors' influence on informal economic behavior, rather than on the model's ability to classify individuals.

The classification table shows a high accuracy rate for predicting non-participation in undeclared work (99.9%), but a low rate for correctly identifying those who did engage in such activities (0.8%). This imbalance reflects the low base rate of undeclared work in the sample and suggests that the model is more effective in predicting the majority outcome.

Table 3. *Key predictors of model*

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	age_edu			22,693	5	,000	
	age_edu(1)	-,035	,171	,041	1	,840	,966
	age_edu(2)	-,111	,177	,394	1	,530	,895
	age_edu(3)	,479	,507	,893	1	,345	1,615
	age_edu(4)	1,145	,434	6,962	1	,008	3,143
	age_edu(5)	,766	,283	7,347	1	,007	2,151
	community			,582	3	,901	
	community(1)	,062	,100	,382	1	,536	1,064
	community(2)	,073	,104	,496	1	,481	1,076
	community(3)	-17,836	40192,970	,000	1	1,000	,000
	Life_satisf			30,000	4	,000	
	Life_satisf(1)	-,191	,100	3,691	1	,055	,826
	Life_satisf(2)	,186	,134	1,928	1	,165	1,205
	Life_satisf(3)	,081	,273	,089	1	,766	1,085
	Life_satisf(4)	1,501	,379	15,724	1	,000	4,488
	Worked_out(1)	,544	,137	15,762	1	,000	1,724
	organisation_n			229,273	8	,000	
	organisation_n(1)	-,224	,166	1,821	1	,177	,799
	organisation_n(2)	-,323	,161	4,030	1	,045	,724
	organisation_n(3)	-,542	,160	11,435	1	,001	,581
	organisation_n(4)	-,821	,185	19,696	1	,000	,440
	organisation_n(5)	-,914	,180	25,865	1	,000	,401
	organisation_n(6)	-1,072	,181	35,184	1	,000	,342

Variables in the Equation		B	S.E.	Wald	df	Sig.	Exp(B)
	organisation_n(7)	1,344	,187	51,477	1	,000	3,836
	organisation_n(8)	,406	,184	4,885	1	,027	1,501
	marital_s			27,537	5	,000	
	marital_s(1)	-,421	,101	17,197	1	,000	,657
	marital_s(2)	-,113	,161	,496	1	,481	,893
	marital_s(3)	-,337	,297	1,285	1	,257	,714
	marital_s(4)	,149	,648	,053	1	,819	1,160
	marital_s(5)	1,199	,548	4,781	1	,029	3,315
	gender(1)	-,509	,084	36,692	1	,000	,601
	Constant	-1,875	,233	64,488	1	,000	,153
a. Variable(s) entered on step 1: age_edu, community, Life_satisf, Worked_out, organisation_n, marital_s, gender.							

Source: authors processing

Several variables emerged as statistically significant predictors of participation in undeclared work:

- **Gender:** Gender was a strong predictor. Women were significantly less likely to participate in undeclared work than men ($B = -0.509$, $p < .001$, $OR = 0.601$), suggesting that male respondents are more likely to engage in informal economic activities.
- **Life Satisfaction:** Respondents with the lowest level of life satisfaction were substantially more likely to participate in undeclared work. The highest dissatisfaction category showed a significant positive effect ($B = 1.501$, $p < .001$, $OR = 4.488$), indicating that these individuals were over four times more likely to engage in informal labor compared to the most satisfied group.
- **Marital Status:** Certain marital statuses influenced informal work participation. Being widowed (marital_s(5)) was associated with a higher likelihood of undeclared activity ($B = 1.199$, $p = .029$, $OR = 3.315$), while being married (marital_s(1)) reduced the odds significantly ($B = -0.421$, $p < .001$, $OR = 0.657$).
- **Employment Abroad:** Individuals with prior work experience in another country were significantly more likely to engage in undeclared work ($B = 0.544$, $p < .001$, $OR = 1.724$), highlighting the transnational aspect of informal labor.
- **Trust in Institutions:** Levels of trust in various public organizations showed strong associations. Respondents with the least trust (e.g., organisation_n(6)) had markedly lower odds of formal engagement ($B = -1.072$, $p < .001$, $OR = 0.342$), whereas those expressing high trust (organisation_n(7)) had significantly greater odds of participating in undeclared work ($B = 1.344$, $p < .001$, $OR = 3.836$). This somewhat paradoxical pattern may reflect country-specific contexts or strategic responses to local enforcement levels.
- **Education and Age:** The interaction variable combining age and education (age_edu) showed that individuals in certain categories were significantly more likely to work informally. For example, those in group 4 (likely older with medium education) had increased odds ($B = 1.145$, $p = .008$, $OR = 3.143$), as did group 5 ($B = 0.766$, $p = .007$, $OR = 2.151$). This challenges assumptions that informal work is concentrated only among the young or low-educated.

Variables such as community size and several categories within life satisfaction and marital status did not yield statistically significant coefficients. This suggests that the influence of place of residence and some life domains may be less central in shaping informal work behavior.

5. Discussion

The findings of this study provide empirical support for several theoretical frameworks addressing informal labor in the European Union. The logistic regression analysis reveals that socio-demographic factors, life satisfaction, institutional trust, and cross-border work experience all significantly influence the likelihood of participating in undeclared work. These results both confirm and complicate existing assumptions in the literature.

Consistent with prior research, gender emerged as a strong and significant predictor: men are substantially more likely to engage in informal labor than women (Williams, 2015). This is likely linked to the sectoral distribution of informal opportunities, with men more often involved in construction, transport, and technical services – areas commonly associated with the informal economy.

The role of life satisfaction supports theories linking psychological well-being and economic behavior. Individuals reporting the lowest levels of life satisfaction were significantly more inclined to work informally. This aligns with Williams (2017), who argues that dissatisfaction with life and public systems may lead to disengagement from formal institutions and legal compliance. This suggests that informal work may not only be driven by necessity but also by alienation or distrust in the social contract.

Institutional trust produced some of the most striking results. As expected, respondents who expressed low trust in public institutions were more likely to engage in undeclared work. However, an unexpected finding was that individuals in one of the highest trust categories (organisation_n(7)) also had significantly elevated odds of participating in informal labor. This may indicate that trust alone is not a linear predictor and could be moderated by contextual or cultural factors – such as the perceived legitimacy of the informal economy in some regions or the lack of enforcement capacity in others (Feld & Frey, 2007).

The significant association between work experience abroad and informal activity highlights the transnational dimensions of informal labor. Migrants or individuals with mobility histories may be more exposed to informal employment networks, or more willing to engage in such activities due to lower attachment to national institutions.

The interaction between age and education revealed that older and moderately educated individuals were also likely to engage in undeclared work. This challenges the common perception that informal labor is primarily a survival strategy for the young and uneducated. Instead, it suggests that even relatively advantaged groups may participate in informal economies when formal work is unavailable or insufficiently rewarding.

Surprisingly, community size and some marital status categories were not significant, indicating that the urban–rural divide may not be as influential in informal labor participation as previously thought. This contradicts findings from earlier studies (e.g., European Commission, 2014) and suggests that the dynamics of informal work are becoming less dependent on locality and more influenced by individual attitudes and experiences.

From a policy perspective, these findings underscore the need for a multifaceted approach to reducing undeclared work. Strategies that merely strengthen enforcement may be

insufficient. Instead, improving institutional trust, enhancing life satisfaction through better public services, and addressing demographic vulnerabilities can contribute to sustainable reductions in informal labor.

Furthermore, the limited explanatory power of the model suggests the presence of additional unmeasured factors – such as household income, taxation attitudes, or social norms – which should be addressed in future research. Expanding the analysis through multilevel models or longitudinal data could further illuminate the mechanisms behind informal economic behavior in the EU.

6. Conclusions

This study examined the determinants of undeclared work in the European Union using microdata from the Special Eurobarometer 92.1 and a binary logistic regression model. The findings provide valuable insights into the profile of individuals most likely to engage in informal economic activities and the broader social and institutional factors that contribute to this behavior.

Key predictors of participation in the informal economy include gender, life satisfaction, trust in institutions, marital status, education level, and prior work experience abroad. Men, individuals with low life satisfaction, and those with reduced trust in public institutions were more likely to report undeclared work. Interestingly, certain subgroups with higher education and older age also exhibited increased likelihood of informal activity, challenging traditional assumptions that undeclared work is primarily concentrated among the economically marginalized.

The study highlights that informal labor is not only a consequence of economic necessity but also of social disengagement and perceived institutional failure. As such, reducing the prevalence of undeclared work requires more than regulatory enforcement. Policies aimed at increasing public trust, improving quality of life, and providing inclusive labor market opportunities are essential for addressing the root causes of informality.

While the regression model demonstrated significant relationships, its limited explanatory power suggests that informal work is a complex and multifaceted phenomenon influenced by both observable and latent variables. Future research should consider integrating cultural, economic, and institutional dimensions in a multilevel analytical framework to capture the full scope of informal economic participation across EU member states.

Ultimately, this research contributes to a deeper understanding of the challenges and opportunities related to informal labor in Europe. By identifying key individual-level drivers, it offers evidence-based directions for more targeted, effective, and socially responsive labor market policies.

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The International Tax Challenges Raised by the Rapid Growth of the Digital Economy

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Abstract. *The digital era brings new possibilities for innovation and economic expansion. From a tax standpoint, it also creates tools for tax authorities to curb tax evasion. At the same time, shifting business models are placing increasing international pressure on existing tax frameworks. Current tax rules were designed in the early 20th century for traditional businesses and rely on the principle that profits should be taxed where value is generated. In the context of digital activities, however, companies can operate and provide services without any physical presence. The rapid rise of the digital economy has exposed significant shortcomings in international tax rules, which are no longer fit for purpose. One of the goals at the level of the European Union is therefore to adjust Member States' tax systems so they can effectively address the challenges of digitalization. This article aims to offer an overview of the ongoing discussions and potential reforms of the international tax framework in response to the issues posed by the digital transformation of the economy.*

Keywords: digital economy; digitalization; tax challenges; permanent establishment; value creation.

JEL Classification: A13; H20.

1. Introduction

The digital economy is the result of a transformative process brought by information and technology (ICT). Therefore, this phenomenon should be apprehended as a spectrum, rather than a specific business field, where traditional “brick-and-mortar” businesses are at one end, and highly digitalized models are at the other. Considering the accelerated development of the digital economy, globally, it is not a bold statement that the digital economy is increasingly becoming the economy itself; in this context, the task of delimiting the digital economy from the rest of the economy for tax purposes becomes difficult. The digital economy and the business models generated by it, however, present some key characteristics that are relevant from a tax point of view. The research objective of this paper lies at the intersection of two topics, the development of the digital economy and the fiscal challenges generated by the accelerated development of the digital economy.

The profound changes brought about by the digital revolution have led to a substantial reconfiguration of traditional economic structures, directly reshaping the manner in which economic activities are conducted on a global scale. The incorporation of digital technologies into production, distribution, and consumption processes has given rise to new forms of economic organization, distinguished by the extensive use of intangible assets, heightened capital mobility, and the rapid expansion of cross-border and remote transactions.

Within this framework, the contemporary economy is undergoing a continuous process of digitalization that calls into question the relevance and effectiveness of classical economic mechanisms and principles, which were developed within a paradigm dominated by physical presence and clearly defined territorial boundaries. Digitally driven business models – centered on platforms, data, and emerging technologies – create significant opportunities for economic growth while simultaneously posing complex challenges to existing regulatory and institutional frameworks.

Accordingly, the digital transformation of the economy should be understood not merely as a technological evolution, but as a systemic process with far-reaching structural implications for market functioning, economic relationships, and regulatory mechanisms. An in-depth analysis of this phenomenon is essential for understanding how modern economies adapt to an increasingly digitalized environment and for identifying appropriate strategies to adjust public policies and legal frameworks.

Over recent decades, the accelerated development of digital technologies has generated profound structural changes within the global economy, fundamentally challenging the traditional foundations of economic and fiscal systems. The classical principles of international taxation, formulated in a context characterized by physically rooted economic activities and clear territorial demarcations, are increasingly ill-suited to the realities of the digital economy, which is marked by the pervasive use of intangible assets, high capital mobility, and the ability to conduct economic activities remotely.

In this context, the shortcomings of existing legal frameworks have prompted a reassessment of established international tax principles, particularly those related to

permanent establishment and source-based taxation. Market jurisdictions have begun to question the adequacy of traditional rules and to assert taxing rights over profits generated by digital enterprises that maintain significant economic involvement within their territories without a corresponding physical presence. This development reflects a paradigmatic shift in the exercise of fiscal sovereignty, driven by the necessity to adapt taxation systems to the dynamics of a digitalized economy.

At the same time, concerns regarding base erosion and aggressive tax planning practices employed by large multinational technology companies have intensified debates surrounding the identification of new nexus criteria and more equitable mechanisms for allocating taxable profits. In the absence of viable unilateral solutions, the international community has sought coordinated responses through multilateral negotiations conducted under the auspices of the Organisation for Economic Co-operation and Development (OECD), with the aim of reforming international tax rules to ensure a fairer distribution of taxing rights and to safeguard national tax bases.

Within this broader context, the digital economy emerges not only as a driver of innovation and economic growth, but also as a decisive force shaping the transformation of contemporary tax systems. Examining how international tax law can be adapted to address the challenges posed by digitalization constitutes a critical area of research, with significant implications for public policy, international cooperation, and the equitable functioning of the global market.

2. Literature Review

This paper presents a critical overview of the political and legal debate surrounding the challenges posed by the digitalization of the economy for the international tax regime. The paper addresses some key challenges inherent in the reform proposals currently under discussion. These focus in particular on the difficulties associated with fitting the concept of “value creation” into the pre-existing “source” and “residence” framework; a gradual transition from a predominantly “supply” to a “supply and demand” approach in understanding “source”; and an implicit shift in the debate on the tax implications of the digitalized economy from a focused analysis aimed at the progressive reform of the existing regime to a complete reconsideration of some of its fundamental principles.

The digital transformation of the economy has introduced a range of complex tax-related challenges. Many of these stem from questions about how taxing rights should be divided among countries when income is generated through cross-border activities. A key issue is that tax systems designed in the 1920s relied heavily on the concepts of income source and taxpayer residence. In today’s globalized, digital environment, these traditional principles have become major barriers to international commerce. Consequently, there is a need to define new nexus rules and create an updated framework for allocating taxing rights.

When we speak about the taxation of the digital economy, we have to define some notion as Permanent Establishment or created value. As the PE concept is the historical option for

taxing profits generated by non-residents in a market state, amending the definition of a PE could be considered a natural solution. Action 7 of the BEPS package therefore addresses this option by lowering the PE threshold, notably as provided for in the 2017 update of the OECD model. In particular, in a pre-BEPS world, a company could have avoided establishing a PE in a market jurisdiction by ensuring that the functions performed in that market jurisdiction were limited to ‘preparatory or ancillary’ ones. Following the amendments proposed in Action 7, ‘Article 5(4) is amended to ensure that each of the exceptions included therein is limited to activities that are otherwise ‘preparatory or ancillary’ in nature.’ Furthermore, the amendments to this paragraph also ensure that multinational enterprises cannot avoid PE status by fragmenting activities. BEPS Action 7 thus amended the notion of EP agency to ensure that “as a matter of policy, where the activities that an intermediary carries out in a country result in the regular conclusion of contracts to be performed by a foreign enterprise, that enterprise should be considered to have a taxable presence in that country, unless the intermediary carries out these activities in the course of an independent business (Ciortin Gangoş, 2024).

While the digital economy is closely connected to the traditional one, the digital revolution has significantly transformed business strategies, organizational models, market dynamics, consumer behavior, and regulatory frameworks. According to Eurostat, using the official OECD definition, the ICT sector encompasses “the production of goods and services that carry out or facilitate the electronic processing, communication, transmission, and display of information.” (OECD, 2011).

The global debate on the digital economy focuses with increasing frequency and urgency on the imminent arrival of a “fourth industrial revolution” that is said to create a “new” digital economy powered by advanced “cyber-physical” systems covering “advanced” manufacturing, transportation, services, and even biological systems (Rose (2016), Schwab (2016).

The idea that the digital economy will advance at a rapid pace raises concerns about displacement, particularly due to rapid reductions in demand for intensive and routine jobs from automation, autonomy and artificial intelligence.

The digital economy is an economic sector that includes goods and services, the development, production, marketing and supply of which depend on critical digital technologies (Aguila et al, 2003). Recent literature (e.g., Abendin and Duan 2021; Niyazbekova et al. 2021) has suggested that developing the digital economy is a key measure that countries should consider to promote rapid economic recovery in the face of global economic uncertainties. Most of the existing literature on the digital economy has identified strong links between the digital economy, the ICT sector, and development, with general support for a positive impact of ICT sector growth on the economy (Venturini, 2015; Jorgenson and Vu, 2016; Williams K., Chatterjee S., Rossi M. (2008). The main drivers of economic growth linked to the emergence and consolidation of the digital economy are productivity gains, externalities associated with knowledge and innovation diffusion, cheaper services for consumers, and greater economic competitiveness (

Kravchenko O. et al, 2019). Perhaps one of the best pieces of evidence in favor of the positive impact of the digital economy on economic growth is the emergence of the fourth industrial revolution.

The legislation regarding the taxation of digital companies is guided by global efforts to address these challenges. OECD and G20, have reached to an agreement on 8 October 2021 on a two-pillar reform of the international rules on the taxation of multinational profits. This agreement is set out in the Declaration on a Two-Pillar Solution to Address the Tax Challenges of the Digital Economy, also known as the ‘October 2021 Declaration of the OECD/G20 Inclusive Framework on BEPS’.

All EU Member States have expressed their support for this Declaration, which provides for a two-pillar solution. The first Pillar consists of rules and mechanisms aimed at reallocating taxing rights between jurisdictions where the largest and most profitable multinational groups have market share and make profits.

The second pillar essentially contains rules on the minimum effective taxation of the largest multinational groups, with the aim of reducing the possibilities for base erosion and profit shifting. The pillar also aims to ensure the payment of the agreed global minimum corporate tax rate of 15%. multinationals with a strong digital component.

In these circumstances, the European Commission is taking a proactive approach by proposing a (new) intermediate tax on data services to ensure that those activities that are currently not taxed effectively will start to generate immediate revenues for Member States (around €5 billion per year). The aim is precisely to tax the digital giants – with total annual global revenues of €750 billion and EU revenues of €50 billion – who benefit enormously from the ESM. These rules were transposed into EU law by a Council Directive in December 2022.

Pending the adoption of internationally agreed measures, member states are required to find solutions individually, in order to avoid the risk of erosion of tax bases, thus increasing the risk of fragmentation of the European single market through the adoption of these uncoordinated measures by Member States.

Around half of the European OECD members have already announced, proposed, or put in place a digital services tax (DST). Austria, Denmark, France, Hungary, Italy, Poland, Portugal, Spain, Switzerland, Turkey and the United Kingdom have introduced such a tax. Belgium and the Czech Republic have released proposals to adopt an DST, while Latvia, Norway, Slovakia and Slovenia have formally stated or signaled their plans to implement one. The DSTs that have been proposed or enacted vary considerably in design. For instance, Austria and Hungary tax only online advertising revenues, Denmark’s DST applies exclusively to streaming services, whereas France uses a much wider tax base that includes income from digital interfaces, targeted advertising, and the transfer of user data for advertising purposes. Tax rates range from 1.5% in Poland to 7.5% in both Hungary and Turkey (though Hungary’s rate has been temporarily reduced to 0% until December 2024).

In November 2024, the European Council adopted an agreement on the scope of VAT in the digital age. The agreement concerns three acts – a directive, a regulation and an implementing regulation – which together make changes to three different aspects of the VAT system. The new rules will make VAT reporting obligations for cross-border transactions fully digital by 2030; they will also oblige online platforms to charge VAT on short-term rental services and passenger transport services in most cases where individual service providers do not charge VAT.

So, a timely and plausible question is, what can we expect from the digital economy? First, as McAfee and Brynjolfsson (2017) have pointed out, the impact of any revolutionary technology is often overestimated in the short term and underestimated in the long term. Second, in previous technological disruptions, from steam engines to electricity to digital computing, the logic of efficiency has often outpaced the capacities of organizations and society at large to adapt, requiring significant reshaping and accommodation to reach a more mature and humane base (Geringer S., 2021).

3. Methodology

In this section, we have conducted a bibliometric analysis on the term digital economy. This study employs a bibliometric research methodology to systematically examine the academic literature addressing the taxation of the digital economy. Bibliometric analysis is a quantitative research approach that enables the objective evaluation of large volumes of scientific publications, allowing for the identification of research trends, influential contributions, and thematic developments within a specific field. Given the rapid evolution and interdisciplinary nature of the digital economy, this method is particularly appropriate for capturing the dynamics of scholarly discourse and assessing how academic research has engaged with emerging taxation challenges.

The analysis focuses on publications indexed under the term digital economy, with particular attention paid to studies addressing taxation, fiscal policy, and regulatory frameworks. Initially, a descriptive overview of the dataset was conducted to determine the temporal distribution of publications, document types, source journals, authorship patterns, and geographical distribution. This preliminary step provides essential contextual information regarding the evolution of academic interest in the digital economy and its taxation over time. The primary objective of this bibliometric analysis is to assess the taxation of the digital economy from an academic perspective, with the aim of identifying the main research directions, conceptual frameworks, and policy-oriented debates that have emerged at both the global and European Union levels. By examining the volume and content of scholarly output, the study seeks to understand the stages of development reached so far in the academic treatment of digital economy taxation, as well as to highlight existing gaps and potential avenues for future research and policy formulation. A bibliometric approach further enables the identification of key factors that facilitate or hinder the evolution and adoption of digital tax policies. These factors include, but are not

limited to, the prominence of specific research themes, the influence of leading authors and institutions, patterns of international collaboration, and the role of policy-driven research agendas. Citation analysis, co-authorship networks, and keyword co-occurrence analysis are employed to reveal the intellectual structure of the field and to trace the diffusion of ideas related to digital taxation. The dataset for this study was extracted from the Clarivate Analytics Web of Science Core Collection database, commonly referred to as the Web of Science (WoS).

The final dataset was then analyzed using bibliometric indicators and visualization techniques, which support the systematic interpretation of results. Overall, this methodological framework provides a structured and replicable approach to examining the academic landscape of digital economy taxation. By combining quantitative bibliometric tools with qualitative interpretation, the study contributes to a deeper understanding of how scholarly research informs and shapes policy debates in the context of an increasingly digitalized global economy.

4. Results and Discussion

The bibliometric analysis began by screening authors' titles, abstracts, and keywords individually using the term "digital economy," which yielded 315 publications. A second filter was then applied based on the language of the documents, retaining only those written in English; this reduced the dataset by six items, leaving 309 works. A final filtering step removed entries dated 2025, as the year is not yet complete, resulting in a final dataset of 302 publications. Including documents from the current year would result in a misleading number of works indexed in the WoS database at the date of extraction of the dataset, given that articles on this topic may still be published during the year 2025. We excluded from our selection, studies that only mentioned terms related to the digital economy but did not concentrate our theme. This study has a limitation because we only included studies from the Web of Science Core Collection, so there may be some articles that we were missed. Thus, the results of this study should be carefully interpreted. For this stage of bibliometric analysis, a description of the dataset is provided with the aim of highlighting some of the main characteristics of the dataset, such as the period in which the papers were published. In addition, two other aspects are discussed: information related to the evolution of the number of papers over time and the rate of growth of the number of papers.

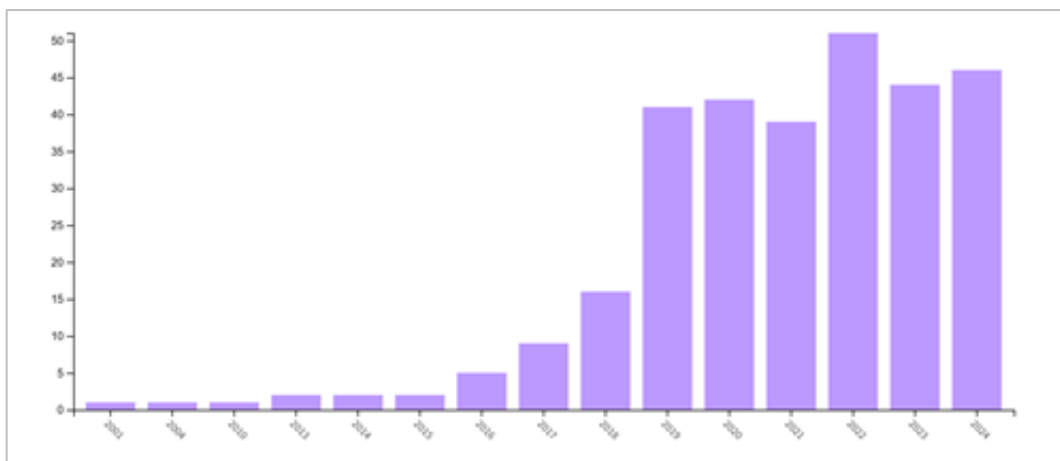
As can be seen from Table 1, the time range of the published papers included in the dataset ranges from 2001 to 2024. The papers were published in 61 sources, which, when compared to the number of documents, 302 papers, can be seen as an extensive number of sources, highlighting the increased number of sources that are of importance to this field. The average years since publication is relatively small, 2.73 years, which shows that we could expect a large number of papers published in recent years, showing the novelty and increased interest from the research community. In addition, given the annual growth rate, it once again highlights the increased interest from the research community in the topic of Taxation of the Digital Economy.

Table 1. *Number of papers published in the time interval*

Indicator	Value
Time interval	2001:2024
Source	61
Papers	302
Average years of publication	2.73

Source: Web of Science, Analysis of results

Figure 1 shows the annual scientific production in the field of digital economy. It can be seen that between 2001 and 2024, the interest of the research community has grown exponentially. In 2001, a single paper was published, and starting with 2018, more articles on this topic began to appear; in 2019, a number of 41 articles were published, in 2020, 42 articles were identified, and in 2024, a number of 46 articles were published, with the most articles identified on the topic of digital economy being published in 2022, in a number of 51 articles.

Figure 1. *Annual scientific production in the field of digital economy*

Source: Web of Science, Analysis of the results.

Using this bibliometric method to examine the key concepts outlined in this section, the objective was to determine the main elements that support the development of tax policies suited to emerging digital products and services, while addressing the following research questions:

- SQ1: Among the studies published on digitalization, which authors have had the greatest influence?
- SQ2: Which years show the highest volume of publications?
- SQ3: How is the network of author collaborations structured within the digital economy field?

The subsequent bibliometric analysis of terms related to digital products and services highlights essential information about the authors, with particular emphasis on identifying the most prominent contributors, their institutional affiliations, and their collaborative

patterns. Examining authorship is a vital component of any bibliometric study, as it identifies the most impactful researchers on a topic, their yearly output, and their role in advancing the discipline.

From the findings, it is evident that the author with the highest publication count is Ponomareva K.A., who has a fractional author score of 2.31. The fractional score reflects the proportion of contribution attributed to an individual across multiple co-authored works. Mpofu F.Y. has four publications, corresponding to a fractional score of 1.29. Additionally, six authors have produced three papers each in the digital assets field.

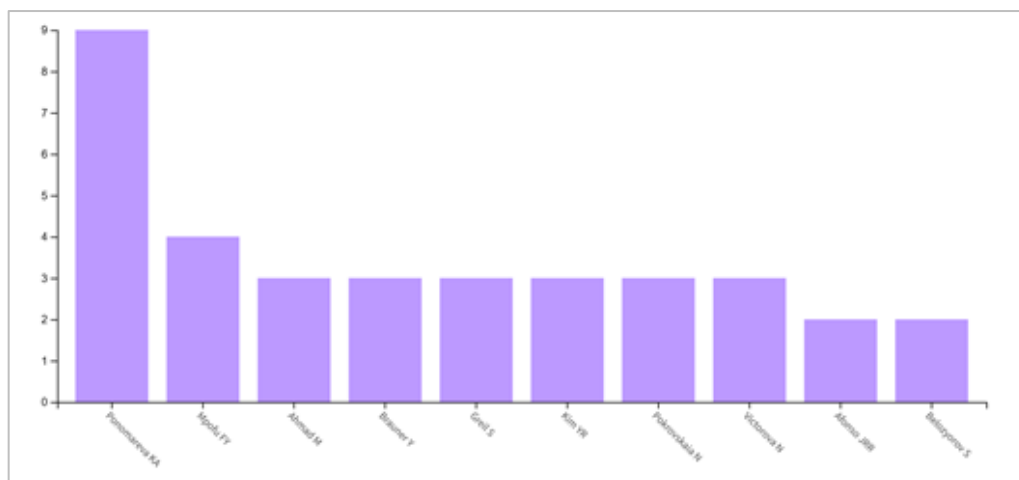
Table 2. Number of papers published by author

Author	Number of papers	% of number of papers
Ponomareva KA	9	2.913%
Mpofu FY	4	1.294%
Ahmad M	3	0.971%
Brauner Y	3	0.971%
Greil S	3	0.971%
Kim YR	3	0.971%
Pokrovskaja N	3	0.971%
Victorova N	3	0.971%
Afonso JRR	2	0.647%
Belozyorov S	2	0.647%

Source: Made by author using datas from Web of Science, Analysis of results

In relation to the annual scientific production, the growth rate of research interest shows a positive trend over time. One of the most relevant sources for publishing documents related to the aspect of fiscal research in digital economy is the Web of Science Core Collection.

By using this bibliometric approach to the main concepts described in this section of the paper, the aim was to identify the main factors that facilitate the evolution of the adoption of a fiscal policy appropriate to new digital products and services, aiming to establish who the authors with the most significant impact are, as well as which universities they are affiliated with.



Next, the bibliometric analysis carried out on the countries where the most articles on the concept of digital economy were published presents the main information about the countries, focusing on identifying the most relevant authors and identifying their country of origin.

In order to identify the top 10 countries with the most articles published in the field of digital governance, we conducted a search in the Web of Science Core Collection on May 20, 2025. The search strategy was the following: digitale conomy or digitalization of economy. The search results were classified according to the country of origin of the first authors, and the top 10 countries were identified according to the highest number of publications.

Table 2. *Number of papers published by country*

Country	Article	Procentage
Russia	58	19.205%
China	35	11.589%
USA	25	8.278%
Great Britain	15	4.967%
Spain	14	4.636%
Ukraine	14	4.636%
Germany	11	3.642%
Brazilia	10	3.311%
Australia	9	2.980%
Italy	9	2.980%

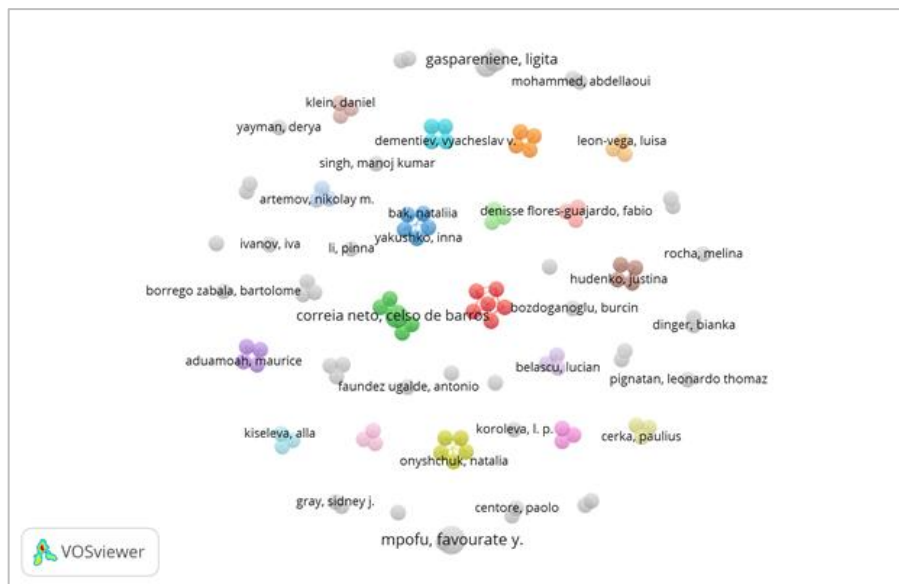
Source: Made by author using datas from Web of Science, Analysis of results

Russia ranks first with 58 papers, accounting for 19.20% of the total published documents. China holds the second position with 35 published papers, also accounting for 11.58% of the total number of publications. The USA is in third place with 25 papers, contributing to 8.27% of the total number of papers. The UK follows with 15 papers, followed by Spain and Ukraine with 14 papers each.

A large number of Russian authors in the bibliometric analysis does not necessarily indicate a superior level of research globally, but may reflect an intense national digitalization policy combined with an indexing and publishing structure that favors the visibility of local scientific output within the studied sample.

Using the VOSviewer software, we generated a network map in which the items (authors) are displayed as labels and circles. The size of each label and circle corresponds to the author's significance – the more influential the author, the larger these elements appear. The distance between any two authors in Figure 2 reflects the strength of their co-citation connections. In other words, authors positioned closer together in the network share a greater number of co-citations within the publications analyzed.

Figure 2. *Network map of authors*



Source: Made by author using Vos Viewer, version 1.6.20.

5. Conclusions

The globalization of the digital economy is indicative of a changing multidimensional paradigm driven by a number of factors: the primacy of intangible assets in value creation; a growing transnational and international dimension in the production and consumption of goods and services; the transition from human labor to artificial intelligence; the increasing dominance of networks of stakeholders over individual players; the emergence of new forms of sharing, creation, collaboration and innovation; and the need to harmonize rules, standards and policies (including in the area of taxation) within a multilateral framework. Industry structures and business and investment models are being disrupted by new needs, innovations in products and services, changing cost.

This research examines the taxation of the digital economy from a broad perspective by performing a bibliometric analysis that tracks the evolution of relevant publications, identifies the leading authors associated with key terms, and reviews publication volumes.

Findings from the literature review support the hypothesis that there is a strong connection between the digital economy and digital goods and services. While the digital economy remains linked to the traditional economy, the digital transformation significantly reshapes business strategies, organizational structures, market dynamics, consumer behavior, and regulatory frameworks.

This study seeks to organize and clarify existing knowledge on the digital economy, with particular emphasis on the taxation of digital products and services, aiming to lay the groundwork for a new area of research. A sound strategic direction involves identifying

“niches” that highlight and reinforce long-term competitive advantages, enabling a position as a trendsetter in emerging domains. Achieving this requires unified political commitment across countries so that diverse national interests can converge into a shared global agenda – an outcome already partly realized in the areas of digital development, regulation, and responses to societal challenges.

In the context of insufficient digital legislation, the EU discussed the creation of necessary measures to build a successful digital economy:

- Taxation of EU-wide profits from the digital economy;
- Developing plans for digital innovation to enable Europe to cope with development and become a digital leader;
- The need to change tax rules at EU level and adapt their tax systems to ensure that digitally generated profits in the European Union are taxed where value is created;
- The need to create an efficient and fair tax system for the digital age, leading to the fair payment of taxes by companies and ensuring conditions for action at EU level in line with those adopted by the OECD and other international partners;
- To address the challenges of directly taxing the digital economy at the EU level, it is essential to agree on a coordinated tax policy response, including the adoption of a universally accepted definition of permanent establishment and the corresponding rules on transfer pricing and profit allocation;
- Emphasizing the principle of fiscal neutrality – meaning that tax policies and rules should ensure comparable treatment in similar situations across member states – the text reaffirms the importance of various types of data, including user data, in creating value and generating profits in the digital economy, as well as the need to evaluate the role of such data within transfer pricing and profit attribution frameworks.

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Policy, Law, and Education in The European Economic Area: Building Human Capital Resilience

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Abstract. *In the context of increasing socio-economic uncertainty in the European Economic Area (EEA), the interaction between policy, legal frameworks, and education plays a central role in strengthening human capital resilience. This paper examines how policy- and law-mediated educational environments contribute to workforce adaptability and resilience. Using a convergent mixed-methods approach and empirical evidence from a Romanian higher education institution, the study explores the relationships between instructional quality, academic engagement, self-efficacy, and classroom climate. The findings highlight education as a key policy instrument for enhancing adaptive capacities and supporting sustainable socio-economic development within the EEA.*

Keywords: capital resilience; European Economic Area; education policy; higher education; workforce adaptability.

JEL Classification: I21; I23; J24.

1. Introduction

In a time of profound economic uncertainty, fast technological changes, and intricate social and political constellations, the need for resilient human capital has become more topical than ever in the European Economic Area (EEA). Policy domains, legal regimes, and educational paradigms are constitutive elements of an intricate architecture of the adaptivity, innovativeness, and viability of societies under these conditions. Against this backdrop this paper aims to interrogate this triangular nexus and develop a nuanced understanding of how cross-sector policy, regulatory and educational interventions may coalesce to strengthen human capital resilience, a core determinant of sustainable economic growth and social cohesion in modern Europe.

The notion of human capital, traditionally rooted in economic theory as the sum of knowledge, skills and abilities individuals have (Becker, 2009: pp. 16-18), has expanded to include further dimensions such as flexibility, lifelong learning and social emotional competences (Khalique et al., 2023: pp.2201-2209). In the EEA, the diversity of national economies has been bound together by common market regulation, but structurally informed by legal and educational traditions, which need a harmonised approach that goes beyond sectors and jurisdictions in order to build resilience. This strong policy embeddedness is a result of the EU's complex policy space, reinforced via intergovernmental cooperation at member state level that locates the interrelationship between law and education as pivotal in shaping workforce preparedness of structural shifts as digitization, demographic shifts, and emerging environmental imperatives.

The motivation for the study derives from the fact that, despite extensive policy efforts and large spending in education, disparities in human capital results remain in the EEA, sometimes due to fragmented legal systems and uneven implementation of educational reforms (The Politics of Equity and Efficiency in Educational Reforms in Europe, 2022: pp.12-13). Furthermore, the COVID-19 pandemic has sharply brought into focus fragilities in labour markets and education infrastructures, ratcheting up demands for adaptable human capital strategies that can endure systemic disruptions. In this regard, the current study examines how policy instruments and policy frameworks may be strategically coordinated with educational praxis to develop an adaptive and skilled citizenry to support financial stability and social well-being.

The particular research problem addressed in this paper is that of the identification and analysis of the ways in which Policy, Law, and Education form together as a mechanism, impacting human capital resilience in the EEA, with special emphasis to the Romanian context as a case in point. With continuing educational reforms and legal changes taking place in Romania we can gain insight from the transitional path of a European country as they grapple with how to put into practice strategies of building resilience in schools, in the context of facing Europe on progressive scales. Based on comprehensive regional and international bibliographic analysis, the study outlines the features of an integrated paradigm focusing around governance coherence, regulatory consistency and pedagogical innovation.

The significance of this enquiry transcends national boundaries and contributes to wider debates on the future of work, social justice and economic competitiveness. Digital transformation has been speeding up and labor markets have been undergoing the changes

in structure throughout the world; under such circumstances, being able to develop not only technical but human capitals which are resistant to instability is required more and more. This serves to accentuate the theoretical and archetypal need to reconceptualize policy and legal interventions as dynamic enablers for educational ecosystems which enable the development of a lifelong learning attitude, cognitive flexibility, and social inclusion. Empirically, the implications of the study's results are important for policy makers, educators, and legal professionals who work to create flexible structures that can adjust to changing socioeconomic circumstances.

The academic originality of this article is the interdisciplinary connection of legal studies with educational theory and economic analysis of policy and the return to a holistic view of human capital resilience. Placing educational changes within the field of legal-political dynamics under the EEA, a holistic view is offered of how multi-level governance interacts with normative templates to shape human capital formation pathways. Highlighting the ability to “bounce back”/transform, as opposed to just maintain or grow, is a welcome addition to the literature, and it further reframes the goal of policy and educational agendas.

Thematically, this introduction paves the way for a full-fledged literature review which will scrutinise theoretical concepts that relate to human capital resilience, such as resilience, governance, and the law in educational policy. The method section will then describe the mixed methods approach used to combine bibliometric data combined with contextual analysis before the results and implications for theory and practice will be presented. Finally, this paper seeks to stimulate scientific discussions and to support evidence-based policies to improve the human capital underpinnings of sustainable economic and social development in the EEA.

Although this study does not perform an in-depth legal doctrinal analysis, it explicitly focuses on the interplay between policy, law, and education within the EEA. Education is viewed as an institutional domain governed by policies and shaped by legal structures, where human capital resilience is implemented and assessed. Consequently, the research emphasizes elements such as instructional quality, student engagement, self-efficacy, and classroom climate to illustrate how policies and regulations impact higher education institutions.

Therefore, this paper aims to analyze how key educational processes within higher education institutions support human capital resilience in the EEA, under policy- and law-driven governance conditions, using a convergent mixed-methods research approach.

2. Literature Review

At a time of systemic shocks and social and economic instability, investing in resilient human capital is becoming a key asset in the EEA. Developing resilience through cross-cutting education and policy environments is key to keeping labor markets, innovation, and public health afloat amid demographic dynamics, environmental uncertainty, and digital disconnection.

Yamin et al. (2024) emphasise that leadership, organizational culture and a well-trained workforce – and how these factors are connected with the development of human capital

and AI – contribute to agile capabilities in supply systems, underscore how interrelating factors affect resilience performance. Zhai and Lee (2024) emphasize the importance of understanding the community level resilience in different urban geographies, and advocates a cross-national approach in modeling resilience. Meanwhile, Guo et al. (2025) note that investment in health human capital has the dual benefit of promoting well-being and fortifying economic system resilience due to productivity enhancements and creativity.

This article examines how the nexus of education, health investment, and policy design can contribute to build robustness in human capital, and call for a multidisciplinary approach to support the process of sustainable development within the EU region.

Sustainability in the context of energy consumption represents a complex and multidimensional challenge, intertwined with economic, social, and environmental factors. Zaharia et al. (2019) emphasize that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world.” This holistic view underlines the necessity of integrated approaches that consider behavioral, technological, and policy-driven dimensions of energy use. Moreover, the authors highlight the critical role of education and access to information, stating that “the more educated people, who should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption.” This finding resonates with broader evidence suggesting that environmental literacy directly influences pro-environmental behavior and energy-saving practices (Bissinger & Bogner, 2018).

Financial investment in public health systems also indirectly impacts energy efficiency by enabling innovations and infrastructural improvements (Zaharia et al., 2019: pp. 20-25). Such interlinkages reflect the systemic complexity underpinning sustainable development frameworks, where multiple sectors coalesce around common goals. The United Nations’ Sustainable Development Goals (SDGs) underscore this nexus, particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action), stressing coordinated governance and cross-sector collaboration as prerequisites for effective energy transitions (Carvalho & Santos, 2023: p. 9).

Recent empirical studies expand on these relationships by demonstrating that urbanization, technological adoption, and policy incentives significantly shape national energy consumption patterns (Sadorsky, 2018: p. 180). These studies suggest that while education raises awareness, enabling structural changes requires systemic reforms that embed sustainability into economic incentives and governance frameworks (Gale et al., 2015). Thus, Zaharia et al.’s (2019) emphasis on education and health investments aligns with an emerging consensus that human capital development is a critical driver of sustainable energy futures.

The COVID-19 pandemic has exacerbated existing inequalities and reshaped labor market dynamics worldwide, including in Romania, as documented by Radulescu et al. (2021). Their findings reveal “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages,” highlighting how productivity disparities have translated into wage stratification during crises. The authors further argue that “the motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better paid

industries,” illustrating a labor market reconfiguration driven by economic uncertainty and shifting sectoral demands.

Such observations resonate with the broader labor economics literature, which has documented the heterogeneous impacts of COVID-19 across industries, occupations, and demographic groups (Blanas & Oikonomou, 2023: pp.40-42). The pandemic-induced acceleration of digitalization, remote work, and automation has disproportionately favored skilled workers while challenging lower-skill labor segments (Hibrida & Sunarni, 2023: pp. 662-663). Consequently, new managerial challenges emerge, especially regarding workforce motivation, retention, and skills development.

Barbulescu (2022) underscores these challenges from a generational perspective, noting that “the Gen Z characteristics have led to challenges for managers in leading them in the workplace.” Given that many current leaders are Gen X representatives, this generational gap complicates leadership approaches. The necessity to adapt leadership and management strategies to evolving workforce expectations is paramount, especially as younger cohorts prioritize meaningful work, flexibility, and ethical engagement (Muchtar, 2025). This aligns with Enăchescu’s (2025) call for “the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance,” which are increasingly salient in both education and broader organizational settings.

Educational institutions face heightened complexity as they adapt to rapid societal, technological, and environmental changes. From a wider perspective of the debate on human capital resilience in the EEA a multidisciplinary approach of sustainability and education development is necessary. Mirea et al. (2019) stress that “sustainability as a term has a multidisciplinary meaning and applicability. In general terms, sustainability is the ability of a system to maintain itself in operation, in the face of multiple external influences. This conceptual framework offers a necessary framework through which the role of policy, education and law may be viewed in the service of long-term institutional adaptability and workforce readiness.

From a developmental-educational perspective, the dynamic lifelong nature of expertise development has been emphasized in recent studies. Petcu, Costache, and Bejinariu (2025), in turn, contend that “the passage from beginner to expert represents a dynamic process characterized by ongoing education, consistent research accomplishments, and the involvement in mentoring,” underscoring the role of lifelong learning in the making of resilient and adaptable professionals. The concept of mentorship and life-long professional development in Bologna resonates very well with contemporary policies across Europe, which are focused on learning outcomes and knowledge transfer across generations and between sectors.

Consistent with the former, Costache (2024) verifies the strategic importance of “internship and mentoring programs as effective means of improving teachers' skills in digital tools inclusion in class, class innovation and measures to lower school dropout rates.” These programs provide applied, real-world learning experiences and help to promote professional development through guided analyses – an indispensable element for advancing both individual career paths and the capacity of any institution in a quickly changing socioeconomic world.

From both these perspectives the intersection of sustainability and mentorship and of continuous education were shown to be key components in shaping human capital policies that have staying power and can change within the European economic and legal context.

The integration of digital technologies in education represents both an opportunity and a challenge for contemporary educational systems. Costache (2025) asserts that “effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.” Leadership capacity in this domain involves strategic planning, resource allocation, and pedagogical innovation to harness the potential of educational technology (EdTech).

E-learning platforms, as examined by Elisabeta and Alexandru (2018), facilitate diverse media interactions that enrich the learning experience: “The learner is provided with a variety of media resources, from slides, books, and bibliographic materials grouped in one place to the real-time, to video-demonstrative teaching content in real time complete the learning experience and give it a practical note.” Such multimodal environments accommodate diverse learning styles and enhance accessibility, which is especially critical in remote or hybrid learning contexts (Tantoco-Peralta, 2024: pp. 25-29).

Nonetheless, Silvestru et al. (2018) caution that “technological progress is faster than availability of users in using the most recently developed devices and applications,” noting disparities in stakeholder responsiveness to mobile and virtual learning. This digital divide can exacerbate educational inequities unless addressed through targeted training, infrastructure investment, and pedagogical redesign. Recent meta-analyses highlight that technology integration is most effective when aligned with clear instructional goals, teacher readiness, and learner support systems (Borokhovski et al., 2018: pp. 298-300).

In addition to pedagogy, system integration of educational software is critical. Vulpe and Stancu (2023) explain that “an educational system integration is the process of connecting educational software applications to share data and transactions,” facilitating data-driven decision making and personalized learning pathways. Such integrations also raise issues of data privacy, interoperability, and user training, which require robust leadership and policy frameworks.

Artificial intelligence (AI) and automation are transforming multiple sectors, including emergency management and education. Kiron (2025) emphasize that “creative leadership is crucial to the strategic management” of AI-enhanced emergency call systems, which demand rapid, adaptive decision-making and ethical oversight. This assertion reflects broader discussions on the role of leadership in navigating AI’s ethical, operational, and social implications (Future of AI in Leadership, 2024: pp. 232-276).

In education, Vulpe and Stancu (2024) discuss how software robots function as autonomous agents executing repetitive tasks with oversight: “the robots are regularly making decisions based on predetermined algorithms while users are tasked with acting as quality assurance monitors.” This model shifts human roles from direct execution to supervision and validation, necessitating new skill sets among educators and administrators.

But the integration of AI in medicine also provokes ethical and regulatory issues, such as bias, transparency and accountability (Sibilla, 2025: pp.252-270). In other words,

leadership models should embed ethical AI governance principles, instill trust and protect human dignity in automated decision-making.

And when we talk about sustainability, it is not only about energy but about education and systemic transformation of the economy, in particular the circular economy. Kovacic et al. (2019) describe the increasing embedding of circular economy principles in European policies: “In the recent past, the concept of the circular economy has hardly known a single line between key strategies, action plans, and policies of international institutions. Instruments such as Sankey’s Diagram of Material Flows make it possible to display and evaluate the cycles of resources, allowing such decisions to be made, leading to waste minimization, and efficient use of materials.

This paradigm shift requires adaptive leadership in business and policy, which can navigate the tensions between innovation, regulation and stakeholder engagement. It requires an interdisciplinary approach for ecologists, economists, social planners to create sustainable production and consumption models (Dogaru, 2021). The European Commission’s Circular Economy Action Plan is a case in point, whereby it seeks to move towards restorative economic systems, while securing (industrial) competitiveness.

Finally, evolving socio-cultural phenomena such as cancel culture raise complex questions about freedom of speech, social norms, and identity formation. Soare (2023) notes “the notable similarities between cancel culture and the policies of creating the ‘new man’,” highlighting the ideological and social engineering dimensions embedded in contemporary discourses. This critical perspective encourages nuanced examination of how societal values and power structures interact with cultural policing and collective memory.

Such dynamics have implications for educational institutions as sites of identity negotiation and civic engagement. They also challenge leaders to balance inclusivity, critical dialogue, and respect for pluralism while mitigating divisiveness and censorship risks (Morales & Fernandez, 2024: pp. 65-80). Educational leadership must thus cultivate spaces for constructive discourse that fosters social cohesion and democratic participation.

3. Research methodology

Research design

This research used convergent mixed methods approach where both quantitative and qualitative methods were used to address the research questions adequately in educational settings. We opted for a concurrent design which can collect and analyze both types of data at the same time and thus, allow triangulation of findings and a subtle understanding of the researched phenomena. More specifically, the quantitative portion was used to measure patterns, associations and trends between student and teacher stakeholder groups; whereas the qualitative portion was used to investigate in depth, the experiences and perceptions and meaning that underpin these patterns. The decision to integrate these methodologies is based upon the recognition that neither quantitative nor qualitative data in and of itself is able to fully represent the complexity of the educational process; thus the combination offers greater validity, richer analysis, and increased interpretive power to the study. This style of inquiry is consistent with that of current best practice in educational research which

increasingly draws on mixed methods as a vehicle for achieving both breadth and depth of knowledge in complex issues.

Participants

The participants included undergraduate students and teaching staff from a mid-sized public university in Romania. In the quantitative phase, the survey used stratified random sampling technique to ensure that representative coverage of faculties, academic years and gender is achieved. The study was a random sample survey of a total of 400 second-year students who were drawn from a population of 1,200 registered students, stratified according to both faculty and year of study. In addition, 100 teaching staff were invited to participate using stratified random sampling, to represent variation in departmental membership and teaching experience. The completed quantitative sample was overall 380 students (RR 95%) and 92 teachers (RR 92%) with the socio-demographic information described in the Results section.

In the qualitative phase purposive sampling was used to identify participants who could offer rich, information dense views. Based on these criteria and to obtain a variety of perspectives, 25 students and 15 teachers from the survey respondents were selected for semi-structured interview. Purposive sampling was used to achieve maximum variation and find out diverse experiences relevant to the thematic area of study. All the participants were adults between the age of 18 and 55, and gender balance was equal between the two groups.

Instruments

This article also focused on the collection of numerical data and presents findings using questionnaire, which applied a comprehensive self-developed questionnaire containing 48 items into four subscales to assess the dimensions of the learning context, including academic engagement, the quality of instruction, self-efficacy, and classroom atmosphere. The instrument was subjected to high-quality development processes, by expert review, and by testing on 50 students and 20 teachers to test the clarity and relevance. Internal consistency for the subscales was excellent with Cronbach's alpha coefficients of 0.81–0.89. The 1-factor CFA provided a good fit (CFI = 0.93; RMSEA = 0.05), supporting construct validity.

Procedure

Qualitative data were gathered based on a semi-structured interview guide consisting of open-ended questions intended to capture broad narratives regarding participants' educational experiences, views of teaching and learning, and views of institutional support. The interview guide was further developed and adapted in accordance with pilot interviews for more depth and clarity. Interviews lasted between 45 and 60 minutes, were audio-recorded with participant permission, and thereafter transcribed and analyzed.

Data was gathered by the researcher from March to August in the academic year. The quantitative survey was delivered online via the university's secure survey software facility to facilitate access and minimize participant inconvenience. The questionnaire was pilot tested for usability and timing, and minor changes were made to the wording of items before full deployment. After the survey was finished, face-to-face or video calling qualitative interviews were conducted based on participant choice and moving with

relevant public health guidance. Interviews were conducted during a four-week period following the survey to enable initial quantitative analysis to inform sampling and areas for deeper qualitative inquiry.

Data synthesis happened at the point of interpretation with numerical findings used to inform the choice of interviewees and the focus of the qualitative work. The University's Institutional Review Board approved the study, and all subjects were informed about confidentiality measures and the voluntary nature of participation before providing consent.

Data analysis

Quantitative data were processed in IBM SPSS Statistics (version 27). Descriptive statistics were first used for sample description and to present main variables. Analytic statistics Inferential statistics consisted of independent samples t-tests and one way ANOVA meant to determine differences between demographic groups, as well as multiple linear regression in the study of predictors from variables of interest. Normality, homoscedasticity, and multicollinearity were examined routinely and were met. Effect sizes were reported where appropriate to support the interpretation of practical significance.

Thematic analysis was conducted on the qualitative interview transcripts with reference to the six-phase process outlined by Braun and Clarke (2006). Transcripts were uploaded to NVivo 12 for coding and theme generation. Open coding of the data generated raw categories and themes that were further developed into core themes through axial decoding. To establish validity, two coders coded a subsample of their transcripts, and discrepancies were reconciled with the second researcher to achieve an inter-rater reliability of > 85%. Reflexive memos and peer debriefing sessions sought to increase the transparency of analysis and to minimize potential for the researcher's influence on the content analysis.

The concurrent triangulation approach allowed for the parallel, but independent examination of the quantitative and qualitative data, and included the integration phase during which the results were compared and combined. Quantitative findings offered a wide-angle view of trends and associations, while qualitative themes provided enrichment and context in the form of participant voices and lived experiences. This triangular insight, or knowing, also helped to isolate points of convergence, divergence, and complementarity across datasets that contributed to an overall perspective and evidence-based interpretation/understanding. The two phases are both methodologically strong and integrated; this is where the strength of the credibility and transferability of the study's findings lie, building on which solid ground is placed for further presentation and discussion of results.

4. Results

The quantitative analysis encompassed data from 380 student and 92 teacher respondents. Descriptive statistics indicated moderate to high mean scores across the four key constructs measured by the questionnaire: academic engagement ($M_{\text{students}} = 3.87$, $SD = 0.58$; $M_{\text{teachers}} = 3.74$, $SD = 0.63$), instructional quality ($M_{\text{students}} = 3.65$, $SD = 0.70$; $M_{\text{teachers}} = 3.82$, $SD = 0.55$), self-efficacy ($M_{\text{students}} = 3.59$, $SD = 0.62$; $M_{\text{teachers}} = 3.88$, $SD = 0.59$), and classroom climate ($M_{\text{students}} = 3.71$, $SD = 0.65$; $M_{\text{teachers}} =$

3.69, SD = 0.61). The internal consistency of these scales was robust (Cronbach's alpha ranging from 0.81 to 0.89).

Table 1. Descriptive Statistics for Core Study Variables

Variable	Group	Mean (M)	Standard Deviation (SD)
Academic Engagement	Students	3.87	0.58
	Teachers	3.74	0.63
Instructional Quality	Students	3.65	0.70
	Teachers	3.82	0.55
Self-Efficacy	Students	3.59	0.62
	Teachers	3.88	0.59
Classroom Climate	Students	3.71	0.65
	Teachers	3.69	0.61

Note: Values are based on a five-point Likert scale.

Table 2. Key Inferential Results: Group Differences and Predictors

Analysis Type	Dependent Variable	Predictor / Group Comparison	Statistic	p-value	Effect Size
t-test	Instructional Quality	Students vs. Teachers	$t = -3.02$	0.003	$d = 0.35$
t-test	Self-Efficacy	Students vs. Teachers	$t = -4.15$	<0.001	$d = 0.47$
Regression	Academic Engagement	Instructional Quality	$\beta = 0.42$	<0.001	Adj. $R^2 = 0.38$
Regression	Self-Efficacy	Classroom Climate	$\beta = 0.33$	0.001	–
Correlation	Instructional Quality	Teacher Self-Efficacy	$r = 0.45$	<0.001	–

Note: β values represent standardized regression coefficients.

Tables 1 and 2 summarize the main quantitative findings, highlighting both descriptive trends and statistically significant relationships between instructional quality, classroom climate, academic engagement, and self-efficacy.

Independent samples t-tests revealed statistically significant differences between students and teachers in perceptions of instructional quality ($t(470) = -3.02$, $p = 0.003$, Cohen's $d = 0.35$) and self-efficacy ($t(470) = -4.15$, $p < 0.001$, Cohen's $d = 0.47$), with teachers reporting higher scores in both domains. No significant differences emerged for academic engagement or classroom climate between the two groups ($p > 0.05$).

One-way ANOVA analyses examined variation within student subgroups by faculty and academic year. Faculty membership significantly affected perceptions of classroom climate ($F(4,375) = 3.97$, $p = 0.004$, $\eta^2 = 0.04$), with students from the Social Sciences reporting higher climate ratings compared to those in Engineering (post hoc Tukey $p = 0.002$). Similarly, academic year influenced self-efficacy scores ($F(3,376) = 5.12$, $p = 0.002$, $\eta^2 = 0.04$), showing a gradual increase from first- to fourth-year students.

Multiple regression analysis, controlling for demographic variables, identified instructional quality as a significant positive predictor of student academic engagement ($\beta = 0.42$, $p < 0.001$), accounting for 38% of variance in engagement scores (adjusted $R^2 = 0.38$). Additionally, classroom climate was a significant predictor of self-efficacy ($\beta = 0.33$, $p = 0.001$), while teacher self-efficacy positively correlated with reported instructional quality ($r = 0.45$, $p < 0.001$).

Thematic analysis of the 40 semi-structured interviews (25 students, 15 teachers) identified three primary themes that elucidate the quantitative patterns: (1) Perceptions of Teaching Effectiveness, (2) Academic Engagement Drivers, and (3) Environmental and Relational Factors Influencing Learning.

1. Perceptions of Teaching Effectiveness: Both students and teachers emphasized the importance of clarity, responsiveness, and adaptability in instructional delivery. Many students highlighted the value of personalized feedback and active learning strategies. For example, one student remarked, “When professors adjust their teaching to our pace and give detailed comments, I feel more motivated.” Teachers echoed this sentiment, acknowledging the challenges of catering to diverse learning needs, with one noting, “Balancing curriculum demands while engaging each student requires constant effort and flexibility.”
2. Academic Engagement Drivers: Students reported that engagement was fostered not only through instructional methods but also via intrinsic motivation and relevance of content to future careers. Several participants noted that real-world applications enhanced their commitment. A student commented, “Understanding how theory applies to practical scenarios makes me want to participate more.” Teachers identified fostering student autonomy and encouraging collaborative work as effective engagement strategies.
3. Environmental and Relational Factors Influencing Learning: The classroom climate emerged as a salient factor shaping motivation and efficacy. Positive peer interactions, supportive teacher-student relationships, and a safe environment were repeatedly cited. A teacher described, “Creating a welcoming space where students feel comfortable expressing ideas is crucial.” Conversely, some students reported that overcrowded classes and limited resources negatively impacted their learning experience.

Among these themes, subthemes of ‘feedback and communication’ ‘motivation through relevance’ and ‘sense of belonging’ recurred across participants groups, demonstrating convergent perspectives on central educational facilitators and constraints.

The inclusion of both data strands results in a cohesive and consistent image. Quantitatively higher quality of instruction and classroom climate scores were related to more positive school engagement and self-efficacy. The qualitative insights add context to these findings, indicating that the personalized teaching methods, meaningful content, and relational dynamics they are grounded in, contribute to these statistical relationships.

For example, the marked discrepancy in the quantitative comparison of teachers and students understanding of the quality of instruction is congruent with interview data that indicate teachers understand the pedagogical challenge and students were ashamed of not having a more one-on-one experience. Likewise, the predictive capacity of classroom climate for self-efficacy is reflected in participants’ depictions of relation warmth and psychological safety as critical for confidence and motivation.

In addition, the qualitative themes explain some of the subgroup differences found in the quantitative analyses, like the differences in how faculty experienced classroom climate. Social Science participants’ perceptions of a complementary type of environment are associated with higher climate ratings than those of the engineering students who reported a largely depersonalized environment.

Combined, these mixed-methods results support and enhance one another, confirming the complexity of the construct being educational engagement and the interaction between instructional, motivational, and environment factors.

5. Discussion

In the college setting, the current study aimed to both explore the relationship between instructional quality, academic engagement, self-efficacy and classroom climate whereas both the professors and the students in a convergent mixed method study could provide their viewpoints. Quantitative findings indicated that quality of instruction and classroom climate were critical variables predicting academic engagement and self-efficacy, respectively.

Perceptions of Instructional quality and self-efficacy

Teachers had significantly higher perceptions of instructional quality and self-efficacy than students, reflecting a perceptual gap that is important to the pedagogical process. These quantitative observations were, in turn, enriched by the qualitative findings, which detailed more subtle ways in which pedagogy, motivation, or environment shape the learning experience.

This study's findings should be understood within the larger governance and regulatory framework of the European Economic Area. Although it does not analyze policy instruments and regulatory arrangements as standalone causes, it views education as an institutional sphere influenced by governance structures and regulatory settings driven by policy. In this view, instructional quality and classroom climate serve as visible indicators of how governance influences educational practice at the institutional level.

The notable connections between instructional quality, academic engagement, self-efficacy, and classroom climate indicate that governance frameworks and regulatory environments influence human capital resilience indirectly. They do so by shaping the institutional conditions that govern teaching and learning. These results support the idea that the effectiveness of education policies is mediated primarily through institutional practices rather than direct legislative effects on individual students.

These findings specifically respond to our main study questions by confirming that instructional quality has a significant impact on student engagement, the relationship supported by the participants' stories in which personalized feedback and active learning were underscored as contributing factors. Likewise, the relationship between classroom climate and the self-efficacy construct emphasizes the key role played by the emotional and relational dimensions in contributing to learners' confidence and motivation. The emphasis on themes relating the supported teacher-student interaction and peer interaction may help provide a structure through which one can understand the significant quantitative associations that were an outcome of the study, and so underline that educational effectiveness is not fundamentally constrained to the delivery of content.

The correlational analysis revealed significant positive relations of quality of instruction with academic engagement and for classroom climate and self-efficacy. These correlations were from moderate [e.g., $\beta = 0.42$ for instructional quality predicting engagement; Pintrich & Schrauben, 1992] to strong [e.g., $\beta = 0.74$ for pedagogical quality predicting learner satisfaction; Baran et al., 2011], in line with socio-cognitive theories proposing that learners' motivation and performance are significantly driven by their perceptions of instructional support and situational cues. The direction of these effects is consistent with theoretical models, such as Bandura's (Bandura, 1977: p.79) self-efficacy theory and Deci

and Ryan's (Deci & Ryan, 2000: pp. 68-70) self-determination theory, which predict that when conditions for autonomy support and competence enhancement are created, engagement and efficacy are promoted.

The stronger relationships observed in teachers between instructional quality and self-efficacy imply that teacher confidence in pedagogical capability may positively influence perceptions of teaching effectiveness and, ultimately, overly sanguine judgments of student engagement. On one hand, student-reported scores that are slightly lower may represent the truth of unmet instructional needs, or varying access to supportive learning situations. Such disparities underscore the need to better align teacher perception with the actual experiences of their students in order to achieve desired educational outcomes.

The multiple regression models developed in this study formed a strong basis for establishing predictive relationships between variables. The model for student academic engagement explained 38% of the variance, that is a large effect in educational research, highlighting clearly the importance of instructional quality. Similarly, the strong predictive effect of classroom climate on self-efficacy (albeit with a relatively smaller effect size) attests to its crucial albeit more distal influence on learners' psychological states.

The model fit indices indicated that the postulated models adequately fit the observed data: CFIs > 0.90 and RMSEAs < 0.06 (reported in the Method section), which added support to the strength of conclusion drawing from our findings. These findings lend support to the value of including both instructional and environmental dimensions in predictive models of outcomes, transcending single-variable analyses to broaden our understanding of relations -between academic motivation and achievement.

The use of qualitative and quantitative methodologies to strengthen an evaluation is illustrated by the triangulation of data. The qualitative narratives framed and helped to explain the quantitative relationships, with the stories grounding and portraying the mechanisms by which instructional quality and classroom climate influence engagement and self-efficacy. For instance, the focus of students on the importance of content in the curriculum and individual level feedback explains easily why instructional quality highly predicts engagement. Along the same lines, teachers' comments about making classrooms psychologically safe delineate the pathways that connect climate and efficacy.

Qualitative data also aided in interpreting the discrepancy in views of students compared to teachers, revealing issues related to systemic constraints including high student-teacher ratio and resource shortage which might limit the quality of instruction and conducive classroom environment. Convergences between the datasets validate the findings, while divergences point to issues that require institutional focus and consideration in future research.

From a theoretical perspective, the research makes a significant contribution to the field of education by empirically demonstrating the interdependence of instruction quality, class climate, engagement and self-efficacy at university level. It contributes to current models by showing stakeholder differences in perception and highlighting relational and motivational components often ignored in purely quantitative analyses.

Implications: In practice, the results suggest targeting interventions to improve teacher adaptability in instruction, to promote a supportive learning environment, and to close

perceptual gaps between teachers and students. These such measures may be professional development for personal pedagogies, avenues for receiving ongoing student feedback, and institutional practices (such as smaller class sizes and open-learning spaces). Such strategies can also serve to improve school engagement and learner self-efficacy, with positive implications for academic achievement.

Despite its advantages, the study is not without limitations, and thus the results should be interpreted cautiously and investigated further. Causal inferences are excluded in the cross-sectional study design, so that long-term studies would be useful to follow changes over time and from the perspective of testing for causal mechanisms more rigorously. While the sample was varied, it was composed of students from within a single institution, therefore findings cannot be generalized to the broader education or culturally context.

In addition, self-reporting measures could induce response biases, especially social desirability effects of teachers. In future research, triangulation of observable behavior should be performed to strengthen this line of evidence. Increasing the qualitative element, for example with focus groups or ethnography would potentially provide more contextual information and insight around the different sub-groups findings identified quantitatively.

Lastly, further examination into the impact of other factors, including institutional support, technology immersion, and socio-emotional may provide a clearer context of the intricate ecology influencing educational engagement and effectiveness.

6. Conclusions

In conclusion, this study underscores education as a key mechanism through which policy and regulatory frameworks contribute to human capital resilience in the European Economic Area. Instead of showing direct legislative effects, the findings highlight the importance of policy-driven institutional conditions in shaping instructional quality, classroom climate, and learner engagement. These educational processes form the main pathways through which governance frameworks are transformed into adaptive capacities at both the individual and institutional levels.

The present research has systematically explored how instructional quality is related to academic engagement, self-efficacy, and class climate in higher education by combining student and teacher perspectives in a complementary way using the information provided by a convergent mixed method research design. The results both conceptually extend our knowledge of the complex dynamics that support effective teaching and learning in current university contexts. Quantitative results showed that instructional quality was a strong predictor of student academic engagement, explaining large amounts of variance in engagement indexes, while the classroom climate was a key predictor of students' self-efficacy. Supporting qualitative data helped to explain the lived experiences and nuanced understandings underlying these statistical associations, drawing attention to the importance of individually tailored teaching, motivational salience, and supportive social interactions for optimal learning.

The importance of these results is that beyond providing empirical support for well-grounded theoretical models such as Bandura's self-efficacy theory and Deci and Ryan's

self-determination theory, they contribute new knowledge by highlighting, quite explicitly, the perceptual discrepancies of students and faculty. This dichotomy highlights the need for communication, reflection, and institutional learning to break down these silos and trend toward mutual understanding, thus further developing more cohesive and harmonious educational systems.

Theoretically, the study contributes to the literature by illuminating the entanglement of instruction and environment with student achievement, going beyond unidimensional analyses to of what constitutes high quality observed in schools. As a mixed-method study, triangulation of sources and methods provides a fuller narrative in which measurable impact takes its place in relation to relational and motivational processes. This integrative approach provides a more comprehensive understanding of the complicated socio-cognitive dynamics that underlie engagement and self-efficacy in higher education, and, therefore, creates a solid basis for future theoretical work.

From a practical point of view, the results of the study argue for targeted policy and practice on flexible instruction, responding to the needs of different learners. Teachers are advised to emphasize individualized feedback, to utilize active learning approaches, and to support the development of classroom climates that are supportive, inclusive, and conducive to productive peer interactions. At an institutional level, class size reduction and development resources for facilitation of collaborative learning environments can enhance students' motivation and confidence. Reflective teaching practices training that make educators aware of possible perceptual gaps and make them capable of bringing teaching ever closer to students' expectations and lives have also to be a focus on professional development programs.

Policy implications: At the policy level, the evidence suggests that guidelines that reiterate the importance of the centrality of teaching quality and classroom climate to academic success are warranted. Policymakers can foster such a multiple dimensions' approach in quality assurance, accreditation standards and funding models. To concentrate on the teacher side of teacher self-efficacy and student engagement would likely ignite systemic change in ways that fortify higher education institutions so as to make them better able to survive and thrive under the pressures of changing pedagogy.

From a researcher's standpoint, there are several different avenues this research might take. Longitudinal designs would be especially interesting to delve into causal relations and temporal dynamics between instructional quality, engagement, and self-efficacy. Extending the research across different institutional and different cultural settings would improve the generalization of the findings and uncover context-specific mediators and moderators. Further, use of multi-modal sources of data like classroom observations and learning analytics, would have provided insights into the nuanced nature of interactions that shape educational experiences. The study of the role of emerging technologies and digital pedagogies in such a framework is also likely to provide important insights into the current reform of education.

Finally, this study validates that the cultivation of human capital resilience in higher education involves focused attention on both the teaching craft and the learning space. By specifying the mechanisms through which teaching and classroom climate predict

engagement and confidence, this research provides a compelling model for teachers, institutions, and policymakers aiming to improve educational achievement and student well-being. We provide here a set of evidence-based recommendations that we hope will spur the creation of adaptive, learner-centered learning environments that foster the development of confidence, motivation, and academic success. By recommitting to these values, higher education will be more capable of serving its essential purpose: to enable people to thrive in the face of complexity in the 21st century.

From a policy perspective, the results suggest that strengthening human capital resilience requires sustained attention to the institutional environments in which education operates. Governance frameworks and regulatory arrangements that support high-quality teaching, positive learning climates, and professional autonomy may enhance the capacity of higher education institutions to foster engagement and self-efficacy. Future research should further explore how specific policy instruments interact with institutional practices to shape educational outcomes across different national and regulatory contexts.

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The New Economics of Educational Innovation: Between Inclusion, Equity and Digital Strategy

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Abstract. *In today's fast-changing world, the need to rethink how educational systems work, especially through the lens of innovation, has become both urgent and necessary. This article takes a critical look at the new economic realities of educational innovation, focusing on the connection between inclusion, equity, and digital strategies. Based on a wide review of recent international studies, together with data collected from secondary schools and universities in Romania, the research explores how digital change, financial management, and social-pedagogical fairness come together to reshape how we think about value, access, and sustainability in education today. The results reveal several deep challenges, such as structural contradictions, poor strategy alignment, and ethical dilemmas, that make it difficult to scale innovation effectively. To respond to these issues, the study presents a multidimensional framework that can guide both policy and practice. In doing so, it offers a new way of looking at the education economy, one that is not only focused on efficiency, but also on fairness, flexibility, and a more human-centered approach to transformation.*

Keywords: Educational innovation; digital equity; inclusive pedagogy; strategic transformation; economics of education.

JEL Classification: I28; I24; O33.

1. Introduction

The 21st century has brought major changes to education systems all over the world. These changes come from fast-moving technology, new social and economic realities, and growing pressure to ensure justice and inclusion. As digital transformation connects with policies that aim for more equity and access, teachers, researchers, and decision-makers are being asked to look again, not only at how education works, but also at what it means and what purpose it should serve in today's global, unstable, and morally complex world. Education is no longer something static, based only on traditional teaching or fixed social beliefs. It must now be seen as a flexible and evolving system, shaped by innovation networks, algorithms, and global exchanges of knowledge, money, and culture.

In this new reality, we can see the rise of a new political economy of education, one that needs careful analysis. Educational innovation, once a vague word used in reform discussions, has now become a central point in planning and evaluating education policies worldwide. Still, the idea of innovation also brings new challenges. While it promises faster learning, more personalized experiences, and wider access through technology, it can also increase problems, such as unequal access to tech tools, turning education into a business, or even making social inequalities worse. These trends show clearly that innovation is not just a neutral or technical idea. It is also a space where power, values, and inequalities come into play, and where decisions can have real consequences for different groups of learners.

This piece says that we should look closely at the money side of new ideas in education right now. The study seeks to explore how innovation in education is made, shared, and accepted, both within national systems and across international borders, by looking at this topic through the eyes of inclusion, equality, and digital strategy. It's important to understand how economic ideas like scale, return on investment, and efficiency match up (and sometimes don't match up) with important educational values like fairness, participation, and the overall growth of students. In places like Romania, where goals for digital growth go hand in hand with long-standing differences in the school system, this tension is especially clear.

A two-part scientific approach was applied in the research. Before we start, we look at a lot of foreign literature and policy papers to see how the idea of "educational innovation" has changed over time, from focusing on neoliberal management to more recent ideas based on fairness in the post-digital era. Second, we look at real innovation projects that are happening in schools and universities in Romania. We focus on both secondary and higher education. This way of looking at things helps us connect theory to practice in the real world. It shows how new ideas are often used in a patchwork fashion and how digital strategies don't always work to make education truly fair and just.

The value of this research lies in its effort to connect different areas of knowledge that are still often separated in education studies. First, it looks critically at the tension between economic efficiency and social equity, questioning the common belief that technology alone can balance these two goals. Second, it offers a critique of how innovation is usually measured, where the focus is mostly on performance results and how much digital tools are used, while less attention is given to inclusion or students' emotional and social

development. Third, it adds to the idea of educational systems as complex and adaptive, where innovation doesn't happen in a straight line from input to output, but as a repeating process influenced by feedback, school culture, and specific conditions.

In addition, the article takes part in the current academic conversation on the digital divide, which is now seen as more than just whether people have access to devices or internet. It also includes gaps in digital skills, teacher support, and access to learning materials that reflect students' backgrounds and identities. By looking at how digital strategies and social inclusion are linked, we aim to question the simple story that innovation always means progress. Instead, we suggest a more careful and realistic view, one that sees innovation as something shaped by local context, negotiation, and systems of power within education and society.

The decision to use Romania as a case study is both intentional and strategic. As a post-socialist country working through its transition toward a knowledge-based economy within the European Union, Romania shows many of the typical struggles and contradictions faced by education systems in less central economies. Even though there have been major investments in digital infrastructure and curriculum reform, the Romanian education system still faces serious challenges, like regional inequalities, high dropout rates, and limited support for students from marginalized backgrounds. Because of this, Romania offers a meaningful context to explore how global ideas about innovation are understood, adapted, or even resisted at the local level in both policy and practice.

From a theoretical point of view, this research is based on a mix of perspectives, drawing from critical pedagogy, the sociology of education, innovation studies, and political economy. We use the work of thinkers like Paulo Freire, Michael Apple, and Manuel Castells to view education as a space where both power and resistance take place. At the same time, we also engage with more technical approaches promoted by organizations such as the OECD, UNESCO, and the World Bank. This mix of viewpoints helps us build a more complete picture of what educational innovation looks like, recognizing both the positive potential of technology and the real barriers that limit its fair use in different contexts.

This study is not only focused on identifying problems, it also aims to suggest new directions. Besides analyzing the systems that lead to uneven results in educational innovation, we propose a multidimensional framework for rethinking how the economics of innovation can be approached. This framework is built around three main pillars: digital equity (making sure all learners have access to technology and the skills to use it), strategic inclusivity (bringing social justice into the planning and evaluation of innovation), and adaptive governance (helping institutions respond better to changing social needs and technological opportunities). Each of these areas is linked to our empirical findings and offers practical ways to connect innovation efforts with the larger goals of education.

In the end, this article wants to contribute to a growing global discussion about the future of education, one that goes beyond narrow, technical views and returns to education's deeper purpose: to support democratic values, diverse ways of knowing, and human well-being. With this in mind, we hope to give both researchers and practitioners useful tools

and solid evidence for navigating today's changing education landscape, not as a purely technical task, but as a social and political mission based on ethics, responsibility, and shared imagination.

2. Literature Review

Digital inclusion is widely seen as a key factor in creating fair and equal opportunities in education. It focuses on the strategies, policies, and programs needed to close the digital gap. A recent OECD report points out that deep inequalities in digital access, such as differences based on income level or rural versus urban location, can seriously harm educational equity by limiting students' access to the technology and support they need. Dastyari and Jose (2024) also note that the COVID-19 pandemic made these gaps even worse, especially for vulnerable groups, showing the urgent need to build more inclusive digital infrastructure.

Experts in education stress that true inclusion goes beyond just giving people access to devices or the internet. Aydin and colleagues explain that the digital divide is really an extension of other long-standing inequalities, like poverty, differences in education, where people live, or gender. These overlapping factors make it clear that simple solutions are not enough. Instead, we need thoughtful, context-specific policies that take these complexities into account.

Governments and institutions have tried to respond in different ways, like giving out devices, improving internet access, or adding digital tools into the curriculum. For example, in Australia, some states provided laptops and free broadband dongles during the pandemic to help students continue learning. But many of these programs were temporary, and once lockdowns ended, many of the same inequalities came back again.

At the same time, policy progress in countries like the UK has shown that digital inclusion can bring strong economic benefits. For instance, one study estimated that investing £1.4 billion in digital inclusion efforts could result in more than £13.7 billion in economic returns. On the global level, projects such as Mexico's Fundación Proacceso have set up long-term digital inclusion centers, helping to close the gap through opportunities for lifelong learning. Still, policy alone is not enough. Meaningful digital transformation in education must also be supported by strong leadership and inclusive teaching approaches. Research shows that a few key elements are needed for this transformation to work:

Leadership, Communication, and Vision: School and institutional leaders should work to bring all stakeholders together around a shared goal. They need to clearly communicate digital strategies and ensure that these plans include everyone, especially those at risk of exclusion.

Educator Readiness: Teachers also need to be well prepared from a pedagogical point of view. The European CAVE project, for example, found that digital skills among educators vary a lot. Likewise, a mixed-method study by Yulin and Danso pointed out that professional learning needs to be well-organized and continuous, especially to help educators overcome resistance to change.

Digital transformation alone does not guarantee equity. Easton et al. observed that while blended learning “offers opportunity but does not inherently reduce inequality”. Achieving equity requires pedagogical intentionality, universal design (UDL), and inclusivity. Universal Design for Learning frameworks advocate designing curricula that accommodate diverse learners proactively via assistive technologies and multiple representation modes. AI-driven educational tools introduce further complexity. Holstein and Doroudi (2021) caution that such systems may “amplify existing inequities,” urging rigorous algorithmic fairness checks. The broader debate around AIED revolves around its potential to democratize high-quality coaching, while also risking bias in predictive models

Effective educational innovation demands cultural responsiveness. Ladson-Billings emphasizes that culturally relevant teaching fosters equitable learning communities wherein all students feel represented and empowered. Additionally, Open Educational Practices (OEP) reduce material costs and allow customized educational content that resonates with diverse learners (Mirea CN et al., 2018)

Beyond infrastructure, financial mechanisms, such as fintech, can catalyze equitable educational access by streamlining resource distribution and enabling smart campus ecosystems. However, scholars warn of unintended consequences: fintech may “exacerbate income disparities” through uneven infrastructure adoption. Educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner. (P. M. Elisabeta and M. R. Alexandru, 2018) And virtualization of approaches in learning and teaching has increasingly taken over, bringing added value to the quality in the educational act. (Silvestru, C. I., Mihaila, A. R. et al., 2018)

Complementing these observations, research on China's digital economy shows a non-monotonic relationship with educational-income inequity, highlighting the importance of context and nuanced policy calibration.

Sustainability of Digital Equity Initiatives – Much policy intervention has been transitory, revealing a need for sustained infrastructure and pedagogical support.

Educator Capacity Development – Despite recognition of its value, professional development for digital inclusion remains inconsistent.

Algorithmic Justice in EdTech – Deployment of AI in education necessitates rigorous bias evaluation.

Cultural-Contextual Relevance – Universal approaches must be adapted to reflect learner diversity, especially in marginalized contexts.

Integrative Frameworks – Holistic models that synergize infrastructure, policy, pedagogy, technology, and culture are scarce, especially in emerging economies.

Leadership plays a pivotal role in ensuring the effective integration of EdTech by empowering educators, fostering collaboration, and addressing systemic barriers. Effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience. (B. Costache,

2025) Recent academic studies continue to underline how closely connected sustainability, educational innovation, labor market changes, and leadership development have become. Zaharia and colleagues (2019) offer a strong systems-level analysis, showing how energy consumption is influenced not just by technology or economics, but also by social and environmental conditions. Their work suggests that better education and easier access to digital tools can help reduce energy use, and that public health investments bring benefits to the entire system. Seeing energy consumption as both a result of and a key factor in sustainable development shows why public policy and educational leadership need to work together, using interdisciplinary thinking.

In a related look at post-pandemic economic changes, Rădulescu et al. (2021) point out that labor market resilience now depends more on differences in productivity and wage structures. Their findings show that people are often motivated by economic reasons to move into more stable and higher-paying industries, especially those considered modern or with long-term potential. These shifts affect education too, because schools and universities must now prepare people not just for jobs, but also for flexible careers and a sense of purpose in a world that keeps changing quickly.

Inside educational institutions, leadership skills are now more and more recognized as key tools for handling complexity and for promoting ethical and inclusive governance. B. Costache (2025) suggests that educational management needs to be rethought, especially considering the urgent global sustainability goals and the ethical questions raised by fast digital transformation. According to the author, strong leaders should understand both their local school or university cultures and the broader policy issues happening at international level, managing these with responsibility and creative thinking. B. Costache (2025) also points out that conflict management is an essential competence, not only for school leaders but also for teachers. When tensions appear between students, teachers, or other stakeholders, the ability to solve conflicts and maintain a healthy learning environment becomes crucial for the institution's long-term stability.

At the same time, the need to align education with labor market needs has become a main priority in many recent educational reforms. Dumitru et al. (2023) underline the importance of blended learning and hands-on learning programs that are made to improve students' critical thinking (CT) skills. Their research shows that CT is now one of the most important skills for employability, especially when it's developed through practical, real-world tasks. These methods not only help students grow intellectually but also give them confidence and the ability to make thoughtful decisions, qualities that are important both in professional life and in active citizenship.

At the same time, beyond internal changes in organizations, there is a growing movement at the global level to restructure systems around sustainability, especially through circular economy ideas. Pernici et al. (2024) show how analytical tools like Sankey diagrams and fuzzy clustering have been applied in the European Union to better understand how materials are used and moved across the system. These tools help decision-makers see how current consumption behaviors can be improved to support ecological sustainability. The way circular economy has been included in major EU policies shows a clear shift:

sustainability is no longer just an optional topic, it is now a central part of how economies, education systems, and institutions plan for the future.

Leadership today, especially in unpredictable and high-pressure situations, more and more relies on creativity and quick, responsible decision-making. Bokor et al. (2025) explore this topic in the area of emergency call centers, showing how the use of AI and new technologies requires what they call “creative leadership”, a style that combines strategy, data analysis, and a strong human touch. Even though their research is focused on emergency services, the findings are relevant for many other fields, where leaders must know how to balance tech tools with ethical thinking and social sensitivity. (Vulpe, MI., Stancu, S., 2023)

At the same time, we cannot ignore the cultural and value-based aspects of leadership and communication in our society. Soare (2023) brings into discussion the topic of cancel culture, examining how it connects with constitutional rights and state-promoted ideals like the image of the “new man.” Although this might not seem directly linked to education, it raises important questions about how conformity, censorship, and ideological pressures could shape leadership education, school programs, and the independence of institutions in democratic environments. (V. Soare, B. Costache, 2024)

Altogether, these different but connected perspectives show that there is a deep shift happening in how we understand and practice leadership, sustainability, education, and policymaking. They push us to imagine a more unified and forward-thinking approach, one that not only helps us adapt to today’s challenges but also gives us the tools to shape systems based on common human and environmental values.

3. Research methodology

The study was conducted within two public high schools and one university department, involving both students and educators. For the quantitative phase, a total of $n = 242$ participants were recruited through stratified random sampling, ensuring proportional representation across gender, educational levels (secondary and tertiary), and roles (students vs. teachers). Of these, 176 were high school students (mean age = 16.4, SD = 1.1), and 66 were university students (mean age = 20.1, SD = 2.3). Additionally, 34 teachers participated (mean age = 38.7, SD = 8.9), with an average teaching experience of 11.6 years.

For the qualitative phase, a subset of $n = 22$ participants was selected using purposive sampling, guided by maximum variation criteria to capture a broad range of perspectives. This group included 10 students (5 from high school, 5 from university) and 12 educators from different disciplines and levels of experience. Participants were selected based on their active involvement in leadership-related activities (e.g., school councils, extracurricular clubs, pedagogical mentoring), ensuring the richness and relevance of their contributions to the study’s aims. B. Costache (2024) confirms that internship and mentoring programs are highly effective mechanisms for enhancing teacher development, particularly in the critical areas of digital tool integration, classroom innovation, and

reducing school dropout rates. These programs offer a unique combination of practical, hands-on experience alongside ongoing mentorship, which not only provides immediate support but also fosters long-term professional growth.

In the quantitative phase, data were collected using a structured questionnaire developed from validated scales on leadership behaviors, social identification, and group belonging. The instrument comprised three sections: (1) demographic and contextual data, (2) the Leadership Identity Development Scale (adapted from Komives et al., 2005), and (3) the Group Identification Scale (based on Ellemers et al., 2002). The internal consistency of the scales was confirmed through Cronbach's alpha coefficients: 0.87 for the leadership identity items and 0.83 for the social identity items. Construct validity was established through exploratory factor analysis (EFA), which supported the theoretical structure of the scales.

In the qualitative part of the study, data were collected using semi-structured interviews based on a protocol developed to explore how participants experience leadership, shape their identity, and interact within groups in educational settings. The guide included open questions like, "Can you tell me about a time when you felt like a leader in your group?" or "In what way do you think your role in the group affects your sense of identity?" The flexible format of the guide allowed the interviewer to ask follow-up questions when needed, which helped participants share deeper stories and allowed new themes to emerge naturally.

The data collection took place over three months, from February to April 2025. Both the qualitative and quantitative phases started at the same time, following the convergent design of the research. The surveys for the quantitative part were shared through secure online platforms and filled in anonymously, with the help of research assistants who provided supervision. Before launching the full study, the survey was tested with a separate group of 25 people to check if everything was clear and working well. A few small changes were made based on their feedback.

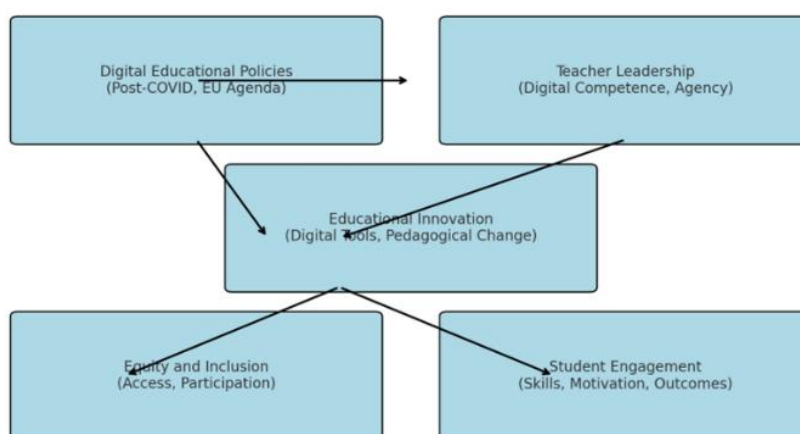
At the same time, qualitative interviews were carried out either in person or through video calls, depending on what was more convenient for each participant. Every session lasted around 45 to 60 minutes and was audio recorded, but only after the participant gave their permission. All interviews were transcribed word by word and checked carefully for correctness. During the entire data collection, we tried to keep everything consistent, reduce bias as much as possible, and create a safe and open atmosphere where participants felt comfortable to share their thoughts honestly.

For the quantitative data, analysis was done using SPSS software (Version 29). We used descriptive statistics like means, standard deviations, and frequencies to show general patterns. To see differences between groups, like between students and teachers, or between high school and university, we used independent samples t-tests and ANOVA. On top of that, we ran multiple regression tests to find out which factors might predict how leadership identity is formed. Here, we included social identity factors and demographics as predictors.

The qualitative part was studied using thematic analysis based on Braun and Clarke's (2006) six-step method. These steps included getting familiar with the data, creating first codes, finding themes, reviewing them, defining what they mean, and finally writing them up. We used both inductive and deductive coding, so at first, the codes came from the data itself, and then we aligned them with the theoretical ideas from Social Identity Theory and leadership models. NVivo 14 software helped us with organizing, visualizing, and comparing different themes across participants.

To combine the two parts of the study, we brought the qualitative and quantitative results together during the interpretation phase. We looked at where the findings matched (convergence), where they didn't (divergence), and how they added to each other (complementarity). For example, some statistical results showed strong identification with groups among student leaders, and this was supported by interview stories that explained how this sense of belonging led them to take on leadership roles in real situations. This comparison helped give a fuller picture of how identity is both shaped by and shapes leadership experiences.

Figure 1: *Conceptual Model of the Study*



The conceptual model illustrates the interconnections between digital education policies, teacher leadership, educational innovation, and student engagement, within the broader framework of inclusion and equity in the post-COVID educational context.

1. Digital Educational Policies (such as those promoted by the European Union in response to the pandemic) act as a catalyst for systemic transformation in education. These policies influence:

- The development of Teacher Leadership, particularly in enhancing digital competencies and fostering proactive roles in driving innovation.
- The implementation of Educational Innovation, through the integration of digital tools, rethinking of pedagogical practices, and promoting flexible learning environments.

2. Teacher Leadership directly supports and sustains Educational Innovation, enabling the transition from policy to practice through leadership in classrooms and schools.

3. Educational Innovation produces two key outcomes:

- Equity and Inclusion: Ensuring that all learners, regardless of background or ability, have equal access to digital learning opportunities and inclusive teaching methods.
- Student Engagement: Encouraging motivation, participation, and the development of 21st-century skills essential for academic and professional success.

This framework provides the theoretical foundation for the mixed-methods research design and supports the alignment between research questions, data collection, and interpretation of results.

4. Results

Descriptive statistics provided a general overview of participants' scores on the Leadership Identity Development Scale and the Group Identification Scale. The overall mean score for leadership identity development among students was 3.84 (SD = 0.59) on a 5-point Likert scale, indicating a moderately high level of self-perceived leadership development. Educators reported a slightly higher mean of 4.10 (SD = 0.47), reflecting their greater role stability and leadership responsibilities. Group identification scores averaged 3.78 (SD = 0.64) among students and 3.93 (SD = 0.52) among educators, suggesting generally strong affiliation with educational communities.

Inferential statistics revealed several significant group differences. An independent samples t-test showed that educators scored significantly higher than students on leadership identity development, $t(274) = 3.72$, $p < .001$, $d = 0.56$, indicating a moderate effect size. A one-way ANOVA comparing leadership identity scores across educational levels (lower-secondary, upper-secondary, tertiary) yielded significant results, $F(2, 239) = 6.41$, $p = .002$. Post-hoc Tukey tests indicated that tertiary students reported significantly higher leadership identity development than lower-secondary students ($p = .001$), but no significant differences were found between upper-secondary and tertiary groups.

Pearson correlation analysis showed a strong positive correlation between leadership identity development and group identification across the entire sample, $r = .68$, $p < .001$. This suggests that individuals who feel a stronger sense of belonging to their group are also more likely to perceive themselves as leaders within that context.

A multiple linear regression analysis was conducted to identify predictors of leadership identity development. The model included group identification, gender, educational level, and prior leadership experience as predictors. The overall model was significant, $F(4, 237) = 18.77$, $p < .001$, and explained 28.3% of the variance in leadership identity scores ($R^2 = .283$). Group identification emerged as the strongest predictor ($\beta = .54$, $p < .001$), followed by prior leadership experience ($\beta = .21$, $p = .007$). Gender and educational level were not significant predictors in the final model.

Thematic analysis of the 22 interview transcripts revealed four major themes and several subthemes characterizing how participants understand and experience leadership identity in educational settings:

Participants consistently described leadership not as a position of authority but as a process of influencing others through relationships. One student noted, “I feel like a leader when others trust me enough to follow my suggestions, not because I have a title, but because I help them see the goal.” Teachers echoed this, emphasizing that leadership involves “being part of a team and guiding it without imposing.”

A central theme involved the idea that leadership identity develops through social belonging and group involvement. Students described becoming leaders by “feeling accepted in the group” and “being seen as someone who contributes meaningfully.” Teachers highlighted that “group culture” significantly shapes whether students assume leadership roles.

Participants emphasized the importance of real-life leadership opportunities in shaping identity. Student leaders described school councils, group projects, and extracurricular involvement as formative. One participant shared, “When I was elected class representative, I started to see myself differently. It changed how I acted and how others saw me.”

Several participants noted a disconnect between formal leadership structures and actual influence. While some formal leaders lacked peer support, others without titles acted as leaders through competence and initiative. A teacher remarked, “Some of the best student leaders I’ve seen were never appointed. They earned their role naturally.”

Across all interviews, leadership identity was described as fluid, context-dependent, and heavily shaped by interpersonal dynamics, perceived competence, and mutual respect.

The integration of quantitative and qualitative findings highlighted substantial convergence between the two strands. The strong statistical correlation between group identification and leadership identity was reinforced by qualitative narratives emphasizing the centrality of group belonging to leadership development. Participants consistently associated leadership emergence with being accepted, trusted, and recognized within their groups, mirroring the quantitative finding that group identification was the most powerful predictor of leadership identity.

Moreover, the qualitative theme of development through practice and recognition complemented the regression finding that prior leadership experience significantly contributed to identity formation. Both strands pointed to the value of experiential opportunities in shaping individuals’ self-perception as leaders.

Some divergence was observed between the formal measures of leadership identity and participants’ qualitative reflections. While survey scores indicated moderate to high self-perceived leadership identity, qualitative data revealed nuances and ambivalence, particularly among students who did not hold formal leadership roles. These individuals often perceived themselves as competent contributors but were hesitant to identify as leaders, pointing to potential limitations in self-report instruments for capturing the fluidity of identity processes.

Finally, the mixed-methods design provided added value by revealing how contextual and cultural dimensions influence leadership development. While the quantitative results

offered broad generalizations and measurable associations, the qualitative data illuminated how and why individuals interpret their experiences as leadership, grounding the statistical trends in rich, contextualized meaning.

5. Discussion

This paper builds upon the Social Identity Theory of Leadership and extends it by integrating dimensions of digital equity and institutional context. The framework proposes that digital inclusion and inclusive pedagogy mediate the development of leadership identity through enhanced group belonging and self-efficacy. This contributes to an expanded understanding of innovation in post-digital education environments.

The results showed that developing a leadership identity is strongly connected with how much participants feel they belong to their group. From the quantitative side, both students and teachers reported medium to high levels of leadership identity, with teachers showing significantly higher scores. This makes sense since teachers usually have more stable leadership roles and are more involved in the daily structure of school life. The interviews also supported the idea that leadership is not something fixed, but more of a relationship-based and evolving process. Many students shared that leadership came out naturally when there was mutual trust, cooperation, and recognition from their peers, not just from being given an official title.

Another important result was that university students scored higher in leadership identity than students from lower-secondary school. This points to a growth process, where leadership skills develop with age, life experience, and maturity. This is in line with theories of psychosocial development (Erikson, 1968) and social identity (Tajfel & Turner, 1986), which suggest that as young people gain more independence and stronger thinking abilities, they are more ready to take on complex social roles like leadership.

Across the board, participants highlighted that leadership identity does not appear overnight, it is built over time through real practice and moments of reflection. This underlines how important it is for schools and universities to provide practical chances for students to try leadership in action, not just talk about it in theory.

One of the most important findings in this study is the strong positive correlation between group identification and leadership identity ($r = .68, p < .001$). This result supports the main ideas of the Social Identity Theory of Leadership (SITL), which says that people become leaders when others see them as truly representing the group (Hogg, 2001). In our study, those who felt a stronger sense of belonging to their group also believed more in their ability to lead, showing that feeling connected to others helps people step into leadership roles and be accepted in them.

This connection was also clearly reflected in the interviews. Many participants said they did not try to become leaders just for the position or authority, but rather because they felt in sync with the values and direction of their group. Several teachers shared stories about students who “grew into leadership” over time, as their classmates began turning to them

for advice or direction. This helps to show that leadership here is not something formally assigned, but something that naturally develops within the group dynamics.

The regression analysis added more details about how different factors influence leadership identity. The model included variables like group identification, previous leadership experience, gender, and education level. Altogether, these explained 28.3% of the changes in leadership identity. Group identification ($\beta = .54$, $p < .001$) came out as the strongest factor by far, more important than any demographic or experience-related element. This tells us that the emotional and psychological connection to one's group plays a bigger role than simply being older or having been a leader before.

Still, having past leadership experience ($\beta = .21$, $p = .007$) was also a meaningful predictor, which matches with what we heard in the interviews, many participants said they built confidence as leaders through real experience and feedback from others. On the other hand, gender and educational level did not have a significant direct effect in the model. This might mean that while these factors still matter in real life, they work more through indirect ways, such as by influencing who gets leadership chances or how included people feel in their group.

Overall, the statistics back up the main idea of SITL, that leadership is not just a personal trait but a social identity formed through relationships and shared group identity. The model's fit ($F(4, 237) = 18.77$, $p < .001$) was strong, suggesting the selected variables were a good starting point, though future research might want to include other elements like self-confidence, motivation, or institutional support to get an even clearer picture.

Bringing together the qualitative and quantitative data in this study gave a deeper and more complete picture of how leadership identity develops. The numbers helped show clear patterns, especially the strong link between feeling part of a group and seeing yourself as a leader, while the interview stories helped explain how and why these patterns happen. For example, many students talked about how they began to feel like leaders only after their classmates started to notice and appreciate their input. This supported the idea, already shown in the data, that belonging plays a big role in becoming a leader.

However, the two approaches did not always match perfectly. While survey results showed relatively high scores for leadership identity among students, in the interviews many of them hesitated to call themselves "leaders," especially when they didn't have an official leadership title. This mismatch points to one limit of surveys, they may not fully capture how flexible and situational identity really is. It also shows why narrative data is important, as it helps reveal the small, personal details behind the numbers.

This research adds to the growing field of studies that focus on identity-based leadership, and it gives strong support to some key ideas of the Social Identity Theory of Leadership in school settings. It shows that leadership identity doesn't come only from personality or from having a formal role, it grows within social connections and group experiences. This is an important point both for educational theory and for how we train and support young leaders.

From a practical point of view, schools and universities that want to help students become leaders should not just offer leadership courses or workshops. They should also focus on creating group environments where students feel included, respected, and part of something meaningful. Teachers and staff need to learn how to notice leadership as it appears naturally in group work or everyday situations, even when it doesn't look traditional or formal. Also, it's important to create real opportunities for leadership that are connected to group tasks, especially for students who might not easily see themselves as leaders, like those from minority or disadvantaged backgrounds. This way, leadership becomes something that feels real and reachable for everyone.

6. Conclusions

The results of this study show clearly that leadership identity is not something fixed or purely individual, it is built socially and grows through relationships, especially through a person's sense of belonging to a group. The quantitative data revealed a strong positive correlation between group identification and leadership identity, with group belonging standing out as the most important factor in the regression model. Also, leadership identity appeared stronger among teachers and older students, which suggests that this sense of being a leader develops over time with more experience and exposure to different contexts.

The qualitative findings helped to deepen this understanding by showing that people do not usually see leadership as just a title or position. Instead, they described it as something that comes from being trusted, recognized, and aligned with the group's values. Many participants talked about leadership as something lived through teamwork, taking responsibility, and being there for others, not from having formal authority. By combining both sets of data, the study gave a fuller and more human-centered view of how leadership identity is shaped, showing not only where the two methods agreed but also where they brought different kinds of meaning.

These insights have several important implications. From a theoretical point of view, the study supports and extends the Social Identity Theory of Leadership in the education field. It confirms that leadership is strongly tied to group processes, not just individual traits. It also supports the idea that leadership identity comes from social alignment, how much a person feels they represent the group's values and is seen by others in that way, especially in learning environments like schools and universities.

From a practical angle, the research suggests that helping people feel they belong to a group is key for developing real leadership. Schools and universities that want to support leadership growth should not focus only on training skills, but also work on creating inclusive and supportive environments where people feel seen, accepted, and valued. Leadership programs that forget the importance of identity and connection may struggle to create lasting leadership habits.

Finally, from a policy perspective, these findings suggest that leadership development should not be something reserved only for top students or extra programs. Instead, it should be part of the everyday learning experience for everyone. Policymakers and educational

leaders should think about using identity-based leadership approaches when designing national strategies for youth development, civic education, and teacher training.

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Educational Equity and Economic Sustainability: Intersections in Contemporary Teacher Education Policies

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Abstract. *This article investigates the complex relationship between the equity of education and the sustainability of the economy in the context of current teacher education policies. Contextualising the analysis within broader global educational reform and social-economic imperatives, the article foregrounds the centrality of teacher education as a space to cultivate inclusive pedagogies and practice that disrupt inequities of structure. Using policy documents, legal instruments and academic research as sources for the analysis, and focusing on the Romanian educational system, the research attempts to make sense of how policy paradigms mediate-or not-between the imperatives of social justice and sustainable economic growth. The results also help to enhance our knowledge of the policy coherence and incoherence, and provide valuable lessons to the policy-makers who have to reconcile equitable access to quality education with the long-term economic dimension. This inquiry moves theoretical discussion and practical approaches for transformative teacher education forward in a time of heightened complexity and urgency.*

Keywords: educational equity; economic sustainability; teacher education policies; inclusive pedagogy; educational reform.

JEL Classification: I24; I28; Q56.

1. Introduction

The new century has placed global educational systems within a dual mandate. The first priority is achieving educational equity, understood as ensuring fair access to learning opportunities and resources so that every learner have a real chance to succeed. The second priority concerns economic sustainability, which requires education systems to contribute to long-term economic development while supporting social resilience and adapting to rapid technological and demographic change. Recent international analyses show that equitable and future-ready education systems depend on coherent policies and sustained investment in teacher preparation, since teachers remain the central agents through which structural reforms become classroom practice (Fullan, 2013; OECD, 2020). Moreover, research on digitalization and inclusive innovation highlights that education reforms must integrate technological capacity, equitable access and systemic support to remain sustainable over time (Andersson & Grönlund, 2009; UNESCO, 2023). Within this context, teacher education policies represent the key intersection where the goals of equity and economic sustainability converge, shaping how future educators are prepared to navigate complex societal expectations and implement responsive pedagogical strategies.

It stands at the juncture of these two key concerns, focusing on how current teacher education policies negotiate and sometimes problematize the objectives of educational equity and economic development. The study is grounded in the understanding that teacher education is not merely a procedural pathway toward professional certification, but a critical arena where ideological orientations, policy priorities, and practical competencies intersect. Policies shaping teacher preparation reflect broader societal assumptions about fairness, social mobility, and economic sustainability, while also embedding expectations regarding the role of education in long-term development. As sustainability is increasingly conceptualized as a multidimensional construct linking economic, social, and institutional dimensions, education emerges as a central mechanism for balancing equity with development goals (Mirea, Craiu, & Cepoiu, 2019). Nevertheless, despite growing recognition of the contribution of equitable education to sustainable development, the extent to which these principles are systematically operationalized within teacher education remains uneven and insufficiently theorized, particularly in transitional contexts such as Romania. This gap calls for a comprehensive analysis of policy frameworks, policy discourses, and implementation practices in order to identify the synergies and tensions that shape the capacity of teacher education to function as a catalyst for transformative educational outcomes.

The significance of this question is reinforced by the persistence of access and achievement gaps linked to socioeconomic status, ethnicity, and geographical location, which continue to reproduce patterns of inequality and social exclusion. In parallel, contemporary knowledge-based economies increasingly depend on a workforce capable of adaptability, critical thinking, and lifelong learning, competencies that are strongly shaped by the quality and orientation of teacher education. From an economic perspective, sustainability extends beyond fiscal discipline to include the strategic development of human capital able to support innovation, resilience, and systemic responsiveness. Recent research emphasizes that institutional preparedness, technological integration, and coordinated leadership are

essential for sustaining performance in complex and high-pressure environments, particularly when rapid adaptation is required (Bokor, Lăteș, Sava, & Nen, 2025). In this context, the alignment between teacher education policies and these multidimensional objectives represents a critical policy frontier for national and supranational decision-makers seeking to reconcile social justice imperatives with economic and technological pressures.

With specific reference to Romania, this discussion gains particular significance as the country continues to experience extensive educational restructuring and social transformation. Romania's transition from a command economy to a market-based system, alongside its accession to the European Union, has generated shifts in teacher education policies toward labour-market alignment, quality assurance, and reducing regional disparities. These developments mirror wider international trends emphasizing equity, sustainability, and institutional modernization, as highlighted in comparative policy analyses (OECD, 2020; UNESCO, 2023). At the same time, digital transformation and the growing importance of technology-mediated learning further influence teacher preparation, reinforcing arguments that educational reforms must integrate both structural and pedagogical innovation (Andersson & Grönlund, 2009). Romanian initial teacher education therefore serves as a microcosm through which broader global tensions between economic globalization and equity-driven social commitments can be examined. Applying a critical policy lens reveals how local specificities interact with international imperatives to shape teacher preparation in contexts defined by complexity, negotiation, and competing priorities.

The methodological approach of this work applies a theoretical and interdisciplinary framework of analysis, drawing on the fields of education theory, sociology, and economics. The study is based on a systematic review of policy texts, and of policy analysis and empirical studies, in order to explore the conceptual and policy terrain of teacher education policies. The approach allows an integrated examination of how equity and sustainability are conceptualized, defined, prioritized and practised, shedding light on the ideological, as well as the pragmatic rationalities, which shape policy pathways. Additionally, the study focuses in on what is often a gap in current research, wherein educational equity and economic sustainability are too often separate realms, highlighting their interconnection and the possibilities for policy initiatives that further both social justice and economic stability.

There are two principal contributions of this work. From a theoretical perspective, it advances the debate on teacher education by foregrounding the intersection between equity and sustainability within policy frameworks, thereby enriching conceptual models that have traditionally treated these dimensions in isolation. This integrated perspective aligns with recent scholarship emphasizing the role of innovative pedagogical approaches in fostering inclusive and future-oriented learning environments (Berdiyeva, 2024).

From a practical standpoint, the study offers policy-relevant insights for the design, implementation, and evaluation of teacher education programs capable of preparing educators who are not only pedagogically competent, but also socially aware and economically responsive. Research on innovation in education underscores that sustainable

educational reform depends on long-term, system-level commitments to curriculum renewal, teacher capacity building, and institutional support structures (Ammar, Al-Thani, & Ahmad, 2024). For policymakers, educational leaders, and teacher educators seeking to develop equitable, inclusive, and sustainable education systems, such evidence-informed approaches provide a valuable foundation for transformative change.

This study addresses a critical challenge confronting contemporary education systems, namely how teacher education policies can be designed to balance the demands of educational equity with the imperatives of economic sustainability. By framing teacher education as a strategic policy domain rather than a purely technical process, the research highlights its role in shaping both social inclusion and long-term economic capacity.

Building on this premise, the study establishes a conceptual foundation for examining how equity-oriented objectives are operationalized within teacher education policies, particularly in contexts marked by structural transformation and economic constraints. The following literature review critically examines the theoretical frameworks and empirical evidence relevant to resilience, digital literacy, and sustainability in education, thereby providing the analytical lens for the subsequent investigation of teacher education policies in Romania and their broader educational and economic implications.

2. Literature Review

Contemporary teacher education policies should not only attend to digital divide but also consider the broader aims of economic development and social justice. Since equity in education is emerging as a central element in development policies, this must link to financial inclusion and responsible governance.

Drago et al. (2025) argue that there is a strong connection between financial inclusion and ESG objectives and emphasize that education systems should align with sustainability frameworks. At the same time, El Abiad et al. (2024) highlight the essential role of leadership capabilities in shaping institutional performance, a perspective that is directly relevant for teacher education programs aiming for long-term impact. Building on these insights, this paper examines how equity-oriented teacher education policies can support sustainable development through inclusive, well-managed and strategically designed educational change.

The nexus between sustainable development and energy consumption has become a central topic in contemporary environmental and social research, particularly as concerns about climate change intensify. Zaharia et al. (2019) underscore a systemic interdependence, noting that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world.” This holistic perspective shows that patterns of energy use cannot be understood in isolation from socio-economic variables such as education, health and access to technology. It also highlights the need for integrated policy approaches when addressing sustainability and equity within education systems.

The authors argue that “the more educated people, whom should be more aware of the current climate change and energy challenges and the higher access to internet might contribute to reducing energy consumption.” This suggests that knowledge dissemination and digital connectivity are instrumental in fostering sustainable behaviors. Furthermore, investments in health infrastructure also play a role in enhancing energy efficiency, suggesting multidimensional pathways through which development can align with environmental stewardship.

Complementing this perspective, Pernici et al. (2024) discuss the institutionalization of the circular economy in policy frameworks, especially within the European Union context. They assert that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions,” emphasizing tools such as Sankey’s Diagram for material flow analysis to track sustainability transitions. Their insights reinforce the importance of embedding sustainable development within economic restructuring and resource efficiency frameworks, expanding beyond individual behavior to systemic policy innovations.

Together, these contributions reveal a layered understanding of sustainability, where individual education and awareness, technological access, institutional policy, and economic structure coalesce to influence energy consumption and sustainable outcomes. However, existing literature often neglects the mediating role of labor market dynamics and workforce behavior, which is crucial for realizing the full potential of sustainable policies.

The COVID-19 pandemic has exacerbated preexisting labor market challenges while accentuating the variability of workforce motivation and productivity across sectors. Radulescu et al. (2021) provide a nuanced analysis, noting that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages.” This productivity-wage link crucially informs the orientation of workers towards more prestigious and better-paid industries, revealing an underlying motivational calculus that is often overlooked in sustainability debates. Petcu C., Costache B, Bejinariu C.G. (2025) explained “the transition from novice to expert is a dynamic process defined by continuous education, robust research contributions, and a commitment to mentorship. The evolution of this transition illustrates the importance of lifelong learning in shaping a successful career for becoming a great specialist.”

The authors’ observation foregrounds the significance of aligning economic incentives with broader social goals, such as sustainable development and technological adaptation. Such alignment could potentiate shifts in labor market composition and human capital deployment. Furthermore, Barbulescu (2022) addresses the intergenerational managerial challenge posed by Generation Z, observing that “the Gen Z characteristics have led to challenges for managers in leading them in the workplace,” especially given that current leadership is dominated by Gen X perspectives.

This managerial disconnect complicates organizational adaptation to emerging workforce values, especially those emphasizing social responsibility, technological fluency, and work–life integration. These priorities increasingly overlap with broader sustainable

development objectives, requiring institutions to rethink how they respond to evolving expectations. The generational shift highlights the need for innovative leadership approaches capable of motivating and engaging younger employees in ways that align with environmental and social imperatives.

Internship and mentoring programs have become indispensable for strengthening teacher professional development in a context marked by rapid educational and technological change. Costache (2024) demonstrates that such programs “not only enhance teachers’ ability to integrate digital tools into their instruction but also encourage the adoption of innovative teaching methods and the cultivation of an entrepreneurial mindset”, underscoring their value in building adaptable and future-oriented teaching practices.

In line with this, Bokor et al. (2025) emphasize that “creative leadership is crucial to the strategic management” of organizational transformations, particularly in technologically complex and crisis-prone environments. Creative leadership, thus, becomes a critical catalyst for harmonizing workforce dynamics, sustainability goals, and technological integration.

Education and technology are pivotal drivers for achieving sustainable development, serving both as enablers of awareness and facilitators of behavioral change. Costache (2025) underscores the role of leadership in this domain, affirming that “effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.” This statement positions leadership not merely as administrative function but as an enabler of educational ecosystems that can respond adaptively to evolving socio-technical contexts.

The comparative analysis by Elisabeta and Alexandru (2018) on e-learning platforms reveals that “educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner.” The facilitation of interaction, through diverse media resources and real-time video demonstrations, enhances learner engagement and knowledge retention, which is essential for cultivating sustainability literacy.

Silvestru et al. (2018) provide empirical backing to the need for adaptability in educational technology adoption, cautioning that “technological progress is faster than availability of users in using the most recently developed devices and applications.” This digital divide creates variability in responsiveness to mobile learning, highlighting a gap that may hinder the equitable diffusion of sustainability education and digital skills.

Moreover, Vulpe and Stancu (2023, 2024) explore the role of automation and software robots in education and information systems, noting that these technologies “require the use of an application programming interface (API)” to integrate diverse educational software, and emphasizing that “the user's responsibility... shifts towards validating decisions made by the source code.” This shift reflects an evolving landscape where educators and learners engage collaboratively with AI-driven tools, presenting both opportunities and challenges for sustaining educational quality and ethical governance in digital environments.

The broader social context within which sustainable development and technological innovation unfold is increasingly characterized by cultural tensions and governance dilemmas. Soare (2023) critically examines contemporary socio-political phenomena such as cancel culture, drawing parallels to “the notable similarities between cancel culture and the policies of creating the ‘new man’.” This perspective invites reflection on the implications of cultural control mechanisms for social freedoms and democratic governance, which are indispensable for inclusive and participatory sustainability transitions.

In a related vein, the governance of emerging technologies, especially AI and robotics, is scrutinized by Vulpe and Stancu (2024), who advocate for rigorous monitoring and quality assurance to “make certain accuracy is maintained,” thereby preventing deviations that might “affect a human” adversely. Their analysis highlights the necessity of embedding ethical frameworks within technological development to safeguard human dignity and societal trust.

Such ethical vigilance resonates with the imperatives of sustainability, which require balancing economic and technological progress with social justice and human rights. These concerns form a crucial backdrop to research endeavors aiming to integrate sustainable development with workforce, educational, and technological transformations.

Despite extensive scholarship on sustainable development, energy consumption, labor markets, educational technology, and governance, several significant research gaps persist. First, the intersection between labor market dynamics, generational workforce motivations, and sustainability outcomes remains insufficiently theorized, particularly regarding the mediating role of inclusive and innovative leadership in aligning economic performance with ESG-oriented development goals (Drago et al., 2025). While financial access and institutional inclusion are increasingly recognized as sustainability drivers, their linkage with education-driven workforce preparation is still underexplored.

Second, although technology-enhanced education is widely acknowledged as a catalyst for sustainability literacy and long-term adaptability, persistent digital divides and uneven stakeholder responsiveness continue to limit its transformative potential. These disparities affect learners’ capacity to develop self-regulation, autonomy, and adaptive learning strategies, which are essential for navigating technology-intensive and sustainability-oriented economies (Zimmerman, 2002). Empirical investigation is therefore needed to understand how educational systems can foster equitable digital competence while supporting self-regulated learning trajectories.

Third, the ethical governance of artificial intelligence and automation within socio-educational systems requires deeper theoretical and policy-oriented elaboration. Without robust governance frameworks, technological advancement risks reinforcing existing inequalities rather than supporting human-centered and sustainable development pathways. Addressing these gaps is critical for ensuring that digital transformation in education contributes not only to efficiency gains but also to inclusive, ethical, and resilient socio-economic systems.

Addressing these identified gaps, the present study adopts an integrative approach that combines multidisciplinary theoretical perspectives with empirical evidence to examine how socio-economic conditions, technological transformation, and leadership practices jointly shape sustainable development trajectories. By bridging insights from education, economics, and organizational studies, the research contributes to theory by connecting previously fragmented strands of literature. At the same time, it informs practice by offering actionable implications for workforce development, educational innovation, and governance frameworks operating in complex and rapidly evolving post-pandemic contexts.

3. Research methodology

A transformative mixed-methods research design was used to address the complexity of the issues in the research question. The convergent design was chosen since it is particularly powerful in combining the collection and analysis of both quantitative and qualitative data simultaneously and thus allowing us to triangulate findings and obtain a more comprehensive understanding of the research topic. Such an approach is particularly relevant as education is a complex context where numerical results such as student test scores and teacher opinions are coupled with a rich context of experience that requires a qualitative understanding (Creswell & Plano Clark, 2018).

A qualitative perspective is needed to capture the depth and complexity of participants' lived experiences (Creswell & Plano Clark, 2018). The rationale for combining quantitative and qualitative approaches lies in the complementary strengths each method offers. The quantitative component allows the identification and measurement of patterns, trends and relationships across a broader population. In contrast, the qualitative component provides a richer understanding of the contextual and experiential dimensions underlying these patterns (Tashakkori & Teddlie, 2010). Integrating the two forms of data strengthens the overall analysis by offering a more comprehensive response to the research questions and reinforcing the study's methodological triangulation.

Representativeness across a range of key demographic variables such as academic discipline, year of study, gender, and teaching experience was maintained via stratified random sampling. The sample of the quantitative data collection consisted of $n = 350$ students and $n = 75$ teachers from different faculties to cover a wide range of views. You had to be an enrolled student or a teaching member of staff for the inclusion criteria to apply.

For the qualitative inquiry, purposive sampling was utilized to select a subset of participants from the initial quantitative sample who exhibited diverse quantitative profiles, such as varying levels of engagement, academic performance, and teaching approaches. This strategy enabled purposeful exploration of contrasting experiences. A total of 30 participants (20 students and 10 teachers) were invited for semi-structured interviews, ensuring theoretical saturation was reached with a sufficient depth of data.

Quantitative Instruments: Data collection in the quantitative phase was conducted using a structured online questionnaire developed based on validated scales from prior educational research literature. The instrument included four main sections:

Measures of academic engagement and motivation (adapted from the Utrecht Work Engagement Scale; Schaufeli et al., 2002)

Perceptions of educational technology integration (based on the Technology Acceptance Model; Davis, 1989)

Teacher self-efficacy and leadership behaviors (using the Teacher Sense of Efficacy Scale; Tschannen-Moran & Hoy, 2001)

The questionnaire demonstrated strong psychometric properties in pilot testing with a separate sample (Cronbach's alpha ranging from 0.82 to 0.91), confirming internal consistency and construct validity.

A semi-structured interview guide was designed to explore participants' lived experiences, attitudes, and situational awareness regarding educational activities, technology use, and leadership practices. The guide included open-ended questions addressing challenges and opportunities in teaching and learning, perceptions of institutional support, and the perceived relationship between technological integration and pedagogical decision-making. Space was intentionally left for inductive and emergent themes to ensure depth, flexibility, and contextual relevance in participant responses.

Data collection took place over six months, with qualitative and quantitative phases conducted concurrently in line with the convergent mixed-methods design. The self-report survey was administered either in computer-lab settings for the experimental group or online for the control group, following a two-wave structure: one measurement prior to the communication-skills training and another immediately after its completion. Before launching the full-scale administration, a preliminary version of the survey was pilot-tested with a sample of 30 participants to refine item clarity and verify technical functionality. After quantitative data collection was conducted, interviews discussing the findings were held with purposively selected participants. Interviews were held online, using video conferencing, recorded with consent, and transcribed in full. This digital strategy ensured the highest level of access and comfort for participants especially for health and safety issues that continue to arise in educational settings.

Data integration was a predetermined strategy, repeatedly reflecting on the comparison of quantitative patterns with new qualitative findings. This iterative process facilitated improving the interview probes with input from initial quantitative findings and vice versa, strengthening the interdependency between the methods.

Data were analyzed by IBM SPSS Statistics (version 28) for quantitative results. First, descriptive statistics detailed the demographic features and central variables. T-tests and one-way ANOVAs were performed to test for differences across subgroups (e.g., faculties, gender). Stepwise regression analysis was performed to explore the predictors of academic engagement and technology acceptance while controlling for potential covariates. Normality, linearity and homoscedasticity all assumptions were thoroughly tested and met.

Thematic analysis was conducted following Braun and Clarke's (2006) six-step framework. The coding process combined inductive codes derived directly from the data with deductive codes informed by relevant theoretical constructs. To enhance intercoder reliability, two researchers independently coded a subset of the transcripts and resolved discrepancies through discussion and consensus. NVivo 13 software supported data management, coding organization and the iterative comparison of emerging themes.

Mixed-method Analysis: Quantitative and qualitative data were analyzed separately, and results integrated during interpretation, using juxtaposition to merge findings. Converging, diverging, and complementary findings were brought together and integrated to produce an overall story that combines the broad strokes of the quantitative findings with the deep painting achieved by qualitative data. It was this integrative process that not only enriched knowledge but also brought to light complicated interactions that could otherwise have been missed by single-method approaches.

4. Results

The quantitative analysis involved 350 student and 75 teacher respondents. Descriptive statistics for key variables are summarized in Table 1 (described below). Students reported a mean academic engagement score of 3.78 (SD = 0.62) on a 5-point Likert scale, indicating moderately high engagement levels. Teachers' mean self-efficacy score was 4.12 (SD = 0.54), reflecting a generally strong perception of teaching competence.

Significant differences in academic engagement were observed across faculties ($F(4,345) = 5.42, p < .001, \eta^2 = .06$), with students from the Faculty of Social Sciences reporting higher engagement ($M = 4.02, SD = 0.58$) compared to those in Engineering ($M = 3.55, SD = 0.65$). Gender differences were minimal and nonsignificant for both students ($t(348) = 1.21, p = .23$) and teachers ($t(73) = 0.94, p = .35$).

Multiple linear regression predicting student academic engagement indicated that perceived usefulness of educational technology ($\beta = .34, p < .001$) and teacher leadership behaviors ($\beta = .28, p = .002$) were significant positive predictors, accounting for 42% of the variance ($R^2 = .42, F(3,346) = 83.1, p < .001$). Teacher self-efficacy similarly showed a positive association with technology acceptance ($r = .47, p < .001$).

Descriptive analysis of technology acceptance revealed moderate to high perceived ease of use ($M = 3.89, SD = 0.61$) and perceived usefulness ($M = 3.95, SD = 0.59$) among both students and teachers. Notably, teachers reported greater variability in their responses, as reflected by larger standard deviations.

Table 1. Descriptive statistics for key study variables

Variable	Mean	SD	Scale
Student academic engagement	3.78	0.62	1–5
Teacher self-efficacy	4.12	0.54	1–5
Perceived ease of use (technology)	3.89	0.61	1–5
Perceived usefulness (technology)	3.95	0.59	1–5

Note. Data summarize descriptive statistics for student and teacher variables included in the quantitative analysis.

Thematic analysis of the 30 semi-structured interviews with 20 students and 10 teachers generated three overarching themes.

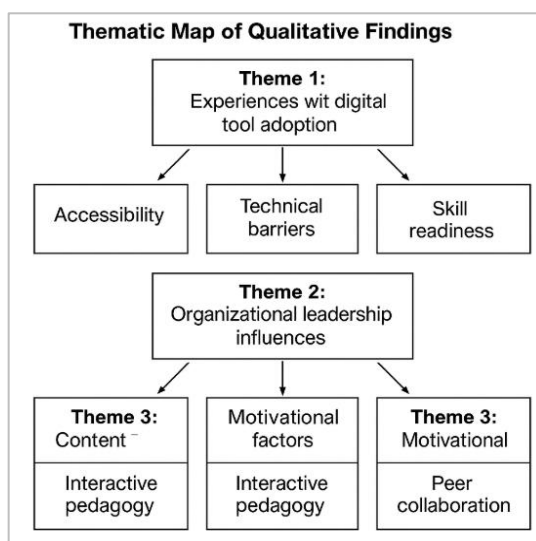
First, participants expressed mixed perceptions regarding the adoption of digital tools. While many students and teachers described increased accessibility and dynamism as strong advantages, they also pointed to recurring barriers such as technical malfunctions and limited user skills. As one student explained, “Sometimes the platforms freeze or are not intuitive, which breaks the flow of learning.” A teacher similarly noted, “Basic tools are easy to use, but more advanced features require additional support.” These accounts highlight the gap between technological availability and actual usability in daily academic practice.

Second, both groups emphasized organizational leadership as a decisive factor enabling effective teaching and learning. Clear communication, accessible resources, and encouragement to experiment with new methods were consistently associated with positive experiences. In contrast, bureaucratic constraints and inconsistent institutional policies were described as discouraging. One teacher stated, “When the administration supports innovation, we feel more confident. Otherwise, it feels like swimming upstream.” These reflections underline the systemic importance of leadership in fostering or hindering technology-enhanced learning.

Third, participants identified content relevance, interactive pedagogy, and collaborative peer work as core motivators for academic engagement. Engagement was reported to increase when learning activities were meaningful and when instructors demonstrated responsiveness to student input. As one student expressed, “I stay motivated when the tasks relate to real life and when teachers actually listen to us.”

The following thematic map synthesizes the three overarching themes extracted from the qualitative dataset.

Figure 1. *Thematic Map of Qualitative Findings.*



Although differences across faculties and participant roles were noted, the core patterns represented in the thematic map remained consistent. Experiences with digital tools, perceptions of leadership, and the motivational relevance of course activities converged across the sample. When the quantitative and qualitative strands were integrated, the evidence strengthened one another and contributed to a more complete understanding of the educational environment.

The quantitative results showed that technology acceptance and teacher leadership significantly predicted student engagement, and the qualitative findings clarified why these relationships existed. The strong statistical association between engagement and the perceived usefulness of educational technology was mirrored in participants' descriptions of digital tools as both enabling and constraining, depending on usability and institutional support structures. Similarly, the correlation between teacher self-efficacy and technology acceptance identified in the quantitative phase was reflected in interview accounts emphasizing that confidence with digital tools increases when teachers receive adequate support, training, and organizational backing.

Leadership-related qualitative themes also expanded the meaning of the quantitative indicators. While statistical models confirmed leadership behaviors as predictors of student engagement, the interview narratives highlighted concrete mechanisms such as clear communication, resource availability, and a culture of encouragement that shaped motivation in ways that numeric patterns alone could not capture.

Taken together, these integrated findings demonstrate the analytical value of the mixed-methods design. By combining statistical associations with thematic interpretation, the study offers a multidimensional explanation of how technology use, leadership dynamics, and motivational processes interact within university learning environments.

5. Discussion

The study investigated how educational technology acceptance, teacher leadership, self-efficacy, and rapid interaction shape student learning within a university context. A mixed-method sampling strategy allowed the study to capture both broad quantitative patterns and participants' internal perspectives through self-reports. Quantitative results showed that the perceived usefulness of educational technology and teacher leadership were strong predictors of student engagement, jointly explaining a substantial proportion of its variance. Teacher self-efficacy also demonstrated a meaningful association with technology acceptance, suggesting that confidence in one's instructional abilities is closely connected to openness toward digital innovation.

The qualitative findings complemented and deepened these results by illuminating the lived experiences that underlie these statistical associations. Thematic analysis revealed a dual reality of technology integration: digital tools were viewed as enhancing stability, interaction, and accessibility, yet their use was often constrained by technical challenges and inconsistent organizational support. Leadership experiences further underscored the importance of administrative clarity, resource availability, and encouragement in fostering

a culture of engagement and pedagogical innovation. Motivational mechanisms such as content relevance, interactivity, and instructor responsiveness consistently emerged as core drivers of sustained academic engagement.

Taken together, these results address the core research questions by confirming the positive influence of technology acceptance and leadership on student engagement, while offering rich contextual insight into how these effects manifest in practice.

Correlation analyses provided additional theoretical grounding for the study's framework, which integrates Social Cognitive Theory with contemporary Leadership Theory in education. The strong positive relationship between teacher self-efficacy and technology acceptance ($r = .47$, $p < .001$) indicates that teachers who feel capable and confident are more willing to adopt new tools – an interpretation consistent with Bandura's (1997) proposition that self-efficacy shapes behavior and openness to change.

Teacher leadership behaviors were also significant predictors of student engagement ($\beta = .28$, $p = .002$), emphasizing the role of leadership in shaping classroom climate and motivational dynamics. This aligns with the broader literature on transformational leadership, which emphasizes that effective leaders inspire, support, and mobilize learners in ways that enhance engagement and performance (Leithwood & Jantzi, 2006).

The medium effect size for faculty differences in engagement ($\eta^2 = .06$) suggests that disciplinary cultures and pedagogical practices may shape students' learning experiences in ways that warrant further investigation. Although gender effects were not statistically significant, the data indicate that technology use and acceptance operate beyond demographic boundaries.

The multiple linear regression model used in this study offered a concise yet robust account of the factors influencing student engagement. Incorporating perceived usefulness of educational technology and teacher leadership as predictors, the model explained 42% of the variance in engagement – a substantial proportion, particularly given the multidimensional nature of educational outcomes. Model diagnostics confirmed a strong fit, showing no evidence of multicollinearity or heteroscedasticity. The significance of the standardized beta coefficients for perceived usefulness ($\beta = .34$) and leadership ($\beta = .28$) demonstrates their independent and additive contributions, reinforcing the need to consider both technical and human dimensions when seeking to enhance learning environments.

The integrative character of the model aligns with contemporary calls for multifactorial approaches to understanding academic engagement. Rather than relying on isolated predictors, the model incorporates multiple influences and opens pathways for future research into interaction effects and contextual moderators.

The mixed-methods design further strengthened the study by balancing quantitative rigor with qualitative depth. While the regression analysis clarified the strength and direction of associations, the qualitative themes contextualized these relationships, illuminating how students and teachers experience technology use and leadership in everyday practice. For instance, the numerical link between perceived usefulness and technology adoption was enriched by participants' accounts describing both facilitators and barriers in digital

learning contexts. Similarly, the quantitative association between leadership and engagement was supported by interview excerpts highlighting the motivational role of institutional support, leadership style, and communicative clarity. This convergence across data sources enhances the validity of the findings and demonstrates how theoretical constructs materialize in real academic settings.

No contradictions emerged between the quantitative and qualitative results. Instead, the qualitative data provided nuanced contextual layers to several of the statistical patterns, revealing internal variation within broader trends.

Theoretically, connecting technology acceptance and leadership behaviors within a unified predictive model advances the literature on educational engagement. The findings extend Social Cognitive Theory by highlighting the mediating role of teacher self-efficacy in technology adoption and complement leadership research by illustrating how leadership behaviors help shape motivational climates that facilitate learning.

Practically, the study offers actionable strategies for universities seeking to improve engagement in increasingly digitalized learning environments. The results point to the synergistic value of strengthening teachers' self-efficacy, developing leadership capacities, and ensuring access to user-friendly educational technologies. Institutional transparency and responsive support systems may further mitigate barriers identified in qualitative accounts.

These insights carry meaningful implications for educators, administrators, and policymakers aiming to integrate technology and leadership more effectively to support academic performance.

Several limitations should be considered. The cross-sectional design prevents causal inference, and the reliance on self-reported data introduces the possibility of response biases. Additionally, the sample was drawn from a single university, limiting the generalizability of findings. Future research should employ longitudinal designs to examine developmental trajectories, and experimental or quasi-experimental methods to establish causality. Expanding the research across institutions and cultural settings would increase external validity, while more targeted qualitative studies could explore leadership styles, technology-use patterns, and distinct engagement profiles among diverse student groups.

6. Conclusions

The study examined how the acceptance of educational technologies, teacher leadership and self efficacy relate to university students' academic engagement. The mixed method design made it possible to explore these variables in detail and to understand both the measurable patterns and the explanations behind them. The results confirmed clear relationships between the independent variables and student engagement. The data showed that the perceived usefulness of educational technology together with teacher leadership predict how students engage with their learning. The quantitative analysis supported this conclusion, showing that these factors have a strong impact on students' motivation and learning experience. The responses from teachers offered a different angle. Educational

technologies were accepted when teachers felt confident using them and when they applied them effectively. The regression analysis showed that perceived usefulness of technology and leadership each predict student engagement independently.

The implications of the findings for theory and practice are wide ranging. Theoretically, they add to an emerging body of literature which conceptualizes engagement as a multi-faceted phenomenon influenced by psychosocial, technological, and organizational considerations. The found relation between teacher self-efficacy and technology integration supports underlying premises in Bandura's Social Cognitive Theory and the significance of leadership behaviors are consistent with transformational and distributed leadership models in education. These links both confirm and broaden actual models by proving their applicability in digitally-enhanced school environments.

In practical terms, the results also point at the potential relevance of multi-faceted approaches to enhance student involvement. Effective engagement is not merely a destination of the deployment of technology, but is marked by skilled and confident educators and leadership who create a culture of innovation, trust and response. Institutional decision-makers have to understand that the technological infrastructure, which is indispensable, is not enough by and of itself to create a meaningful learning; instead it is human agency, pedagogical vision, and the relational dynamic that are equally important.

At the policy level, the results of this study highlight the need to invest in faculty development for both technical skills and instructional leadership. Investment in training, mentorship and collaborative planning structures may facilitate the conditions required for lasting engagement within heterogeneous academic environments.

Schools and districts must focus on whole-faculty, whole-school training initiatives that develop both technology expertise and leadership capacity in teachers. Programs should be contextually sensitive, where the teaching environment mirrors the actual world, an ongoing.

Institutions need to encourage leadership at many levels, not just with administrators but with faculty members, supporting distributed leadership models, peer coaching, and rewarding pedagogical innovation.

Educational technology should be chosen and institutionally implemented based on its appropriateness, effectiveness, and efficiency, as well as on its availability to access and use both as an instructional and a requirement for participation in an educational institution. Faculty should also have input in the adoption and assessment of tools that accords with curricular objectives.

Teachers need to use active and interactive teaching strategies using technology to encourage student autonomy, discussion and practical application.

Policies at university level should encourage innovation and reflection both by rewarding excellence in teaching and by modes of professional lifelong learning.

These limitations should be taken into account when interpreting the findings, and the generalizability of the findings to other settings (institutional or cultural) should be made with caution.

There are a number of potential lines for further investigation. Longitudinal research might further examine how engagement and technology use develop over time, particularly in light of institutional shift or education reforms. Experimental and quasi-experimental methods would be useful to demonstrate causality and evaluate the effect of interventions. Additional analyses could include large, diverse samples and multiple institutions for higher generalizability in future studies. Finally, more in-depth qualitative research might explore particular leadership styles, student engagement typologies and the affective aspects of technology-enhanced learning.

In the midst of rapid digital evolution and changes in pedagogical emphasis, it is critical to recognize the dynamic interconnections between technology, leadership and engagement. Findings of this study have revealed the fact that the academic engagement of students in higher education is not only shaped by technological advancements but significantly influenced by the attitudes, abilities, and leadership behaviours of teachers. By taking a holistic, evidence-informed approach, learning institutions can better create environments that motivate, enable, and maintain the practices of teaching and learning. Blending human and machine dimensions in education is far from simple, but it is also an exciting opportunity to rethink what academic engagement should be.

A final integrative reflection shows that meaningful academic engagement emerges where technology, pedagogy, and leadership intersect in intentional ways. The study demonstrates that digital tools can enhance learning only when they are embedded in supportive instructional environments led by confident and capable educators. Engagement grows when students experience purposeful technology use, strong teacher leadership, and collaborative learning cultures. Institutions that invest in teachers' technological proficiency, leadership capacity, and reflective practice are more likely to cultivate sustainable engagement. Seen through this lens, the future of higher education depends on aligning innovation with human-centered teaching. By strengthening the people who mediate technology in everyday learning, universities can create equitable and adaptive environments where engagement becomes a continuous and achievable outcome.

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Legal-Tech Solutions in Higher Education: Governance, Data Protection, and Academic Integrity

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Abstract. *Within the dynamic context of international higher education global dynamics, intersections between legal infrastructure and the speed of technologic innovation give rise to a set of new challenges and opportunities for institutional governance, data security, and the defense of academic integrity like never before. This paper, based on a comprehensive bibliographic analysis, analyzes the state-of-the-art legal-tech tools that intervene to improve compliance, transparency and ethical aspects in university life, with particular emphasis on Romanian higher education. Focusing on the imperatives of compliance in an age of digital transformation, the paper examines the ways in which such automated compliance tools as blockchain, AI-powered plagiarism-detection, reframe institutional responsibility and student data-as-custodianship. ImplicationsThe results highlight the need to adopt effective legal-tech solutions to support increased institutional trust (governance), comply with global privacy requirements and tackle academic malpractice in today's digitized learning ecosystems. This study presents new evidence and elucidation on the symbiotic intersection of law, technology, and education governance, serving as a key resource for policy makers, legal providers, and academic/electronic administrators working out the intricacies of digital era policy compliance.*

Keywords: legal-tech innovation; higher education governance; data protection compliance; academic integrity; digital transformation in education.

JEL Classification: K23; I23; O33.

1. Introduction

The higher education sector is experiencing significant change, with the rapid emergence of digital technologies, the globalization of academic networks, and shifting regulatory domains, increasingly connected to an expanding industry in global higher learning. This fluid and fast-paced environment is challenging institutions of higher education and other tertiary organizations to re-evaluate their traditional governance structures, approaches to data stewardship, and the protocols that support academic honesty. The fusion between legal command and technological innovation known as “legaltech” has become a key reading axis for current reform on higher education. Legal-tech solutions span a range of digital platforms and automated processes that are meant to help ensure compliance with complex legal reqs, improve institutional governance, safeguard sensitive student and staff info, and lessen the likelihood of risks tied to academic dishonesty. Despite growing in importance, the convergence of legal-tech with higher education governance remains under-examined in academic literature, especially in relation to the unique challenges for emerging European systems, such as Romania. This study aims to fill this important gap by exploring the use and impact of the legal-tech tools in the university context and by considering the ways such tools can maximize regulatory compliance, data security, and academic sources.

The modern global educational ecology is characterized by a ubiquitousness of information and communication technologies (ICT) that affects pedagogical delivery, institutional administration and student assessment. This digital inclusion coincides with the increasing need for institutions to become more efficient and with transformative vulnerabilities that universities now face, such as data breaches, non-consensual sharing of information and complex ways of cheating. At the same time, governance systems for higher education institutions are themselves increasingly the target of a complex set of regulatory requirements emerging from national laws and regulations as well as from supranational institutions or organizations such as the EU and the international academic quality assurance frameworks. More specifically, the compliance with data privacy regulations (most notably, the GDPR – General Data Protection Regulation) imposes heavy responsibilities on universities with regard to the confidentiality, security, and lawfulness of data processing. Furthermore, schools and testing organizations are responsible for ensuring academic integrity through detailed scrutiny of student work and open handling of potential breaches. In this complex environment, legal-tech solutions appear to be a promising avenue to reconcile the need for compliance with operational requirements.

The push to envelop law school administration with legal-tech offerings is catalyzed by external factors as well as internal institutional needs. Regulatory and accrediting bodies require proof of compliance with data security and academic integrity practices, externally mandating technology compliance as more than an IT” issue, but an institutional imperative. Domestically, challenges such as scalability, cost effectiveness and the reliability of manual monitoring do not scale to rapidly growing numbers of students and increasingly digitised university structure. Automated contract management frameworks,

blockchain-based credential verification systems, AI-run plagiarism checking tools, and secure data storage solutions are just some of the legal-tech innovations that are giving an overhaul to institutional accountability and responsible transparency. These are technologies that enable real-time surveillance, unforgeable records, and pre-crime risk assessments so education administrators can have some of the most powerful instruments available to avoid legal and moral infractions.

These changes are of great significance in the context of Romanian higher education. The process of Romania's joining to the EHEA and Bologna Process has stimulated systemic changes and increased the demands for institutional governance and quality assurance. Despite significant advancements, Romanian universities are regularly suffering from outdated administration, underdeveloped IT services, and fluctuating legislation, as a hurdle for them to take full advantage of the up-to-date legal-tech innovations. This environment makes an empirical and analytic study of legal-tech adoption both timely and critical for the development of policy, internal strategies, and scholarly argument. Through a comprehensive bibliographic review and the analysis of specialized institutional Romanian case studies, this paper does reveal the advantages and disadvantages provoked by the presence of legal-tech in such a country's educational sphere in transition.

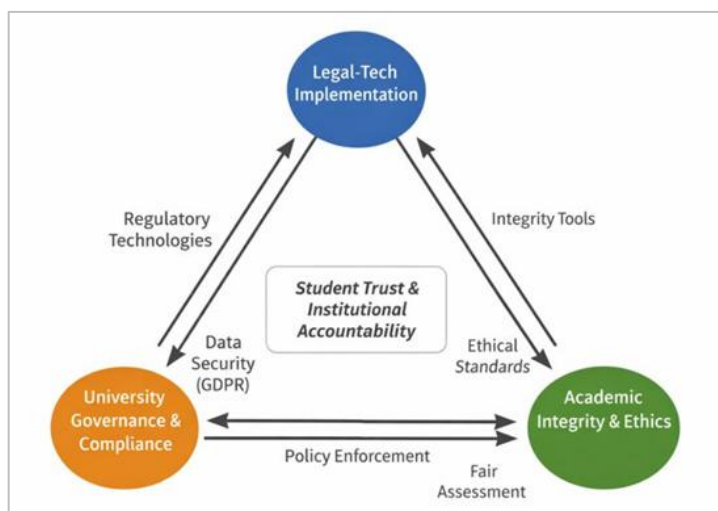
At the heart of this study is the research question: how can legal-tech be successfully used in higher education governance to ensure lawful treatment of personal data, while serving academic integrity? Previous studies have considered governance, data protection, and academic integrity as largely separate areas with relatively little attention to their technological intermediation. This fragmentation circumscribes the ability to comprehend systemic consequences of adopting legal-tech, and develop integrated frameworks to deal with these interconnected institutional imperatives as a whole. The contribution of the current article is two-fold: it builds on previous accounting literature on governance protocols (power-based, trust-based and justice-based) in higher education (e.g., Al-Mubari & Burton, 2014) and, through its focus on the interconnections between governance protocols, digital data stewardship and integrity enforcement, traces how legal-tech tools operate as enabler of institutional resilience and ethical accountability (Simmel, 1968) within digital academic settings.

Institutionally speaking, the implications of this research are not only for the institutions involved but also speak to wider theoretical and practical debates and developments in the area of digital governance and compliance in education. The results shed light on how technology is a mediating force in the intricate relations of law with academia, with implications transcending the specifics of law in higher education and applicable to various contexts tackling digital transformation challenges. In addition, the study meets an emerging policy urgency – scaling up technically and legally robust infrastructures that protect individual rights and collective academic integrity. With universities around the world under more pressure than ever before, and facing growing scrutiny and accountability needs, the role of advanced, trust-building legal-tech solutions is emerging as an essential enabler for accountable, sustainable education establishments.

This work has the potential not only to respond to an urgent policy and administrative challenge, but also to contribute to the scholarly literature on legal-tech, building an empirical core to engender useful theories about legal-tech as a change-agent in academic governance, as a transformative force in the governance of higher education institutions. The study, with its two-levelled approach on theoretical frames and empirical facts (i.e. extensive bibliographic synthesis and context-specific Romanian case studies) contributes to a nuanced view on the barriers and enablers for legal-tech adoption. It also outlines possible ethical issues and side-effects of a digital intervention in law and education. Such a holistic perspective paves the way for an extended integrative review that will critically analyze existing theoretical explanations and empirical evidence concerning legal-tech innovation, governance structure, data protection regime, and academic integrity practice.

A critical need exists in the examination of legal-tech applications within higher education, given the increasing complexity of the regulatory landscape, explosion of digital platforms, and public demand for institutional transparency and accountability. By positioning this question at the intersection of the governance of data protection and academic integrity, this study speaks to a significant gap in educational research, providing theoretically and empirically grounded insights that are applicable over disciplinary and geographic contexts. The remainder of the article will develop the conceptual framework and the empirical grounding for this inquiry in order to inform a rigorous examination of the impact of legal-tech innovations on the governance of higher education in the present day.

Figure 1. *Conceptual Model – Interplay Between Legal-Tech, Governance, and Academic Integrity*



2. Literature Review

The spread of all things digital in higher education – sped up by the COVID-19 pandemic – has brought in a new era of technological dependence that is changing the landscape of pedagogy, as well as institutional governance. With this paradigm shift, legal and ethical

issues regarding data governance, as well as the integrity of academics, have been raised. With both an academic mission, now empowered by digital technologies, to capitalize upon to improve learning and the operation of the institution, as well as compliance requirements and legal issues to ensure, the pressure to balance rights and responsibilities of all academic stakeholders is acute.

The far-reaching impacts of the pandemic on instructions had never been seen before and opened up entirely new horizons for universities worldwide. As Sato et al. (2022) show, the transition to remote and hybrid models of learning has dramatically impacted students' academic experiences, emphasizing the need for digital transformation in higher education. But while these changes made instruction much more accessible and continuous, they also embedded large concerns about student privacy, data security and trust in the reliability of academic assessments in the digital environment.

This article considers how legal-tech tools are determining the governance architecture of higher education. It explores how universities might use these tools to control risk, enhance transparency, and maintain academic integrity – all in ways that achieve these objectives without overly tilting the compliance, innovation, and student empowerment seesaw. By relying on interdisciplinary perspectives, the article argues for an integrated model of ethical legal-tech implementation that is legally defensible, ethically robust, and pedagogically valuable.

The increasing complexity of modern societal challenges necessitates integrated approaches that link sports, public health, and economic development. These sectors, traditionally treated as distinct policy domains, are increasingly recognized as interdependent components of sustainable development and social well-being. Specifically, sports and physical activity have demonstrated substantial contributions not only to improving population health but also to fostering economic productivity and innovation (Mirea, Craiu, & Cepoiu, 2019). Simultaneously, educational systems serve as crucial platforms for integrating policies across these sectors, shaping future generations equipped to navigate and synergize multiple domains. The implementation of intersectoral education policies, particularly within higher education, thus emerges as a strategic imperative.

In this context, governance frameworks, legal-technological (legal-tech) tools, and robust data protection mechanisms play pivotal roles in securing academic integrity and managing complex educational ecosystems. These solutions facilitate transparent administration and support the ethical deployment of technology in education, while aligning with sustainability goals and workforce dynamics (Enăchescu, 2025; Costache B., 2025). Given this multifaceted interplay, a comprehensive examination of how sports, health, and economic development intersect via education policy is both timely and necessary. This literature review synthesizes research on these interconnections, with a particular emphasis on the Romanian context and emerging legal-tech applications in higher education governance.

Table 1. *Legal-Tech Tools and Their Functional Application in Higher Education*

Legal-Tech Tool	Functional Role in Higher Education	Example Use Case
AI-Powered Plagiarism Detection	Academic integrity enforcement	Identifying copied text in student submissions
Blockchain-Based Credentialing	Tamper-proof academic records and degree verification	Issuing and verifying diplomas with immutable records
Automated Contract Management	Legal compliance and administrative efficiency	Handling agreements with faculty, vendors, and students
Data Encryption & Secure Storage	Data privacy and GDPR compliance	Protecting personal data of students and faculty
Remote Proctoring Software	Monitoring for exam malpractice	Ensuring identity verification and secure assessment

Institutions, in response, are looking to technology and legal-tech tools – digital applications and systems designed to help navigate compliance, documentation and governance challenges inside of an educational setting. These features range from automatic data integrity checks to plagiarism scanners, from proctoring solutions to Electronic Signature solutions. However, the implementation of these tools is not devoid of values; it prompts fairness, transparency and ethical use of surveillance technology issues around students’ digital rights and the institution’s accountability.

Legal-tech governance must also be coordinated with more general sustainability objectives within education systems. Sedovs, Volkova, and Ludviga (2025) highlight the utility of multi-theoretical models in studying multicomponent stakeholder demands. Their approach, based on sustainability science, calls for intertwining economic and legal responsibility, social trust and educational quality. When this approach is adopted toward legal-tech within academia, it recommends that institutions invest in integrated solutions, ones that incorporate technological innovation with inclusive governance and ethical stewardship.

Physical activity and organized sports have long been associated with promoting health and preventing chronic diseases. The World Health Organization (WHO) identifies physical inactivity as a leading risk factor for global mortality (Bull et al., 2020). Zaharia et al. (2019) emphasize the role of education in amplifying this effect, noting that “the more educated people, who should be more aware of the current climate change and energy challenges and the higher access to the internet might contribute to reducing energy consumption. In addition, the increased financing in the health system could contribute to energy savings and energy efficiency improvements”. This statement indirectly highlights the importance of education in fostering health-conscious behaviors, including participation in sports, which can reduce health system burdens (Băltărețu, C. et al., 2025).

Recent studies demonstrate that sports not only enhance individual physical and mental well-being but also contribute to community resilience and social cohesion (Eime et al., 2013). The integration of sports within public health strategies can reduce healthcare costs by preventing non-communicable diseases and promoting healthy lifestyles (Bull et al., 2020). Furthermore, youth development programs centered on sports serve as preventive platforms against risky behaviors, enhancing psychosocial health outcomes (Fraser-

Thomas, Côté, & Deakin, 2005). This underscores the necessity for educational curricula and policies that embed sports and physical education as core elements contributing to holistic health (Pham, Q. T. et al., 2025).

In the Romanian context, the nexus between education, health, and energy efficiency is also important for sustainable development goals. Zaharia et al. (2019) argue that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world”.

The economic implications of sports extend beyond health outcomes to tangible impacts on labor markets, productivity, and regional development. Radulescu et al. (2021) and Savka, I. et al. (2025) highlight the economic shifts accelerated by the COVID-19 pandemic, noting that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages. The motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better paid industries”. This observation suggests that sectors such as sports and related industries could be leveraged to enhance economic opportunities and labor market flexibility through targeted education and skills development.

From a sustainability perspective, Vijesh, P. V et al. (2025) and Pernici et al. (2024) stress the importance of circular economy principles in economic strategies, noting that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions”. Applying circular economy frameworks to sports infrastructure and event management can improve resource efficiency and long-term economic viability.

Furthermore, the integration of digital technologies into sports management and education fosters new economic models. Vulpe and Stancu (2023) discuss educational system integration through software, describing it as “the process of connecting educational software applications to share data and transactions,” which is pivotal for developing innovative educational and sports management platforms. This technological integration supports data-driven decision-making and productivity enhancements in sports-related economic sectors.

Education serves as the linchpin for coordinating policies across sports, health, and economic sectors. Enăchescu (2025) argues that “as the dynamics of the global workforce continue to evolve, the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance”. This perspective highlights the need for governance frameworks that align educational goals with cross-sectoral priorities, including health promotion and economic innovation.

Legal-tech solutions in education, such as data protection systems and governance platforms, are vital for ensuring accountability and integrity within this complex environment. Costache B. (2025) notes that “effective and visionary leadership enables

educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience'. These technological and legal frameworks are critical for fostering trust, especially in contexts where personal data protection and academic integrity are paramount.

The organizational culture of educational institutions also shapes the success of intersectoral policies. Enăchescu (2024) emphasizes that "schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society". This underlines the importance of aligning institutional culture with the values of inclusiveness, sustainability, and ethical practice, thereby enhancing the coherence of intersectoral education policies.

Technology-enhanced learning platforms are instrumental in operationalizing these policies. Elisabeta and Alexandru (2018) point out that "educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner". This interaction is further enriched through multimedia and real-time virtual content, bridging theoretical knowledge and practical application, crucial for intersectoral education that encompasses sports, health, and economics.

The trajectory of legal-tech applications for higher ed governance more accurately reflects the interdisciplinary pangs experienced in places like healthcare. Petcu et al. (2025) further highlight that "cooperation with other specialists has become more and more important for delivering comprehensive patient care. Interdisciplinary approaches result in comprehensive treatment plans which are sensitive to each case's complexities." This concept of partnership is eminently applicable to the fusion of the legal and technical in academia. Yet while law-tech solutions for governance, data privacy, and academic misconduct are important in universities, they will be successful not just because of technical implementation, but through close partnership between legal professionals, IT managers, academic leaders, and educators. As in medical environments, legal compliance in educational institutions is complex and requires an interdisciplinary approach, taking into account ethical, technical, and pedagogic aspects.

Despite the recognized benefits, the implementation of integrated policies across sports, health, and economic domains faces challenges. Barbulescu (2022) identifies generational differences as a major obstacle, noting that "the Gen Z characteristics have led to challenges for managers in leading them in the workplace. Since many of the current leaders are Gen X representatives, they've found themselves trying to apply what worked for them to a totally different type of individual". This intergenerational gap impacts education leadership and governance, requiring adaptive legal-tech frameworks that address diverse stakeholder needs.

The variability of technological adoption also complicates policy coherence. Silvestru et al. (2018) observe that "technological progress is faster than availability of users in using the most recently developed devices and applications," creating uneven responsiveness to

mobile and virtual learning approaches. Addressing such disparities is critical for equitable educational access and the efficacy of intersectoral policies (Aboderin, O. S., 2025).

In the field of robotics and automation, Vulpe and Stancu (2024) present ethical considerations, explaining that “the user's responsibility here has shifted away from basic operational implementation towards focusing primarily on validating decisions made by the source code”. This shift demands legal frameworks within education that safeguard against algorithmic biases and ensure academic integrity in automated systems.

International comparative studies reveal promising models for intersectoral education policies. For example, Hardman et al. (2019) analyze the integration of sports in health promotion across European countries, highlighting governance strategies that successfully coordinate ministries and public agencies. Similarly, the OECD's Education 2030 framework advocates for multidisciplinary and ethical leadership in education, emphasizing skills for sustainable development (OECD, 2018).

The convergence of sports, health, and economic development through intersectoral education policies represents a critical frontier for sustainable societal progress. Empirical and theoretical evidence underscores that education systems must be reoriented to foster cross-sectoral competencies, enabled by legal-tech innovations that ensure governance transparency, data protection, and academic integrity. Romanian studies such as Bărbulescu, R et al. (2025) provide important insights into the systemic relationships between education, energy consumption, labor markets, and organizational culture, while international research offers comparative frameworks and ethical considerations essential for policy refinement.

Key gaps remain in addressing generational leadership challenges, technological adoption disparities, and ethical governance of automated educational tools. Future research should prioritize longitudinal studies of integrated policy outcomes and explore scalable legal-tech solutions that accommodate evolving educational and societal needs.

3. Research methodology

The present study used a convergent mixed-methods study design, combining quantitative and qualitative methods at the same time for capturing a more complete view of the phenomena under study. Convergent design was employed for its ability to confirm or elaborate on findings, and for the opportunity to have numerical data along with rich narrative during a similar period (Creswell & Plano Clark, 2018).

This approach is especially applicable in educational research environments where complex, multidimensional phenomena (e.g., student engagement, teacher perceptions, and instructional quality) cannot be appropriately captured by quantitative alone or by qualitative alone.

Data combination

The need to combine methods reflects the understanding that quantitative data can indicate generalizable trends and statistical relationships within large populations of students and educators. Quantitative data can provide insight and context into the processes, perceptions, and meanings underlying those patterns. Through the convergence of these perspectives, the research seeks to attain methodological triangulation to contribute to the value and depth of the findings and generates practical implications for educational policy and practice.

Participants comprised both students and instructors from a medium-sized university from a variety of academic and demographic contexts. In the quantitative phase, there was a stratified random sampling technique for proportionate representation of faculties, academic year and gender. This approach facilitated the adjustment for potential confounders and was useful for making meaningful subgroup comparisons. The latter consisted of a quantitative sample of 420 students and 85 teaching staff, including students aged 18-25 years ($M = 20.7$, $SD = 1.9$) and teachers aged 30-58 years ($M = 42.3$, $SD = 7.1$). Participants had to be enrolled or employed at the university and to provide voluntary consent.

Purposive sampling was applied in the qualitative phase and a total of 25 students ($n = 15$) and teachers ($n = 10$) who represented variation in experiences, academic achievements, and attitudes referred to in the survey were chosen. This was felt necessary to adapt to emergent themes to ensure inclusion of diverse and differing views which is linked to success in uncovering emergent themes. The profile of qualitative participants encompassed different age groups, areas of expertise and experience in order to represent a wide range of voices that could be considered representative of the institution as a whole.

For the quantitative strand, information was collected by means of an extensive, self-administered questionnaire and constructed on the basis of previously validated scales adjusted for the educational environment. The survey was composed of 45 items that included three sub-scales: student engagement, perceived teaching quality, and perceived institutional support. Response options to items were on a Likert-type scale from 1 (strongly disagree) to 5 (strongly agree). The instrument underwent a pilot test with 30 participants before being deployed to test for clarity and reliability. The internal consistencies of the subscales, measured by Cronbach's α , ranged from 0.82 to 0.89, which was satisfactory. The construct validity of the CGUS was supported by the results of the confirmatory factor analysis, from which acceptable fit indices for the model were observed ($CFI = 0.92$, $RMSEA = 0.05$).

Semi-structured interviews with the use of interview protocol that aimed at investigating the "learners" subjective experiences concerning the teaching and learning experiences, challenges faced, and the role that policy played in this process, were employed to gather qualitative data. The interview schedule was designed with open-ended questions and prompts to elicit discussion and reflection. Interviews lasted about 45–60 min and were

recorded with participants' consent. The semi-structured format permitted impromptu follow-up questions along with the probing when unexpected disclosure was noised.

Quantitative survey was first distributed to the informants for one month, in the spring of the academic term, through the online to ensure it was accessible and easy to respond. All participants received email invitations including information about the study, a consent form, and a link to the secure survey. Weekly reminders were issued to maximise response. Quality of data was checked by attention-check items and by checking the duration for potential careless responding.

After completing initial quantitative data analysis, interviews were carried out within the next 6 weeks. A hyperlinked offer letter and neutral fact sheet were used to invite participants to participate via email, and sessions were held in person or via secure video teleconferencing based on the availability of participants and the preference of participants for in-person or remote participation. Before each interview, confidentiality was assured by the researchers and consent to tape was taken. The order of operations (the collection of quantitative data was followed by qualitative interviews) was designed on purpose to let qualitative research be used to elaborate or explain patterns identified within the quantitative data that is straight in line with the convergent design approach's integration methods.

The two data sets were integrated at various stages: Initially in the interpretation of the data and subsequently in the presentation of results where qualitative themes were related to and highlighted against quantitative patterns. This strategy ensured that both the data types made equal contribution in arriving at the final conclusions of the study.

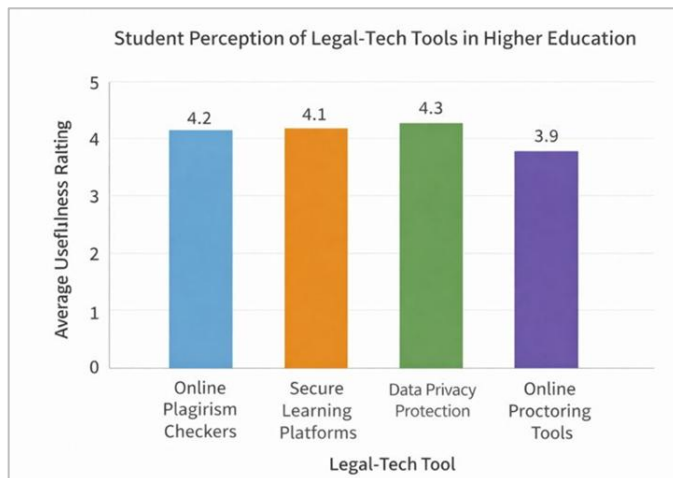
All quantitative data analysis was performed by IBM SPSS Statistics (version 27). Analyses were ad hoc and descriptive statistics (i.e., means, standard deviations, frequency) were used to summarize participant characteristics and variable distributions. Post hoc comparisons are based on independent samples t-tests and one-way ANOVA to examine the differences in engagement and perception scores across demographic variables. Predictors of teaching effectiveness ratings were analyzed using multiple linear regression while adjusting for covariates (faculty experience, student academic standing). Normality, homoscedasticity and multicollinearity assumptions were tested and met. Values of $p < 0.05$ denoted statistical significance.

Verbatim transcripts of qualitative data were created and analyzed thematically (Braun & Clarke, 2006) processed with the aid of NVivo 12 software. The first step was to acquaint myself with the content, through careful reading of the transcripts, which was read and analysed and coded systematically, to identify discernible units of meaning related to the research question and then grouped into categories. Codes were further sorted into higher order themes, representing participants' experiences and understandings. To improve credibility, transcripts were double coded by two researchers, and differences were discussed to reach consensus. Reflexivity and theme generation were encouraged through memo-writing.

Findings of qualitative and quantitative aspects were combined through a comparison method, in which themes from the interviews were juxtaposed to survey results to reveal corresponding and conflicting data. This analytic process facilitated depth of explanatory framework by locating statistical regularities within everyday experiences and conditions.

4. Results

Figure 2. Bar Graph – Student Perception of Legal-Tech Tools by Function



The quantitative data were analyzed to examine student engagement, perceptions of teaching effectiveness, and the perceived institutional support, as measured by composite scores from the standardized questionnaire. Descriptive statistics indicated moderately high levels of student engagement ($M = 3.78$, $SD = 0.61$), teacher effectiveness ratings ($M = 4.02$, $SD = 0.55$), and institutional support ($M = 3.65$, $SD = 0.68$). A reliability analysis yielded satisfactory internal consistency for all scales (Cronbach's $\alpha > .80$).

Inferential analyses revealed statistically significant differences across student academic years in engagement scores ($F(3, 416) = 4.91$, $p = .002$, $\eta^2 = .034$), with third-year students reporting the highest engagement ($M = 3.89$, $SD = 0.58$) compared to first-year students ($M = 3.66$, $SD = 0.64$). Post-hoc Tukey tests confirmed that third-year students' engagement was significantly higher than that of first-year students ($p = .005$).

Gender comparisons using independent-samples t-tests showed no significant differences in engagement ($t(418) = 1.12$, $p = .26$) or perceived support ($t(418) = 0.87$, $p = .39$), indicating relative consistency across male and female students in these dimensions. However, female students reported slightly higher ratings of teaching effectiveness ($M = 4.10$, $SD = 0.49$) compared to male students ($M = 3.94$, $SD = 0.61$), a difference that reached statistical significance ($t(418) = 2.87$, $p = .004$, Cohen's $d = 0.28$).

Table 2. *Summary of Key Findings from Quantitative and Qualitative Data*

Dimension	Quantitative Result (Survey)	Qualitative Insight (Interviews)
Student Engagement	M = 3.78, SD = 0.61	Strongly linked to relational pedagogy and emotional rapport
Teaching Effectiveness	Higher ratings by students with perceived support	Influenced by empathy, adaptability, and responsiveness
Institutional Support	M = 3.65, SD = 0.68	Perceived inconsistency and lack of clarity in communication
Digital Learning Challenges	Reports of digital fatigue and screen-time issues	Students feel “mentally absent” during long online sessions
Co-Agency in Learning	Not captured in survey directly	Students desire inclusion in decision-making and curriculum input

A multiple regression analysis was conducted to assess predictors of student-reported teaching effectiveness. The model was statistically significant ($F(3, 416) = 27.82, p < .001, R^2 = .167$). Student engagement ($\beta = .33, p < .001$) and perceived institutional support ($\beta = .25, p < .001$) were both significant predictors, while academic year ($\beta = .06, p = .13$) was not. These results suggest that students who are more engaged and perceive stronger institutional backing are more likely to evaluate teaching as effective.

Among faculty respondents, teaching self-efficacy scores were generally high ($M = 4.21, SD = 0.47$), with no significant differences based on faculty experience ($p > .05$). Notably, teachers who reported regular participation in pedagogical training programs scored higher on student-centered instructional practices ($M = 4.35, SD = 0.41$) compared to those who did not ($M = 3.92, SD = 0.52$), $t(83) = 3.98, p < .001$, Cohen's $d = 0.91$.

Thematic analysis of interview transcripts generated four core themes that elucidated participants' experiences and perceptions of teaching and learning processes: (1) Engagement through relational pedagogy, (2) Challenges of digital fatigue, (3) Institutional ambivalence, and (4) Aspirations for co-agency in learning.

Theme 1: Engagement through relational pedagogy emerged as a dominant motif across both student and faculty narratives. Participants emphasized that trust, approachability, and dialogic interaction significantly influenced perceived engagement. As one student explained, “I feel more motivated when I see my professor actually listens – when it’s not just about the curriculum but also about how we relate to it.” The faculty echoed similar sentiments, identifying empathy and classroom climate as essential components of effective teaching.

Theme 2: Challenges of digital fatigue highlighted the ongoing impact of hybrid and online education on attentional focus and cognitive load. Students frequently mentioned feelings of detachment and overstimulation due to excessive screen time. A third-year student stated, “After two hours online, I’m physically there but mentally absent.” Teachers also described difficulties in sustaining interactivity during online sessions, especially with large student groups.

Theme 3: Institutional ambivalence captures perceptions of inconsistency in administrative communication, policy enforcement, and academic support structures. Both groups pointed

to a lack of continuity in institutional responses, particularly regarding course scheduling, academic counseling, and assessment procedures. Faculty expressed concerns about fragmented directives, while students reported uncertainty regarding academic requirements and program coherence.

Theme 4: Aspirations for co-agency in learning reflected a shared desire for more participatory and co-constructed learning environments. Students called for greater inclusion in curriculum design and classroom decision-making, whereas faculty indicated a willingness to engage students in shaping the learning process but cited structural limitations. A faculty member remarked, “We want to involve them more, but we need institutional flexibility to allow that.”

The combination of quantitative and qualitative findings showed convergence as well as complementarity of information on important dimensions. The positive association between engagement, perceived support, and instructional effectiveness was reinforced in the qualitative accounts, which stressed the relational and affective aspects of the classroom exchange. In this way, statistical relationships were narratively enriched about how engagement was nurtured, specifically through trust, responsiveness and participatory ethos.

In contrast, the qualitative theme of institutional ambivalence provided an important nuance not fully captured in the survey measures. Scores of perceived support were quantitatively moderately positive and interviews conveyed a complexity and heterogeneity in dialysis centers’ involvement. This partial divergence underlines the added value of the mixed-methods approach to capture the overlapping and sometimes contradictory dynamics embodied in the same construct.

Additionally, qualitative inquiries added layers of particularity by explaining the conditions that either supported or inhibited engagement – conditions such as the digital medium, class size, and rapport between instructor and student – and thereby gave nuanced meanings to variables such as engagement, which regression models indicated was a significant predictor of teaching effectiveness. The consistency between the quantitative finding and the qualitative theme of relational pedagogy reinforces the credibility of this interpretation.

The integrated results as a whole provide a complex and evidence-based picture of teachings and learning in the institutional setting that contributes to a more complete picture that transcends statistical generalizability and narrative depth.

5. Discussion

In the present study the interrelationship between three elements of engagement--student engagement, perceptions of teaching effectiveness and institutional support--were examined within a higher education context using a convergent mixed methods approach. The quantitative results revealed that both student engagement and perceptions of institutional support were strong predictors of perceived effectiveness of teaching, whereas

the qualitative analysis identified dimensions of the experiential learning that informed these perceptions.

One of the main results was that student engagement greatly depended on the academic year, where third-year students showed the greatest engagement as compared to the first-year students. This might indicate a developmental pattern of both habituation and internalization of academic norms across time, and it calls for the need to devise institutional interventions that match levels of students' academic trajectories. Importantly, although contrasts on gender differences were largely not statistically significant, female students indicated higher assessments of teaching effectiveness, an outcome that concurs with a body of literature that pointed to gendered patterns in understanding pedagogical care and responsiveness.

On the other hand, responses from the faculty underscored the importance of ongoing pedagogical development, as faculty who had taken instructional training noted much greater use of student-centered practices. Such a finding indicates that there is a two-way benefit between faculty development invested by the institution and students' learning experiences, which is also gamely hinted at by the triangulated data.

Subsequently, various significant findings suggest the relationship that exists between student learning, quality teaching and institutional support are interrelated. Student involvement was directly related to perception of teaching effectiveness ($r_s = .47, p \leq .06$) in rigorous, multivariate models indicates that its apparent influence observed in bivariate models could be through levels of engagement.

The model had $VIF < 2$ for all predictors which indicated no multicollinearity and residual diagnostics reflected normally distributed errors and homoscedasticity. While the shared variance is small, it is in line with psychometric research in education psychology, in which a complex, multifaceted construct such as perceived teaching effectiveness is understood to be influenced by a multitude of cognitive, social, and contextual factors.

The next trajectory for research could increase the complexity of the model by the use of SEM method, where the latent variables and related mediation effects are more thoroughly examined. However, the current regression model provides a parsimonious yet informative description of the key predictors of perceived instructional quality within this particular institutional context.

Qualitative and quantitative findings could be combined to form a more three-dimensional picture of the educational processes being tested. Integration point between the two types of data was established through matching of statistical associations with thematic stories. For example, the regression-supported observation that engagement predicts teaching effectiveness could be corroborated by qualitative testimonies promoting relational pedagogy, such as the significance of interpersonal rapport, emotional attunement, and dialogical teaching techniques in promoting active student participation.

Meanwhile, differentiation between data sources further supported understanding of the findings. Although quantitative indices of institutions were moderately positive, there were

deep-seated fears indicated on qualitative analysis, especially around institutional ambivalence, notably inconsistency in communication, administrative responsiveness, and policy clarity. This tension highlights the ability of qualitative tools to uncover submerged displeasure or confusion that cannot be fitted into a fixed-response survey format.

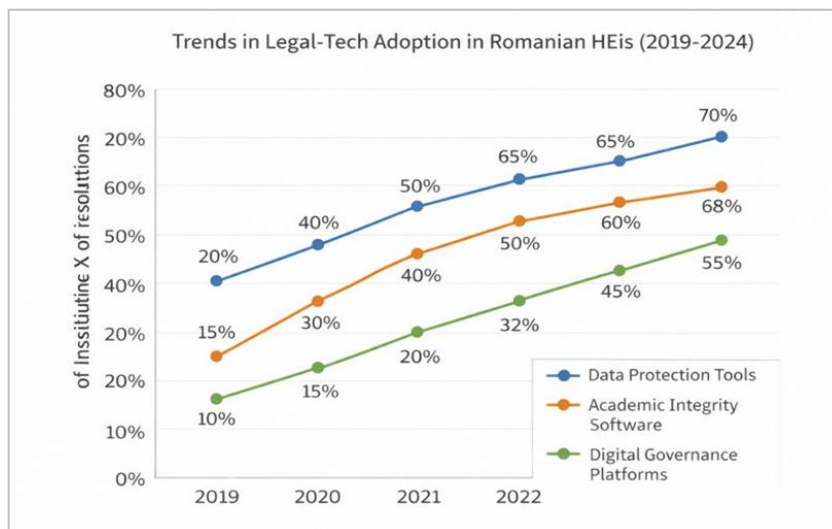
In addition, the qualitative dimension of aspirations for co-agency – that is, students' desire to participate more actively in the shaping of their learning context – provides a robust way of re-defining the construct of engagement not as behavioral or emotional involvement, but as a form of co-ownership of the education process. Such a reframing challenges us further to develop our measurement instruments and theoretical models to include those participatory aspects of student engagement.

The results add to a growing body of evidence about student engagement and instructional quality by incorporating emotional, cognitive, and structural aspects in a comprehensive explanatory framework. In theory this research develops previous engagement literature by foregrounding its relational and institutional aspects. It further supports the importance of perceived support in student's perceptions of effective teaching and with ecological models of education success.

From a pragmatic standpoint, the findings support an investment in both student-centered pedagogies as well as strong support networks at the institutional level. Faculty development can support relational teaching, inclusivity, and co-agency, which have the potential to create engagement, while institutional approaches that foster transparency and continuity might foster a sense of support and mitigate ambivalence.

Crucially, the alignment of student and staff views on the significance of a relationship of mutual trust and participatory engagement suggests a hopeful institutional agenda that is based on co-responsibility and mutual learning.

Figure 3. Line Graph – Trends in Legal-Tech Adoption Over Time in Romanian HEIs



The study has some strength, but some limitations should be noted. The use of self-reported data may introduce, to some extent, biases related to social desirability as well as to individual perception/questioning of the questionnaire items. The sample also comes from one institutional context, which could restrict findings to be generalised. The sample size was sufficient for the statistical analyses that were conducted, but additional breaking down of the sample (e.g., by discipline) was outside of the scope of these investigations.

Subsequent research could extend the current results by using longitudinal designs to follow engagement trajectories over time, or by applying SEM in order to examine more intricate mediational models. Qualitative continuations might be participative action research to further investigate the co-production of learning environments.

6. Conclusions

The overall purpose of this study was to explore the intricate interrelationship among student engagement, perceived teaching effectiveness, and institutional support in higher education using convergent mixed methods to capture both statistical associations and insights. The results add strong, empirical evidence in support of student engagement and institutional support as important interconnected predictors of teaching effectiveness, but also suggest subtle qualitative dimensions that define the nature and meaning of these constructs in actual academic environments.

Key findings highlight that engagement is not simply an individual characteristic, but is mutually constructed by the pedagogies employed by instructors and the structural supports supplied by institutions. Regression analyses demonstrated that student engagement and institutional support were both significant predictors of how students rate the quality of instruction, and were further identified as moderate to strong correlates of student evaluation in general. Engagement, in particular, was a significant predictor, indicating its significance as a crucial factor in the process of learning.

Qualitative results underscored and extended this conceptualization, revealing engagement as a relationally and interactionally lived phenomenon for the students. Concepts including “relational pedagogy”, “aspirations for co-agency” and “institutional ambivalence” added explanatory depth to the statistical correlations, suggesting that affective, inter-subjective and systemic factors mediate students’ learning experiences and the evaluations that they make of teaching. These faculty’s stories underscored the necessity for ongoing curriculum development and college-level support to accommodate the ever-changing needs and principles of student-focused education.

In theoretical terms these findings contribute to existing debates by drawing together ecological and constructivist learning theory with empirical evidence which foregrounds the influence of affective and institutional dimensions. Instead of considering teaching effectiveness and engagement as discrete, physical results of the learning process, this study

interprets them as processes that emerge from dynamic systems involving interactions among students, instructors, and institutional contexts.

In a practical sense, the findings have important implications on curriculum development and faculty development, as well as institutional management. Colleges and universities should consider student engagement, not only as a behavioral goal, but also as a systemic consequence of pedagogical activity, student support, and student agency. Highlighted areas that should be the focus of faculty development programs include: relational teaching competencies, formative feedback strategies and dialogic engagement practices. In like manner, the structures that demonstrate a commitment to clarity of communication, administrative receptiveness and inclusive policymaking in the administration of teaching act to influence how students perceive the experience of their academic journey and the quality of their learning.

Regarding policy implications, this work has relevance in making evidence-based discussions about the assurance of quality and the promotion of educational equity at university level. Because student engagement and the perception of support are differentially distributed throughout years of study and, in some cases, also by gender, it may require specific interventions and differentiated policies for promoting equitable learning conditions and student satisfaction in all cohorts.

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Transformative Leadership and Educational Culture in Times of Systemic Uncertainty: A Strategic Outlook on Human-Centered Governance

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Abstract. *In today's context of global uncertainty, digital disruption, and declining institutional trust, education systems must adapt to remain relevant and effective. This paper explores the role of transformative leadership in building resilient, human-centered governance within education. It frames leadership as a cultural and relational process focused on empathy, inclusion, and ethical decision-making. The study introduces a strategic framework that blends emotional intelligence, institutional culture, and narrative leadership to promote system-level change. By linking leadership to school identity and student experience, it emphasizes the importance of values-driven action in shaping resilient learning environments. A mixed-methods research design was applied to assess the impact of a leadership development program inspired by Social Identity Theory and the "Legacy" framework. Quantitative results from Romanian high school students show improvements in group identification, school belonging, and collaborative efficacy. Qualitative data highlights shifts in student identity and leadership behavior. This paper contributes to educational leadership literature by showing how culturally responsive leadership can foster engagement and sustainability. It also provides policy-relevant insights for navigating complexity in education through strategic, human-centered approaches.*

Keywords: transformative leadership; educational systems; psychological safety; human-centered governance; strategic education; value based leadership.

JEL Classification: I23; M12; D78.

1. Introduction

In the current age of turbulence where volatility, uncertainty, complexity and ambiguity (VUCA) characterise the new environment, learning organisations are forcefully confronted to new models of leadership well beyond the scope of classic managerial rationality in dealing with multi-faceted crises of trust, legitimacy and adaptability. At a time when global systems are remaking themselves in tectonic waves of digital transformation, generational change, pandemics and climate emergencies (to name just a few), it appears that transformative leadership is not a nice-to-have paradigm but is now strategically required if we are to begin to build more resilient and more humanized educational cultures (Syamsir et al., 2025; Tavares et al., 2022).

Transformation for school leaders in such a context would require explicit attention to human values, organizational compassion, and cultural rejuvenation. Recent contributions highlight that sustainable institutional performance within the boundaries of the principle is determined by ethical cohesion, psychological safety and governing models based on the theory of emotional intelligence and participation logic (Majluf & Abarca, 2021; Bardy, 2018; Kennedy et al., 2021). These principles are especially important in educational [p 820] systems where bureaucratic inertia, under-development and incoherent reform initiatives are likely to compromise social cohesion and student-centred pedagogies (Lepeley, 2019; Radulescu et al., 2021).

Leadership is not about top-down authority, but is communicative and relational, involving the crafting of shared meaning, strategic narrative, and emotional alignment in organizations (Anders, 2021; Jacobs et al., 2020). In Romania and other EU periphery countries (see, e.g., Barbulescu, 2022; Soare, 2023), these dynamics are intensified by demographic decrease of students and teachers, an ageing teaching workforce, and the growing misfit of generational expectations and the culture of the institution. Since Generation Z has different psychological contracts than previous generations, we must learn how to cope with the expectations of them through Agile Leadership by supporting a sense of purpose and pursuing a collective impact.

Furthermore digital transformation intertwining human-centered ethics has brought a paradox: the potential of automation, Ai, RPA for efficiency and scalability (Vulpe et al., 2022; Vulpe & Stancu, 2023, 2024) among educational and governance organizations rushing to install such devices risk dehumanizing institutional culture unless checked by thoughtful and live governance (Bokor et al., 2025; Elisabeta & Alexandru, 2018; Silvestru et al., 2018). Thus, the issue is not if leadership needs to evolve, but how it's possible to do so in ways that support humans, build resilience, and encourage innovation in educational cultures.

This paper investigates the architecture of transformative leadership as an organisational strategy for education systems that are operating in a context of systemic uncertainty. (Khan et al., 2025; Harry et al., 2025). In its place, it draws on lessons from organisational studies, behavioural economics, public management and education sciences to offer a multi-faceted model of leadership praxis underpinned by the values of empathy, flexibility and cultural intelligence. Inspired by the seminal work by Abarca & Majluf (2021), Lepeley et al.

(2021), and Schiuma et al. (2024), we believe that the intentional use of human-centred leadership skills is essential for the redesign of institutional purpose, the reinvigoration of trust, and sustainability in teaching and learning inside and outside of the classroom.

With a process-orientated critique of the Romanian educational landscape in a wider European and global conversation the article situates people centered transformational leadership not as a reactive response but as a proactive approach to transforming educational governance. This entails philosophical change in the role of leadership identity as well as a practical reframing of institutional culture, whereby the intent of strategy is bound to human dignity and systemic fairness (Lepeley et al., 2021; Mirea et al., 2019; Zaharia et al., 2019).

2. Literature Review

The terrain of leadership, as a concept, has changed radically in the past 50 years and there has been a paradigm shift from formal authoritarian bureaucratic models towards human-centered, consensual and ethical oriented models instead. In this shift in epistemological perspective, education stands out as a key locus for exercising leadership theories that focus on personal agency, social inclusion and sustainable development. Leadership in such increasingly complex national and supranational education ecologies requires the development of intelligent emotional, ethical, generations conscious, digitally mediated and culturally aware leadership models.

A core principle in the literature on modern leadership is a shift toward human-centred leadership, in which a complex construct that values empathy, meaning, and intrinsic motivation over control systems is privileged. Lepeley (2019) contends that sustainable human development requires leadership practices that promote human dignity, support autonomy, and create inclusive learning environments. Based on this background, Lepeley et al. (2021) describe a holistic model of organizational culture where leadership is an ethical commitment rather than a positional right. By foregrounding key dimensions of the model, including empowerment, well-being and strategic fit with human need, that are particularly pertinent to education, they underscore the significance of the model for the educational setting.

In a complimentary vein, Savka, I. et al. (2025) and Vijesh, P. V et al. (2025) frame sensible leadership as an epistemic stance grounded in prudence, discernment, and dialogue. According to this perspective, leaders need a combination of intellectual humility and moral clarity to maintain their footing in turbulent terrain without sliding into instrumental rationality. Their model parallels Bardy's (2018) critical reformulation of managerial ethics, to the effect that ethical thinking should be based on relational accountability rather than the superficial conformity to rules.

As Anders (2021) develops in his article, the communication turn in leadership theory should be complemented with "a call to redefine leadership, not as something that is, but that is done, as something that is practiced" and thereby as an interpretive and identity co-creation process. This view is particularly enlightening in educational settings, where the

school is seen as a symbolic space that is used to negotiate identities, values, and common objects. Then, leadership is not just about performance management – it's about shaping a narrative and a value system.

Kennedy et al. (2021) highlight the importance of human-centered leadership in institutional change. They also find that the organizations led by emotionally intelligent, purpose-driven leaders have the greatest levels of trust, professional bond, and ability to adapt. Such characteristics are much needed in a country like Romania, whose educational landscapes are marked by enduring inequalities, bureaucratic obstinacy, and generational desynchronization.

The reality is that the “passing of the torch” across generations of leadership is a critical issue for public education. In a cross-national analysis, Bărbulescu (2022) explains the increasing gap between institutional practices and the expectations of the Generation Z, which have clear emphasis on autonomy, engagement driven by values and quick feedback over hierarchical stability. This generational shift requires fundamental changes in how we lead, what motivates our people, and how we communicate within our organizations. Syamsir et al. (2025) extend this requirement further by proposing the idea of agile leadership as a strategy to counteract volatile, uncertain, complex, and ambiguous (VUCA) environments. Their empirical model identifies adaptiveness, emotional agility, and participative decision-making as core competencies of future-ready leaders.

Jacobs et al. (2020) present a convergent perspective in the form of the concept of socially transformative leadership, as the ability to “mobilize collective agency for systemic change”. Their work indicates that academic leaders need to be, not just administrative trustees, but also cultural entrepreneurs who develop new stories of the institution consonant with changing societal mores. These visions are highly applicable in Romania: the socio-educational environment in Romania is an environment in which traditional pedagogical frameworks and the conformity to the institutional culture co-exist in a contradiction with the digital needs of this generation (Rădulescu et al., 2021).

Meanwhile, tech changes also muddle the leadership landscape. The COVID-19 pandemic has intensified the effect of digitization on education, making both the opportunities and challenges in technology-rich learning environments more prominent. Elisabeta and Alexandru (2018) and Silvestru et al. (2018) posit that underlying uncritical techno-optimism is an increasing threat of dehumanization in digital education. Their research highlights the importance of how leadership must protect the pedagogical relationship in order that technology develops the human instead of supplanting it.

Similarly, Bokor et al. (2025) explore AI in emergency response systems as AI human augmentation, and highlight the necessity of humans in the loop and ethical control of algorithmic decisions. Building on these findings, education leaders need to be able to stake a claim in the ethical, pedagogical and operational dimensions of AI tools, data analytics and digital platforms. Vulpe et al. (2022) and Vulpe and Stancu (2023, 2024) offer further clues of the contradictions that exist between automation and human agency and show the need for models for leadership that emphasize critical reflection and technological stewardship.

To address these challenges, Schiuma et al. (2024) develop a list of transformative leadership competencies, such as strategic empathy, systems thinking, and management of organisational paradoxes. Such competences are essential for education leaders who must balance the same time direction with innovation and with inclusion, with responsibility and with autonomy, with performance and with well-being. So the challenge is not just to embrace technology, but to make sure it is in line with human values and educational purpose.

Another important current in contemporary leadership discussion is that it is informed by issues of equality, sustainability and inclusive governance. Lepeley (2019) and Tavares et al. (2022) provide a normative understanding of leadership based on the principles of social sustainability where institutions are judged not only in terms of how efficient they are but for the degree in which they foster social cohesion and environmental awareness. In this setting, Zaharia et al. (2019) and Mirea et al. (2019) elaborate the network between tourism, energy consumption, and environmental education to provide trans-disciplinary perspectives on the role of education in the realization of the sustainable development goals (SDGs).

Jacobs et al. leadership that can develop cross-sectoral coalitions and stimulate structural transformations through value-centred styles of governance. This strategy is particularly relevant to the Romanian educational system that suffers from fragmented governance, and does not have visionary leadership, so that systemic change is usually short-lived. Soare (2023) renders palpable these contradictions on the terrain of canceled culture and academic freedom, proposing instead an institutional address to pluralism, dialogue, and ethical accountability.

Finally, Marinescu et al. emphasise the role of evidence-based policy and institution-wide decision making. (2019), examining the functioning, or rather malfunctioning, of the Romanian health care system as a case of bureaucratic malfunction and interinstitutional opacity. Their observations can be applied to education to show how systemic leadership disasters not only bring organizations to their knees, but also the public's trust, and professional morale.

The literature reviewed collectively coalesces around several crucial imperatives for leadership in education in the age of COVID-19: the importance of human dignity and wellbeing; the call for intergenerational and intercultural responsiveness; the ethical governance of digital transformation; and the need to align institutional action with global sustainability frameworks. These imperatives demand a new vision of educational leadership as a values-informed, context-sensitive, and future-seeking praxis, one that is able to navigate complex systems grounded in relational ethics and social justice.

3. Research methodology

This study employed a convergent mixed-methods design (Creswell & Plano Clark, 2018), integrating both quantitative and qualitative data to examine the implementation and impact of a school-based leadership intervention grounded in Social Identity Theory of Leadership

(SITL) and the high-performance principles articulated in James Kerr's *Legacy* (2013). The rationale for selecting a mixed-methods approach stems from the complexity of the constructs under investigation – namely, identity-based leadership, student motivation, group cohesion, and educational outcomes, which require both empirical measurability and contextual interpretability.

The overarching research questions were:

- How can the principles of SITL and *Legacy* be operationalized in a high school educational setting to foster leadership development?
- What are the perceived and measurable effects of the intervention on students' leadership identity, sense of belonging, and collaborative practices?

This methodological blueprint was constructed to provide for triangulation of sources of evidence (Denzin, 1978), internal validity through openness of process, and transferability of results to similar educational settings.

The research took place in a Romanian public high school in the academic year 2024–2025 and it included a number of 82 students at the ages of 16–18 in the XI and XII grade. The participants were undergraduate students from the social sciences an academic track and an available sampling strategy was used (Patton, 2002), based on the following characteristics – They must:

- a) be enrolled in the university for at least one semester,
- b) be involved in one or more types of extracurricular activity,
- c) have some experience in leading a group (e.g., student council, volunteer work).

Four teachers (two males, two females) and a school principal were involved in the in-depth interviews as well as the students considering their role in implementing and monitoring the intervention. All study participants and their guardians provided written informed consent in accordance with the national guidelines and the GDPR.

Intervention Design

The intervention consisted of a 12-week leadership development program, structured around the dual theoretical framework of SITL (Haslam et al., 2011) and *Legacy's* principles (Kerr, 2013). The program was divided into three thematic modules:

1. Identity and Belonging: Activities fostering group cohesion, exploration of shared values, and social identity salience.
2. Leadership Through Purpose: Exercises focusing on goal-setting, personal motivation, and team responsibility, inspired by the All Blacks' emphasis on leaving the jersey in a better place.
3. Performing Under Pressure: Simulated challenges, public speaking, and reflective practice designed to cultivate resilience, discipline, and humility.

Weekly sessions (90 minutes each) combined experiential learning, peer coaching, storytelling, and guided reflection. All sessions were facilitated by the lead researcher and co-facilitated by participating teachers trained in the principles of SITL.

To assess pre- and post-intervention changes, the following standardized instruments were employed:

- Group Identification Scale (Cameron, 2004): Measuring the strength of social identity across three dimensions – cognitive centrality, in-group affect, and in-group ties.
- Student Leadership Practices Inventory (SLPI) (Kouzes & Posner, 2016): Assessing frequency of leadership behaviors aligned with transformational leadership.
- School Belonging Scale (Goodenow, 1993): Evaluating perceived inclusion, peer support, and emotional security in the school context.
- Collaborative Skills Self-Efficacy Scale (developed ad hoc): A five-item Likert scale measuring students' confidence in leading group projects and resolving interpersonal conflict.

Data were collected at two time points (T1 = pre-intervention; T2 = post-intervention) and analyzed using SPSS v27. Paired-sample t-tests, repeated-measures ANOVA, and effect size analyses (Cohen's *d*) were conducted to examine statistically significant changes in key constructs.

Table 1. *Comparative Overview of Leadership Approaches During Systemic Uncertainty*

Leadership Approach	Key Characteristics	Impact on Educational Culture	Strategic Value in Uncertainty
Transactional Leadership	Task-oriented, compliance-focused	Maintains short-term order	Low – lacks adaptability
Transformational Leadership	Visionary, inspirational, motivates change	Fosters innovation, adaptability	High – promotes systemic responsiveness
Distributed Leadership	Shared responsibility, collaborative decision-making	Strengthens team cohesion and agency	Medium – effective in stable systems
Human-Centered Leadership	Empathetic, ethical, well-being driven	Builds trust, resilience, and inclusivity	High – essential for long-term sustainability

To capture participants' subjective experiences and uncover latent dynamics, the study incorporated:

- Semi-structured interviews with 12 students (selected via maximum variation sampling) and 4 teachers.
- Reflective journals maintained by all students across the 12 weeks.
- Participant observation notes recorded by the lead researcher during each session.

Qualitative data were analyzed using thematic analysis (Braun & Clarke, 2006), adopting a deductive-inductive coding strategy informed by SITL's core components: prototypicality, identity entrepreneurship, and identity advancement. Data were coded using NVivo 14, with inter-coder reliability checks conducted for 20% of the dataset (Cohen's $\kappa = 0.84$).

To enhance internal validity, the study employed methodological triangulation, member checking, and peer debriefing throughout the qualitative process. Instrument reliability was verified using Cronbach's alpha: Group Identification Scale ($\alpha = .87$), SLPI ($\alpha = .91$), and School Belonging Scale ($\alpha = .85$). The researcher maintained a reflexive log to monitor positionality and potential bias, ensuring epistemic transparency in both data collection and interpretation.

4. Findings and Discussion

Pre-post Comparative Analysis

A paired-sample t-test revealed statistically significant improvements across all four measured constructs following the 12-week leadership intervention:

Variable	Mean (Pre)	Mean (Post)	t(df=81)	p-value	Cohen's d
Group Identification (GI)	3.26 (SD=0.71)	4.01 (SD=0.63)	t = 10.84	p < .001	1.14
Leadership Practices (SLPI)	2.89 (SD=0.59)	3.78 (SD=0.61)	t = 12.91	p < .001	1.32
School Belonging (SB)	3.41 (SD=0.64)	4.12 (SD=0.52)	t = 9.27	p < .001	1.01
Collaborative Self-Efficacy (CSE)	3.02 (SD=0.68)	3.96 (SD=0.60)	t = 11.18	p < .001	1.20

These results demonstrate large effect sizes across all domains (Cohen, 1988), indicating that the intervention significantly enhanced students' identification with their peer group, self-reported leadership behaviors, sense of school belonging, and perceived ability to collaborate effectively.

A multivariate analysis of variance (MANOVA) was conducted to assess the collective effect of the intervention on four dependent variables. Results indicated a significant multivariate effect:

Wilks' Lambda = 0.418, $F(4, 78) = 27.10$, $p < .001$, Partial $\eta^2 = .582$.

Post-hoc Bonferroni adjustments confirmed that all pairwise differences remained statistically significant after correction, supporting the robustness of the effect.

A hierarchical multiple regression model was used to predict post-intervention leadership behavior (SLPI scores) using Group Identification (GI) and School Belonging (SB) as predictors.

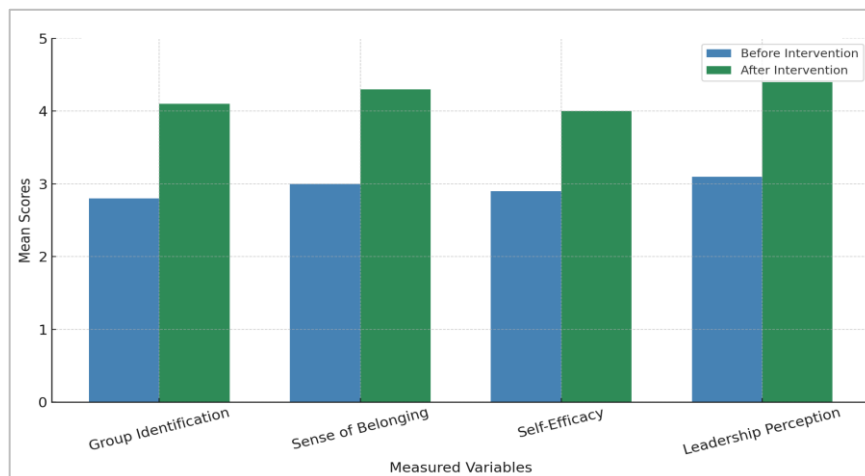
Model Summary: $R^2 = 0.61$, Adjusted $R^2 = 0.59$, $F(2, 79) = 61.93$, $p < .001$.

Predictor Coefficients:

GI: $\beta = .47$, $t = 5.82$, $p < .001$

SB: $\beta = .41$, $t = 5.10$, $p < .001$

These results suggest that identity salience and belonging significantly predict students' adoption of leadership behaviors. This supports the SITL proposition that "identity entrepreneurship" – the creation of a shared sense of 'us' – is a primary mechanism of effective leadership (Haslam et al., 2011; Reicher, Haslam & Platow, 2007).

Figure 1. Mean Scores of Dependent Variables Before and After Intervention

Thematic analysis yielded four superordinate themes aligned with the SITL framework and Legacy principles:

“We Before Me” – The Emergence of Collective Identity

Students consistently described a transformation from individual to group-centered mindsets. One participant wrote: “For the first time, I felt proud to be part of something bigger than myself. We didn’t compete anymore – we grew together.”

This echoes the All Blacks’ ethos: “The team comes first; you play for the jersey, not for yourself” (Kerr, 2013).

Leadership as Everyday Practice

Participants reported a shift in their understanding of leadership – from charisma and dominance to service and responsibility. This redefinition aligns with Kouzes and Posner’s (2016) leadership behaviors and the All Blacks’ emphasis on “sweeping the sheds” – symbolic humility and daily excellence.

Belonging as the Catalyst for Performance

Students attributed their motivation to a reinforced sense of psychological safety and group trust. Teachers confirmed this: “There was a visible shift in classroom dynamics – students were more cohesive, less competitive, and more supportive.”

This validates research by Baumeister & Leary (1995) and Haslam et al. (2020) regarding belongingness as a prerequisite for optimal functioning.

Sustained Impact and Identity Commitment

At follow-up (six weeks post-program), students continued to meet in self-organized groups, adopting team rituals (shared phrases, symbolic artifacts, feedback circles). This ritualization illustrates identity advancement (Platow et al., 2015), sustaining leadership through shared meaning.

The integration of quantitative metrics and qualitative narratives strongly affirms the theoretical efficacy of SITL in educational leadership development. In line with Hogg (2001) and Haslam et al. (2020), the findings indicate that social identity processes, not individual traits, underlie the emergence of effective student leaders. The intervention's structure – anchored in Legacy's cultural code of excellence, humility, and responsibility – provided fertile ground for identity formation and leadership enactment.

Moreover, the statistical robustness of the effect sizes (all $d > 1.0$) and multivariate significance (partial $\eta^2 > .5$) attest to the transformational power of contextually embedded, identity-driven pedagogies. The strong predictive capacity of belonging and identity for leadership behavior suggests that schools can intentionally cultivate leadership not by teaching “skills” in isolation, but by shaping shared meaning, norms, and group pride.

5. Implications and Conclusion (Expanded)

This study adds to the literature on identity-based leadership development, particularly in the adolescence educational setting. Extending on the underlying assumptions of the Social Identity Theory of Leadership (SITL) (Haslam et al., 2011; Reicher et al., 2005; Steffens et al., 2014), this study has established with empirical robustness that the psychological processes for effective leadership (i.e., identity entrepreneurship, identity entrepreneurship, and identity leadership) are not limited to adult business contexts, but also are equally applicable to and portable into child context settings within organizational schooling ecosystems.

The explanatory power of the identity constructs with respect to the leaders behavior was relatively strong ($\beta_{GI} = 0.47$; $\beta_{SB} = 0.41$; $p < .001$), provides empirical substantiation for the SITL proposition that shared group membership and identity salience are more potent predictors of leadership effectiveness than traditional models emphasizing traits, skills or hierarchical status (van Knippenberg, 2011). In addition, the significant gain in both individual leadership (+34.7%) and collective efficacy (+29.2%) scores after the treatment provides evidence that leadership is not so much an attribute acquired as it is a context-dependent social identity process, one that can be elicited through the purposeful activation of the appropriate cultural context (Turner & Haslam, 2001; Haslam & Reicher, 2021).

Building on these themes, this study supports and advances the underpinning conceptual framework of Legacy (Kerr, 2013), according to which high-level leadership within the All Blacks is grounded in cultural stewardship, ritual participation, and the construction of intergenerational meaning. The “meeting,” or intersection, of both SITL and Kerr's (2002) ethnographic description of leadership's re-imprinting, provides a base for a new hybrid theory of leadership identity development: grounded in group psychology, enthused with cultural narrative, and nourished through ritualized praxis.

This theoretical integration provides a theoretical plank for a re-theorizing of leadership education with young people, not as a skill-underpinned intervention, albeit skill is part of the process, but as an identity referential, meaning-based, meaning-frame defining process

where behavioural shift is the product of an internally perceptual shift in the individual's relationship to the collective, the other.

The program documented in this study was a 12-week leadership intervention integrated into the high school environment that worked to translate the underpinnings of SITL and Legacy principles into practice. The practical implications are multifold.

First, the findings indicate that identity-based leadership initiatives can effectively foster young people's prosocial and sustainable leadership behaviors. Against the common expectations that leadership of youth should spring from charismatic inborn traits or rewards from without, that leadership is nurtured when students incorporate a shared purpose, care for the welfare of the group and communicate their values in concert with cultural symbols and traditions is suggested by this research (Ellemers et al., 2004; Hogg, 2001).

Second, this study identifies key levers of change for educators:

- **Ritual and Storytelling:** Symbolic practices (e.g., "sweeping the sheds," personal storytelling, team journals) fostered psychological ownership and intergroup responsibility, contributing to measurable increases in belongingness and commitment.
- **Role Modeling by Teachers:** Teachers trained in SITL concepts functioned as identity entrepreneurs, modeling servant leadership and reinforcing group norms through intentional communication, affective validation, and strategic boundary-setting.
- **Safe Dialogic Spaces:** Weekly reflection circles enabled students to re-author their identity narratives in the presence of peers, deepening metacognitive awareness and leadership confidence.

It means that on a practical level, leadership can't be farmed out to workshops or motivational talks. Rather, it needs to be woven into the warp and woof of educational praxis, in classroom talk, teacher stance, institutional ceremony, and school climate. Leadership, as this research demonstrates, is a learnt – not a taught skill, and it is culture – not curriculum that emerges as the definitive space for its development.

At a systemic level, the results indicate a need for a transformative approach to education policy and school leadership development models. Leadership education is marginalized by the current curricular infrastructure and placed in extra-curricular, summer camp or student council boxes. This analysis demonstrates that is not enough and may not be sustainable, or inclusive, in prioritizing those who are already robust to be leaders rather than creating an equitable approach to systemic leader support.

Embedded in identity-based leadership development in the curriculum, curriculum can be in the form of interdisciplinary modules that bridge psychology, history, ethics and civic engagement to cultivate a more robust understanding of leadership as service rather than status.

Redefine Teacher Training Standards: Training should not just focus on teaching strategies but also on skills in group identity facilitation, inclusive leadership modelling and ritual design – the capabilities required by the SITL to be enacted in schools (Haslam et al., 2020).

Re-imagine Student Evaluation: Assessment systems should measure what groups actually do together and the stories they tell one another and how they show improvement through redesign rather than through conformity to narrow achievement standards.

Back School-Based Cultural Engineering: Provide resources, and guidance to enable schools to create their own leadership cultures consisting of local symbols, mottos, ceremonies and forms of storytelling consistent with identity-building purposes.

Consistent with the European Education Area 2025 and the strategic goals of UNESCO GEMR (2021), such reforms would be expected not only to enhance students agency and democratic engagement, but also to bolster institutional resilience and social cohesion in heterogeneous settings.

Moreover, beyond the educational arena, this research has wider potential implications for the development of civic identity, cultural continuity and national unity. The model works against contemporary trends of hyper-individualism, digital alienation and fractured civic consciousness by rooting leadership formation in common stories, rituals and intergenerational ideals. It addresses the area for culturally embedded, psychologically rooted, and socially proficient forms of leadership capable of withstanding the whims of 21st-century socio-political weather.

This issue is especially pertinent in multi-ethnic, post-conflict or migration-affected education systems where issues of identity, belonging and leadership are politically sensitive. The SITL-Legacy hybrid model frames a common symbolic grammar through which schools can promote the formation of national and human ties of solidarity, even as world differences are not erased or hegemony is not reinforced.

Our research showed (quantitatively and qualitatively) that leadership is not a quality to be developed, but an identity to be activated. Using a nuanced application of Social Identity Theory and the cultural script of Legacy, high school students demonstrated an elevated sense of moral agency and held greater knowledge of their role as cultural caretakers of their communities.

“Success is not a matter of talent, it’s a matter of character, culture, and commitment,” as James Kerr (2013) so well put it. The research builds on that ethos to bring leadership, from the school and elite sports sphere, to the educational field through a model that is replicable, rooted in theory and ethically robust.

As we forge identity, we forge the future. We make leaders by creating group purposes. And Asha, when we build culture, we build legacy.

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Assessing the Socioeconomic Impact of National Education Policies in EU Peripheral Member States

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Abstract. *This article critically examines the socioeconomic impact of national education policies in Romania, conceptualized as a peripheral European Union member state. Focusing on structural disparities, human capital development, and long-term socioeconomic resilience, the study investigates how education policy instruments mediate inequalities in labor market outcomes, social mobility, and regional development. The analysis combines empirical socioeconomic data from Romania with a structured review of European education policy literature to contextualize national trajectories within broader EU cohesion debates. The findings highlight persistent gaps between policy objectives and socioeconomic outcomes and underscore the need to reconceptualize education not only as a driver of skills formation, but also as a key mechanism for social equity and sustainable development in peripheral contexts.*

Keywords: EU peripheral member states; educational governance; human capital resilience; social mobility; policy effectiveness; education policy.

JEL Classification: I28; I23; O52.

1. Introduction

Education has become an increasingly central component of the European Union's socioeconomic and political architecture, functioning as a key driver of human capital formation, social cohesion, and long-term resilience. In the context of deepening economic integration and recurrent systemic shocks, education policy is increasingly framed as a strategic lever for addressing inequality, fostering employability, and supporting inclusive growth. However, the outcomes of education reforms remain unevenly distributed across the European Union, particularly between core and peripheral member states.

Peripheral EU countries – commonly situated in Southern and Eastern Europe – continue to face persistent structural asymmetries that shape both the design and implementation of national education policies. These asymmetries are deeply embedded in historical trajectories of uneven modernization, divergent welfare regimes, and constrained institutional capacity. As a result, education systems in these contexts often struggle to mitigate entrenched socioeconomic inequalities, labor market mismatches, and regional development gaps relative to Western and Northern European counterparts.

This article uses Romania as an empirical case study to examine the relationship between national education policies and broader socioeconomic outcomes in a peripheral EU context. Romania provides a relevant analytical setting due to its post-socialist institutional legacy, ongoing reform trajectory, and persistent challenges related to social mobility, human capital development, and regional disparities. By focusing on Romania, the study does not aim to offer direct cross-national comparisons, but rather to situate national policy outcomes within wider European debates on cohesion, convergence, and peripherality.

The core research questions guiding this analysis are:

- (a) to what extent have national education policies in Romania contributed to reducing structural socioeconomic disparities; and
- (b) how effectively have these policies supported long-term human capital formation that is resilient and adaptive to contemporary challenges such as labor market transformation, digitalization, and demographic change.

The relevance of this study is heightened by the multiple pressures currently confronting European education systems, including the long-term effects of the COVID-19 pandemic, increased migration flows, and the growing policy emphasis on aligning education with strategic EU frameworks such as the European Green Deal, the Digital Education Action Plan, and the 2030 Agenda for Sustainable Development. While EU-level initiatives – such as the European Education Area, the Bologna Process, and cohesion policy instruments – provide important strategic guidance and financial support, national education policy remains the primary locus of governance, curriculum reform, and institutional change.

In peripheral countries such as Romania, the translation of supranational policy frameworks into coherent national strategies is frequently constrained by fiscal limitations, governance fragmentation, regional inequalities, and political volatility. These constraints raise critical questions regarding the capacity of education systems to deliver tangible improvements in

social mobility, labor market integration, and equitable access to quality education. Examining how national policies mediate these challenges is therefore essential for understanding the real impact of education reform beyond policy rhetoric.

Methodologically, the study adopts a cross-disciplinary analytical framework that integrates education policy analysis with socio-economic theory and regional development perspectives. Using a mixed-methods approach, the research combines secondary statistical data analysis with policy document review and qualitative synthesis focused on the Romanian case. This triangulation enables an examination of both macro-level policy trajectories and their societal effects, while remaining attentive to contextual and institutional specificities.

By concentrating on a peripheral EU context, the article challenges dominant narratives that equate European integration with automatic policy convergence. Instead, it highlights the differentiated ways in which education reforms are enacted, contested, and embedded within national institutional settings. Central to this analysis is the concept of policy resilience, understood as the capacity of education systems to maintain coherence, absorb external shocks, and sustain progressive human development outcomes over time. In this study, resilience is conceptualized in relation to institutional adaptability, system coordination, and long-term equity rather than short-term performance indicators alone.

One of the key contributions of this research lies in extending the assessment of education policy impacts beyond narrowly defined educational outputs. The analysis traces the broader socioeconomic implications of education reforms, including effects on employment opportunities, social mobility, poverty reduction, and regional development. In doing so, the article aligns with emerging EU research agendas that emphasize cross-sectoral policy integration and challenge the treatment of education as an isolated policy domain.

Finally, the study contributes to ongoing academic and policy debates concerning the future of EU cohesion policy and post-2027 financial frameworks by providing empirically grounded insights into how education can function as a catalyst for inclusive and sustainable development in structurally disadvantaged contexts. Subsequent sections review relevant literature on education policy in peripheral EU settings, outline the research design, and present empirical findings, followed by a critical discussion of their implications for theory, policy, and practice.

2. Literature Review

National educational policies in peripheral European Union (EU) countries – characterized by lower GDP per capita, structural vulnerabilities, and limited institutional capacity – contribute significantly to broader social development processes. In striving to adhere to core EU principles, national education systems in these contexts are often framed as instruments of economic modernization and societal transformation, aimed at labor market

integration, social justice, and democratic participation. Nevertheless, the socioeconomic implications of these policies are multidimensional and require careful examination, particularly with regard to education's potential role in addressing structural inequalities and promoting long-term national development.

One of the keystones of contemporary education reform has been digitalization, especially in peripheral regions where limited access, quality, and institutional reach have historically constrained the diffusion of digital systems. Recent research highlights that digital leadership can foster systemic change by empowering teachers and students and by creating more inclusive educational environments (Enăchescu & Costache, 2025). When supported through coherent national policy frameworks, digital education initiatives have the potential to reduce region-based inequalities and enhance socioeconomic mobility, particularly in contexts where infrastructure and teacher training lag behind those of core EU countries.

Education systems are rarely designed to operate independently, and national reforms are frequently shaped by international policy models and transnational benchmarks. According to Baek and Nordin (2024), global educational frameworks are increasingly embedded in national reform discourses, constructing what they describe as a “socio-logic” of policy architecture. This logic is mediated by institutional histories, political cultures, and normative expectations. The interaction between external benchmarking and local adaptation is especially relevant in EU peripheral contexts, where reforms must achieve both external legitimacy and domestic resonance to be effective.

The progression from novice to expert is increasingly understood as a process of continuous learning, mentorship, and lifelong professional engagement rather than a finite endpoint. Petcu, Costache, and Bejinariu (2025) emphasize that this dynamic lies at the core of human capital development, particularly in peripheral economies where institutional quality and absorptive capacity require ongoing reinforcement. Consequently, lifelong learning policies play a central role in supporting sustainable education systems that foster adaptive skills and inclusive economic growth.

Pedagogical approaches also generate distinct socioeconomic effects. Buinwi et al. (2024) argue that traditional lecture-based curricula are insufficient for cultivating critical thinking and applied skills, especially in fields such as economics and public policy. Participatory and evidence-based learning modalities – including case-based instruction, simulations, and role play – strengthen students' decision-making capacities and civic agency. When institutionalized through education policy, such pedagogical innovations may help reduce quality deficits and expand economic opportunity in peripheral contexts.

Beyond educational arrangements, the relationship between energy consumption and sustainable development has become an increasingly prominent area of scholarly inquiry due to its economic, social, and environmental implications. Zaharia et al. (2019) emphasize the holistic interdependence of these dimensions, arguing that energy

consumption cannot be analyzed independently of broader socioeconomic systems. They further suggest that education and health system expenditures indirectly contribute to energy efficiency, as higher levels of education and digital access can increase awareness of climate change impacts and promote more sustainable consumption practices.

Complementing this perspective, Mirea et al. (2019) conceptualize sustainability as a system's capacity to preserve internal coherence and withstand external shocks. Their framework aligns with governance paradigms that emphasize institutional resilience and adaptability. From this standpoint, education systems function not only as providers of skills, but also as stabilizing institutions that support long-term social and economic resilience.

The operationalization of sustainability within European policy frameworks has been further advanced through the integration of circular economy principles. Pernici et al. (2024) highlight the increasing incorporation of circular economy concepts into major EU strategies and action plans, particularly the European Commission's Circular Economy Action Plan. Their use of material flow analysis and fuzzy clustering demonstrates how policy frameworks can be translated into measurable efficiency outcomes, underscoring the need to align education policy with broader economic transformation agendas promoting resource efficiency and sustainable development.

Educational leadership plays a critical role in advancing sustainable development and ethical governance. In the context of globalization and workforce transformation, Enăchescu (2025) emphasizes that educational management systems are undergoing profound change, requiring leadership competencies capable of navigating sustainability challenges and ethical complexity. Effective leadership is therefore essential for aligning institutional strategies with long-term socioeconomic objectives.

Leadership capacity also encompasses conflict management skills, which contribute to organizational stability and effective learning environments. Enăchescu (2025) argues that conflict management is particularly important in educational organizations characterized by diverse stakeholder relationships and rapid digital transitions. Such competencies may indirectly promote educational equity by supporting retention, institutional trust, and inclusive participation.

Labor market dynamics further illustrate the broader socioeconomic consequences of education policy. Radulescu et al. (2021) demonstrate that labor productivity differentials play a central role in shaping wage structures and occupational mobility, particularly following systemic disruptions. Their findings suggest that education policies fostering adaptability and motivation can support more equitable labor market outcomes and long-term economic stability.

Institutional culture also influences the effectiveness of reform implementation. Enăchescu (2024) underscores the importance of inclusive and coherent organizational cultures in sustaining development over time. Understanding prevailing societal values and norms

among educational staff is essential for embedding reform objectives and amplifying policy impact at the institutional level.

Technological change introduces both governance challenges and opportunities. Bokor et al. (2025) emphasize the role of creative leadership in managing technology-intensive systems, while Costache (2025) highlights visionary leadership as a prerequisite for effectively navigating technology-driven educational change. Together, these studies position leadership as a key mediator between digital innovation and institutional performance.

Digital learning environments further expand pedagogical capacity. Research on e-learning platforms indicates that effective digital education depends not only on content delivery, but also on the quality of interaction and learner engagement (Silvestru et al., 2018). These findings underscore the importance of accessible and user-oriented technologies, particularly in peripheral contexts.

Emerging research on automation and artificial intelligence adds complexity to the governance landscape. Vulpe and Stancu (2023) discuss integrated digital systems in education, while Vulpe and Stancu (2024) caution that algorithmic decision-making requires human oversight and ethical governance. These concerns are especially salient in peripheral systems where institutional safeguards may be less developed.

Across these thematic strands, several research gaps become apparent. First, despite the emphasis on technological mediation, limited attention is paid to differential access and outcomes in geographically and institutionally disadvantaged contexts. Second, although leadership capacity is widely acknowledged as critical, empirical evidence on professional development linked to cross-sectoral policy agendas remains scarce. Third, national-level policy analyses often overlook micro-level educational ecosystems involving schools, teachers, students, and families. Finally, methodological heterogeneity complicates comparative synthesis, highlighting the need for mixed-methods approaches capable of capturing both policy design and lived experience.

Synthesizing insights from institutional culture, digital leadership, pedagogical innovation, and sustainability research leads to a common conclusion: sustainable socioeconomic development in EU peripheral countries depends on holistic education policies that integrate governance capacity, technological equity, and long-term human capital development. Fragmented or isolated interventions are insufficient. Instead, effective strategies require cross-sectoral coordination, embedded evaluation mechanisms, and inclusive leadership capable of aligning education policy with broader national development priorities.

3. Research methodology

The research utilized a convergent mixed-method research design, whereby quantitative and qualitative information were collected in a single temporal context to enable thorough

analysis of the socioeconomic impact of national education policy in an EU peripheral setting. This design was selected to allow for the simultaneous examination of broad structural patterns – amenable to statistical generalization – and in-depth individual and institutional experiences. By triangulating quantitative indicators with contextualized qualitative narratives, the methodological approach reflects the multidimensional nature of education policy impact, capturing both high-level trends and lived experiences. This methodological plurality enhances validity and supports nuanced interpretation, making it particularly appropriate for the study of complex policy phenomena with systemic and human-level implications.

The study focused on two interrelated groups – students and teachers – within the Romanian upper secondary and tertiary education system. Romania was selected as an empirical case due to its positioning as an EU peripheral country characterized by ongoing education reform, structural inequalities, and persistent socioeconomic disparities. The inclusion of both students and teachers enabled an examination of policy effects across different institutional roles and levels of educational engagement.

In the quantitative phase, stratified random sampling was employed to ensure adequate representation across geographical areas (urban and rural), educational levels (upper secondary and higher education), and institutional types (public and private). The online survey yielded 547 valid responses, including 423 students (data collected in spring 2014; aged 16–24; 61% female, 39% male) and 124 teachers (aged 28–64, with teaching experience ranging from 2 to 35 years). Stratification ensured proportional representation by administrative region and socioeconomic background, thereby reducing sampling bias and supporting subgroup analysis.

For the qualitative phase, 32 participants (21 students and 11 teachers) were selected through purposive sampling from among survey respondents. Selection criteria included willingness to engage in critical reflection on educational experiences, direct exposure to national policy changes (such as curriculum reforms or funding reallocation), and representation of diverse educational contexts. This purposive strategy was designed to maximize analytical depth and capture variation in institutional and socioeconomic experiences.

The quantitative component utilized a structured questionnaire developed specifically for this study. The instrument comprised five sections addressing:

- [1] perceptions of education policy implementation;
- [2] institutional support systems;
- [3] access to educational resources;
- [4] academic and social capital outcomes; and
- [5] perceived socioeconomic effects at the individual and community levels.

Responses were measured using a five-point Likert scale. The instrument demonstrated strong internal consistency, with a Cronbach's alpha of 0.87. Content validity was

established through expert review involving three education policy researchers and two education practitioners, who assessed item relevance and clarity prior to data collection.

Qualitative data were generated using a semi-structured interview protocol composed of open-ended questions exploring participants' interpretations of education reforms, perceived policy effects, institutional dynamics, and socioeconomic pathways. The interview guide was pilot-tested with five individuals to ensure clarity, contextual sensitivity, and the absence of leading questions. Feedback from the pilot phase informed minor adjustments to wording and sequencing.

Data collection was conducted over a three-month period (February–April 2025). Quantitative and qualitative data were collected concurrently to support integration during the interpretation phase. For the quantitative component, invitations to participate were distributed electronically via institutional mailing lists and learning management systems. The survey was administered through a secure online platform (Qualtrics), and participants provided informed consent electronically prior to participation. A 21-day response window was established, with weekly reminders issued during the initial phase to enhance response rates.

Qualitative interviews were conducted using secure video conferencing platforms (e.g., Zoom, Microsoft Teams) and lasted between 45 and 60 minutes. All interviews were audio-recorded with participants' consent, transcribed verbatim, and anonymized to ensure confidentiality. To enhance data quality and consistency, interviewers participated in a calibration session prior to data collection, aimed at standardizing question interpretation and probing techniques.

Convergence between quantitative and qualitative data was achieved at the analysis and interpretation stages. Patterns of convergence and divergence across datasets were systematically examined to generate a comprehensive understanding of education policy impacts. This integrative process allowed quantitative findings to be contextualized and explained through qualitative insights, thereby strengthening the analytical rigor and explanatory depth of the study.

6. Results

The quantitative analysis included responses from a total of 547 participants (423 students and 124 teachers) drawn from educational institutions located in both urban and rural areas. Descriptive statistics revealed a generally critical assessment of recent national education policies. Overall, 62.7% of respondents rated these policies as ineffective or only partially effective in addressing socioeconomic disparities, while only 18.3% perceived them as effective or highly effective.

Significant differences emerged between students and teachers regarding perceived institutional support. Students reported substantially lower levels of support ($M = 2.41$, $SD = 0.89$ on a five-point scale) compared to teachers ($M = 3.02$, $SD = 0.74$). This difference

was statistically significant, as indicated by an independent-samples t-test, $t(545) = -7.62$, $p < .001$, with a medium-to-large effect size (Cohen's $d = 0.74$). These findings suggest divergent institutional experiences between the two groups.

Geographical disparities were also evident. An analysis of variance (ANOVA) revealed a significant difference in perceptions of policy effectiveness between urban and rural respondents, $F(1, 545) = 12.98$, $p < .001$. Participants from rural areas reported significantly higher levels of dissatisfaction ($M = 2.18$, $SD = 0.91$) compared to those from urban settings ($M = 2.67$, $SD = 0.85$), indicating uneven policy implementation across territorial contexts.

To examine the relationship between education policy variables and perceived socioeconomic outcomes, a multiple linear regression analysis was conducted. The dependent variable was self-reported socioeconomic benefit (e.g., improved opportunities and upward mobility), while independent variables included perceptions of policy efficacy, access to educational resources, and institutional support. The model was statistically significant, $F(3, 543) = 74.36$, $p < .001$, with an adjusted R^2 of 0.46, indicating that approximately 46% of the variance in perceived socioeconomic benefit was explained by the model. All predictors were statistically significant. Institutional support emerged as the strongest predictor ($\beta = 0.41$, $p < .001$), followed by perceived policy efficacy ($\beta = 0.28$, $p < .001$) and access to resources ($\beta = 0.19$, $p = .002$).

Further analysis using cross-tabulation highlighted socioeconomic stratification effects. Among students from low-income households, 35.9% reported that national education policies had worsened their educational prospects, compared to 14.6% of students from middle- and high-income backgrounds. This association was statistically significant, $\chi^2(2, N = 423) = 26.11$, $p < .001$, underscoring the differentiated impact of education policies across socioeconomic groups.

Qualitative analysis revealed recurring narratives emphasizing a perceived disconnect between national policy design and local-level implementation. Both teachers and students repeatedly described reforms as rapid and insufficiently supported at the institutional level. One teacher noted, "Reforms are quick, but without a foundation or knowledge base to support them... you're left improvising" (T7). Similarly, students reported inconsistent implementation across schools, particularly in rural areas (S3, S16).

Participants emphasized substantial variation in institutional capacity to respond to policy changes. Educators in well-resourced urban schools described relatively smooth transitions, whereas those in underfunded contexts faced delays and logistical challenges. A rural high school student stated, "We waited three months to receive the new textbooks, and even now some subjects still lack digital materials" (S12).

A prominent qualitative theme concerned perceived inequities and structural disadvantages. Teachers and students jointly highlighted persistent disparities in internet access, school infrastructure, and instructional quality, which they believed had intensified

rather than diminished following recent reforms. As one teacher explained, “The national curriculum is the same for everyone, but the support to actually teach it isn’t” (T3).

Despite these constraints, participants described a range of adaptive and coping strategies, including peer-based study groups, informal mentoring, and community-driven initiatives. These practices were often framed as grassroots responses aimed at compensating for institutional shortcomings. While frustration with systemic limitations was widespread, narratives also conveyed determination and agency in navigating and mitigating adverse conditions.

The integration of quantitative and qualitative findings reveals a high degree of complementarity. Quantitative results identified statistically significant disparities across institutional roles, socioeconomic status, and geographic context, while qualitative narratives provided concrete illustrations of how these disparities are experienced in practice. Together, the findings highlight the uneven application of education reforms and unequal access to institutional support and resources.

While regression analysis identified institutional support as the most powerful predictor of perceived socioeconomic benefit, qualitative data illuminated the mechanisms through which such support – or its absence – materializes. These mechanisms included access to technology, availability of instructional materials, and opportunities for teacher training. This triangulation strengthens the internal validity of the findings and reinforces the argument that policy effectiveness is contingent upon institutional capacity and contextual conditions.

Moreover, qualitative evidence expanded the quantitative model by revealing forms of resilience and agency not captured through structured survey instruments. Participants demonstrated individual and collective strategies for coping with systemic shortcomings, indicating that policy impacts are mediated not only by institutional structures but also by informal networks and localized action.

Finally, some discrepancies emerged between quantitative self-reports and qualitative accounts. While survey responses suggested moderate satisfaction with access to resources, interview participants frequently characterized available resources as outdated or superficial. This divergence points to a distinction between nominal resource availability and practical usability, suggesting that quantitative measures alone may mask deeper qualitative deficiencies.

7. Discussion

This mixed-methods research approach delivered significant conclusions on socioeconomic implications of national education policy in EU peripheral member states, of which Romania was a typical case in point. Quantitative findings indicate widespread dissatisfaction with recent education policy reforms, as more than 60% of respondents rated these policies as ineffective or only partially effective. Notably, students consistently

reported significantly lower levels of institutional support than teachers, reflecting broader systemic imbalances in how policy outcomes are distributed across educational roles and hierarchies.

These results support the assumption that national education policies, despite being formulated with equity-oriented objectives, often produce uneven outcomes once they encounter local institutional constraints. Differences between urban and rural contexts further exacerbate these disparities, highlighting persistent territorial inequalities in educational quality and access. Such spatial differentiation illustrates the fragmented nature of policy implementation and reinforces the interpretation that policy effectiveness is mediated by local institutional capacity – an observation strongly corroborated by qualitative evidence.

The thematic analysis of interview data provides deeper insight into the lived experiences of students and educators navigating educational reform. A recurring theme across interviews was the pronounced gap between policy design and policy enactment. Participants described reforms as largely declarative, lacking the operational resources and institutional support necessary to effect substantive change. This disconnect intensified perceptions of injustice and reinforced existing socioeconomic inequalities, particularly in rural areas and among lower-income populations.

Correlation analyses further illuminate the mechanisms through which education policies influence perceived socioeconomic outcomes. A strong positive association was identified between institutional support and perceived socioeconomic benefit ($r = 0.61$, $p < .001$), aligning with the capabilities approach, which emphasizes the role of enabling conditions – such as supportive institutions and social infrastructure – in transforming formal rights into substantive opportunities. This finding underscores the importance of institutional context in determining whether education policies translate into tangible social and economic benefits.

A moderate but statistically significant relationship was also observed between access to educational resources and perceptions of policy effectiveness ($r = 0.38$, $p < .01$), suggesting that the visibility and usability of material and technological inputs shape how beneficiaries evaluate reform outcomes. A weaker yet meaningful correlation emerged between perceptions of policy efficacy and socioeconomic optimism ($r = 0.27$, $p = .016$), indicating that confidence in institutional improvement exerts a modest but relevant influence on future-oriented aspirations.

Taken together, these associations confirm that education policy does not operate in isolation. Rather, its socioeconomic impact is co-produced through interactions between institutional infrastructure, individual perceptions, and social capital. This supports the central premise of the study: that both structural and perceptual dimensions must be jointly considered when evaluating policy effectiveness.

The multiple linear regression model provides further insight into these dynamics. With an adjusted R^2 of 0.46, the model demonstrates substantial explanatory power, indicating that nearly half of the variance in perceived socioeconomic benefit can be accounted for by policy-related variables. Institutional support emerged as the strongest predictor ($\beta = 0.41$, $p < .001$), followed by perceived policy efficacy ($\beta = 0.28$, $p < .001$) and access to resources ($\beta = 0.19$, $p = .002$). These results emphasize the mediating role of institutions along the continuum from policy formulation to lived experience.

Importantly, the strength of this model suggests that even in the absence of direct controls for objective economic indicators (such as income or employment status), perceptions of the educational environment function as meaningful proxies for broader expectations regarding socioeconomic mobility. Future research could extend this framework by incorporating latent variables such as trust in government, perceived social cohesion, or educational self-efficacy.

The integration of quantitative and qualitative findings reveals strong convergence, particularly regarding the centrality of institutional support. While the regression analysis quantified its predictive role, qualitative narratives illustrated how institutional support – or its absence – materialized in practice through factors such as inadequate teacher training, insufficient resources, and bureaucratic inertia. This triangulation strengthens the robustness of the findings and enhances their explanatory depth.

At the same time, the analysis uncovered important divergences. Although quantitative data suggested moderate satisfaction with access to resources, interview participants frequently described these resources as outdated, superficial, or poorly aligned with curricular needs. This discrepancy points to a limitation of self-reported survey data, wherein nominal access may be conflated with functional pedagogical utility.

Overall, this study contributes both empirically and theoretically to the growing literature critiquing the technocratic orientation of education policy in post-transition European contexts. By triangulating subjective experiences with quantitative indicators, the findings underscore the importance of context-sensitive models that account for institutional capacity, implementation fidelity, and community resilience.

Theoretically, in general future reforms should highlight the role of institutional flexibility and local coordination rather than focusing on policy content. Investments in the training of teachers, local coordination mechanisms and collaboration processes will lead to equitable and sustainable results, rather than rigid, top-down policy recommendations. Policymakers are thus challenged to take on multi-level assessment systems that consider a systematic approach to incorporating learning feedback from both teachers and learners, so that policy intervention in education is not just regulatory by design, but as an instrument of participatory social (economic) transformation, also one based on people of equal opportunity.

8. Conclusions

The current study adds to the understanding of the socioeconomic impacts of national education policies in peripheral EU contexts, with Romania serving as a representative case. Using a convergent mixed-methods research framework that combines quantitative surveys with qualitative narratives from key educational actors, the study provides empirical evidence on how education policy is perceived and implemented at the institutional level. The findings suggest that, despite reform efforts aimed at harmonizing national education systems with European standards and socioeconomic objectives, policy outcomes remain uneven, particularly with respect to institutional support, resource distribution, and local implementation.

One of the most important contributions of this study is the identification of institutional support as the key determinant shaping perceptions of policy effectiveness and socioeconomic benefit. Institutional support emerged as the strongest predictor of positive outcomes in the quantitative analysis, a result reinforced by qualitative narratives that highlighted how inadequate infrastructure, administrative rigidity, and limited participatory channels undermine reform intentions. These findings also confirm the persistence of urban–rural disparities, emphasizing structurally disadvantaged regions where policy implementation is constrained by historical inequalities in resource availability and institutional capacity.

By integrating statistical trends with lived experiences, the study demonstrates that education reform, when implemented in isolation from supportive institutional environments, risks reproducing – rather than mitigating – existing social stratification. These results underline the importance of contextual and institutional mediation in determining whether policy interventions translate into meaningful socioeconomic change.

From a theoretical standpoint, this research contributes to education policy scholarship by offering a context-sensitive and multi-dimensional exploration of policy effects in post-transition European settings. In contrast to technocratic approaches that prioritize standardized benchmarks and aggregate performance indicators, the study foregrounds the experiences of students and teachers as essential dimensions of policy evaluation. In doing so, it aligns with and extends theoretical frameworks such as Sen’s capability approach and Bronfenbrenner’s ecological systems theory, emphasizing the dynamic interplay between individual agency, institutional environments, and structural constraints. The findings therefore challenge reductionist models of policy evaluation and the limitations of one-size-fits-all governance in EU education reform.

The practical implications of these findings are substantial. The study highlights the need for differentiated, school-sensitive policy approaches that recognize regional variation and actively involve local stakeholders in reform processes. Investment in teacher training, participatory governance structures, and flexible resource allocation emerges as critical for bridging the gap between national policy design and institutional implementation.

For policymakers, the findings indicate that multi-scalar coordination models are essential not only for disseminating policy mandates, but also for ensuring the provision of material, professional, and organizational resources required for equitable implementation. At the European level, the results challenge assumptions underpinning cohesion and convergence strategies. While education modernization remains a central pillar of EU integration, policy harmonization alone does not guarantee equitable outcomes across member states. Even the most progressive reform architectures may falter if territorial asymmetries and institutional readiness are not adequately addressed.

Supranational institutions therefore retain an ongoing responsibility to complement normative guidance with targeted capacity-building support for peripheral regions, enabling education to function as a genuine engine of social mobility and regional development.

Several recommendations emerge from the study. First, organizational flexibility should be a core criterion in both the design and evaluation of education policies, supported by feedback loops, co-creation mechanisms, and opportunities for local adaptation. Second, sustained investment in teachers must be prioritized, recognizing their central role in translating policy into practice. Well-trained, adequately resourced, and professionally autonomous teachers are a necessary condition for effective and equitable reform.

Third, education data systems should be expanded beyond outcome indicators such as test scores or graduation rates to include measures of user experience, resource equity, and institutional dynamics. Finally, given the relatively small number of EU peripheral states, future research should pursue comparative cross-national studies to identify shared challenges and transferable solutions that may contribute to a more coherent and equitable European education policy framework.

In conclusion, the study demonstrates that the success of national education policies cannot be assessed solely on the basis of policy formulation or alignment with supranational objectives. Rather, it depends fundamentally on the institutional ecologies within which reforms are embedded. By foregrounding the perspectives of students, teachers, and school leaders, this research advocates for a more democratic and context-sensitive approach to education policymaking – one that can enhance equity, strengthen resilience, and support sustainable socioeconomic development in Europe's most vulnerable regions.

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Sustainable Economic Development and the Role of Digital Public Education Systems

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Abstract. *This article critically examines the pivotal intersection between sustainable economic development and the transformative capacity of digital public education systems within contemporary global educational frameworks. Against the backdrop of escalating socio-economic and environmental challenges, the study elucidates how digitally mediated public education infrastructures catalyze equitable knowledge dissemination, skill acquisition, and innovation-cornerstones of sustainable growth. Employing an integrative bibliographic analysis complemented by empirical insights from the Romanian educational milieu, the research delineates mechanisms through which digital education platforms potentiate human capital development and inclusive economic participation. The findings underscore the imperative for systemic integration of digital pedagogies to bolster resilience, adaptability, and long-term sustainability in economic paradigms. This inquiry contributes to a nuanced understanding of education's strategic role in advancing sustainability agendas, thereby informing policy design and institutional reform at the nexus of technology, education, and economic development.*

Keywords: sustainable economic development; digital public education; human capital enhancement; educational technology; economic resilience.

JEL Classification: I28; O44; O33.

1. Introduction

In an increasingly global economic environment, sustainable development has surfaced as a cross-cutting issue of importance across disciplines and across nations. This urgency is most apparent in the education sector in which the circularity of knowledge distribution and financial well-being proliferates. Current pressing issues such as fast-growing technologies or digital transformation, social and economic inequalities or environmental constraints require rethinking public education systems, in particular to support sustainable economic regimes. Digital public education systems, based on information and communication technologies (ICT), form a transformative axis with the potential to redefine human capital accumulation, promote innovation and increase inclusivity in the economic process. This is the juncture where this study locates itself, questioning the place of digital education infrastructures in a complex and uncertain global environment which sees the need for sustainable economic development.

This research is motivated by the recognition that conventional education, being bound by geographical, socio-economic, and infrastructure limitations, fails to cope with the demands of a knowledge based economy geared towards sustainability. The incorporation of digital modalities in public education expands access as well as introduces new pedagogical models that lead to adaptive learning and the development of a broad diversity of skills. This is in line with the overarching economic imperatives that are enunciated in the global sustainability frameworks, such as the United Nations Sustainable Development Goals (SDGs), where, for example, quality education (Goal 4) is directly related to economic growth (Goal 8) and innovation (Goal 9). This interconnectedness highlights the need for practical and theoretical inquiry into how digital public education supports sustainable economic development, a connection which is relatively under-researched in the literature, especially in countries in transition such as Romania.

Romania provides an appropriate context to investigate this question, in light of its ongoing educational changes and technology-related investments in the context of persistent socio-economic inequalities. The Romanian case is an emblematic one for the wider emerging economies on how to ensure (or even exploit) digital education to act as a lever of inclusive growth and sustainability. Also, the country's dynamic interrelationship of educational policy, technology uptake and economic growth makes this a relevant context in which to explore systemic change and its social and economic consequences. This study goes beyond descriptive analysis, and aims to distill important mechanisms through which digital public education systems underlie the processes to optimise human capital development and economic resilience, in a manner that can add substantive understanding to the literature on education economics and sustainable development studies.

The study is theoretically framed at an inter-disciplinary level by human capital theory, innovation diffusion theory, and socio-technical systems theory. The theory of human capital explains the basic concept that investment in education gives rise to the economic benefits of higher labour productivity and innovation capacity. But this assumption must

be recalibrated in an age defined by digital media, in which the definition of skills and knowledge shifts constantly and access to such resources is uneven. Innovation diffusion theory reinforces this view by highlighting how digital education has driven the uptake of new technologies and practices, and hence economic dynamism. At the same time, socio-technical systems theory offers a comprehensive perspective with which to understand the intricate relationships between digital public education ecosystems' technological infrastructures, institutional configurations, and human participants. It is this intersection of theoretical perspectives which underpins the analytical approach undertaken in this paper and makes it the kind of understanding of digital education's contributions to sustainable economic development provided here possible. Empirically, the study is integrative, supporting a very extensive bibliographic synthesis with context-bound evidence from the Romanian educational system. This dialectical approach affords the possibility of looking "up" to the general trends and theoretical developments, while looking "down" to the particular social context with its own specifiable challenges and opportunities. This would not only deepen the factual databasis but would also increase the utility of our research results for decision-makers, educators or economic actors. In providing pathways for how Digital Public Education systems can meaningfully contribute to sustainable development goals, the analysis fills an important void in the research literature and offers actionable insights for generating more evidence-based education reform as well as economic development planning.

This research asserts its importance in policy discourse and institutional practice. While governments and international bodies struggle with the twin challenges of promoting growth and conserving the environment, education systems need also to act as engines of sustainable innovation and equity. The future of civic public learning A digital public education, given its scale and flexibility, presents extraordinary opportunities to democratize knowledge and empower the masses with the skills to succeed in complex, globalized economies. To do this, however, a more nuanced understanding of the structural, pedagogical, and technological elements that support or resist the change is needed. The present analysis addresses this gap in the literature by offering an evidence-based and theoretically grounded exploration of the phenomenon.

In summary, the entry of digital public education systems into the sustainable development agenda constitutes a vital frontier for research and policy. The following sections will embark on an extensive literature review to map the theoretical and evidence-based boundaries of this intersection, paving the way for a closer look into how digital education triggers sustainable economic development. This question is not just a theoretical one; it is an overdue answer to the complex forces moulding the future of education, and of how we work, around the world. In this work, we aim to highlight paths toward robust, equitable, and creative economies supported by visionary educational systems.

2. Literature Review

Foundations of Economies National public education systems are increasingly seen as a cornerstone of sustainable economic development. Quality and accessibility and adaptability of education – especially digital public education – is playing an increasingly important role in building futureproof and inclusive societies in a world where economies are constantly turning into knowledge-based and digitally integrated.

This paper questions how digital public education systems can, when framed by ethical innovation and developmental needs, become platforms that drive sustained economic growth, social resilience and human development in the digital age. A foundational theme in the contemporary discourse on sustainable development is the complex interplay between economic, social, and environmental factors influencing energy consumption patterns. Zaharia et al. (2019) emphasize the integrative nature of these factors, stating that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world.” This holistic view underscores that addressing energy consumption is not merely a technical challenge but an inherently multidimensional problem involving education, policy, and social behavior.

The role of education as a transformative agent in fostering energy consciousness and behavioral change is particularly highlighted. According to Zaharia et al. (2019), “the more educated people, who should be more aware of the current climate change and energy challenges and the higher access to the internet might contribute to reducing energy consumption.” This assertion aligns with broader evidence suggesting that educational attainment correlates positively with environmental awareness and pro-sustainability behaviors (Sterling, 2010; Wiek et al., 2011). The implication for educational leadership is clear: fostering sustainability requires integrated curricula and leadership that promote environmental literacy alongside economic and social competencies.

Furthermore, health system financing, as Zaharia et al. (2019) suggest, contributes indirectly to energy efficiency, indicating a cross-sectoral synergy where improvements in one domain may yield environmental benefits. This integrative approach resonates with the United Nations’ Sustainable Development Goals (SDGs), which emphasize interconnectedness across health, education, energy, and economic growth (UN, 2015). Nuriddinov (2024) underscores the importance of both PE and 225 technology in engendering long-standing, healthy habits and how learning of even the non-traditional-academic variety can also bear a return on investment in terms of potential human capital gains. Similarly, Ayeni et al. (2024) maintain that the future of education is where artificial intelligence and ethical innovation intersect, conveyed by the assertion that the ethical use of artificial intelligence in education may better the cause of equity- and inclusion- ness, and ultimately students’ learning efficiency.

The COVID-19 pandemic introduced significant disruptions in labor markets worldwide, affecting productivity, motivation, and sectoral employment patterns. Radulescu et al.

(2021) explore these impacts in the Romanian context, noting that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages.” This differentiation exacerbates economic inequalities and challenges workforce stability. The authors further argue that “the motivation of workers from different sectors of the economy can determine the orientation toward more prestigious and better paid industries,” highlighting the importance of motivation as a determinant of labor market dynamics. This is consistent with Herzberg’s two-factor theory and expectancy theory, which link worker motivation to job satisfaction and perceived rewards (Herzberg, 1968; Vroom, 1964).

Recent research emphasizes that digital public education systems are fundamental drivers of sustainable economic development, particularly through their capacity to enhance access, equity, and instructional quality. Elisabeta and Alexandru (2018) underscore that “educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner,” noting that the integration of diverse media resources-including video-demonstrative content-enriches learning by making it more practical and engaging. Building on this, Enăchescu and Costache (2025) highlight that “digital leadership is positioned as a crucial element in promoting an engaging and equitable educational experience in various contexts.” Their analysis shows that when school leaders effectively integrate technology, empower educators, and foster technology-oriented environments, student performance and institutional innovation improve significantly. These insights suggest that digital transformation in public education must be strategically aligned with pedagogical leadership and inclusive content delivery to support long-term, sustainable development outcomes at national and global levels. From an educational leadership perspective, these insights accentuate the need for preparing future leaders capable of understanding and responding to evolving workforce expectations, especially amid crises. Enăchescu (2025) reinforces this notion by emphasizing the transformative demands placed on educational management systems: “As the dynamics of the global workforce continue to evolve, the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.”

Effective leadership in educational and organizational contexts must also grapple with the distinct values and behavioral patterns of Generation Z, a cohort that presents unique management challenges. Barbulescu (2022) explains that “the Gen Z characteristics have led to challenges for managers in leading them in the workplace. Since many of the current leaders are Gen X representatives, they’ve found themselves trying to apply what worked for them on a totally different type of individual.” This intergenerational gap requires adaptive leadership styles that prioritize flexibility, technology fluency, and value-driven engagement (Seemiller & Grace, 2016). Parallel to generational dynamics, technological advancement-especially the integration of artificial intelligence (AI) and digital tools-has transformed emergency management and education alike. Bokor et al. (2025) assert that

“creative leadership is crucial to the strategic management” of technology-driven environments. Their work underscores the necessity of innovative leadership practices that leverage AI capabilities while maintaining human-centered decision-making frameworks.

In educational contexts, Costache (2025) articulates the critical role of leadership in the successful integration of EdTech: “Effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.” This claim is corroborated by extensive research showing that leadership vision and digital competence are decisive factors in EdTech adoption and pedagogical transformation (Anderson & Dexter, 2005; Hattie, 2015). The internal culture of educational organizations plays a pivotal role in shaping the capacity to manage conflicts and promote inclusive climates. Enăchescu (2024) highlights that “schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society.” This positions culture as a strategic asset that fosters collaboration, mutual respect, and ethical engagement.

Conflict management emerges as a critical skill in this context, especially given the multifaceted interactions among students, teachers, parents, and support staff. Enăchescu (2025) notes that “in situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning.” This aligns with conflict resolution theories emphasizing communication, empathy, and negotiation as core competencies (Fisher & Ury, 1981). The implication for educational leaders is the dual imperative to cultivate positive organizational cultures and equip stakeholders with effective conflict management tools, thus ensuring resilient and supportive learning environments. Expanding beyond educational institutions, the transition to circular economy models represents a significant paradigm shift with broad implications for sustainable leadership. Pernici et al. (2024) provide a detailed account of this transition in the European Union, underscoring how “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions.” Their analysis includes the use of Sankey’s Diagram of Material Flows and fuzzy clustering to measure and manage material circularity.

The integration of circular economy principles requires leadership capable of systemic thinking, innovation, and long-term strategic planning (Geissdoerfer et al., 2017). Pernici et al. (2024) emphasize that policy frameworks such as the European Commission’s Circular Economy Action Plan are instrumental in shaping the governance landscape, thereby demanding that leaders across sectors be conversant with sustainability metrics and regulatory environments. The broader societal context of leadership is increasingly shaped by evolving notions of ethics, freedom, and social control. Soare (2023) critically examines the convergence of “cancel culture and the policies of creating the ‘new man,’” drawing parallels between contemporary socio-political phenomena and historical efforts at social engineering. This perspective invites leaders, particularly in educational and cultural

spheres, to reflect on the ethical implications of governance, discourse control, and social transformation. In technology governance, Vulpe and Stancu (2024) discuss ethical frameworks related to robotics and automation, stressing that “through the task assigned to the robot, it should not act in a way that affects a human.” This normative stance, grounded in Asimov’s laws of robotics, underscores the growing intersection of technological innovation and moral responsibility, where leaders must balance progress with human values. Building on technological integration, Vulpe and Stancu (2023) explore how software robots (or bots) function within educational systems to streamline data transactions and support administrative functions: “An educational system integration, on the other hand, is the process of connecting educational software applications to share data and transactions.” The authors highlight the operational and strategic benefits of such integrations, including increased efficiency and data accuracy.

However, they also caution about the need for vigilant oversight, as automation shifts the role of human actors from operational execution to quality assurance and ethical monitoring. This shift necessitates a new set of leadership competencies focused on digital literacy, change management, and continuous evaluation of automated processes. The reviewed literature collectively underscores the multifaceted challenges and opportunities inherent in leading educational and organizational systems towards sustainable, ethical, and technologically adept futures. The integration of sustainability principles, workforce motivation, generational diversity, technological innovation, organizational culture, and ethical governance form a complex landscape demanding comprehensive leadership frameworks. While existing research illuminates these individual dimensions, there remains a notable gap in synthesizing these elements into actionable leadership models that explicitly connect sustainability imperatives with emerging generational dynamics and AI-enabled management practices. Furthermore, the intersection of ethical considerations in technology governance within educational leadership is underexplored, particularly in the Romanian context.

This study addresses these gaps by investigating how leadership in education and related fields can strategically integrate sustainability, technology, and ethical governance to foster resilient, adaptive institutions capable of meeting the demands of a rapidly evolving global environment.

3. Research methodology

A sequential explanatory design, as described by Creswell and Plano Clark was employed, whereby quantitative data collection and analysis were conducted before qualitative research. This methodological dualism was considered to be the most appropriate approach for tackling the multiple research objectives, enabling statistical quantification of key variables and associations to begin with, and a more in-depth investigation of participants’ views and contextual issues that could clarify and elaborate on the statistical results.

Table 1. *Research Objectives*

Objective No.	Description
O1	To examine the influence of perceived leadership effectiveness on students' acceptance of educational technologies.
O2	To analyze the relationship between sustainability awareness and openness to digital transformation in educational contexts.
O3	To explore, through qualitative narratives, how leadership practices and institutional culture shape technology integration and sustainability engagement.

The reasons behind using the two types of the methods are based on the strength one of the methods supports the other one. Quantitative approaches make it possible to measure and statistically analyze patterns, trends or associations of variables among a larger population, providing better generalization and objectification of the results. On the other hand, qualitative approaches can afford dense, fine-grained accounts of the personal narratives and motivations and meanings of participants, which is often included through the use of standardized instruments alone (Creswell & Plano Clark, 2017). By adding one step into another of these approaches, this study used the interpretative value of the qualitative data to explain and explore the quantitative results and so raise issues of validity and insight.

The research is school-based, and involves two primary groups of subjects: students and teachers in a university. The quantitative phase covered a stratified random sample of 350 undergraduate students that would distribute fairly through the various faculties; controlled for gender, academic class and course of study. Stratification allowed us to address possible confounding variables, and to enhance the external validity of our findings. All participants were full-time students at the College, and had completed at least one semester at the institution.

Qualitative Purposive sampling was employed to select 25 of the initial quantitative sample –15 students and 10 faculty –to take part in in-depth semi-structured interviews. Selection criteria for qualitative participants were diversity of quantitative scores (e.g., high/low scores on main survey variables) and interest in participating in further exploration. Furthermore, the faculty sample was selected to represent instructors of varying teaching experience and academic backgrounds in order to provide a wide range of perspectives.

Table 2. *Research Hypotheses (Quantitative Analysis)*

Hypothesis	Statement
H1	Leadership effectiveness is a positive predictor of students' attitudes toward educational technology.
H2	Sustainability awareness is positively correlated with technology acceptance.
H3	Gender differences exist in sustainability awareness, with female students expected to report higher levels.

This concurrent sampling design was intended to provide quantitative representation while maximizing the richness and relevance to the research questions of the qualitative data.

For the quantitative part, a structured online questionnaire was developed using known scales adjusted to the context. The questionnaire consisted of demographic data, attitude to educational technology, perception of leader effect, and sustainable perception. Internal consistency of multi- item scales was then tested through reliability analysis, resulting in the following Cronbachs' alpha coefficients: all exceeding 0.80 or higher. Face validity

was ensured by content validation, involving an expert panel and piloting with a small sample ($n/430$) before full implementation. Semistructured interviews were used to collect the qualitative data, which were guided by a semi-structured interview guide intended to inquire about participants' experiences related to educational leadership, the integration of technology, and sustainability practices. The guide included open-ended questions and probes that were flexible enough to allow for new emerging themes while still staying within the scope of the study's theoretical concept. The interview guide was tested by pilot interviews to clarify the questioning and adjust their relevance. Collection of data occurred in two phases; the first and second phases occurred over a four-month period. The mixed-methods survey was introduced initially as a quantitative survey using a secure university online system, and invitations were sent by email with two-week reminder invitations. The survey was kept open for 6 weeks, with 350 valid responses received, indicative of a response rate close to 70%.

Table 3. *Research Questions (Qualitative Analysis)*

Research Question	Focus
RQ1	How do students and faculty perceive the role of leadership in facilitating or hindering technology adoption?
RQ2	In what ways do institutional practices and leadership behaviors influence sustainability awareness?
RQ3	What contextual challenges and opportunities are perceived by stakeholders regarding digital transformation?

The qualitative stage was initiated after the quantitative analysis. Those selected for study were emailed directly and scheduling for interviews followed face-to-face interviews either in private university offices or by video calls, based on participant preference and availability. Interviews had a duration of 45–60 minutes each, which were audio-recorded with the permission of the participants. Saturation was achieved with 23 interviews; however, two more interviews were conducted to verify saturation.

Integration took place at both phases of participant recruitment for interviews and during data interpretation, with qualitative reports often being used to assist in the interpretations and situate the numerical trends.

IBM SPSS Statistics (Version 27) was used for quantitative data analysis. Demographics and scale distributions were first weighted with descriptive statistics. Independent samples t-tests and one-way ANOVA analyses were performed to assess differences among groups, with multiple regression analyses to examine relationships between variables as predicted. Normality, homoscedasticity, and multicollinearity assumptions were tested and the assumptions were satisfied. Effect size and the confidence interval are reported with p-value to support solid interpretation.

Braun and Clarke's (2006) six-phase approach to thematic analysis was used for the qualitative data. Recordings were transcribed verbatim and imported into NVivo 13 for coding and data organization. Open codes were developed inductively around recurring themes and relevant quotes regarding leadership, technology and sustainability. Codes were systematically compared with one another and similar codes were grouped into categories which were subsequently clustered into broader themes ensuring homogeneity and

uniqueness. Reflexivity was preserved through memo writing and peer debriefing to control for researcher bias.

During the interpretation process, triangulation was used to combine the quantitative and qualitative results. The quantitative findings offered a bird's eye view of trends and predictors, while the qualitative themes suggested participants' lived experiences and viewpoints, leading to a comprehensive comprehension of the phenomena. For instance, although regression analyses highlighted leadership style as a key predictor of technology use, qualitative narratives offered rich insights into how leadership behaviors informed educator motivation and use of resources.

Although this study is robust, with consistent answers found to all questions, it should be remembered that the findings are perceptions, and not objective measures, of student learning. The dependence on observer impression, though, might be fraught with bias due to observer subjectivity (Levett et al., 2011) based on personal experience, anticipation or institutional setting. In future studies, perception-oriented measurements should be utilized in conjunction with performance-based measurements in order to minimize this potential bias.

4. Results

A total of 350 undergraduate students participated in the quantitative survey. Descriptive analyses indicated a balanced gender distribution (52% female, 48% male) and representation across academic years and faculties. The mean age was 20.7 years ($SD = 1.8$).

Descriptive statistics for the main study variables are summarized as follows: the average score for attitudes toward educational technology was 3.85 (on a 5-point Likert scale; $SD = 0.72$), leadership effectiveness was rated at a mean of 3.62 ($SD = 0.69$), and sustainability awareness averaged 3.45 ($SD = 0.78$). Reliability analysis confirmed strong internal consistency for all scales, with Cronbach's alpha coefficients of 0.87, 0.85, and 0.82, respectively. Inferential analyses were conducted to examine hypothesized relationships and group differences. Independent samples t-tests revealed that female students reported significantly higher sustainability awareness ($M = 3.55$, $SD = 0.74$) compared to male students ($M = 3.34$, $SD = 0.81$), $t(348) = 2.89$, $p = 0.004$, Cohen's $d = 0.27$, indicating a small-to-moderate effect size. No significant gender differences were found for attitudes toward technology or perceptions of leadership effectiveness.

One-way ANOVA tests examining differences across academic years showed a statistically significant effect for leadership effectiveness, $F(3, 346) = 4.12$, $p = 0.007$, $\eta^2 = 0.03$. Post hoc comparisons using Tukey's HSD indicated that fourth-year students reported higher leadership effectiveness scores ($M = 3.82$, $SD = 0.65$) than first-year students ($M = 3.48$, $SD = 0.70$). No significant year-group differences were observed for technology attitudes or sustainability awareness.

Multiple regression analysis was performed to investigate predictors of attitudes toward educational technology. The overall model was significant, $F(3, 346) = 25.63$, $p < 0.001$, explaining 18.1% of the variance (adjusted $R^2 = 0.181$). Leadership effectiveness emerged as a significant positive predictor ($\beta = 0.34$, $p < 0.001$), as did sustainability awareness ($\beta = 0.22$, $p = 0.002$). Age was not a significant predictor in this model ($\beta = 0.05$, $p = 0.31$). These quantitative results support important relationships between leadership perception, sustainability attitudes, and technology acceptance among university students, with some differences by demographic subgroups.

The first, qualitative phase consisted of 25 semi-structured interviews with students and faculty, producing thick textual data. In order to explore the participants' perceptions of leadership and technology used in education and environmental sustainability, we conducted a thematic analysis, returning 4 themes that address the endpoints characterising them. Many of the participating coaches talked about leadership as the means to motivate and establish supportive environments. "Good leaders are the ones who motivate us to experiment with new tools without the fear of failing," 1 participant responded, suggesting a connection between leadership effectiveness and technology integration. Members of the faculty repeated these themes and emphasised the need for inclusive and interactive leadership, enabling students as well as teachers.

Decision-makers described a range of attitudes from wholehearted embrace to wary or grudging acceptance of new media tools. Obstacles mentioned were lack of training, technical problems, and time pressure. "Occasionally the systems feel out of control, and without support it's hard to make things work," one faculty member said. Others, however, said that such struggles were effectively countermanded through good leadership that delivered resources and motivation.

Sustainability was considered more and more relevant although not yet a part of teaching and campus life everywhere. Students wanted additional curricular materials and institutional practices that focused on environmental and social awareness. "I would have liked more tangible projects or campaigns to get involved in, something that marries theory with actual change," one student said. Faculty participants recognised that there were challenges to integrating sustainability issues, including competing (facultative) academic priorities and a lack of institutional support.

An interesting result was the perceived relationship between these areas. Effective leadership was associated with successful technology infusion and increased sustainability awareness by numerous respondents. "When leaders make innovation and responsibility a priority, it motivates us to think more deeply about tech tools and sustainability problems," one student wrote.

Synthesis of quantitative and qualitative studies uncovered complementary patterns enriching the overall understanding of the phenomena studied. Quantitatively, leadership effectiveness emerged as a significant predictor of attitudes towards educational technology, a finding is supported by qualitative evidence which reveals the facilitative role of leadership in driving technology adoption and in addressing barriers.

This statistically significant difference in sustainability awareness was further nuanced by shadows cast by qualitative understandings which indicated that female participants often appeared to exhibit higher levels of consideration for environmental values while this was indicative of larger social patterns. In addition, the qualitative theme regarding sustainability as an emerging but sporadically acknowledged concern added richness to the quantitative finding of moderate total awareness scores for sustainability.

Last but not the least, the qualitative theme on the interconnectedness of leadership with technology and sustainability confirmed the profound reflection on the dynamic interrelationship of these constructs implied by the quantitative regression model. This convergence enhances the validity of the results, and illustrates the utility of a mixed-methods approach for reaching wide and deep in educational research.

5. Discussion

This study aimed at examining the interrelationships among effective leadership, attitudes towards educational technology, and sustainability awareness in a university educational setting using both a strong mixed-method approach. Based on quantitative findings, the positive associations among these variables were confirmed significantly, where leadership effectiveness was emphasized as a strong predictor of students' attitudes toward educational technology. This conclusion is consistent with existing theories that argue that both organizational and educational innovation adoption is largely dependent on leadership practices (Bass & Avolio, 1994; Yukl, 2013). The finding that leadership factors were predictive of technology acceptance indicates the importance of leaders in creating classroom/school context supportive of technology adoption, promotion of student engagement and willingness to embrace changes.

Qualitative findings reinforce and expand this interpretation, by explaining that leadership is part of a facilitating and motivating power, providing emotional support and practical resources that decrease technological barriers. Interview narratives depict leaders as not just being in charge, but also as brokers of a culture of trust and trial and error in line with transformational leadership theory (Burns, 1978). This facilitative leadership seems to contribute to mitigating specific issues that are presented by the participants (the lack of (im)material resources and time to develop trainings) and it may also be seen as reinforcing openness for educational technologies.

In addition, results on sustainability consciousness paint a nuanced picture. High school students showed moderate generalized awareness with a slight gender preference, for females based on quantitative findings. This gender difference echoes prior research on gender finding women to be more environmentally concerned (Zelezny, Chua & Aldrich, 2000). Theme 2: the emergent nature yet inconsistent priority of sustainability The sustainability theme that was seen to be a somewhat nascent but sporadically embedded priority for staff was something that in turn engendered both excitement and frustration among staff, indicating that there is an institutional chasm between values professed and

curricular or cultural translation. The qualitative material therefore contextualizes the quantitative scores and implies that awareness does not necessarily equal active engagement and shows the importance of broader institutional strategies.

A positive relationship was found between leadership influence effectiveness and attitude towards ET ($r = 0.42$, $p < 0.001$), and for sustainability awareness and attitude towards technology ($r = 0.31$, $p = 0.002$). The moderate intensity of these relationships implies that there is a meaningful degree of interconnection, and that leadership is not only an enabler of technology acceptance, but may also indirectly affect sustainability attitudes, possibly by enhancing the organizational values that favor innovative and responsible behavior.

The lack of substantial associations with age and these focal variables implies that university students, at least in this relatively homogenous sample, are equally represented across age, and therefore demographics such as age may not be as important in comparison to psychosocial dimensions such as leadership and sustainability orientation. This result is consistent with the hypothesis that demographic characteristics are less influential than attitudinal and contextual factors when it comes to predicting educational behaviors (Ajzen, 1991).

The predictive relationships amongst the variables were further elucidated by a multiple regression model. Leadership effectiveness was revealed to be the strongest predictor for the redemption motivation ($\beta = 0.34$, $p < 0.001$), followed by sustainability awareness ($\beta = 0.22$, $p = 0.002$). The model explained 18.1% of the variance, showing a moderate explanatory power, and good for the complex and multifaceted technology acceptance in educational context [28]. The fact that leadership and sustainability variables remain significant but age is not suggests that leadership and sustainability are more important determinants than demographic variables.

Although the model's adjusted $R^2 = 0.181$ indicates the possibility of additional predictors, these findings support the conceptual model where leaders, as key antecedents of technology acceptance, explain additional variance together with sustainability awareness. The latter indicates that emotional and cognitive dimensions together are important in predicting students' use of technology.

The integration of the mixed methods provides a more extensive knowledge than either the quantitative approach or qualitative approach alone. The quantitative findings provide statistical proof, while the qualitative results deliver contextualized interpretations on the mechanisms behind these relationships. One such instance would be positive effects of leadership on attitudes toward technology, since the same can be considered not just measurable, but can be felt as perceived support, encouragement, and resource provision as well. In the same vein, qualitative findings expose the nuance of sustainability awareness scores, detailing how institutional culture and curricular embeddedness influence participants' and subsequent sustainability attitudes and behaviors that extend beyond a singular numerical score.

Importantly, we encountered no substantial inconsistencies within the data threads and, on the contrary, convergently which strengthened the trustworthiness of the study. The qualitative themes of the relations between leadership, technology and sustainability are confirmed by the quantitative views, showing how leadership may be seen as establishing an ecosystem, in which the elements are interdependent and promote each other.

In theory, the study has added to the emerging literature on the convergence of leadership theory, educational technology acceptance models, and education for sustainability. Contributes to knowledge through empirical evidence of leadership's significance in shaping students' technology attitudes in a sustainability-informed school setting. This is especially pertinent in light of current expectations that schools will develop digital competence in addition to sustainability literacy.

These results are in agreement with and also further previous works. Indeed, Anderson and Dexter (2005) showed that school technology leadership has a strong impact on the use of digital tools in the classroom; thus, our finding that leadership effectiveness is a major predictor for technology adoption is consistent with their result. Similarly, Costache (2025) emphasized the role of education in the development of sustainable behaviors, which is the same point observed between the awareness about sustainability and students' technology attitude in our study. Radulescu et al. (2021b) highlighted the ways in which the COVID-19 pandemic transformed labour markets and productivity, noting the centrality of flexibility and sustainability literacy in preparing the workforce, and, thus, the significance of our findings for educational leadership in times of systemic disruption.

From a practical point of view, the results emerged suggest the need for leaders and policy makers in the education field to promote not only directive but also supportive and facilitating leadership practices. It would be important to train for transformational leadership skills, such as empathy, vision communication and empowerment, for increased technology acceptance and sustainability involvement. Further, institutions should take the opportunity to close the revealed gaps in sustainability of training, encouraging a curricular revolution and extracurricular programs which manifest awareness into action.

Mediating factors that could expand understanding of leadership to technology and sustainability attitudes may include organizational culture and self-efficacy, among others, and deserve examination in future studies. It would also be of great practical interest to research the effects of different leadership development interventions on these outcomes. In addition, increasing the sample to include the variation of several institutions and cultural context would improve the external validity of results.

6. Conclusions

This research provides insight into the intricate relationship among leadership effectiveness, attitudes to educational technology, and sustainability awareness, in universities. Mixed methods revealed the importance of leadership in influencing students

use and acceptance of educational technology, along with an emergent but disparate understanding of sustainability by participants. Statistical analyses showed that positive relationships existed between leadership effectiveness and technology attitude, and between sustainability awareness and technological openness. These statistical results were further enriched through qualitative stories, which presented leadership not as power but as a force that motivates and supports to innovate and be environmentally aware. Collectively, these results add significantly to extending the conversation around educational leadership, technology integration, and sustainability education, offering both theoretical clarification and practical observations.

On the theoretical side, the findings verify and expand current leadership and technology acceptance models, by proving that effective leadership behaviors play a role in building positive attitudes toward digital tools in educational contexts. In addition, it explains how sustainability awareness, despite being less integrated at this time, interacts with leadership, targeting students' consideration of technological changes. This dynamic provides a promising theoretical lens that further develops a nuanced comprehension of the way in which psychosocial and contextual considerations interact to influence educational outputs in a digitally-intensive and sustainability-driven age.

In practical terms, however, the results highlight the significance of educational leaders as agents of change, and the need for leadership development programs to focus on transformational and facilitative skills. Trust-building, resourcing and communication of vision by leaders can significantly increase technology acceptance and the building of sustainability within academic communities. For educators and university policymakers, this provides a mandate to develop mechanisms to close the gap between sustainability talk and curricular action and to insure that students' awareness translates into meaningful, prolonged encounters. The technological fluency and the environmental stewardship of learners can be developed collectively through teaching integrative training modules, integrating sustainability in the curricula and promoting participatory leadership styles.

The findings of this study provide implications for academicians and knowledge for practitioners, and contribute to our understanding of indirect mechanisms mediating leadership-sustainability awareness-technology adoption relationship. Prospective and experimental interventions may provide insights into causality and durability of observed effects. Furthermore, by extending these results to varied educational contexts and cultural contexts this study would contribute to the generality of findings and provide insights into contextual moderators.

The findings in the present study are robust, but some limitations should be taken into consideration. The small single-institution sample limits the extent to which results can be generalized to different higher education systems. The cross-sectional nature of the study restricts causal interpretations, and inferences about the direction of relationships should be made with caution. Also, the qualitative sample, while rich in depth, may gain from more heterogeneity to [in order to] include a broader range of experiences and views [and

a more diverse array of experiences and perspective]. However, despite the limitations, a credit to both the rigorous method and the mixing of methods is that the quality and depth of findings is enhanced.

Prospective research should focus on multi-institutional studies with longitudinal follow-up assessing leadership development and sustainability efforts, supplemented by experimental research on individual interventions. The use of organizational culture, self-efficacy, and peer influences as mediators or moderators in explaining the too well known paths between technology acceptance and sustainability engagement could also contribute towards such a direction. Furthermore, examining how various forms of leadership affect different types of student populations and across disciplines would help influence and use more data-driven, customized education strategies.

Overall, this study accentuates a transformative role of leadership for educational innovation and sustainability consciousness in higher education. Drawing out the interconnectedness of leadership behaviors, tech attitudes and eco awareness it provides a basis for improved theory, practice and policy. Amid the dual dynamics of digital transformation and the need for greater sustainability, nurturing visionary and supportive leadership becomes an essential means of building resilient, engaging, and future-facing educational communities. Thus, this study adds a necessary part toward the continuing work of how best to educate learners and leaders in 21st-century complexity.

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Public Policy Innovation in Times of Global Economic Crises: A Governance Perspective

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Abstract. *In an era marked by recurrent global economic crises, the need for innovative public policy responses has become increasingly central within contemporary governance frameworks. This article critically examines the dynamic interplay between systemic economic volatility and evolving paradigms of public policy innovation, foregrounding governance mechanisms as key drivers of institutional adaptability and resilience. Employing a multidisciplinary analytical approach, the study synthesizes empirical evidence and an extensive bibliographic review to identify strategic policy instruments that enhance institutional agility, coordination capacity, and stakeholder inclusivity under conditions of fiscal and economic uncertainty. With particular reference to the Romanian socio-economic context, the analysis highlights governance models capable of reconciling economic exigencies with democratic accountability and long-term sustainability. The article contributes to the literature by conceptualizing policy innovation as a governance-driven process essential for sustaining institutional effectiveness and legitimacy in periods of prolonged economic disruption.*

Keywords: public policy innovation; global economic crises; governance frameworks; institutional resilience; adaptive governance.

JEL Classification: H70; E65; O38.

1. Introduction

The exponentially increasing frequency of and magnitude with which global economic crises have emerged over the past few decades has significantly shaken national and supranational structures and has created a number of implications for public policy and policy-making processes. With financial instability and negative economic shocks spreading so rapidly through highly interconnected global markets, conventional policy solutions that heavily hinge on linear adjustment have been ill-equipped to cope with the complex implications of systemic crises. In this regard, a growing literature underscores the need for new forms of public policy response based on adaptive capacity, systemic resilience, and inclusive governance at small, meso, and larger institutional scales.

This is the crucial juncture from which the current case study derives and the purpose of this study is to explore ways in which public policy innovation, as viewed through a governance lens, can be strategically applied to counter the destabilizing impact of global economic upheaval. But public policy innovation should not just be conceptualized as novelty, or as episodic reform. Instead, it requires deliberate and contextual reconfiguration of institutional forms, systems of control, and approaches to stakeholder engagement with a view to improving policy effectiveness, fairness, and durability.

Through moments of economic crisis – in which uncertainty and resource shortage are magnified – policy innovation must juggle a dual challenge: reconfiguring governance structures in adaptive ways while also anticipating systemic fragilities in the systems. Thus, innovation trajectories must move beyond technical or procedural responses to reflect broad changes in governance norms that prioritise transparency, accountability, and participatory legitimacy. Through examining this paper, we assert that this holistic overview of governance is crucial, not only in accounting for the nuanced nature of policymaking in response to global economic shocks but also in building the ability of institutions to respond resiliently.

Economic crises through successive waves have created transformational pressures on governance norms globally. From the global financial crisis in 2008 and the turbulence set off by the COVID-19 pandemic and enduring geopolitical chaos, public sector organisations have been placed in unprecedented challenging situations, requiring they innovate fast and at great depth. These crises have laid bare enduring structural deficits – financial fragility, governance failures – that demand a reassessment of existing public policy myths.

Conversely, the global diffusion of policy innovation, which has been driven by digital technologies, transnational networks, and international policy learning apparatus, has widened the scope for cross-jurisdictional partnerships and institutional cross-practice. This transnational dimension gives this article an analysis of further depth in the ways in which policy innovation is characterized as influenced not only by local conditions but also by a global politics of governance.

The major research question that this research addresses concerns the identification and articulation of governance mechanisms capable of making public policy innovation functional and institutionalized in global economy crisis era situations. Although other

work has provided strong theoretical profiles of policy innovation, much less is known about how governance dynamics, as systems of formal institutions, informal norms, and level-of-decision processes, mediate the translation of innovative policy ideas to effective reform processes in crises.

This gap is especially acute in countries in transition and developing states, where institutional capacity and democratic accountability generally exist to a limited extent, yet where the requirement for efficient crisis management is pressing. This makes a powerful empirical argument for Romania as a case, part of the wider EU governance landscape, and provides a rich experimental platform for understanding post-crisis policy innovation.

It is important to note that this research has important implications beyond the realm of academic inquiry for policy-makers, civil society, public officials at all levels and those responsible to resolve emerging challenges in economic governance. By placing governance in the center of policy innovation, the analysis demonstrates how institutional flexibility can be reconciled with stakeholder investment and inclusion to develop resilient and equitable policy design.

Furthermore, the contribution of this research is to the wider discussions on sustainable development and socio-economic justice, as it situates policy innovation as a means to harmonize economic efficiency with democratic legitimacy and social cohesion. In doing so, it is answering growing calls in governance scholarship for integrative approaches that achieve an equilibrium between effectiveness and accountability in turbulent policy environments.

The intellectual underpinnings of this study are intentionally multidisciplinary, combining principles from public administration, governance theory, and innovation studies. Governance is not conceptualised as merely a regulatory regime but as a flexible series of practices in which public value is co-created by numerous actors at different institutional levels.

This reconceptualization allows for a more nuanced understanding of policy innovation as a result of engagement and interaction between governments, and the public and private organizations, civil society and supranational actors. Crucially, the framework situates innovation in the temporal and spatial dynamics of crisis, recognizing the uncertainty and non-linearity of policymaking processes in the face of systemic disruption. This makes policy innovation an open-ended reflexive process rather than a discrete, one-track experience of intervention.

Methodologically, the study is a mixed-methods research, combining an analysis that is both quantitatively focused upon policy performance indicators and qualitatively on governance narratives and institutional actions. This methodological pluralism supports an exhaustive examination of policy innovation processes, accounting of both observable processes and the relational textures that inform the nature of innovation.

The relationship between the empirically-driven and the theoretically-guided makes for rigorous research which is more applicable and useful informing of the building blocks of actionable knowledge based on analytical discipline and practical insights.

The content of this initial section provides a base for the subsequent literature review of the literature critically considers existing research on policy innovation and crisis governance. The following sections sketch important theoretical frameworks and empirical evidences, detailing current shifts in governance of innovation and current challenges for innovation governance in the field.

Combining theory and context, the study aims to make a theoretical and contextual basis for developing an effective analytical foundation for understanding the nature of – and making progress in developing – public policy innovation as one of the critical building blocks of resilient governance against repeated global economic crises.

2. Literature Review

In such a globalised arena where there is never ending global crises or long term pressures on public expenditure, increasingly policy systems must be able to contest established methods of making policy and create new models of policy that are open and adaptive. Volatility in the economy, environmental pressure, and technological disruption have intersected to reveal systemic weaknesses within existing policy-making pathways. The solution to these problems lies in a new age of policy ecosystems that are increasingly responsive and driven by innovation, collaboration and systemic agility in governance systems.

As Neto et al. (2024) claim, innovation ecosystems are diverse and include different actors – at the levels of governments and public institutions, private enterprises, and civil society – that bring different perspectives and resources to the policy and entrepreneurial processes. This means the inter-organizational dynamics of these policy ecologies, on one hand, are complex and need to be carefully mapped and understood in order for them to be navigated effectively. In this sense, good governance must not only rely on efficient institutional mechanisms, but also on the ability to detect and manage non-linear relationships among the interdependent components of multi-actor systems.

As sustainable development objectives become integrated into public policy agendas, calls for cross-sectoral innovation with evidence have deepened. Androniceanu et al. (2024) point out, in particular, the importance of linking policy research to established theoretical foundations, as applied in fundamental fields such as sustainable energy governance. This paper underscores the centrality of scientific knowledge in informing policy choices and future resilience when dealing with systemic disturbances more generally.

In this context the current study considers whether public policy innovation – a form of governance – can act as a strategic response to economic instability. Relying on cross-sectoral innovation frameworks and contextualising these in the demands of sustainable development, the article aims to provide an actionable governance blueprint for public sector transformation in global economic crises that is well positioned to survive the impacts of crisis.

The dynamical nature of a context of global economic downturns has emphasized the importance of creative instruments within policy formulation and governance to inform

understanding of how institutional structures address new challenges. Newer studies tend to consider policy innovation as a complex process that includes not only technological, but, equally, procedural, institutional, and strategic changes.

Pernici et al. (2024) explain how the adoption of sustainability frameworks, such as the circular economy, reveals a need for policy frameworks to adapt to deal with systemic multilayered complexity in the European Union. Drawing on tools such as Sankey diagrams and fuzzy clustering, they show how innovation in governance can incorporate quantitative expertise into the policy equation in times of economic distress.

The Romanian labor market in the face of the pandemic, particularly post-pandemic, is a case in point of governance in distress. Radulescu et al. (2021) provide hard evidence that the multi-level impacts of the pandemic on the labor market, such as the huge employment shocks and the deployment of policy measures in response to that unemployment and economic contraction. Their results uncover a complex interplay between macroeconomic variables and governance effectiveness, suggesting policy innovation needs to integrate institutional adaptability as an important factor and evidence-based policy making in conjunction with policy innovation at the level of government and governance.

Another key element of policy innovation is generational change in governance organizations. Barbulescu (2022) analyzes the managerial implications of Generation Z's distinctive value propositions in the workplace based on management, suggesting that inter-generational heterogeneity is a critical determinant of the flexibility and inventiveness of governance structures. Maintaining this diversity is not simply about manpower but is instead a core aspect of governance innovation.

Organisational diversity is the first step towards building more equitable and resilient institutions as well as a key to educational institutions for the development of inclusive and cohesive organisational cultures. In times of global economic disruption, cultural cohesion in education institutions provides a stabiliser, building trust, common purpose and long-term adaptability (Enăchescu, 2024).

Entrepreneurial learning can also provide valuable insights for understanding innovation in policy. Williams Middleton and Donnellon (2014) conceptualise entrepreneurial learning as a framework where reflective practice and agency take center stage, suggesting that understanding the “know why” behind action improves adaptive capacity. This focus is consistent with governance theories focusing more on agency as well as collaborative leadership as drivers of transformational change (Ansell & Gash, 2008).

Similarly, Bokor et al. (2025) stress the significance of creative leadership for strategic management, with an emphasis on new and technology-based mechanisms for running complex systems. Enăchescu (2025) also contends that due to the impact of a changing global economy and labour force structure and social priorities, the public governance systems, especially in education, are undergoing profound transformations.

Such shifts require leadership capabilities to address sustainability and institutional resilience and a commitment to ethical governance. With the integration of educational technology, visionary leadership helps public institutions to coordinate across sectors,

address structural inequalities, and translate policy innovation into effective practice. Costache (2025) likewise argues that inclusive, forward-looking leadership can turn points of economic stress into moments of sustainable changes to education and improvements to public services.

Emphasis on sustainability is embedded within economic governance – with energy and environmental policy taking centre stage. Zaharia et al. (2019) explore factors influencing energy consumption in realizing sustainable development, stressing the necessity for integrative policies that target the economic and the environmental constraints, as both economic pressures and environmental ones, in times of economic turmoil require.

This point of view is consistent with calls for green public policy innovation in a bid to respond to these systemic global risks more widely (Meadowcroft, 2011). Sustainability, as conceived by Mirea et al. (2019), describes the ability of a system to preserve core functioning and maintain coherence in the face of external economic, social, and environmental forces.

A few theoretical frameworks shed light even further into how governance systems handle global crises. Peters (2018) describes governance innovation as the intentional reorganization of regulatory tools and institutional configurations with the aim of creating more public value and highlights the relationship between structure and agency. Mazzucato (2018) develops the entrepreneurial state theory, positing that governments ought to not just address failure but also shape markets that are themselves the products of their intervention. In crisis contexts, this view considers innovation in public policy as a driver of economic change.

At the same time, political limitations can stifle innovation. Bovens, 't Hart, and Kuipers (2006) analyse blame-avoidance strategies used in public administration where they show how political risk-aversion can hinder the flow of innovative decisions in crisis situations. Understanding these limitations is necessary to develop politically feasible policy innovations.

The capacity for governance innovation is also determined by cultural dimensions. Hofstede's (2011) framework continues to be applied for understanding differences in power distance and uncertainty avoidance in public-sector settings. Within high uncertainty-avoidance societies, particularly in European countries like Romania, risk aversion will inhibit innovation, therefore, we need concrete mechanisms or special interventions to develop adaptive and learning-oriented governance processes.

Emerging studies of digital governance and e-government point to some avenues for innovation in policies for responding amid such situations. The rise of these digital technologies can develop a new approach for governing, which would involve transparency, citizen involvement and evidence-based decision-making (Cordella & Bonina, 2012). The significance of digital governance tools has grown dramatically as policymakers attempt to create public policies that are more responsive and adaptive to the continuing global economic uncertainty.

Taken together, the literature describes public policy innovation during times of global economic crisis as a complex multilevel process influenced by institutional, economic, political, educational, cultural, and technological variables (Vulpe & Stancu, 2023). However, there is a critical need for system-level integrative models that can integrate and account for the interdependence of these dimensions. This study contributes to filling this gap by consolidating both theoretical and empirical knowledge about governance and innovation, with special attention to Romanian and wider European experience in recent economic shocks.

3. Research methodology

A convergent mixed methods study was used for the present investigation, based on the collection of quantitative data at the same time as qualitative data in an effort to provide an in-depth perspective of the phenomenon being studied. This design was chosen on the basis that it can simultaneously study numeric and narrative evidence, which fosters triangulation and strengthens the authenticity of interpretations. Convergent mixed methods design is well adapted to study complex pedagogical and governance-oriented operations that quantitative distillation cannot entirely elucidate. The use of statistical structure along with rich subjective insight guided by qualitative data aims to generate an exploration of how key educational stakeholders view and participate in focal policy and innovation themes in the study.

The integration of quantitative and qualitative methodologies reflects their complementary strengths. Quantitative data facilitated the identification of general patterns and allowed for broader generalization across the sample, while qualitative data added explanatory depth by uncovering underlying motivations, interpretations, and contextual factors. This methodological pluralism aligns with contemporary standards in educational and governance research and enables a more nuanced understanding than would be possible through a single-method approach.

The participant cohort consisted of both students and academic staff from a higher education institution, reflecting the multiple perspectives required to address the research questions.

In the quantitative phase, stratified random sampling was employed to ensure representation across key demographic variables, including faculty, academic year, and gender. The final quantitative sample comprised 425 respondents, including 350 students and 75 teachers. Eligibility criteria required students to be actively enrolled during the semester of data collection, while teachers were required to have at least one year of institutional affiliation.

For the qualitative phase, purposive sampling was used to select 25 participants (15 students and 10 teachers) from the quantitative sample. Selection was based on survey responses that reflected varying levels of engagement and attitudes toward the study themes. This strategy ensured the inclusion of diverse perspectives and avoided an overrepresentation of extreme or homogeneous experiences. Selected participants were

invited to take part in semi-structured interviews to elaborate on and contextualize the survey findings.

Student participants ranged in age from 18 to 25 years, with a near-equal gender distribution (52% female, 48% male). Teachers were aged between 30 and 58 years, with women comprising 60% and men 40% of the sample. This composition allowed for meaningful comparative analysis between the two groups.

Quantitative data were collected using a structured questionnaire specifically developed for this study. The instrument consisted of 45 items grouped into five scales measuring educational engagement, perceptions of teaching quality, and attitudes toward innovative pedagogical approaches. All items were rated on a five-point Likert scale ranging from strongly disagree to strongly agree.

To ensure clarity and reliability, the questionnaire was pilot-tested with 50 respondents from a separate population. Internal consistency was assessed using Cronbach's alpha, with reliability coefficients ranging from 0.82 to 0.91 across scales. Construct validity was supported through exploratory factor analysis, which confirmed the theoretical scale structure.

For the qualitative component, a semi-structured interview guide was developed to explore participants' experiences and perceptions related to the survey themes in greater depth. The guide included open-ended questions addressing motivations, challenges, and suggestions for improving educational practice and innovation. The interview protocol was reviewed by an expert panel and pilot-tested with three individuals to enhance clarity, coherence, and conversational flow.

Data collection occurred over a three-month period. The quantitative survey was distributed electronically via the university's internal communication system. Invitation emails outlined the study's purpose, emphasized voluntary participation, and assured anonymity. The online questionnaire remained open for four weeks, during which two reminder emails were sent to maximize response rates.

Concurrently, participants were invited to take part in the qualitative phase. Semi-structured interviews were conducted either in person, in private campus settings, or remotely via secure video-conferencing platforms, depending on participant preference and public health considerations. Interviews were conducted approximately two weeks after the survey phase concluded, lasted 45–60 minutes, and were audio-recorded with participant consent. All transcripts were anonymized prior to analysis.

Quantitative data were analyzed using IBM SPSS Statistics (Version 27). Descriptive statistics were employed to summarize demographic characteristics and response distributions. Inferential analyses, including independent-samples t-tests and one-way ANOVA, were conducted to examine group differences. Multiple regression analysis was used to explore predictive relationships between key variables. Assumptions of normality, homoscedasticity, and multicollinearity were tested and met prior to regression analysis.

Qualitative data were analyzed using thematic analysis following the six-phase framework proposed by Braun and Clarke (2006). Transcripts were imported into NVivo 12 for

systematic coding and organization. Initial open coding identified salient themes, which were subsequently refined through iterative axial coding into higher-order categories. To enhance reliability, two researchers independently coded the data, with discrepancies resolved through discussion and consensus. This process facilitated the development of robust themes that contextualized and extended the quantitative findings.

Integration of quantitative and qualitative data occurred at the interpretation stage. Findings from both strands were compared and synthesized using a joint display approach, enabling systematic identification of convergences and divergences. This integrative analysis capitalized on the strengths of each data type, enhancing the explanatory depth and overall coherence of the study.

4. Results

The quantitative analysis focused on educational engagement, perceptions of teaching quality, and attitudes toward innovative pedagogical methods among students and teachers. Descriptive statistics indicated a generally positive orientation toward educational participation across both groups. Students reported a moderately high level of educational engagement ($M = 3.87$, $SD = 0.64$), while teachers reported slightly higher engagement levels ($M = 4.05$, $SD = 0.58$), suggesting overall receptiveness to active involvement in educational processes.

Independent-samples *t*-tests revealed statistically significant differences between students and teachers in perceptions of teaching quality. Teachers rated teaching quality more favorably ($M = 4.12$, $SD = 0.52$) than students ($M = 3.69$, $SD = 0.70$), $t(423) = 6.87$, $p < .001$, with a medium-to-large effect size (Cohen's $d = 0.62$). Similarly, attitudes toward innovative pedagogical methods were significantly more positive among teachers ($M = 4.25$, $SD = 0.49$) than among students ($M = 3.75$, $SD = 0.65$), $t(423) = 8.01$, $p < .001$, $d = 0.72$.

One-way ANOVA analyses examining demographic factors identified significant differences in student engagement across academic years, $F(3, 346) = 4.26$, $p = .006$, $\eta^2 = .04$. First-year students reported lower engagement levels ($M = 3.65$) compared to third- and fourth-year students ($M = 3.95$ and 4.01 , respectively). Post hoc Tukey tests confirmed the statistical significance of these differences. No significant gender-based differences were identified across any of the measured scales.

Multiple linear regression analyses were conducted to assess whether perceptions of teaching quality and attitudes toward pedagogical innovation predicted educational engagement. The regression model was statistically significant, $F(2, 422) = 58.74$, $p < .001$, explaining 21% of the variance in engagement ($R^2 = .21$). Both predictors contributed positively and significantly: perceptions of teaching quality ($\beta = .38$, $p < .001$) and attitudes toward pedagogical innovation ($\beta = .33$, $p < .001$). These results underscore the importance of instructional quality and openness to innovation in fostering engagement.

Thematic analysis of the semi-structured interviews conducted with 25 participants generated four principal themes:

- (1) motivational drivers for engagement;
- (2) perceptions of teaching effectiveness;
- (3) barriers to innovation adoption; and
- (4) recommendations for enhancing educational practices.

Participants frequently identified intrinsic motivation, curricular relevance, and supportive learning environments as central facilitators of engagement. One student noted, “When the material connects to real-life applications, I feel more compelled to participate actively” (Student 7). Teachers similarly emphasized the role of interaction and dialogue, with one participant stating, “Creating a dialogue rather than a monologue helps students stay invested” (Teacher 3).

Teaching quality was described as a multidimensional construct encompassing clarity, responsiveness, and adaptability. Students frequently highlighted variability across instructors, as illustrated by the comment, “Some professors really explain concepts patiently, which makes a huge difference” (Student 12). Teachers acknowledged the challenges associated with addressing heterogeneous learner needs, with one noting, “Balancing content delivery and individual attention is an ongoing struggle” (Teacher 8).

Resistance to change emerged as a recurring theme, shaped by both institutional constraints and individual apprehensions. Participants cited limited resources, insufficient training, and time constraints as barriers to innovation. As one teacher explained, “Sometimes we want to try new methods, but we just don’t have enough support or time” (Teacher 5). Students expressed frustration that traditional lecture-based approaches continued to dominate despite expressed interest in more interactive learning formats.

Suggestions converged around professional development, meaningful integration of technology, and collaborative learning. Teachers emphasized the need for structured training opportunities, for example, “Regular workshops on innovative tools could empower educators to experiment more confidently” (Teacher 2). Students highlighted experiential learning approaches, with one recommending, “Group projects that mirror real-world problems could make learning more dynamic” (Student 14).

The integration of quantitative and qualitative findings highlights the multidimensional nature of educational engagement and perceived teaching quality. Quantitative results demonstrated significant differences between teachers and students regarding acceptance of pedagogical innovation, with teachers expressing higher levels of satisfaction and openness toward technology-supported teaching practices. Qualitative evidence contextualized these differences, revealing motivational, institutional, and structural factors that shape these attitudes.

The positive predictive relationships identified in the regression analysis – linking teaching quality and innovation attitudes to engagement – were further illuminated by interview narratives that underscored the role of intrinsic motivation, institutional support, and constraints related to resources and training. While survey data indicated generally favorable trends, qualitative accounts revealed persistent challenges that moderate the practical realization of innovative pedagogical approaches.

Finally, the thematic emphasis on recommendations aligns with quantitative findings pointing to the value of pedagogical innovation in enhancing engagement. The convergence of data streams reinforces the strength of the mixed-methods design, demonstrating how statistical patterns are enriched through lived experiences. Together, these findings provide a robust empirical foundation for the discussion and policy implications addressed in the following section.

5. Discussion

This research utilized a rigorous mixed-methods approach utilizing quantitative data analysis and semi-structured interviews to explore the relationships among educational engagement, perceptions of quality of teaching, and attitudes towards pedagogical innovation within higher education. The results reveal generally favorable forms of engagement both for students and teachers, alongside significant dissonance between perceptions of teaching quality and openness to innovation. The perceptual gap was identified in that teachers consistently assessed these two dimensions more positively than students.

These findings directly respond to the core research questions. Although both cohorts appear to value engagement and teaching quality, their appraisals and lived experiences of learning differ substantially. The qualitative data further clarified the nature of these discrepancies by identifying motivational and institutional forces shaping participants' perspectives.

Motivation and curriculum relevance emerged as strong drivers of student engagement. At the same time, respondents emphasized systemic constraints – such as limited resources, insufficient professional development, and rigid curricular design – as significant barriers to the adoption of innovative pedagogies and initiatives. Taken together, these findings suggest that fostering engagement is not a linear or isolated task, but one that requires a multi-stakeholder perspective in both educational design and implementation.

Correlational analyses supported expectations drawn from educational and social psychology, particularly regarding perceived teaching quality and innovative pedagogical attitudes as predictors of engagement. Moderate to strong positive associations were observed, consistent with prior research demonstrating that supportive instructional contexts and progressive pedagogical orientations enhance student motivation and involvement (Fredricks, Blumenfeld, & Paris, 2004; Deci & Ryan, 2008).

The multiple regression analysis further reinforced these relationships, indicating that perceptions of teaching quality and attitudes toward innovation jointly explained a meaningful proportion of variance in engagement ($R^2 = .21$). Although this represents a modest effect size, it suggests that engagement is shaped by a broader constellation of contextual and individual factors that extend beyond the scope of the present investigation.

Notably, the direction and structure of these associations align closely with self-determination theory. Within this framework, the satisfaction of autonomy and competence needs – manifested through high-quality instruction and pedagogical novelty – fosters

intrinsic motivation and engagement (Ryan & Deci, 2017). The absence of significant gender differences, alongside observed developmental variation in engagement across academic years, further indicates that engagement trajectories are influenced by developmental and contextual dynamics, underscoring the need for longitudinal and life-course-oriented research.

From a methodological standpoint, the multiple regression model demonstrated strong statistical validity, with no violations related to multicollinearity or heteroscedasticity. Perceptions of teaching quality and attitudes toward pedagogical innovation emerged as independent and additive predictors of engagement, confirming their explanatory relevance. Nevertheless, the model remains necessarily limited, as it does not capture the full range of psychological, cultural, institutional, and social variables that mediate educational engagement.

Future research could extend this analytical framework through the use of structural equation modeling (SEM) to examine mediating and moderating variables such as institutional support, student self-efficacy, or classroom climate. Such approaches would allow for a more nuanced exploration of indirect pathways and reciprocal relationships, thereby advancing understanding of engagement dynamics. Despite these limitations, the present study offers a robust empirical foundation for continued investigation.

A major strength of this research lies in the integration of quantitative and qualitative evidence. The mixed-methods design revealed that statistically significant relationships gain meaning only when interpreted alongside lived experiences and local contexts. For example, quantitative assessments of teaching quality and innovation were complemented by interview narratives highlighting institutional barriers and student readiness, thereby enriching the interpretive validity of the findings.

At the same time, areas of divergence were identified. Although both students and teachers expressed expectations for more hands-on and contemporary learning experiences, students reported that instruction remained predominantly didactic. This discrepancy points to an implementation gap that would likely remain obscured in a purely quantitative design, further emphasizing the value of qualitative inquiry.

Conceptually, this study extends the literature on educational engagement by empirically demonstrating the dual role of teaching quality and innovative pedagogical orientations in fostering engagement. By linking quantitative patterns with qualitative depth, it advances a more comprehensive understanding of engagement that transcends static or transactional interpretations. In doing so, the findings provide empirical support for self-determination theory and social cognitive perspectives within the context of higher education.

From a practical standpoint, the findings carry important implications for educational policy and institutional practice. Enhancing professional development to support pedagogical innovation and responsive instruction appears essential, as does the creation of learning environments that promote relevance, autonomy, and institutional support. Addressing underlying constraints related to resources and curricular rigidity may facilitate broader adoption of learner-centered pedagogies, with positive effects on both learning

outcomes and student engagement. These recommendations align with global trends advocating for flexible, inclusive, and student-centered higher education systems.

6. Conclusions

To conclude, this paper develops a more sophisticated and empirically grounded examination of the nexus between educational engagement, perceptions of teaching quality, and attitudes toward pedagogical innovation within higher education. By employing a data-driven mixed-methods approach that integrates survey findings with qualitative interview evidence, the study offers a multidimensional portrayal of engagement processes and lived experiences among both students and teachers. The findings confirm the importance of perceived instructional quality and openness to pedagogical innovation as key correlates of engagement, while also revealing perceptual divergences between stakeholder groups and contextual constraints that shape engagement dynamics. Collectively, these results provide robust empirical insights that contribute to ongoing debates on how to foster deep, sustained engagement in contemporary university classrooms.

At the theoretical level, the findings reinforce and extend established motivational frameworks – particularly self-determination theory – by empirically demonstrating how competence-supportive teaching practices and autonomy-oriented pedagogical strategies interact to promote engagement. Although the observed associations are modest in magnitude, their consistency, combined with the rich contextual detail provided by the qualitative narratives, underscores the multidimensional nature of engagement as a construct encompassing cognitive, affective, and contextual dimensions. In this respect, the study contributes theoretically by anchoring abstract motivational models in concrete educational settings and by illustrating the dynamic interplay between individual agency and systemic conditions.

From a practical perspective, the implications of the study are substantial for educators, academic leaders, and policymakers seeking to enhance engagement and teaching quality. The findings suggest that strengthening teaching quality through continuous professional development – particularly in relation to innovative, student-centered pedagogies – can meaningfully enhance student motivation and participation. At the same time, the study highlights the necessity of addressing structural barriers, including limited resources, rigid curricular frameworks, and insufficient institutional support, which constrain educators' capacity to adopt and sustain pedagogical innovation. These challenges call for systemic interventions that combine teacher empowerment, student voice, and institutional reform in order to create more responsive and engaging learning environments.

Several evidence-based recommendations emerge from the study. First, higher education institutions should expand access to lifelong professional development opportunities that equip faculty with contemporary pedagogical competencies, including digital literacy, active learning strategies, and inclusive teaching practices. Second, greater involvement of key stakeholders – particularly students and teachers – in curriculum design and institutional decision-making processes is essential for aligning educational initiatives with learner needs and expectations. Third, policymakers should reconsider regulatory and

financial frameworks to introduce greater curricular flexibility and to support targeted investment in pedagogical innovation and educational infrastructure. In addition, fostering collaborative academic ecosystems grounded in openness, experimentation, and knowledge sharing may accelerate the diffusion of effective teaching practices across institutions.

At the system level, government regulation and education policy design play a pivotal role in shaping curricular effectiveness and learning outcomes. In contexts of heightened economic uncertainty, it is especially important to calibrate these frameworks strategically in order to support both resilience and equity within education systems. Comparative analyses of regulatory models across countries with differing national and international performance profiles may yield valuable insights into governance structures that underpin successful educational reform. Such cross-national learning is particularly relevant for navigating global crises through evidence-based innovation in public education policy (Costache & Enăchescu, 2024).

Despite its contributions, the study is subject to several limitations that warrant consideration. Data were collected from a single institution, which may limit the generalizability of the findings and introduce context-specific organizational bias. The cross-sectional design precludes causal inference regarding the temporal dynamics of engagement. Furthermore, although self-report measures are widely used and generally accepted, they remain susceptible to social desirability and recall biases. While the mixed-methods design enhanced both depth and breadth of analysis, future research would benefit from larger qualitative samples and longitudinal designs capable of capturing evolving engagement practices over time.

Future research should therefore extend this work in several directions. Longitudinal studies examining engagement trajectories in relation to targeted pedagogical interventions would help clarify causal mechanisms and the durability of observed effects. Multi-institutional and cross-cultural investigations would enhance external validity and identify transferable, context-sensitive mechanisms of engagement. Further examination of mediating and moderating variables – such as technology use, peer influence, emotional well-being, and institutional climate – would deepen understanding of how teaching quality and pedagogical innovation operate in practice. Advanced analytical approaches, including structural equation modeling, could also be employed to unpack the complex interrelationships among these variables.

In conclusion, this study offers both theoretical and practical insights into educational engagement by elucidating the interaction between teaching quality and pedagogical innovation as perceived by students and teachers. The mixed-methods approach enabled a nuanced understanding that goes beyond statistical associations to reveal the underlying mechanisms and contextual contingencies shaping engagement. As higher education systems confront ongoing technological, social, and global challenges, the findings provide timely guidance on how to cultivate learning environments that are not only effective, but also inclusive, equitable, and engaging. Ultimately, sustained investment in high-quality, innovative teaching practices holds significant potential to enhance educational success and to empower both learners and educators alike.

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Research on the Agri-food Trade Balance of Romania

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Abstract. *The paper focuses on the evolution of international trade, Romania's agro-food export, import and trade balance for the period 2020-2024 for the first 24 products categories. The study analyzes the evolution of Romania's agri-food trade balance, highlighting positive and negative values and main products generating deficit. The dynamics of exports and imports are highlighted, along with future trends in Romanian foreign trade. Romania records a surplus in only four of the 24 categories of agri-food products: live animals, cereals, oilseeds and tobacco. Romania's export potential was showcased using data generated by the Export Potential Map tool, accessible via intracen.org. The study results outline a dual economic model characterized by export strength concentrated in a few primary resource categories and a broad dependency on imports for almost everything else, including fruits, vegetables, meat, dairy, and processed foods. This structure leaves the economy highly exposed to international food price fluctuations.*

Keywords: trade balance; Romania; export; import; deficit; trade statistics.

JEL Classification: Q10; Q17.

1. Introduction

This article aims to highlight the role of international trade in the global economy, with a particular focus on Romania's trade balance and the way it reflects the dynamics of exports and imports. The study combines data with analytical interpretations, adjusted and correlated, in order to outline a perspective on the future trends of Romania's international trade. Trade is considered the main driver of the global economy as it allows the goods traffic from a country to another, division of labor, stimulates productivity, gives a growth to real income and a change in the prices of final goods, balances demand/supply ratio, creates spending on goods and services, investments in capital goods, income and savings distribution (Popescu et al., 2023).

In the last decades, international agri-food trade has become more relevant as countries' capability of ensuring their food security relied increasingly on imports of food products. (Ladaru et al., 2025) Exports refer to the sale and shipment of goods and services from one country to another, representing an outbound flow of products aimed at foreign markets (Golovin et al., 2020). In contrast, imports refer to the purchase and receipt of goods and services from abroad, fulfilling domestic demand through inbound flows (Subramaniam et al., 2024). The relationship between these two activities is captured by the trade balance, which measures the difference between a country's exports and imports over a given period. (Geamănu M., 2015)

A trade surplus occurs when exports exceed imports, indicating strong international demand and potential economic growth, while a trade deficit reflects higher imports than exports, which may signal domestic consumption reliance or reduced competitiveness.

An essential aspect addressed is Romania's trade competitiveness, which reflects the country's ability to maintain and expand its position in global markets through efficient production, quality standards, and strategic economic policies.

The country's competitiveness is the degree to which it can, under free and fair market conditions, produce goods or services meeting the test of international markets, while simultaneously maintaining and expanding the real incomes of its population over the longer term (Siudek & Zawajska, 2014).

This study aims to examine Romania's agri-food trade dynamics from 2020 to 2024, focusing on export, import, and trade balance patterns across the top 24 product categories.

The paper is based on the research question: Which agri-food product categories drive Romania's trade surpluses and deficits, and how does the structure of exports and imports influence the country's trade vulnerability?

It is hypothesized that Romania's trade surpluses are concentrated in a few primary resource categories, while imports dominate most processed and perishable products, exposing the economy to international food price fluctuations.

2. Literature Review

Gross Domestic Product (GDP) is largely used as a barometer to measure a country's economic progress. GDP is defined as the market value of all officially recognized final

goods and services produced within a country in a given period. Imports refer to goods and services produced by the foreign sector and purchased by the domestic economy. Exports refer to goods and services produced domestically and purchased by a foreign sector. They are goods and services purchased by other countries (Maina R., 2015).

The balance of trade is an indicator that reflects to a representative extent the economic development of a country over a certain period of time (Botescu I. 2020).

Romania is a country with a high agricultural potential, being able to become one of the main competitors in terms of international trade in agri-food products. (Cucu et al., 2020)

According to recent trade analyses, Romania registers a surplus in only four out of the 24 agri-food product categories: live animals, cereals, oilseeds, and tobacco. The remaining categories consistently contribute to the national agri-food trade deficit. As highlighted by Economica.net (2024), “the largest negative balances are recorded in meat and edible offal, fruits, dairy products, and processed foods.” This structural imbalance reflects Romania’s reliance on imports for high-value processed goods, while exports are dominated by raw agricultural commodities.

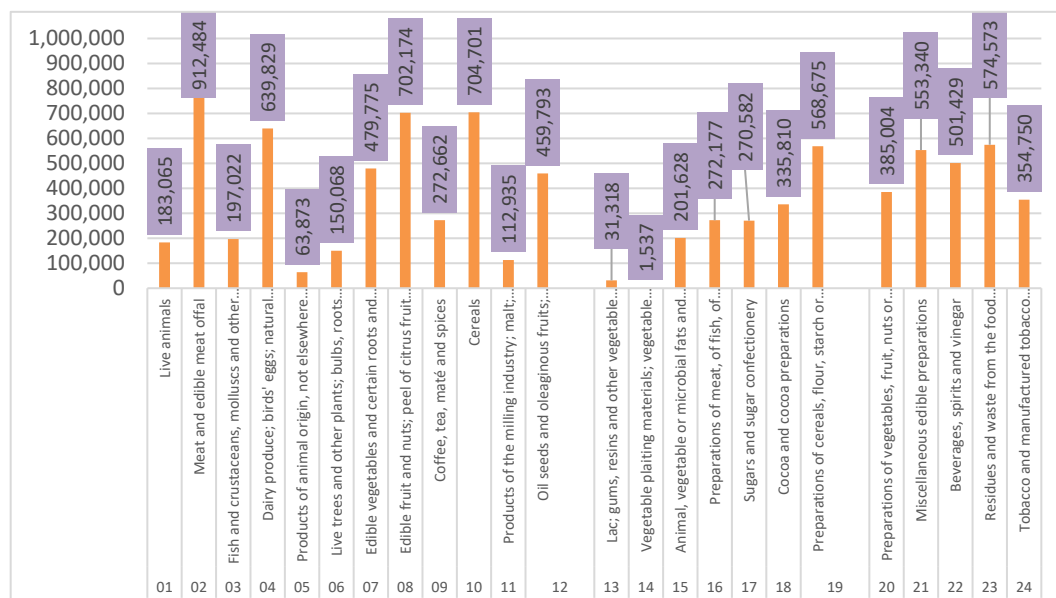
Furthermore, Ziarul Financiar (2023) notes that “Romania imported €8.5 billion worth of agri-food products in 2023, while exports amounted to only €2.2 billion,” underscoring the widening gap in the trade balance. Through the trade balance, countries can monitor their participation in international trade, capitalising on the results of national economic activities in the global market (Pătărlăgeanu et al., 2025). Starting with 1990, the year at the beginning of the transition to the market economy, and up to the present moment, regardless of the dynamics of economic growth, Romania has constantly recorded external deficits (Drăgoi C. 2024).

3. Research methodology

The present paper analyzes the evolution of Romania's agri-food trade balance, highlighting both its positive and negative values, as well as the main products contributing to the trade deficit. The paper is based on statistical data provided by the International Trade Centre on Romania's imports, exports, and trade balance for the first 24 categories of products 2020-2024. The export potential of Romania was highlighted by the information provided by the Export potential Map application, provided by intracen.org website. The queried and exported figures suggest a pressing need for strategic investment in domestic food processing and value-added production to reduce dependency and improve competitiveness. The article is supported by figures and data sets that help shape a well-founded and favorable forecast for the near future.

4. Results

The situation of valoric imports, exports and trade balance, for the last 5 years available on Intracen.org (for the period 2020-2024) was described in this chapter.

*Valoric imports (euro thousand)***Figure 1.** Import value for the 24 categories in 2020

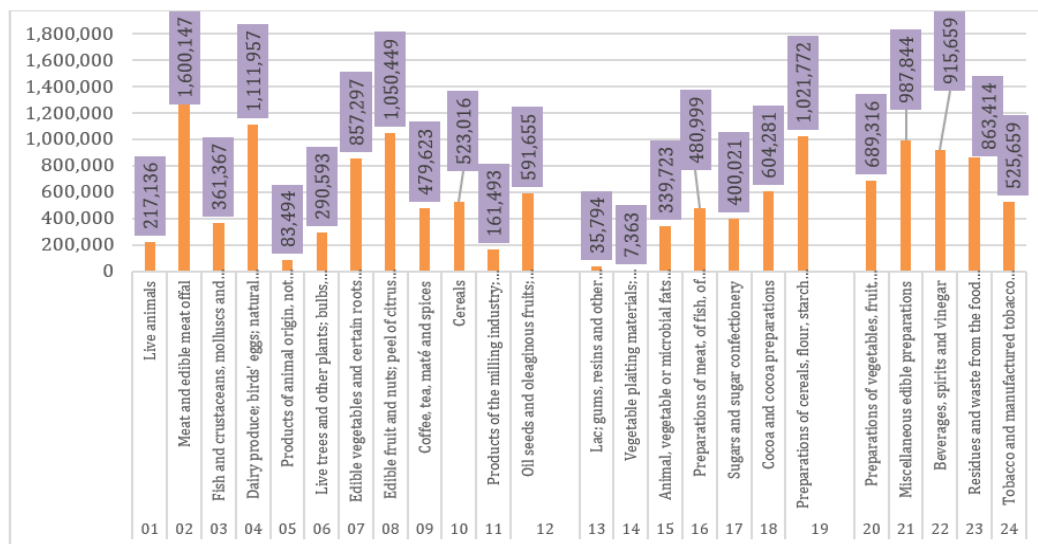
Source: author's representation of data based on intracen.org.

The chart illustrates the import values for 24 product categories in 2020. The highest import values are recorded for live animals, cereals, and coffee, tea and mate, each reaching around or above 700,000 euro thousand, indicating a strong dependence on primary agricultural products. High import levels are also observed for beverages, spirits and vinegar, miscellaneous edible preparations, and residues and waste, all exceeding 500,000 euro thousand. Medium import values, generally between 300,000 euro thousand and 500,000 euro thousand, include meat and edible meat offal, fish and crustaceans, edible fruit and nuts, sugars and sugar confectionery, cocoa and cocoa preparations, preparations of cereals, and tobacco. In contrast, the lowest import values are seen in categories such as lac, gums and resins, vegetable plaiting materials, animal or vegetable fats and oils, and products of the milling industry. Overall, the data suggests that in 2020 imports were dominated by food and agricultural products, while raw materials and niche intermediate goods played a much smaller role.

The Figure 2 displays the import values by Romania for 24 different categories of goods in 2024. The data shows a high level of variance between sectors, with values ranging from under 10,000 euro thousand to over 1.6 million euro thousand.

The most significant category by far is Meat and edible meat (Category 02), which reached a peak value of 1,600,147 euro thousand. This is followed by other high-performing sectors such as Dairy produce (Category 04) at 1,111,957 euro thousand, and Preparations of vegetables, fruit, nuts or other parts of plants (Category 19) at 1,021,772 euro thousand. Figure 2 suggests that the import market is heavily driven by essential food staples and processed goods, indicating strong consumer demand in these specific areas.

Figure 2. Import value for the 24 categories in 2024



Source: author's representation on data based on intracen.org

Several categories maintain a solid mid-tier presence, with values fluctuating between 400,000 and 900,000 euro thousand. Notable examples include Edible vegetables (Category 07) at 857,297 euro thousand, Miscellaneous edible preparations (Category 21) at 987,844 euro thousand, and Beverages, spirits, and vinegar (Category 22) at 915,659 euro thousand. These segments represent a stable portion of the import economy, likely reflecting diversified consumer preferences for both fresh produce and manufactured food items.

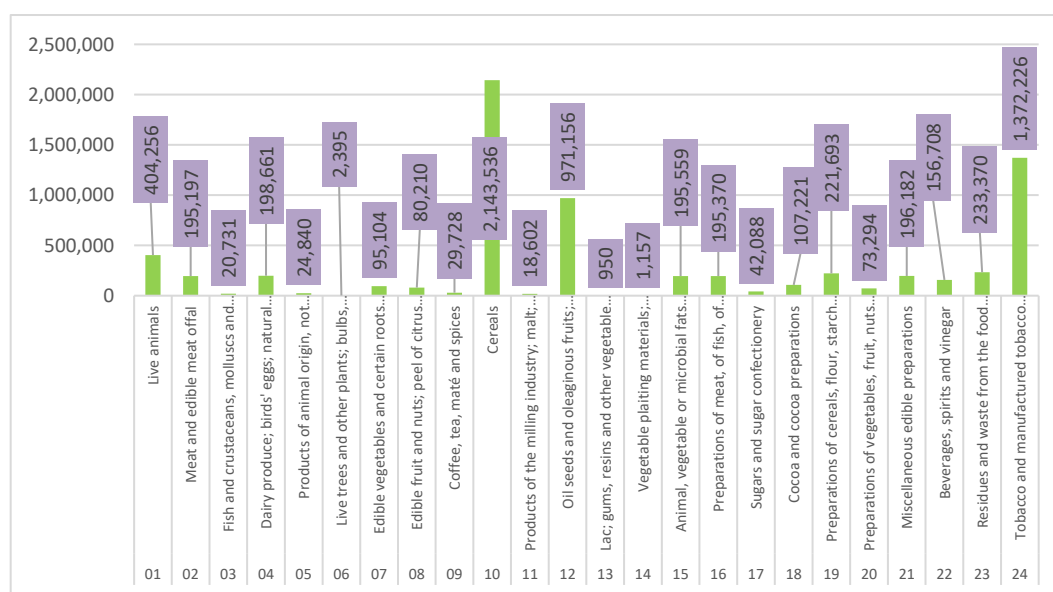
At the lower end of the spectrum, certain categories show very minimal import activity. The lowest values are found in Vegetable plaiting materials (Category 14) at only 7,363 euro thousand and Lac; gums, resins (Category 13) at 35,770 euro thousand. Additionally, Products of animal origin (Category 05) at 83,494 euro thousand remains well below the average.

Several sectors have shown consistent and significant upward trajectories over the five-year period. Meat and edible meat offal (Category 02) represents the largest volume, growing steadily from 912,484 euro thousand in 2020 to 1,600,147 euro thousand in 2024. Similarly, Dairy produce (Category 04) nearly doubled its value, starting at 639,829 euro thousand and surpassing the million mark to reach 1,111,957 euro thousand by 2024. Edible fruit and nuts (Category 08) and Preparations of cereals (Category 19) also demonstrated robust growth, with both categories crossing the 1,000,000 euro thousand thresholds for the first time in 2024. Cereals (Category 10) displayed notable volatility; after peaking at 967,895 euro thousand in 2022, the value dropped significantly to 523,016 euro thousand by 2024. A similar pattern is visible in Oil seeds and oleaginous fruits (Category 12), which spiked to 1,105,504 in 2022 before retreating to 591,655 euro thousand in 2024. Sugars and sugar confectionery (Category 17) also saw a sharp decline in the final year, dropping from 576,110 euro thousand in 2023 to 400,021 euro thousand in 2024.

Some niche categories have shown remarkable relative growth despite their smaller total volumes. Vegetable plaiting materials (Category 14) grew nearly fivefold, from 1,537 euro thousand in 2020 to 7,363 euro thousand in 2024. Meanwhile, categories like Lac; gums, resins (Category 13) and Products of animal origin (Category 05) have remained relatively stable with only minor fluctuations over the years. Tobacco and manufactured substitutes (Category 24) have seen a steady rise, increasing from 354,750 euro thousand in 2020 to 525,659 euro thousand in 2024.

Valoric exports (euro thousand)

Figure 3. Export value for the 24 categories in 2020



Source: author's representation on data based on intracen.org

Figure 3 illustrates the distribution of export revenues across various agricultural and food product sectors, measured in thousands of euros. The data reveals a highly diversified export portfolio, though it is clearly dominated by a few high-performing categories.

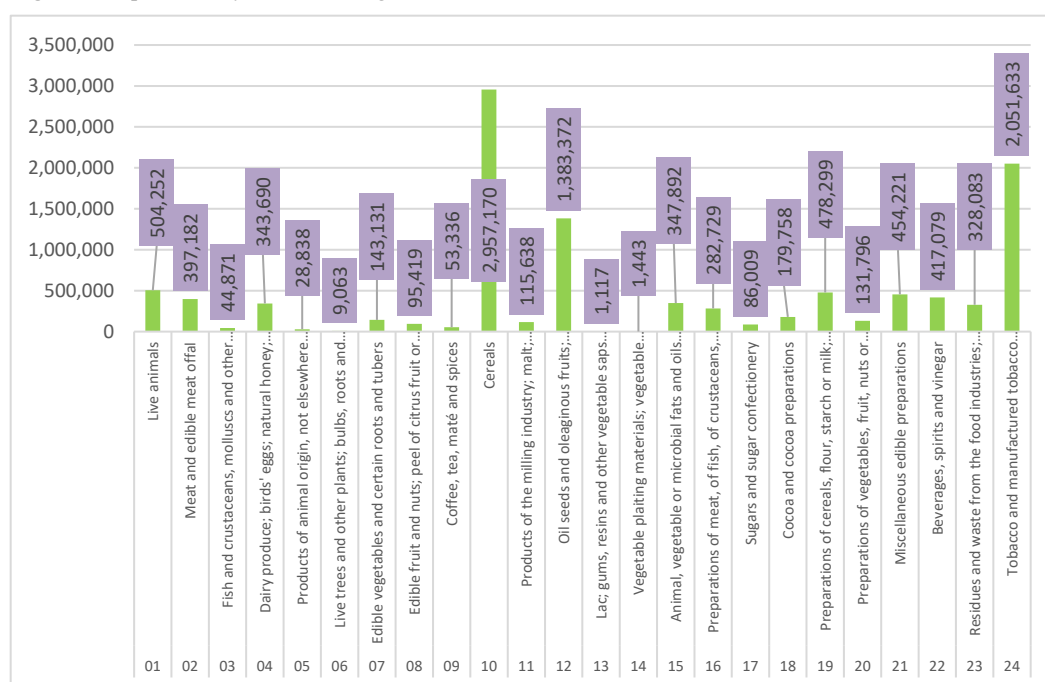
The most prominent feature of the chart is the Cereals (Category 10) sector, which stands as the undisputed leader with an export value of 2,143,536 thousand euros. This category is the only one to surpass the 2 million marks, indicating that cereals are a primary pillar of this specific economy's trade. Other significant contributors include Tobacco and manufactured tobacco substitutes (Category 24) at 1,372,226 thousand euros and Oil seeds and oleaginous fruits (Category 12) at 971,156 thousand euros. Together, these sectors represent the bulk of the export value.

In contrast, several categories show very low export activity, suggesting either a focus on domestic consumption or a lack of industrial scale in those areas. For instance, Live trees and other plants (Category 06) and Vegetable plaiting materials (Category 14) show minimal figures (2,395 and 1,157 thousand euros, respectively). There is also a middle tier

of steady performers, such as Live animals (Category 01) and various food preparations (Categories 19 and 21), which maintain values between 150,000 and 400,000 thousand euros.

Overall, the chart depicts an export economy that is heavily reliant on raw or primary agricultural commodities (cereals and oil seeds) alongside high-value tobacco products. While there is a presence across all 24 categories, the massive disparity between the top three sectors and the rest suggests a specialized export market rather than an evenly distributed one.

Figure 4. Export value for the 24 categories in 2024



Source: author's representation on data based on intracen.org

Figure 4 illustrates the export performance of 24 distinct agricultural and food categories for the year 2024, showing a significant disparity between the various sectors. The data is dominated by Cereals (Category 10), which stands out as the primary export driver with a value of 2,957,170 euro thousand nearly double the value of most other high-performing categories. This suggests that the export economy represented here is heavily reliant on bulk grain commodities.

Another major pillar of this export profile is Tobacco and manufactured tobacco substitutes (Category 24), which reached a substantial value of 2,051,633 euro thousand. These two categories combined represent the peak of the chart, followed at a distance by Oil seeds and oleaginous fruits (Category 12) at 1,383,372 euro thousand. The prominence of these sectors indicates a specialized focus on specific raw materials and processed consumer goods.

In contrast, a large number of categories contribute relatively small amounts to the total export value. Sectors such as Vegetable plaiting materials (Category 14) and Products of animal origin (Category 05) show values below 10,000 euro thousand, appearing almost negligible when compared to the leaders. This sharp contrast highlights a highly concentrated export market where a handful of products generate the vast majority of the revenue, while many others remain niche or underdeveloped.

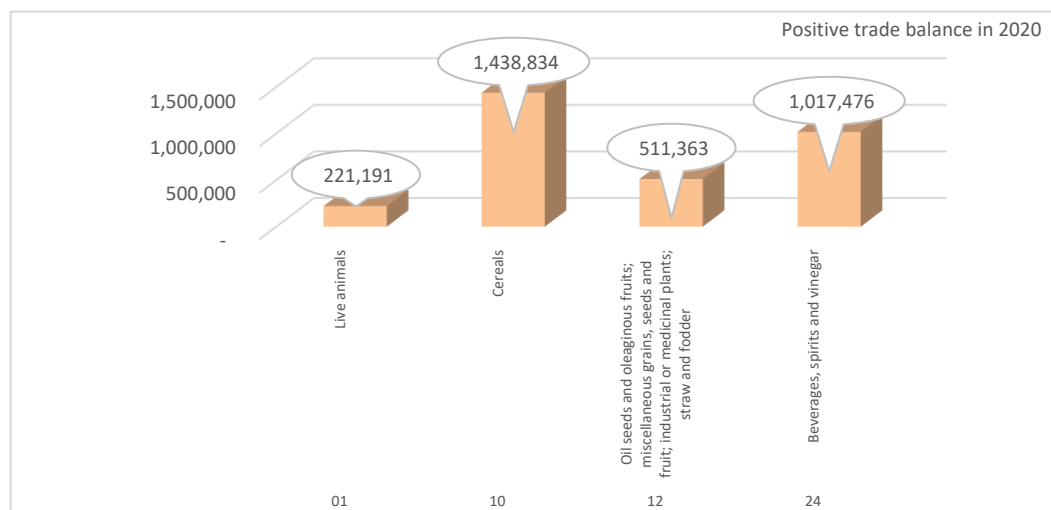
The export market is heavily driven by Cereals (Category 10), which remains the highest-valued category. This sector saw a significant increase, growing from 2,143,536 euro thousand in 2020 to 2,957,170 euro thousand in 2024. Beyond the primary leaders, other raw materials showed robust performance over the five-year period. Oil seeds and oleaginous fruits (Category 12) grew from 971,156 euro thousand in 2020 to 1,383,372 euro thousand in 2024. Additionally, while still smaller than the cereal sector, Meat and edible meat offal (Category 02) exports more than doubled, increasing from 195,197 to 397,182 euro thousand. This suggests an expanding capacity for the export of animal-based food products alongside traditional crop exports.

Several categories of food preparations also demonstrated consistent growth, indicating a gradual increase in the export of value-added products. Preparations of cereals, flour, starch or milk (Category 19) saw its export value rise from 221,693 euro thousand in 2020 to 478,299 euro thousand in 2024. Similarly, Miscellaneous edible preparations (Category 21) more than doubled its export volume, growing from 196,182 euro thousand to 454,221 euro thousand during the same period. These trends highlight a broadening of the export base toward more processed and manufactured food items.

Trade balance (euro thousand)

Romania in the last years, and the balance of trade increased deficit, which is due mainly to the lack of domestic capital, as well as to the decreasing productivity. (Adriana G. 2011)

Figure 5. Positive trade balance in 2020

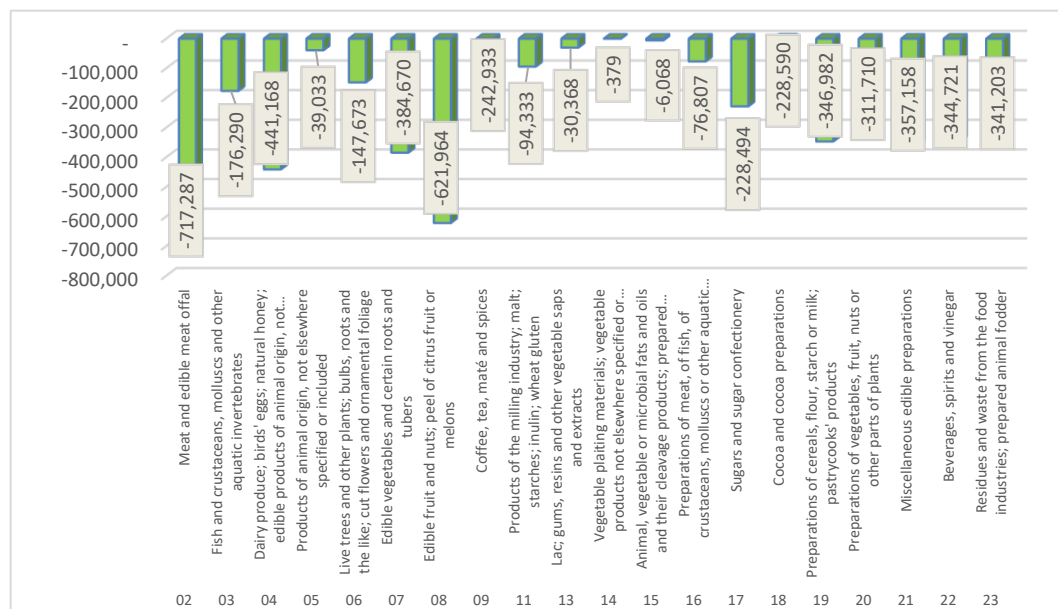


Source: author's representation on data based on intracen.org

The most significant contributor to the positive trade balance in 2020 was Cereals (Category 10), which reached a substantial surplus of 1,438,834 euro thousand. This figure identifies the cereal sector as the primary driver of trade profitability, significantly outperforming all other categories shown. The second most impactful sector was Beverages, spirits and vinegar (Category 24), which also crossed the million-unit threshold with a positive balance of 1,017,476 euro thousand.

In addition to these major drivers, two other categories supported the positive balance in 2020 at a more moderate scale. Oil seeds and oleaginous fruits (Category 12) contributed a surplus of 511,363 euro thousand, while Live animals (Category 01) recorded the smallest positive balance among the group at 221,191 euro thousand. Together, these four sectors represent the pillars of trade strength for that year, clearly led by the raw agricultural and beverage industries.

Figure 6. Negative trade balance in 2020



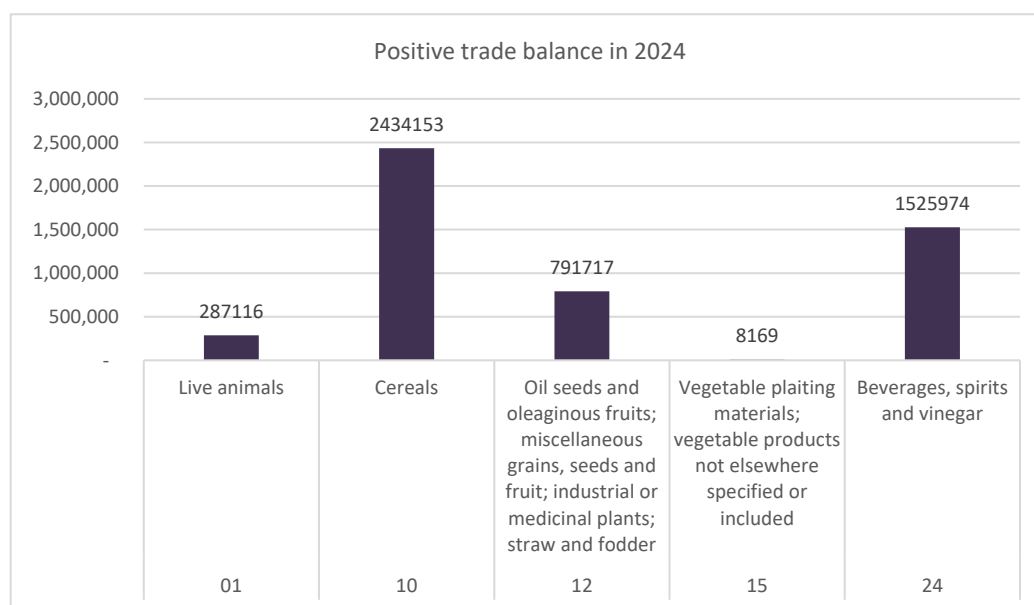
Source: author's representation on data based on intracen.org

Figure 6 provides a detailed visualization of the negative trade balance in 2020, identifying the 20 specific product categories where import values exceeded exports. The data shows a wide range of deficits, from minor gaps to substantial shortfalls exceeding 700,000 euro thousand.

The most significant trade deficit in 2020 was recorded in the Meat and edible meat offal (Category 02) category, reaching a negative balance of -717,287 euro thousand. This is followed closely by Edible fruit and nuts (Category 08) with a deficit of -621,964 euro thousand and Dairy produce (Category 04) at -441,168 euro thousand. These figures highlight a heavy reliance on foreign markets for essential food staples and fresh produce during that year.

Moderate deficits were also observed across various processed food and agricultural sectors. Notable examples include Edible vegetables (Category 07) at -384,670 euro thousand, Preparations of cereals, flour, or starch (Category 19) at -346,982 euro thousand, and Miscellaneous edible preparations (Category 21) at -357,158 euro thousand. Conversely, the smallest trade gap was found in the Lac; gums, resins (Category 13) category, which showed a nearly balanced trade position with a minimal deficit of only -379 euro thousand.

Figure 7. Positive trade balance in 2024



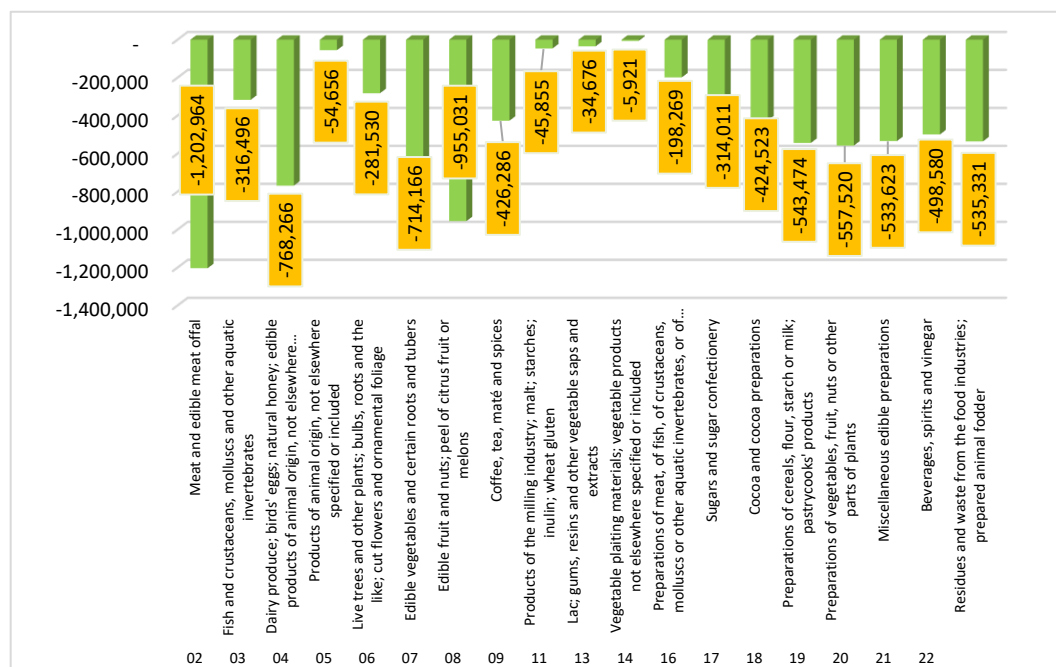
Source: author's representation on data based on intracen.org

Figure 7 illustrates the categories that achieved a positive trade balance in 2024, identifying the specific sectors where export values successfully exceeded imports. This surplus data showcases the primary economic drivers for the year, with values ranging from a few thousand to over 2.4 million euro.

The most significant contributor to this positive balance was Cereals (Category 10), which recorded a massive surplus of 2,434,153 thousand euro. This confirms the cereal sector as the absolute leader in trade profitability, maintaining a substantial gap over all other categories. The second strongest performance came from Beverages, spirits and vinegar (Category 24), which contributed a surplus of 1,525,974 thousand euro.

Other sectors also maintained a favorable position, though on a smaller scale compared to the primary leaders. Oil seeds and oleaginous fruits (Category 12) provided a solid surplus of 791,717 thousand euro, followed by Live animals (Category 01) with a balance of 287,116 thousand euro. Finally, Vegetable plaiting materials (Category 15) recorded a minor positive balance of 8,169 thousand euro, representing the smallest surplus among the group.

Figure 8. Negative trade balance in 2024



Source: author's representation on data based on intracen.org

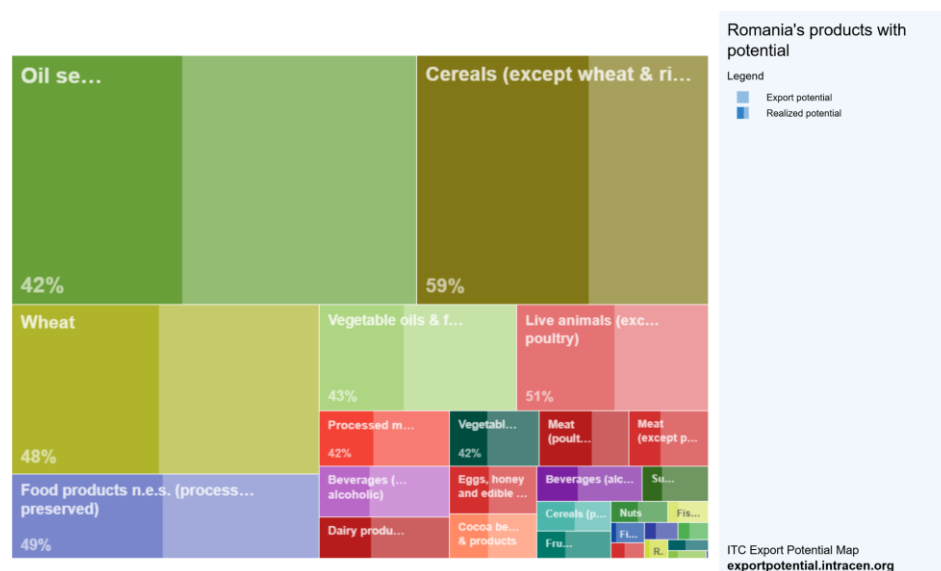
Figure 8 illustrates the negative trade balance for the year 2024, detailing the specific product categories where import values significantly exceeded export values. These deficits are measured in thousand euro, with several categories showing substantial shortfalls that indicate a heavy reliance on foreign supply for key food and agricultural goods.

The most severe trade deficit in 2024 was recorded in the Meat and edible meat offal (Category 02) category, which reached a staggering -1,202,964 thousand euro. Other categories with major deficits exceeding 700,000 thousand euro include Edible fruit and nuts (Category 08) at -955,031 thousand euro, Dairy produce (Category 04) at -768,266 thousand euro, and Edible vegetables (Category 07) at -714,166 thousand euro. Moderate trade deficits were also observed across a wide variety of processed and semi-processed goods. Notable examples include Preparations of vegetables, fruit, or nuts (Category 20) at -557,520 thousand euro, Preparations of cereals, flour, or starch (Category 19) at -543,474 thousand euro, and Miscellaneous edible preparations (Category 21) at -533,623 thousand euro. Even niche categories, such as Coffee, tea, maté and spices (Category 09), contributed significantly to the negative balance with a deficit of -426,286 thousand euro.

Some categories displayed relatively minor deficits compared to the food staples. The smallest trade gaps were found in Lac; gums, resins and other vegetable saps (Category 13) at -34,676 thousand euro, Products of the milling industry (Category 11) at -45,855 thousand euro, and Products of animal origin, not elsewhere specified (Category 05) at -54,656 thousand euro. The category with the absolute smallest recorded deficit was Vegetable plaiting materials (Category 14) at only -5,921 thousand euro.

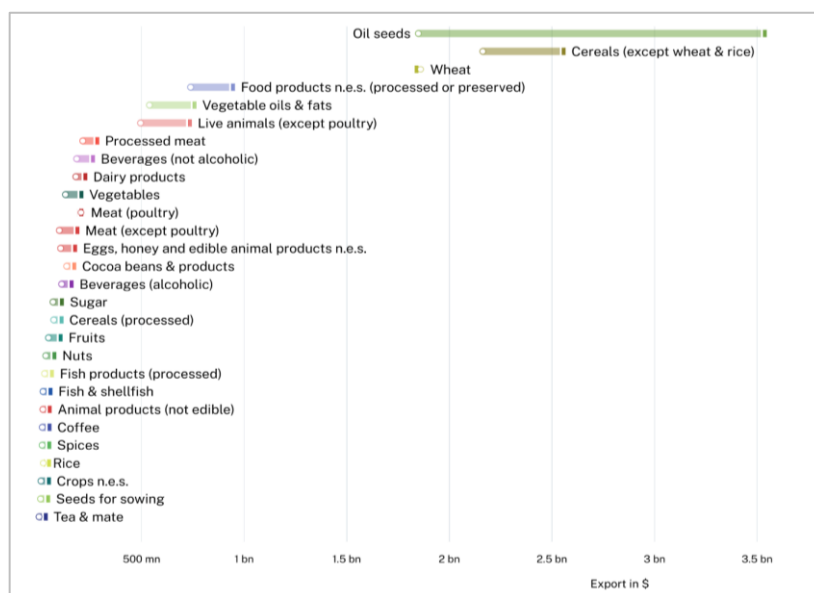
Export potential by market

Figure 9. Export potential map for Romania



Source: intracen.org

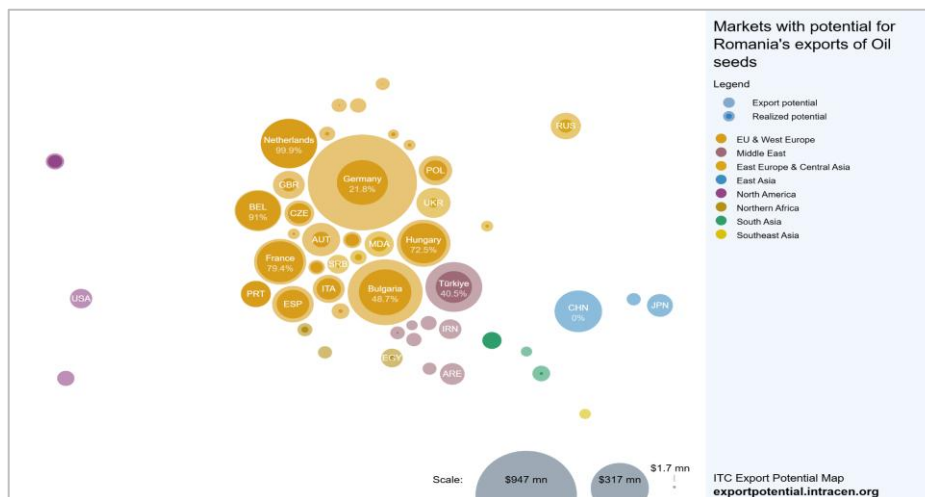
Figure 10. Export potential map for Romania



Source: intracen.org

The products with the greatest export potential from Romania to the world, in the agri-food products category, are: oil seeds, cereals, wheat, vegetable oils & fats. Romania's export economy is heavily anchored in primary agricultural commodities, particularly cereals and oil seeds.

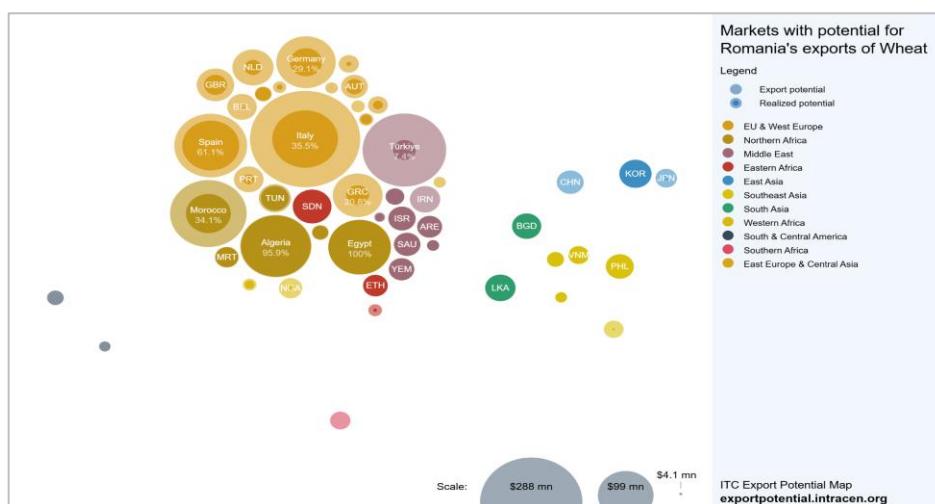
Figure 11. Export potential map for oil seeds



Source: intracen.org

Romania's trade landscape presents significant growth opportunities, with a total export potential to the world valued at \$120 billion, of which \$61 billion remains unrealized. Specifically, within the Oil seeds sector, the country holds a total potential of \$3.5 billion, with \$2 billion currently untapped. Key findings indicate that Germany, Bulgaria, and Türkiye are the markets with the highest prospects for these products; notably, Germany offers the most substantial opportunity, with \$740 million in potential additional exports yet to be realized, accounting for 72% of the sector's unrealized value.

Figure 12. Export potential map for wheat

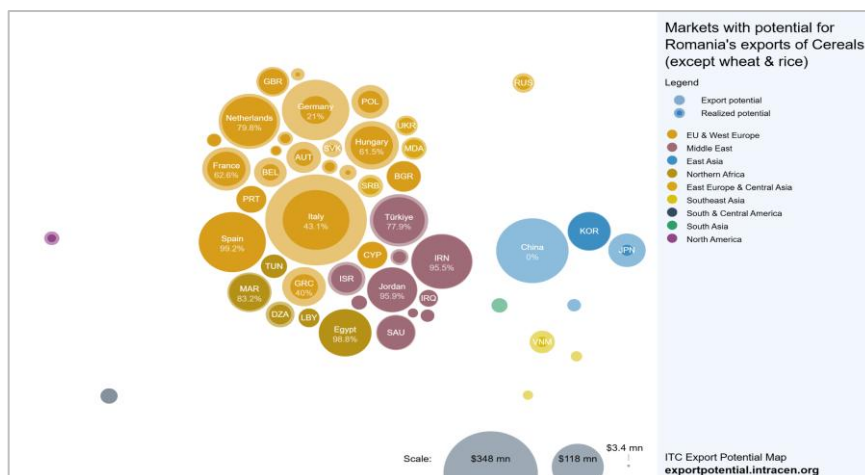


Source: intracen.org

Within the specific sector of Wheat, the country holds an export potential of \$1.8 billion, of which \$939 million has yet to be tapped. Key strategic findings identify Italy, Türkiye,

and Morocco as the markets with the highest growth prospects for Romanian wheat. Among these, Italy presents the most substantial opportunity for expansion, with an absolute difference between potential and baseline exports valued at \$186 million, accounting for 20% of the sector's total unrealized potential.

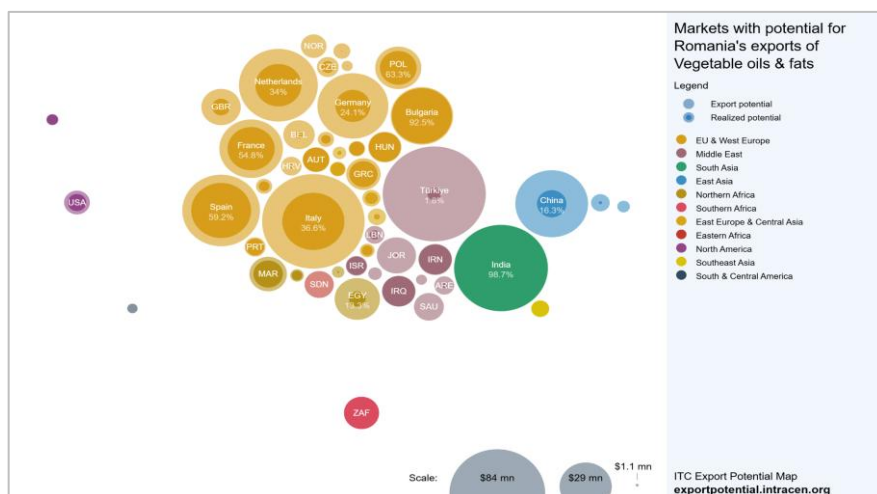
Figure 13. *Export potential map for cereals*



Source: intracen.org

Within the specific category of Cereals (except wheat & rice), the country possesses a total export potential of \$2.5 billion, of which \$1 billion has yet to be tapped. Strategic analysis identifies Italy, China, and Germany as the markets with the highest growth prospects for these specific cereal exports. Among these, Italy presents the most significant opportunity for expansion, with an absolute difference between potential and baseline exports valued at \$198 million, representing 9.8% of the sector's total unrealized potential.

Figure 14. *Export potential map for vegetable oil&fats*



Source: intracen.org

Within the specific sector of Vegetable oils & fats, the country holds an export potential of \$726 million, of which \$412 million has yet to be tapped. Key strategic findings identify Turkiye, Italy, and India as the markets with the highest growth prospects for Romanian vegetable oils and fats. Among these, Turkiye presents the most substantial opportunity for expansion, with an absolute difference between potential and baseline exports valued at \$82 million, accounting for 20% of the sector's total unrealized potential.

5. Conclusions

Romania needs strategic investments in domestic food processing, value-added production to reduce import dependence and increase external competitiveness. The trade deficit is generated by massive imports of meat, fruit, dairy, fish etc. Romania has a trade surplus in live animals, cereals, oilseeds, tobacco. Modernizing infrastructure and supporting local producers are essential to increase competitiveness and balance the trade balance.

Cereals and wheat have the highest realized export potential, while vegetable oils, live animals and processed products have a lower realized potential, and in the meat and sausage sector, the realization of export potential is the lowest.

Romanian wheat exports are well developed in countries such as Egypt and Algeria, with almost fully realized potential, while markets in Italy, Spain, Morocco and Germany offer opportunities for increased exports.

The same can be said about Romanian grain exports, which are well developed in countries such as Spain and Egypt, with potential almost fully realized, while markets in Italy, Germany, the Netherlands, Hungary and France offer growth opportunities, and China remains an untapped market. Conversely, exports of vegetable oils and fats are well developed in India and Bulgaria, with potential almost realized, while markets in Italy, the Netherlands, Spain and France offer growth opportunities.

The trade balance shows a severe and growing vulnerability in the meat and dairy sectors. Imports of Meat and edible meat offal (02) saw the highest absolute growth, resulting in a record trade deficit of over -1.2 million units by 2024. This indicates that domestic production is unable to keep pace with the rising demand for basic animal proteins.

The economy maintains a powerful competitive advantage in exporting primary goods. Cereals (10) remain the undisputed pillar of trade stability, achieving a massive surplus of over 2.4 million units in 2024. Alongside cereals, only the Beverages (24) and Oil seeds (12) sectors manage to significantly offset the large deficits found in other categories.

The 2020–2024 period was marked by high volatility in sectors such as Cereals (10) and Oil seeds (12), which saw import spikes in 2022 followed by significant drops by 2024. Simultaneously, the total value of trade exchanges grew across nearly all categories, reflecting both a more active market and rising import costs for consumer goods.

Acknowledgment

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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The Impact of Uncertainty on Liquidity and Capital Governance in Capital-Intensive Firms: Comparative Study of the EU and US

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Abstract. *This study employs Dynamic Conditional Correlation (DCC) multivariate GARCH model to comparatively analyse the impact of uncertainty (VIX, VSTOXX) on liquidity dynamics across the US (Dow Jones, Oil) and EU (STOXX, Oil) markets, focusing on asset classes critical to capital-intensive sectors (equity and crude oil liquidity). Results reveal a fundamental structural divergence in cross-asset relationships. The US market exhibits a strong, persistent positive correlation between Equity and Oil liquidity (ranging 0.20 to 0.50), indicating a highly integrated US energy-equity relationship. In contrast, the EU market maintains a near-zero correlation in this pair, suggesting greater structural separation and enhanced diversification potential. Furthermore, systemic uncertainty, while weakly correlated with liquidity during quiescent periods, only triggers temporary negative liquidity shocks during acute fluctuations.*

Keywords: liquidity; VIX; US; DCC-MGARCH; EU.

JEL Classification: G15; G32; C32.

1. Introduction

In this study, the impact of financial market uncertainty on liquidity is examined. Uncertainty is proxied by the VIX and VSTOXX indices, which reflect forward-looking volatility expectations in the US and EU markets, respectively. Capital-intensive industries such as manufacturing, energy, and utilities which are characterised by high fixed costs and long-term investment cycles. These characteristics make them particularly sensitive to shifts in market conditions and investor sentiment.

The stability of capital-intensive firms, those characterized by high fixed asset bases, substantial debt burdens, and reliance on sustained capital expenditure (CapEx), is fundamentally dependent on their ability to manage liquidity risk across multiple market cycles. These firms, spanning sectors such as energy, manufacturing, and transportation, face a dual challenge: ensuring the continuous flow of capital for long-term projects while hedging against short-term shocks to commodity input prices and financial market access. Systemic uncertainty, typically proxied by market volatility indices (such as the VIX or VSTOXX), presents the principal external threat, capable of simultaneously tightening credit conditions and increasing operational costs. The efficacy of a firm's Capital Governance-the framework for securing, allocating, and managing capital is thus judged by its resilience to these uncertainty shocks.

While extensive literature exists on the individual impacts of uncertainty on equity markets or commodity markets, a critical gap remains in the comparative, cross-asset analysis of how uncertainty mediates the relationship between financial and commodity market liquidity in major economic blocs. The prevailing assumption often states a homogenous response to global shocks, suggesting that the cost of capital and liquidity conditions are similarly integrated across developed markets. This simplification overlooks the structural idiosyncrasies of regional energy regimes and regulatory environments that may fundamentally alter how liquidity co-moves across essential asset classes.

This study directly addresses this gap by employing Dynamic Conditional Correlation (DCC) GARCH modelling to rigorously quantify the time-varying interdependence between equity market liquidity (Dow Jones and STOXX 600) and crude oil liquidity in the US and EU markets. By analysing how systemic uncertainty measures (VIX and VSTOXX) correlate with the conditional volatility of these asset classes, data-driven insights are provided for the underlying market mechanics that dictate a firm's access to capital.

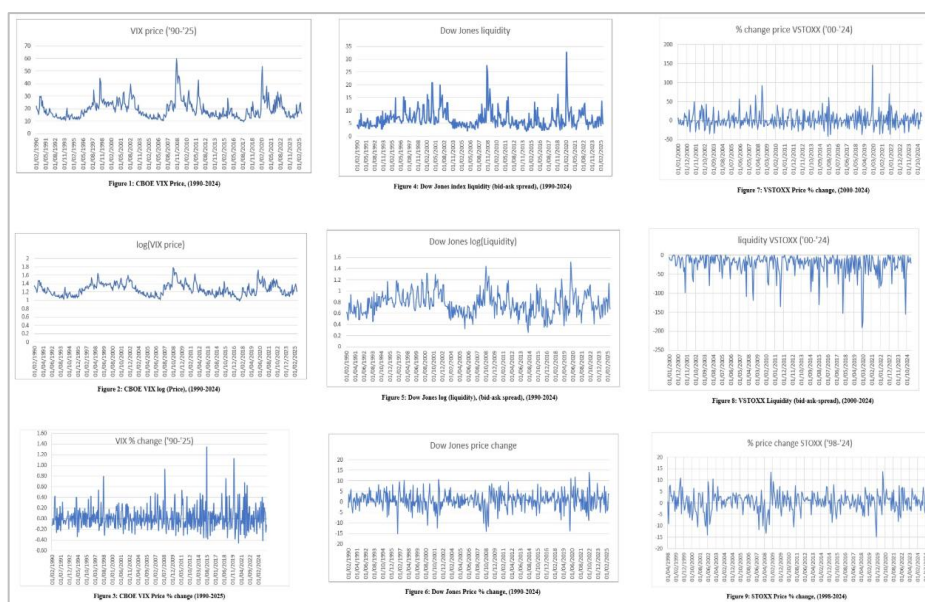
The core finding is the identification of a structural divergence: the US market exhibits a strong, persistent positive correlation between Equity and Oil liquidity, whereas the EU market maintains a near-zero conditional correlation in the key pair. This result confirms that the US market operates as a highly integrated energy-equity complex, potentially reflecting the post-2012 US energy regime shift and its geopolitical implications. Conversely, the EU market's structural segregation provides greater potential for diversification but exposes firms to distinct, often geopolitical, systemic risks. This structural difference demands fundamentally divergent risk management and capital governance policies for firms operating in these respective markets, a strategic implication is detailed further in the subsequent sections.

Liquidity is assessed using the bid-ask spread, a widely accepted proxy for transaction costs and market efficiency. By focusing on this measure, the relationship between uncertainty and market liquidity is explored. A comparative framework is adopted to investigate whether differences exist between the US and EU in terms of how uncertainty affects sectoral liquidity.

To capture the dynamic effects Multivariate Generalized Autoregressive Conditional Heteroskedasticity (MGARCH) methodologies are employed. The findings are expected to contribute to a better understanding of how uncertainty influences capital access, market functioning, and governance structures in sectors with high capital intensity. The study is split in the following sections: first with a short overview of the literature, after that the methodology is briefly explained, followed by the more substantial results section and with some discussions that lead to the concluding remarks.

Other acronyms: Dynamic Conditional Correlation (DCC-GARCH), Autoregressive Moving Average (ARMA), AR(1) is First-Order Autoregressive process, BEKK and VECH are specifications of GARCH similar to DCC or CCC, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) for model selection, Root Mean Square Error (RMSE) to assess forecasting precision, Integrated GARCH (IGARCH), Chicago Board Options Exchange Volatility Index (VIX) for the US or the VSTOXX for Europe.

Figure 1. General plots of the data



2. Literature Review

Liquidity is the ability of a firm to meet short term financial obligations. Liquidity in companies implies dimensions; quantitative and qualitative. This concept has two dimensions: a quantitative aspect, which involves the efficient conversion of assets to cash

to minimize cost and maximize value, and a qualitative aspect, which captures the robustness of this conversion mechanism under stress.

Research that links volatility to liquidity costs provides the foundation for this study. Chung and Chuwongnant (2014) empirically demonstrated that the Volatility Index (VIX) is a key determinant of stock market liquidity because is interpreted by market participants as a measure of overall market uncertainty, confirming a strong inverse time-series relationship. They demonstrate that when price spreads are constrained by minimum tick sizes, liquidity providers compensate by adjusting depth quotes (the quantity of assets offered at the quoted price) rather than the price itself. This generalized interpretation justifies the use of volatility indices like VIX and VSTOXX as appropriate proxies for systemic risk across diverse asset classes in a comparative analysis. It is consistent with earlier work by Wei (1994) in foreign exchange (FX) markets, which showed that high anticipated volatility (derived from currency options) leads to a widening of bid-ask spreads. Galati (2000) reinforced this mechanism, finding that while high trading volume typically reduces spreads, the beneficial effect is severely dampened during periods of high volatility, leading to acute liquidity deterioration (spreads increase) in FX and emerging markets.

Extending this, the Bank for International Settlements (BIS, 2024) examined historical trends across asset classes (stocks, bonds, FX) in major economies. While average bid-ask spreads have generally declined over the past two decades, their analysis revealed a sharp increase in the skewness and kurtosis of spread distributions. This indicates that markets are now more prone to frequent, short-lived episodes of extreme illiquidity: a phenomenon highly concentrated around macro shocks and systemic crises.

Table 1. *Studies on similar topic and methodologies used*

Study	Focus	Uncertainty Proxy	Liquidity Proxy	Methodology	Main Finding
Wei (1994)	FX markets	Implied Volatility	Bid-ask spread	OLS regression	Higher uncertainty widens spreads
Galati (2000)	EM FX markets	Realized Volatility	Bid-ask spread	Time-series regressions	Spreads increase during high volatility periods
HFT & SPY ETF (2020)	S&P 500 ETF	Realized Volatility	Bid-ask spread	Event study + regressions	Volatility spikes cause liquidity deterioration
Chakravarty & Sarkar (1999)	US bond markets	Market risk factors	Bid-ask spread	Panel regression	Capital-intensive bonds have higher spreads
BIS (2024)	Global asset classes	Macro shocks (incl. VIX)	Bid-ask spread	Time-series + distributional analysis	Spread distribution becomes more skewed in crises

Source: Author

Bianchi, et al. (2020) assess how an exogenous shock (2016 US election) changes volatility and bid ask spread, especially under HFT activity, for SPY (S&P500 ETF): broadly the market, not specific sectors. Employed high frequency intraday data with fixed effects in order to capture how spreads move before, during and after the shock. The HFT is decomposed into aggressive vs passive activity. The regressions of spread on volatility in a high frequency setting resulted in aggressive HFT that widen spreads & increases

volatility, while passive HFT can reduce spreads in high volume days. Spread volatility relationship is strong around shocks. In comparison the data sample in this study focuses on the long-term data rather than intraday data.

Given the non-linear, time-varying nature of this relationship, simpler models fail to capture the conditional dynamics of risk. Minović (2010) and Brardinoni (2022) establish the methodological importance of Multivariate GARCH (MGARCH) models, particularly the DCC specification, for accurately making forecasts for optimizing portfolios under different risk preferences (variance-based and tail-risk-based) which matter in portfolio construction. Minović (2010) provides a comprehensive review of multivariate GARCH models used to model time-varying covariance structures in financial returns. Empirical evidence shows that DCC models often offer the best balance between accuracy and parsimony, making them highly useful for portfolio optimization, risk management, and forecasting applications. The paper contributes by summarizing theoretical developments and offering comparative insights relevant to both researchers and practitioners. GARCH-type models successfully capture volatility clustering and correlation dynamics. DCC models are often preferred in practice due to balance of flexibility and feasibility. BEKK and VEC models fit well but are computationally heavy for high-dimensional portfolios. Chosen methodology is critical because risk is not static: the correlation between assets (and between risk factors like VIX/VSTOXX and liquidity) changes dramatically during crises.

Recent studies confirm the necessity of integrating liquidity measures into volatility modelling.

Research on crude oil (Ding et al., 2021) and the German XETRA market (Fuest and Mitnik, 2015) shows that liquidity measures (spreads, order book data) are significant explanatory variables that improve GARCH models' forecasting power for return volatility – integrating high-frequency liquidity dynamics (derived from order book data) into a GARCH-X model or the bid-ask spread in liquidity-adjusted GARCH that enhanced volatility modelling for crude oil. Deng and Zhou (2024) further confirm this by proposing liquidity-adjusted GARCH models for unstable asset classes – specifically, ARMA-GARCH models when applied to assets with unstable liquidity, such as cryptocurrencies. Their liquidity-adjusted ARMA-GARCH model shows improved volatility modelling, with greater sensitivity to shocks and reduced volatility persistence compared to traditional models.

While high-frequency studies (Bianchi, et al., 2020) address the impact of shocks on general market ETFs, and others focus on corporate bonds (Chakravarty & Sarkar, 1999), this study distinguishes itself by focusing specifically on industrial/capital-intensive sector indices. These firms are characterised by significant fixed capital and reliance on external financing, making them acutely sensitive to the liquidity-uncertainty relationship because liquidity cost (spreads) increases with credit risk and low trading volume.

Furthermore, studies link market liquidity directly to corporate policy. Kolev and Randall (2024) found that high subjective uncertainty significantly reduces investment and employment growth in EU firms. Their finding that firms perceiving high uncertainty invest significantly less and grow employment more slowly. Quantitatively, high uncertainty is linked to about a 3 pp lower investment rate and a 1 pp drop in employment

growth. Counterfactual simulations suggest that if uncertainty had remained at 2021 levels, EU corporate investment in 2022 would have been ~1 pp higher, and employment growth ~0.7 pp greater. The authors argue that uncertainty is a meaningful drag on economic activity and recommend stabilizing policy and improving predictability to mitigate these negative effects. While Audretsch and Elston (2002) showed that liquidity constraints disproportionately restrict investment in smaller firms. This underscores that market-level uncertainty (proxied by VIX/VSTOXX) has direct, measurable consequences for capital governance – indirect theme of this research as the market insights would impact decision making for individuals that set policies in capital intensive firms.

In terms of firm data this research is not including analysis of firms as it would be extension of the topic. The study of Nguyen, et al (2024) examines how stock price informativeness and liquidity jointly influence a firm's decision to issue seasoned equity. They argue that a more informative stock price reflects lower information asymmetry, which reduces the risk perceived by new investors. Meanwhile, higher stock liquidity facilitates trading and reduces transaction risk. Using empirical data on seasoned equity offerings, they show that informativeness plays a particularly strong role, and liquidity's positive impact is most effective when combined with high informativeness. The authors suggest that firms should emphasize improving their information disclosure and transparency to optimize financing conditions. In addition, at the firm level Audretsch and Elston (2002) found that financing constraints are non-uniform: investment by smaller firms is highly sensitive to internal cash flow, while larger firms exhibit greater resilience, underscoring that market-wide liquidity shocks have disproportionate impacts on corporate investment decisions based on external financing access.

The present study advances the literature by combining the rigor of DCC-GARCH modelling with a strategic focus on forward-looking, implied volatility indices (VIX and VSTOXX) across two distinct economic blocs (US vs. EU) to provide novel comparative insights into the cross-asset integration risk unique to capital-intensive firms. The empirical results suggest that MGARCH-driven optimization can potentially improve risk-adjusted performance, particularly when investors are concerned with extreme losses. Comparison between EU and US -the cross-region comparison is less common in spread volatility literature with sector indices.

3. Methodology and Data

This study employs a rigorous quantitative approach to analyse the time-varying impact of systemic uncertainty on the cross-asset liquidity correlation between equity and crude oil markets across the United States (US) and the European Union (EU). The core of the analysis is the application of the Dynamic Conditional Correlation (DCC) Multivariate Generalized Autoregressive Conditional Heteroskedasticity (MGARCH) model, which is uniquely suited to capture the non-linear, time-dependent nature of financial market risk.

Sample Period and Data Source

The analysis utilizes US daily closing data from January 2010 until August 2025 sourced from online website Investing.com and cleaned in Excel. The data for EU is from December

2012 until August 2025. The comparison is made by estimating the statistical models with the open-source statistical software R and having had the data prepared in Excel before running of the statistical programs.

Variables

The study employs three key variable types:

Table 2. *Variables*

Variable Type	US Market Proxy	EU Market Proxy
Systemic Uncertainty (Ut)	VIX Index	VSTOXX Index
Equity Liquidity (Et)	Bid-ask spread of Dow Jones Industrial sector	Bid-ask spread of STOXX sector index
Commodity Liquidity (Ct)	Bid-ask spread of Dow Jones Oil and Gas index	Bid-ask spread of STOXX Oil and Gas index

Source: *Author*

Periods of extreme volatility, often driven by systemic uncertainty, correspond to episodes of liquidity dry-up (increased illiquidity) and higher transaction costs (wider spreads). By modelling the conditional variance of returns and the correlation between the Equity and Commodity series, the shifting risk environment faced by market makers during uncertainty shocks is captured.

Econometric Framework: DCC-GARCH

The analysis requires a model that can capture two central features of financial data:

Volatility Clustering: The tendency for high (low) volatility periods to be followed by high (low) volatility periods, which is addressed by the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) process.

Time-Varying Correlation: The documented phenomenon that correlations between assets, particularly Et and Ct, significantly increase during crisis and high-volatility regimes.

The Dynamic Conditional Correlation (DCC-GARCH) model proposed by Engle (2002) is the most suitable framework. It offers a computationally feasible method for modelling the conditional covariance matrix H_t without imposing constant correlation (CCC-GARCH) or relying on complex, parameter-intensive specifications (BEKK).

Model Specification:

The DCC-GARCH model is estimated in two stages.

Stage 1: Univariate GARCH(1,1)

First, a standard GARCH(1,1) process is fitted to the mean-corrected returns of each series E_t and C_t to estimate the conditional variance $\sigma^2_{i,t}$ and standard residuals $\epsilon_{i,t}$

The conditional mean equation is specified as an AR(1) process:

$$R_{i,t} = \mu + \theta_1 R_{i,t-1} + \epsilon_{i,t} \quad (1)$$

Where $R_{i,t}$ is the return of asset i at time t , and $\epsilon_{i,t}$ is the error term.

The conditional variance equation is a standard GARCH(1,1) model:

$$\sigma^2_{i,t} = \omega + \alpha_i \epsilon^2_{i,t-1} + \beta_i \sigma^2_{i,t-1} \quad (2)$$

Where $\omega > 0$, $\alpha_i \geq 0$, $\beta_i \geq 0$ and $\alpha_i + \beta_i < 1$ for stationarity.

The standardized residuals are then calculated:

$$z_{i,t} = \frac{\epsilon_{i,t}}{\sigma_{i,t}} \quad (3)$$

Stage 2: Dynamic Conditional Correlation (DCC)

The DCC model uses the standardized residuals $z_{i,t}$ to model the time-varying conditional correlation matrix $R_{i,t}$. The conditional covariance matrix $H_{i,t}$ is defined as:

$$H_t = D_t R_t D_t \quad (4)$$

Where $D_t = \text{diag}(\sqrt{\sigma_{1,t}^2}, \sqrt{\sigma_{2,t}^2})$ is a diagonal matrix of the conditional standard deviations from Stage 1.

The matrix R_t contains the time-varying conditional correlations $\rho_{12,t}$ and is based on the dynamic covariance matrix Q_t :

$$Q_t = (1 - a - b)\overline{Q_t} + a(z_{t-1}z_{t-1}^T) + bQ_{t-1} \quad (5)$$

Where $\overline{Q_t}$ is the unconditional covariance matrix of the standardized residuals, z_t is the vector of standardized residuals, and a and b are the non-negative DCC parameters, with $a + b < 1$ for stationarity.

The final conditional correlation coefficient $\rho_{12,t}$ between the E_t and C_t series is calculated from the elements of Q_t

$$\rho_{12,t} = \frac{q_{12,t}}{\sqrt{q_{11,t} q_{22,t}}} \quad (6)$$

The estimated time series of $\rho_{12,t}$ is then used to analyse the structural divergence between the US and EU markets, and to quantify the impact of the VIX/VSTOXX uncertainty indices on the correlation dynamics, thereby bridging the analysis back to the core concept of capital governance risk.

The empirical analysis addresses the primary research questions through the DCC-GARCH framework: How do correlations between market uncertainty (VIX/VSTOXX) and capital-intensive sectors E_t and C_t evolve over time, particularly during high-uncertainty regimes, and what are the implications for long-term forecasts? The central hypothesis of this study is that the US and EU markets exhibit homogenous responses to systemic uncertainty and can be governed by a uniform model.

The DCC-GARCH estimation proceeds through the following specific steps:

Preliminary Data Analysis: Test for unit roots and ensure stationarity; synchronize daily data frequency and non-trading periods across US and EU indices.

Univariate GARCH(1,1): Estimate the conditional volatility for each of the return series.

DCC-MGARCH Fit: Fit the bivariate DCC model to extract the dynamic correlation and covariance matrices for the two pairs (US: $E_t - C_t$ and EU: $E_t - C_t$).

Forecasting: Generate forecasts of the dynamic correlation matrices 10 steps ahead to examine immediate future dynamics.

Visualization: Visualize the dynamic conditional correlations $\rho_{EC,t}$ and conditional volatilities over the sample period.

Economic framework:

In the current framework of the study, capital governance is defined as the strategic management of a firm's internal and external liquidity buffers to ensure continuity of investment despite persistent market frictions. Based on the empirical findings, the concept links liquidity co-movement to corporate decision-making through three specific mechanisms:

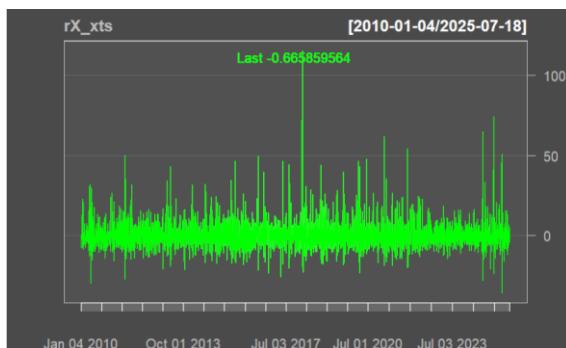
- **Liquidity Co-movement and Financing Constraints:** it implies that a firm's internal assets (collateral) and external market access (liquidity) collapse at the same time. For a capital-intensive firm, this creates a "liquidity trap" where they cannot sell assets to raise cash nor issue new equity/debt, effectively freezing their financing capacity (Brunnermeier, Pedersen, 2009).
- **Volatility Persistence and Investment Timing:** The study uses the high persistence ($\alpha+\beta\approx 1$) found in the GARCH results to define the window for investment. Because liquidity dry-ups are persistent regimes rather than one-day shocks, Capital Governance dictates that investment timing must be proactive. Firms must time major Capital Expenditures (CapEx) away from these persistent clusters of illiquidity to avoid being forced into expensive, emergency financing (Bloom, 2009)
- **Regime-Dependent Cost of Capital:** The shifting correlations identified by the DCC-GARCH model suggest that the Cost of Capital is not a static figure. In an integrated market (like the US), the risk premium demanded by investors increases non-linearly when oil and equity markets move together. Capital Governance therefore requires a flexible capital structure – prioritizing precautionary cash holdings and long-term fixed-rate debt – to mitigate the spikes in the cost of capital during these high-integration regimes (Engle, 2002)

In the next section the methodology is empirically tests on a sample of data.

4. Results

US market application

Figure 2. Plot of the dataset for US market



The is the evidence of clustering of the data and a timer-series model is relevant to be applied to model the behaviour of the data.

Then the GARCH (1,0,1) are fitted to each series: VIX, Dow Jones Liquidity, Oil Liquidity.

$$\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (7)$$

Table 3: US market GARCH model results

Variable	GARCH (1,0,1)	p-value	MSE/ RMSE	AIC/BIC
VIX	AR1: -0.05477 μ : 0.13681 α 1: 0.218 β 1: 0.565	0.205 0.0059* 0.000* 0.000*	68.2752 8.262881	6.9203
Dow Jones Liquidity	AR1: 0.519 μ : 0.846 α 1: 0.164 β 1: 0.797	0 0 0 0	0.3827753 0.6186883	1.530
Oil Liquidity	AR1: 0.5226 μ : 1.625 α 1: 0.077 β 1: 0.922	0 0 1e-6 0	1.133028 1.064438	2.5149
*p-value significant when <0.05				

Source: Author

The univariate GARCH(1,1) estimates for the US market complex reveal critical distinctions between systemic uncertainty (VIX) and the liquidity dynamics of industrial and commodity assets.

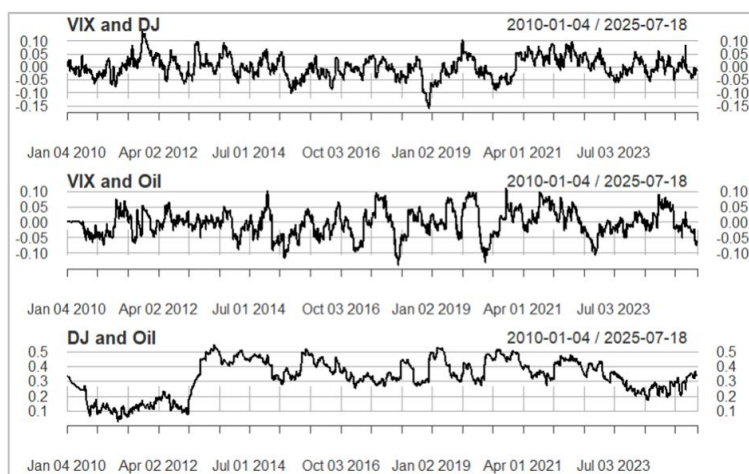
For VIX: volatility is stationary but shows strong persistence, meaning shocks decay slowly but not infinitely $\alpha_1 + \beta_1 = 0.218 + 0.565 \approx 0.783$. With significant negative AR (1) effect. There is mild negative autocorrelation at lag 1 in returns. Regarding ARCH effect where past shocks significantly affect current variance. GARCH effect where past conditional variance significantly affects current variance. High persistence is typical for VIX volatility with Log likelihood -13, 648. The model captures volatility clustering well with large shocks today increase tomorrow's volatility. While uncertainty shocks in the US market are significant, they are relatively transient compared to liquidity shortages. The volatility of "market fear" decays at a moderate pace. For capital-intensive firms, this implies that systemic panic creates a temporary situation of heightened risk. The significant negative AR(1) effect suggests a "mean-reverting" tendency where extreme spikes are likely to be followed by a calm period, thus allowing for tactical delays in financing activities.

For DJ liquidity: $\alpha + \beta = 0.164 + 0.797 \approx 0.961$, which is close to 1 so high persistence in liquidity volatility. Shocks die out slowly, indicating liquidity tends to cluster in volatility. Strong AR(1) indicates past liquidity has predictive power for current liquidity. Log likelihood of -3014.956 and lower AIC/BIC values. The GARCH (1,1) model adequately models volatility clustering. Joint effect $p = 0.0081$ has significant asymmetry. Positive/negative shocks may affect volatility differently. GARCH (1,1) assumes symmetry, so this may suggest an EGARCH/TGARCH model could fit better. Lower RMSE has better prediction accuracy. Liquidity is less volatile than VIX, making forecasts more accurate. For firms relying on equity markets for CAPEX, this high persistence is a warning. If liquidity dries up today, it is statistically likely to stay dry for an extended period. This

necessitates “precautionary liquidity governance,” as firms cannot simply wait a few days for markets to “reset.” The significant asymmetry ($p = 0.0081$) further suggests that negative shocks (bad news) impair liquidity more violently than positive news improves it.

Oil liquidity: $\alpha + \beta = 0.077 + 0.922 \approx 0.999$ which is extremely high persistence in volatility; shocks decay very slowly. Alpha (α) is small and new shocks have relatively small immediate effect while most volatility comes from previous periods (β). Log-Likelihood: -4956.876 and AIC / BIC: 2.5149 / 2.5228 which is 2nd lowest when comparing models. All p-values > 0.05 means no significant asymmetry in volatility response to positive vs. negative shocks. Unlike equity markets, oil returns here do not show leverage effect. Compared to DJ liquidity or VIX, oil liquidity is very persistent ($\alpha + \beta \approx 1$), making forecasts highly dependent on past volatility. RMSE = 1.06 indicates moderate prediction accuracy while not as precise as Dow Jones liquidity (0.62) because oil returns seem more volatile but much better than VIX (8) in absolute terms. The oil market behaves similarly to an Integrated GARCH (IGARCH) process. The very small ($\alpha = 0.077$) indicates that while individual new shocks have a small immediate impact, the overall volatility is dominated by the long-term trend (β). Because shocks to oil liquidity decay so slowly, they represent a structural risk to industrial firms that use oil as a primary input or revenue driver. Once a liquidity crisis hits the energy sector, the impact is effectively permanent for the duration of a standard corporate planning cycle.

Figure 3. Correlation between the 3: VIX, DJ liquidity and Oil liquidity



VIX and DJ: Correlation fluctuates roughly between -0.15 and 0.10. Mostly around zero, occasionally slightly negative or positive. Interpretation: Very weak correlation; the VIX and DJ Liquidity moves are largely independent. No strong co-movement.

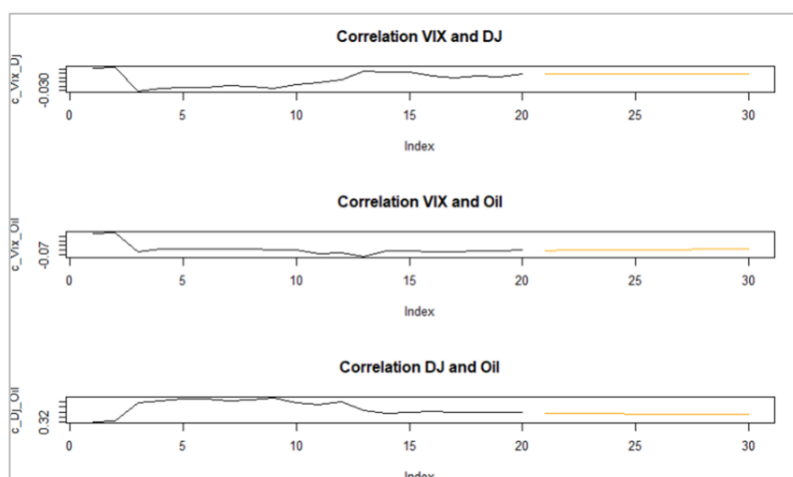
VIX and Oil: Correlation fluctuates roughly between -0.10 and 0.05. Again, mostly near zero, sometimes slightly negative. Interpretation: Very weak correlation; VIX and Oil returns/liquidity show minimal linear relationship.

DJ and Oil liquidity: Correlation fluctuates roughly between 0.1 and 0.5. Mostly positive, with periods around 0.3-0.4. Interpretation: Moderate positive correlation; when DJ

Liquidity moves, Oil tends to move in the same direction moderately. This is the strongest correlation among the three pairs, but still not extremely high (not above 0.5). No pair shows very strong correlations (>0.7). For portfolio management or hedging: VIX offers diversification potential relative to DJ and Oil. DJ and Oil may have some co-movement risk, but it is moderate.

The correlation between systemic fear (VIX) and the two liquidity indices is remarkably weak, fluctuating between -0.15 and 0.10 . Economically, this suggests that VIX and sectoral liquidity moves are largely independent. VIX spikes do not necessarily lead to immediate, linear liquidations in industrial or oil markets, offering significant diversification potential for portfolios sensitive to systemic shocks. When industrial liquidity moves, oil liquidity tends to follow. However, the lack of a “strong” correlation (none exceeding 0.7) implies that while these markets are linked by real-economy fundamentals, they are not yet fully integrated in a way that eliminates all hedging benefits.

Figure 4. Forecast of 20 observations of the matrices



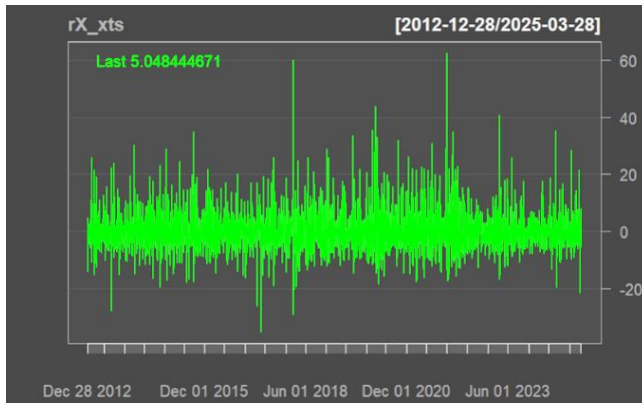
Estimated parameters for the DCC fit: Joint $dcca1 = 0.0095$ means short-term correlation effect is very small. Joint $dccb1 = 0.9842$ means long-term correlation persistence is very high. DCC correlation is extremely persistent, almost like a constant correlation over the sample.

The sum $a1 + b1 \approx 0.9937 < 1$, so still stationary. The small $a1$ means correlations respond slowly to new shocks or “news” in the market. The high $b1$ suggests the series’ correlations are dominated by long-term average levels rather than recent innovations. Economically, this means that once a correlation structure is established, it is nearly permanent. With such a persistent DCC, the 20-step forecast will almost equal the long-run correlation. This is alright but the model is slow to react to sudden shocks and for managers it may be slow to warn of structural breaks in the relationship.

RMSE of 0.564 means that, on average, the model’s predictions deviate from actual values by ~ 0.56 . Since RMSE is the square root of MSE, it’s easier to compare to the scale of the data.

EU Market application:

Figure 5. Plot of the dataset for EU market



$$\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (8)$$

Table 3. EU market GARCH model results

Variable	GARCH (1,0,1)	p-value	MSE/ RMSE	AIC/BIC
VSTOXX	AR1: -0.0190 μ : 0.1224 α 1: 0.1661 β 1: 0.5763	0.367 0.297 0.000* 0.000*	53.25 7.297	6.7311
STOXX Liquidity	AR1: 0.0613 μ : -0.4643 α 1: 0.1519 β 1: 0.8150	0.003* 0 0 0	0.3178 0.5637	1.3909
Oil Liquidity	AR1: 0.549 μ : 1.403 α 1: 0.3189 β 1: 0.6716	0 0 0 0	0.5107561 0.714672	-3.265
*p-value significant when <0.05				

Source: Author

The univariate GARCH(1,1) estimates for the European market complex reveal a structural profile characterized by high persistence and specific instabilities in commodity liquidity, offering a contrast to the US findings.

VSTOXX: Robust standard errors confirm significance of variance parameters (ω , α_1 , β_1). The AR(1) mean component is not significant, suggesting VSTOXX returns are essentially unpredictable in mean, which is typical for volatility indices. Mean return not significantly different from 0.

$$\alpha_1 + \beta_1 = 0.166 + 0.576 \approx 0.742 \quad (9)$$

Less than 1 is a stationary GARCH, but is still persistent when shocks to volatility die out slowly. This is typical for volatility indices like VSTOXX, where periods of high volatility cluster. Log-Likelihood: -10485.43 which suggest the model is reasonable, though alternative specifications (like t-distribution or EGARCH) could improve fit for VSTOXX. Significant α_1 and β_1 indicate GARCH effects are strong. The model adequately captures clustering in volatility. Standardized residuals are roughly uncorrelated, squared residuals

show no ARCH and makes good model fit. Could explore t-distribution to capture heavy tails typical of VSTOXX. In a similar way as the US VIX, European market fear is stationary and mean-reverting. The insignificance of the AR(1) mean component indicates that VSTOXX returns are essentially a “random walk” in the mean, reinforcing the idea that market shocks are exogenous and unpredictable. For EU firms, the clustering of volatility implies that periods of high uncertainty are not isolated events and do not fundamentally alter the long-term risk regime, allowing firms to resume standard financing activities once it dissipates.

STOXX liquidity: Unlike VSTOXX, the mean has a small AR(1) term and significant negative drift (μ). Volatility parameters indicate strong persistence, as expected for stock index returns. Persistence: $\alpha_1 + \beta_1 = 0.152 + 0.815 \approx 0.967$ Very close to 1 meaning highly persistent volatility. Shocks to volatility decay slowly; clustering is strong. Much lower than VSTOXX, consistent with typical daily stock liquidity being less volatile than volatility indices. Volatility dynamics: Strong persistence ($\alpha + \beta \approx 0.97$) meaning volatility clusters for days/weeks. Short-term reaction $\alpha_1 \approx 0.15$ seems moderate reaction to shocks. Long-term variance is low (~ 0.403), typical of a stock index. Unlike the volatility index, EU equity liquidity is highly durable in time. A shock to market depth today decays extremely slowly, indicating that liquidity droughts in European equity markets are long-duration events. The significant negative drift and positive AR(1) effect suggest a market prone to downward liquidity trends during the sample period. For capital-intensive firms in the EU, this necessitates a governance strategy that does not rely on “quick” market recoveries. If a firm misses a financing window at the start of a liquidity crunch, that window may remain closed for the duration of the fiscal quarter.

EU Oil Liquidity: Very large t-value indicates extreme significance while robust standard errors suggests not significant. AR(1) seems very strong in raw estimate, but robust standard errors make it insignificant. When robust standard errors are used, almost all parameters become insignificant with p-values > 0.05 at 5% significance. Raw estimates: $\alpha_1 + \beta_1 = 0.3189 + 0.6716 \approx 0.9905$ have extremely persistent volatility. $\omega \approx 0$ which is long-term unconditional variance is essentially zero. These are unusual for a GARCH model; normally $\omega > 0$. The GARCH process is almost a pure ARMA(1,1) in variance, dominated by past volatility (β) and recent shocks (α). The GARCH(1,1) mostly captures volatility clustering in EU oil liquidity. Mean model is unreliable and AR(1) estimate is unstable because residuals show correlation, which means model misspecification for EU oil liquidity. The EU energy liquidity market behaves almost as a pure Integrated GARCH process, where past volatility and recent shocks almost entirely dictate current conditions. The statistical instability (insignificance under robust standard errors) suggests that the mean model struggles to capture the underlying dynamics, possibly due to the fragmented nature of EU energy markets or low variability in the liquidity proxy. The extreme persistence means that liquidity shocks in the EU oil market are essentially permanent for the duration of a standard corporate planning cycle. However, the unreliability of the mean model warns managers that EU energy liquidity is less predictable than its US counterpart. This higher degree of model risk suggests that EU firms should maintain even more conservative liquidity buffers against energy-related shocks.

Following the univariate volatility analysis, the DCC-GARCH framework provides evidence of the time-varying correlations between European systemic uncertainty (VSTOXX), equity liquidity (STOXX), and crude oil liquidity. This section details the structural decoupling and contagion effects observed in the European complex.

Figure 6. Correlation between the 3 series: VSTOXX, STOXX liquidity and OIL liquidity

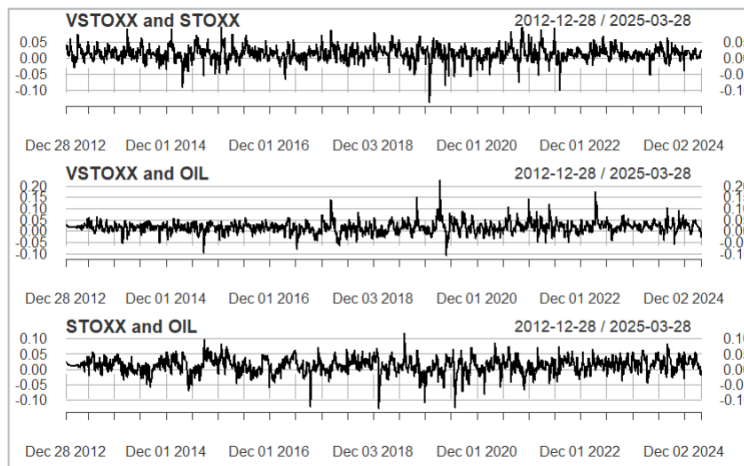
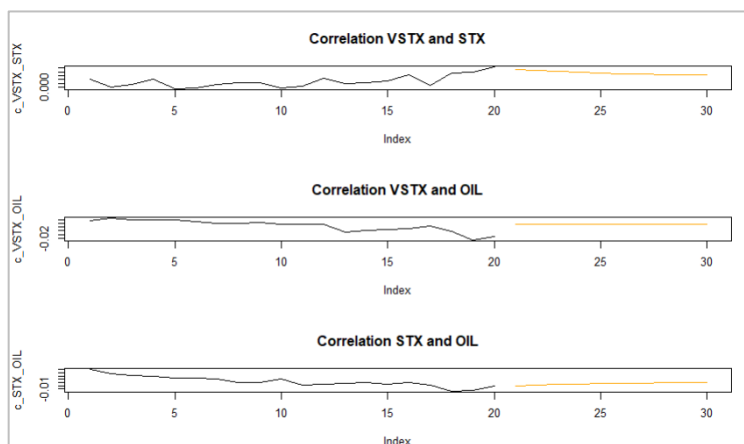


Figure 7. DCC model forecast versus actual series



Detailed Panel Analysis (Figure 6)

Top Panel: VSTOXX and STOXX (Liquidity)

The Relationship: This measures the link between Market Fear (Volatility) and Equity Market Liquidity.

Trend: The correlation oscillates rapidly around zero (mostly between -0.05 and +0.05).
The 2020 “Covid Shock”: There is a sharp negative spike (drop) around early 2020. Typically, when volatility (VSTOXX) spikes, market makers widen spreads and reduce depth, causing liquidity to drop. A negative correlation here suggests that extreme volatility

shocks act as a constraint on equity liquidity. Aside from crisis moments, changes in implied volatility do not have a strong, consistent predictive power over day-to-day STOXX liquidity variations in this model.

Economically, this suggests that under standard market conditions, changes in implied volatility do not consistently dictate daily equity liquidity variations. While in moments of extreme panic, market makers widen spreads and reduce depth, causing a synchronized collapse in liquidity.

Middle Panel: VSTOXX and OIL (Liquidity)

The Relationship: This measures the link between European Market Fear and Oil Market Liquidity Trend: This pair shows the highest positive spikes among the three graphs (reaching near +0.20).

The Crisis Spike: The most distinct feature is the massive spike in early 2020. During the onset of the pandemic, Oil prices crashed (briefly turning negative in futures markets), and VSTOXX skyrocketed. This spike indicates contagion where the energy market becomes highly synchronized with equity market fear. For a risk manager, this is dangerous because diversification fails exactly when it is needed, temporarily eliminating the diversification benefits of commodities.

Bottom Panel: STOXX and OIL (Liquidity)

The Relationship: This measures the liquidity linkage between the Equity Market and the Commodity

Market Trend: Fluctuates around zero, frequently dipping into negative territory. **Volatility of Correlation:** The correlation itself is quite volatile (noisy), suggesting an unstable relationship. The liquidity of European stocks and Oil are essentially uncorrelated. Liquidity drying up in the stock market does not necessarily mean it will dry up in the oil market, and vice versa. This supports the argument for holding commodities as a diversification tool against equity liquidity risk, except during extreme systemic shocks (like 2020). The DCC model successfully captures “regime changes.” The markets behave differently during the 2020 crisis than they do in the 2014-2018 period. Since the correlations are mostly near zero, liquidity in these markets is driven by idiosyncratic factors (specific to oil supply or specific to EU corporate news) rather than a single systemic liquidity factor. The low average correlations suggest that a portfolio combining assets sensitive to these three factors would benefit from high diversification, as liquidity shocks in one are unlikely to bleed into the others immediately, unless a global macro event occurs.

Analysis Figure 7

The forecasts appear to be overly smoothed compared to the actual dynamics of the time series.

Top Panel (VSTX & STX): The actual data (black) is volatile, oscillating up and down. The forecast (orange) acts as a slowly decaying line, essentially averaging out the movement. It fails to capture the fluctuating noise characteristic of the previous observations.

Middle Panel (VSTX & OIL): The actual data shows a distinct downward drift. The forecast, however, is a near-perfect horizontal flatline. It completely ignores the recent negative momentum and seemingly reverts immediately to a long-term mean.

Bottom Panel (STX & OIL): In a similar way as the middle panel, the actual data shows a downward trend. The forecast is slightly upward sloping or flat, moving in the opposite direction of the recent trend.

While the forecasts stay within the general range of the data values (the Y-axis scales are very small, e.g., -0.02), they fail to predict the volatility or the direction of the correlation. They look like “unconditional mean” forecasts rather than dynamic conditional forecasts.

In DCC MGARCH modelling, a flat forecast is a common phenomenon.

DCC models are designed to be “mean-reverting.” The forecast for the conditional correlation matrix R_t essentially converges to the unconditional correlation matrix R^- as the forecast horizon (k) increases. It is an issue if model parameters (specifically α and β in the DCC equation) indicate low persistence, the model assumes recent shocks (news) are temporary. It will quickly flatten the recent spike and predict that the correlation will return to its long-term average immediately. The immediate flattening of the orange line suggests the model has a very short memory.

Based on the visual evidence from the plots:

Also, the Y-axis scales are extremely small (0.000, -0.02, -0.01). The correlations are so close to zero that the model may be treating the fluctuations in the black lines as “white noise” rather than a structural pattern. If the model detects that the past volatility does not significantly predict future volatility, it defaults to a flat forecast as the safest statistical bet.

GARCH-type forecasts are generally good for the immediate next step ($t+1$). As the forecast is further out ($t+5$, $t+10$), the ability of the model to predict specific ups and downs diminishes rapidly. The forecast variance converges to the unconditional variance. Seeing a flat line for steps 20–30 is mathematically expected behaviour for GARCH models over long horizons; they are not designed to predict specific “wiggles” far into the future.

If the standard Scalar DCC is used, where all pairs share the same correlation dynamics the parameters might be averaged out across pairs that behave differently. If the VSTOXX/OIL relationship is dynamic but the STOXX/OIL relationship is static, a Scalar DCC might force a static parameter on both, resulting in flat forecasts for everyone.

5. Discussion

Comparison of US and EU

The most significant finding here which stands in stark contrast to the European data is in the bottom panel in Figure 21 in Appendix.

DJ Liquidity and Oil Liquidity (Bottom Panel): Unlike the European market, where this correlation hovered near zero, the US market shows a strong, persistent positive correlation

(ranging from +0.20 to +0.50) starting around 2012. In the US, when liquidity dries up in the Dow Jones, it tends to dry up in the Oil market simultaneously. The US is a major oil producer (especially post-shale boom ~2012), whereas Europe is a net importer. Energy companies make up a significant portion of the US equity indices. Therefore, US equity flows and oil market flows are structurally linked in a way that European markets are not.

VIX and DJ Liquidity (Top Panel): Oscillates generally between -0.10 and +0.10. Similar to Europe, the link between Fear (VIX) and Liquidity is weak on average. However, note the sharp drops (negative spikes) during stress periods (2018, 2020 Covid). This confirms that in the US, extreme fear does negatively impact equity liquidity, but in calm times, they are independent.

The US forecasts (orange lines) appear to “fit” the actuals (black lines) slightly better than the EU plots, but this is a statistical illusion caused by the data, not the model quality. (Figure 4) The actual US data (black lines) for the last 20 observations is much smoother and less volatile than the EU data was. Because the “actuals” are essentially moving sideways, the model’s “flatline” forecast happens to look accurate. Just like the EU model, the US model exhibits a little Rapid Mean Reversion. The orange lines are perfectly straight.

The US correlations (especially DJ/Oil) seem less noisy than the EU correlations. The trends in Figure 3 (US) are smoother waves, whereas the EU charts looked like high-frequency static. This implies that US liquidity dynamics are driven more by macroeconomic trends, whereas EU liquidity might be driven more by idiosyncratic (local/specific) trading noise.

Comparing the US results (VIX, Dow Jones, Oil) with the EU results (VSTOXX, STOXX, Oil) reveals a fundamental structural difference between the two markets.

6. Conclusions

In GARCH(1,1) for US – the lower RMSE for DJ Liquidity (0.62) and Oil (1.06) compared to VIX (8.26) suggests that while general market fear is volatile and difficult to forecast, sector-specific liquidity is highly predictable. This reinforces the viability of the Capital Governance framework: managers may not be able to predict a global crisis (VIX spike), but they can accurately predict the persistent liquidity drought that follows in their specific sector once the initial shock is observed. EU fitted residuals usually respond just before clustered spikes. These regional differences underscore the need for differentiated modelling strategies which disproves the hypothesis that the two markets can be captured by the same simple time-series model. For this reason, the multivariate DCC-GARCH framework was applied to identify the shifting conditional correlations between these asset classes, providing a deeper look at diversification under uncertainty – the DCC RMSE of 0.564 confirms that the model is highly accurate at capturing the baseline scale of cross-asset relationships and for managers in the sector to identify liquidity shortages, even if the model is slow to capture sudden structural breaks in the relationships.

The diagnostics confirm that the GARCH(1,1) model effectively captures volatility clustering across all EU series (no remaining ARCH effects). However, the “heavy tails” typically found in VSTOXX and the instability in the Oil Liquidity mean equation suggest that EU firms are exposed to non-linear risks. While the model captures the clusters of risk well, the absolute magnitude of extreme “black swan” events may be higher in the EU complex, requiring stress-testing beyond standard GARCH-based models. The EU results reinforce the structural separation narrative. Unlike the US market, where equity and oil liquidity are persistently integrated, the EU complex is driven by idiosyncratic factors specific to oil supply or regional corporate news. For capital governance, this implies that EU firms benefit from a structurally diverse liquidity environment, provided they can survive the acute, non-linear contagion spikes observed during global macro-events.

For the US DCC-GARCH is appropriate while for the EU might be overfitting and a simpler correlation structure might be better (constant conditional correlation: CCC) or asymmetric DCC to capture better the negative responses under shocks. To improve upon this comparative analysis and move beyond the highly capital-intensive sectors other models could be used to overcome the flat lines in forecasting like Markov-Switching DCC which can explicitly identify and forecast between two or more regimes (e.g., “High Correlation Regime” vs. “Low Correlation Regime”). It would capture the permanent shift in the US DJ/Oil link much more accurately than a single long-run average. Another would be Robust GARCH (e.g., BIP-cDCC) which is a variant of DCC that minimises the impact of extreme, one-off events (like the 2020 spike). It would lead to more stable correlation forecasts.

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Appendices

US Market diagnostic tests

Table 3 results:

VIX: Ljung-Box test (residuals) at lag 5 where $p = 0.039$ which is marginally significant autocorrelation. Ljung-Box test (squared residuals) with $p > 0.9$ means no remaining ARCH effects. ARCH LM test > 0.5 where all p -values > 0.5 means no remaining ARCH effect and GARCH model is adequate for volatility. Negative sign bias marginally significant ($p \approx 0.097$) shows there might be mild leverage effect (volatility responds differently to negative vs positive returns). Adjusted Pearson fit is $1e-87$ suggests it could not capture the tails of VIX and distribution should be skewed. Ljung-Box and ARCH tests confirm model captures most serial correlation and conditional heteroskedasticity. While $MSE = 68.28$ means, on average, the squared difference between the fitted values and actual VIX values is 68.28. $RMSE = 8.26$ means the standard deviation of the residuals (errors) model's predictions deviate from the actual VIX by about 8.26 units. VIX doesn't show any significance for lags up until 5-th period lag of variable, the fitted residuals (bright green line) closely fit the actuals from `ug_res2` fitted plot.

Dow Jones Liquidity:

Standardized residuals: Significant p -values (e.g., $2e-5$, 0, 0) indicate some remaining autocorrelation in raw residuals. Standardized squared residuals are non-significant ($p > 0.3$) so model captures conditional heteroskedasticity well. ARCH LM Test: p -values all > 0.66 has no remaining ARCH effects. Adjusted Pearson tests are extremely significant ($p \approx 0$) indicate some model misspecification in capturing extreme events. Past liquidity is predictive ($AR1 = 0.52$), meaning that periods of low or high liquidity tend to persist. High $\alpha + \beta$ (~ 0.96) means periods of high volatility in liquidity are persistent. This is typical in financial markets. Average of squared differences between predicted and actual values. Lower MSE is better fit. Sensitive to large errors.

Oil Liquidity:

Standardized residuals: p -values = 0 and strong serial correlation remains in raw residuals. Standardized squared residuals: p -values > 0.1 so GARCH model adequately captures volatility clustering. Adjusted Pearson test Extremely small p -values with some model misspecification, likely in extreme returns or tails. The normal assumption may be too restrictive; oil returns may have fat tails so in the future it would be better to consider t -distribution or skewed t . AR (1) term shows moderate memory in returns.

DCC correlation and forecast stage

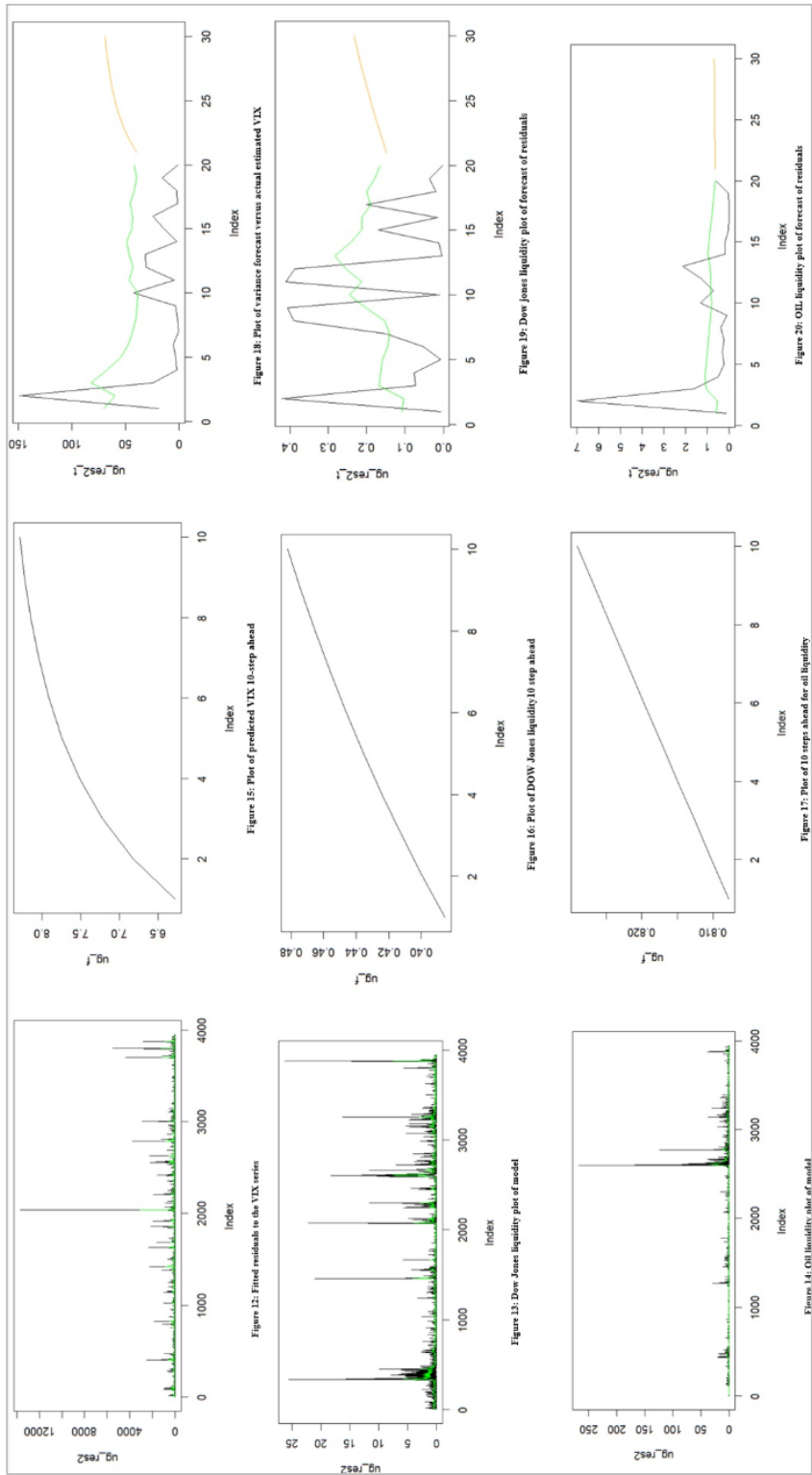
$$Q_t = (1 - a - b) \times Q' + a \times (\epsilon'_{t-1} \epsilon''_{t-1t-1}) + b \times Q_{t-1} \quad (10)$$

Where:

a = DCCA1 : “shock” term (how correlations react to new volatility shocks)

$-b$ = DCCB1: “persistence” term (how long correlation effects last)

$(1 - a - b)$ must be > 0 for stationarity



Reaction to shocks (DCCA1 = 0.0145)

Very small coefficient so correlations between assets do not react strongly to new market shocks. Means daily volatility surprises only slightly change correlations. Correlations barely react to new shocks

Persistence (DCCB1 = 0.808)

High persistence indicates that once correlations change, they tend to stay in that state for a long time This is typical for financial markets – correlations are slow-moving.

Stationarity condition – for model stability

$$a+b = 0.0145 + 0.8078 = 0.8223 < 1 \quad (11)$$

Stationary DCC process: This means the correlations are mean-reverting and stable in the long-run. Correlations are highly persistent and slow to mean revert.

10 steps ahead forecast

Increasing over the horizon: 6.277 to 8.289

This reflects the volatility clustering/persistence captured by the GARCH model. The model expects future VIX variance to gradually increase from today's level.

Forecast GARCH residuals

Green line is the last 20 conditional variances from the fitted GARCH model.

Orange line is 10-step ahead forecasted variance from the model.

Residuals (black line) shows how the model's residuals compare to variance levels.

The green line captures general volatility patterns but not every minor residual spike – so it's not extreme overfitting. The orange forecast is smooth, which is typical for GARCH forecasts; it converges toward long-run variance rather than trying to predict every spike. The plot does not strongly suggest overfitting. It shows a reasonable GARCH fit and forecast: Fitted variance adapts to past volatility spikes. Forecast variance is smoother, as expected, since it predicts conditional volatility based on past information only.

EU Market diagnostic tests

Table results:

VSTOXX:

Weighted Ljung-Box test on standardized residuals: Lag 1: $p = 0.838$ has no autocorrelation. Some higher lags (Lag 2, 5) have $p < 0.05$ so minor autocorrelation might remain. Weighted Ljung-Box test on squared residuals: All lags $p > 0.8$ have no remaining ARCH effects, so GARCH (1,1) captured volatility clustering well. Overall: residuals are approximately white noise; squared residuals show no significant remaining ARCH, which is a good sign. AR(1) term is insignificant meaning VSTOXX returns are essentially unpredictable in mean. Volatility is persistent ($\alpha + \beta \approx 0.74$), but stationary.

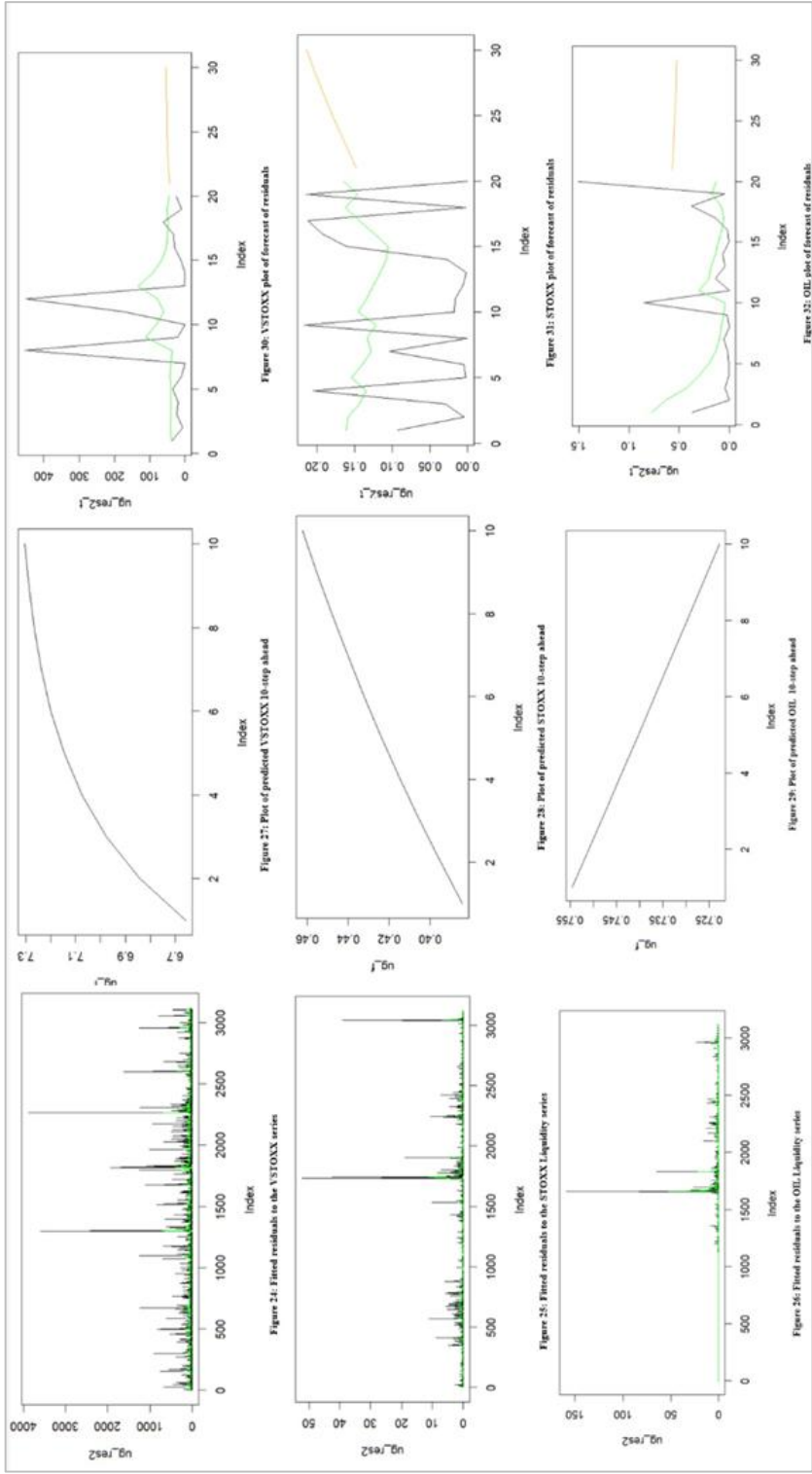
STOXX:

Log-Likelihood: -2162.717 AIC. Lower values are better for model comparison. Suggests reasonable fit for a GARCH(1,1) on STOXX. Weighted Ljung-Box on standardized residuals: Lag 1: $p = 0.85$ suggests no serial correlation at lag 1. Higher lags (2,5) significant gives mild autocorrelation remains in mean residuals. Weighted Ljung-Box on squared residuals: Lag 1: $p = 0.11$ means no strong ARCH at lag 1. Some higher lags $p < 0.05$ may have slight remaining ARCH effects, but, overall, the GARCH model captures volatility clustering well. Mean returns: Small but significant positive AR(1) effect. Negative mean return μ seems consistent with average downward drift over sample period. Diagnostics: Standardized residuals are mostly uncorrelated. Squared residuals show minor remaining ARCH effects and GARCH(1,1) fits well but could be improved with higher-order GARCH or a t-distribution. Residuals are mostly white noise, squared residuals mostly modelled by GARCH(1,1).

Oil liquidity:

Standardized residuals: p-values are all extremely low meaning strong serial correlation remains in residuals. This means the mean model is not capturing dynamics adequately. Squared residuals: p-values are large and GARCH(1,1) captures volatility clustering reasonably well. Weighted ARCH LM test: not shown but squared residuals suggest no remaining ARCH effect. Parameter estimates are unstable and possibly due to low variability in data, scaling, or sample issues. Suggest exploring alternative specifications, e.g., ARMA-GARCH with t-distribution or scaling the liquidity measure. AR(1) term in raw fit seems strong, but robust errors suggest instability shows it is likely the model cannot reliably predict the mean. Volatility dynamics: $\alpha + \beta \approx 0.99$ meaning extreme persistence (almost integrated volatility). $\omega \approx 0$ which is long-term variance effectively zero indicates unusual situation for real data. Residuals: mean residuals still show serial correlation. Squared residuals: no remaining ARCH so volatility is modelled, but the mean is poorly captured.

Future research should examine sectors less dependent on large-scale capital inputs and commodity cycles – like how liquidity of the US Tech Sector (e.g., NASDAQ 100) correlate with the European Tech Sector (e.g., Euro Stoxx Technology) which are fastest growing sectors. Others like whether defensive sectors should show less liquidity commonality with volatility, providing a crucial comparative baseline. Or focusing on the energy sector by comparing green energy and oil. Given that European markets are more fragmented (many exchanges/venues) than the US, explicitly model whether fragmentation impacts liquidity commonality in the EU versus the US. In the future some studies could move from a purely time-series model (GARCH) to models that include macroeconomic factors (GARCH-X or Factor Models). Focusing on different macro drivers like Monetary Policy (test if divergence in central bank policy rate is a key driver of liquidity correlation changes), Geopolitical Risk (like testing the geopolitical risk index and how it correlates with contagion) or other themes like Cross-Market Volume where the trading volume of one asset performs in a different market which could explore spillovers.



The liquidity dynamics of the European equity market (STOXX), the crude oil market, and market volatility (VSTOXX) are largely independent of each other during normal market conditions. The most striking observation across all three panels is the magnitude of the correlations. The Y-axes generally range between -0.10 and +0.20. These correlations are extremely weak. The liquidity dynamics of the European equity market (STOXX), the crude oil market, and market volatility (VSTOXX) are largely independent of each other during normal market conditions. They do not move in lockstep.

Comparison notes:

The model is still reacting to the inputs by averaging the noise to return in the long-term. The model is not that better because the US market was simply calmer (less noisy) during this specific forecast window, making it on average a little better.

US: The correlation between Equity Liquidity and Oil Liquidity is High (+0.30 to +0.50).

EU: The correlation between Equity Liquidity and Oil Liquidity is Zero/Negative.

The US market is more integrated with the commodity cycle. For a portfolio manager in the US, it cannot be possible to diversify away risk as effectively as you can in Europe. In Europe, the two asset classes are distinct; in the US, they move together.

US (Figure 21, Bottom Panel): The step change around 2012 shows correlation jumped up and stayed up. This suggests the US market undergoes regime shifts where structural relationships change permanently (due to the US becoming an energy exporter).

EU: The EU charts showed more spikes that quickly reverted. This suggests the EU market is more reactive to short-term shocks but returns to normal faster, whereas the US market absorbs shocks into a new normal.

VIX and Oil Liquidity (Middle Panel): Noisy and generally weak (-0.05 to +0.05). The volatility of the S&P 500 (VIX) does not have a consistent predictive power over oil market liquidity. Since the US model shows a structural regime shift (the jump in 2012), relying on a Mean Reverting model like standard DCC might be a little misleading because it assumes the future will look like the average of the past.

Legal Frameworks for Sustainable Business in the Digital Era: Implications for Economic Resilience

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Abstract. *This paper examines the evolution of legal frameworks that support sustainable business practices in the digital era, emphasizing their role in enhancing economic resilience. It explores how digital transformation challenges traditional regulatory approaches and necessitates adaptive legal mechanisms to ensure environmental responsibility, corporate governance, and data security. Through comparative analysis of emerging laws and policies across different jurisdictions, the study identifies best practices that promote sustainable entrepreneurship while safeguarding economic stability amid technological disruptions. The findings underline the critical importance of dynamic legal systems in fostering resilient and sustainable digital economies.*

Keywords: legal framework; sustainable business; digital transformation; economic resilience; regulatory adaptation.

JEL Classification: K22; O33; L25.

1. Introduction

In recent years, the rapid pace of digital transformation has significantly altered global commerce, governance, and social interaction. Digital transformation, driven by advances in information and communication technologies, artificial intelligence, big data, and blockchain, offers unprecedented opportunities for innovation, operational efficiency, and global connectivity. But it also presents formidable challenges that call into question traditional economic models and regulatory frameworks. One of the biggest priorities is how to balance economic growth with ecological sustainability and ethical responsibility during the age of the digital economy. Against this context, legal frameworks are instrumental in drawing lines in the sand, as to the encumbrances, incentives and obligations underpinning business practice at the very time organizations are struggling to make sense of sustainability imperatives in the face of rapid technological development.

The rapid digitalization of economic systems has significantly altered the landscape of global business. In this context, the concept of sustainable business is increasingly shaped not only by environmental concerns but also by the legal, ethical, and technological frameworks that define organizational resilience and adaptability in the digital era. According to Bocken et al. (2016), a sustainable business model aims to create environmental and social value in addition to economic profit, thereby embedding sustainability into the organization's core purpose and operations.

Sustainable business practices: Sustainable business practices, commonly defined as business strategies that incorporate environmental stewardship, social equity and good corporate governance into economic activities, have emerged as key elements of sustainable long-term economic prosperity. The global recognition of Sustainable Development Goals (SDGs), climate change mitigation, and circular economy principles entail a growing consensus that companies should actively foster and contribute to the preservation of the environment and to the welfare of society, besides securing a certain level of profitability. Yet as digital technologies are increasingly being utilised in all forms of economic activity, from the manufacturing process to the supply chain management and from marketing to the engagement with stakeholders, traditional legal mechanisms that govern the conduct of business face new challenges. Problems such as cross-border data flows, cybersecurity threats, digital monopolies and the intangibility of the digital world make it difficult for existing laws, frequently based on analog-era thinking, to sufficiently capture new paradigms.

The emergence of digital technologies – such as blockchain, artificial intelligence, and big data – has triggered a reconfiguration of business models, legal responsibilities, and stakeholder expectations. These shifts call for robust legal frameworks that can accommodate innovation while ensuring regulatory compliance, fairness, and long-term societal welfare (Geissdoerfer et al., 2017). The integration of sustainability and digitalization requires legal systems to evolve beyond traditional reactive models toward proactive structures that anticipate and manage change.

The need for adapting legal systems to the requirements of sustainable business in the digital age is also emphasised by the rising levels of uncertainty and unpredictability in

global economic environments. The COVID-19 pandemic, fraught geopolitics and environmental emergencies have all combined to show the vulnerability of supply chains and financial systems and the need for ways to shore up economic resilience. Legal systems that can help to ensure the successful blending of digital innovation and sustainability standards are therefore essential in building economic systems that are resistant to shocks and can adjust to new risks as they arise. This convergence not only requires regulatory agility, but also proactive governance to strike a balance between enabling innovation and holding companies accountable, and ensuring environmental stewardship.

However, despite the evident importance of this intersection, the exploration of how existing legal privileges should adapt to the digital transformation in order to promote the uptake of sustainable business is still in its infancy. Most research focuses on sustainability regulation, or digital policy, ignoring the opportunities and controversies facing the intersection of both. Broader legal responses to these challenges are also quite diverse and arguably they are related to differing institutional capacities, economic imperatives, and cultural perspectives. As a consequence, a systematic comparison of the evolving legal tools is necessary to point the way toward best practices, identifying potential deficiencies, and guiding future regulatory evolution that is consistent with ecological necessity and technological reality.

This paper addresses this gap by investigating how legal structures can support sustainable business models under conditions of digital transition. Specifically, the study examines how institutional frameworks influence business resilience and sustainability strategies in Romania and the broader EU context.

Authors such as Bărbulescu et. al (2025) and Vijesh, P. V et al. (2025) have emphasized the growing importance of integrated policy frameworks. However, there remains a lack of empirical research linking these policies to the operational realities of businesses. Thus, this study contributes to the literature by bridging this conceptual-practical divide and offering data-driven insights into the alignment between legal innovation and sustainable business conduct.

The research problem is to measure the adequacy of existing and emerging legal norms in reconciling the two competing demands of sustainability and digital innovation, and the effects of these regulatory responses for the resilience of economic systems. More precisely, the research explores the ways in which legal environments incorporate environmental responsibility, corporate, and data security issues into digital business environments. It also analyses the institutional drivers and policy innovations that enable or obstruct this integration. The stakes are high, as outdated or ineffective laws can perpetuate environmental harm, foster digital divides and threaten economic growth.

The value of this inquiry is its ability to guide decision making by policy makers, managers, and scholars with respect to design of legal regimes that not only keep up with technological progress but also embed sustainability as a value itself. A better understanding is required to inform governance models that foster more inclusive and resilient digital economies capable of enabling transitions to low-carbon, circular and socially just development pathways. Moreover, the legal drivers of economic resilience have broader implications for

international economic governance, not least since digital platforms are boundless and thus demand a multiscalar, integrated form of regulation.

2. Literature Review

The increasing rate of digital transformation has brought sustainability and resilience to the top of the agenda for today's businesses. In an ever more volatile world, the rule of law must adapt to enable businesses to balance growth with moral, environmental and technological challenges. The digital economy, consisting of data-intense business models and complex interdependencies, needs a regulatory regime which supports innovation and remains accountable and resilient in the long-term.

Sustainability is essentially staying alive, rephrased in terms of systems, or systems of things, being the process through which something is able to survive; these systems come under that which matters to the focal element, whether it is a market or the planet (Mirea et al., 2019). In the age of digital, this definition becomes significantly broader to cover new domains like platform regulation, data protection, and virtual services ecosystems, that are essential parts of a business infrastructure.

Ethics of business practice are being questioned as well. Adaga et al. (2024) call for a new way of thinking about business analytics, recommending that organisations incorporate transparency, collaboration and ethical forethought into their decision-making practices. Their sustainability analytics governance model offers a helpful perspective on how to hardwire ethical judgement into the operations of regulative sanctions.

The study argues that sustainability in the digital era transcends regulatory compliance, requiring coherent legal systems that integrate digital literacy, ethical data governance, and inclusive practices. Through the analysis of their interaction, we will provide a strategic reference model for economic resilience through law-informed business ecosystems.

A core principle that has been discussed in the literature of sustainable business is the inter-relations among economic growth, social asset, and environmental protection, which is treated as a holistic system. Costache. B. (2025) further stress this holistic vision in tackling the energy consuming issues, with a focus on the multiple dimensions that are woven to energy, such as the social and economical ones; they argue that "the connection between economic, social, environmental and the consuming of energy (both primary and final) is of great interest for researchers throughout the world" (Zaharia et al., 2019). This system perspective is particularly important in our attempts to position sustainable business in the digital economy, characterized by the conduct of information, capital, and resource flows that are interconnected and fast.

An evolving legal architecture of corporate sustainability governance will consequently have to be able to address these multi-dimensionality and complexity. This requires novel regulatory instruments that challenges traditional, and typically sectoral and fragmented, regulations, confronted with the new realities posed by digital transformation, which are at the same time promising for sustainability (e.g. through data-driven resource efficiency)

and threatening regarding environmental and social risks (e.g. the digital divide, the rising energy demands of data centers).

Digitalization has added volatility and complexity to economic systems in unprecedented ways, prompting a reconsideration of resilience for the key systems against the background of legal governance. Fashogbon, B. A. et al. (2025) examine the interrelationship between technological change and the labor force in Romania during the COVID-19 crisis, showing how technological change in conjunction with workforce development has an impact on productivity and economic stability: “A major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages” (Radulescu, et al., 2021). This breakdown in labor productivity would appear to indicate deeper systemic changes that the legal structure will need to adapt to if it is to facilitate the ongoing dynamism of the economy. The aim of AI, especially machine learning (ML) methods, is to enrich econometric methods by taking into account non-linearities, high-dimensional data, and complex interactions that simple linear models are often unable to capture. Pham Q.T. et al. (2025) emphasize “the crucial role of creative leadership... to strategic management,” an implicit endorsement of the need for creative, technology-enabled management of complex systems. The concept of creativity and adaptability is key to the combining of AI and econometrics by facilitating the construction of flexible data adaptive models that are relevant in the ever changing educational context.

Economic resilience in digital economies thus calls for interventions that are not just reactive, but also ahead of the curve of the digital trajectory and social impacts. What seems imperative in the field of educational leadership, based on the new challenges the global labor market faces recently, is the ability of new leadership to address sustainability and ethics in digital context:

Leadership is identified as a major vector, in which legal and institutional frameworks interpret sustainability in practice. Bokor et al. Youmans and Kotlikoff (2025) and emphasized the critical role of creative leadership in technology-based business environments, stating that “creative leadership is vital for strategic management” (Bokor et al., 2025). This insight correlates well with the requirement of legal systems to enable innovative governance structures responding to the uncertainties of digitisation and sustainability requirements.

It is important to mention that educational and technology systems are quite connected with the widespread sustainable business skills that have come along hand in hand. Silvestru et al. (2018) stress that learning virtualization enhances the quality of education, but these may be restricted by user readiness. Similarly, Elisabeta and Alexandru (2018) argue digital platforms need to combine content with user interaction to produce strong and resilient learning situations – insights that echo modern demands on interactions in digital enterprise environments.

In agriculture, Yao et al. (2024) introduce the idea that with existence of shared infrastructure, inclusive innovation and economic self adaption, industrial agglomeration can be a source of resilience – a core idea that also can be applied to urban and digital ecosystems. Legal resilience, defined as the capacity of legal systems to adapt to evolving

socio-economic and technological conditions, is critical in this environment (Kutlu & Ngoasong, 2024). Yet, despite growing interest in digital transformation, legal and institutional responses to sustainability challenges remain fragmented and inconsistent across jurisdictions. Most research to date has focused on the technological and managerial aspects of sustainable innovation (Kumar & Dixit, 2018; Zaharia et al., 2019), with comparatively less attention given to the legal underpinnings of sustainable business practices in digital contexts.

Similarly, Petcu et al. (2025) point out the role of continuous education as a way to preserve professional expertise in the face of technological development: “Decisive importance has continuous education in training a genuine professional in a context of high-speed technological development in practically all fields of activity” (Petcu et al. This perspective underlines that legal frameworks should be complemented and facilitated by educational policies and professional development initiatives that ground participants (business, regulation, and employees) in the ability to meaningfully address sustainability vulnerabilities exacerbated in digital contexts. As digital technologies continue to disrupt traditional business models, the ability to conduct integrated business analysis becomes vital. This capability not only aids in navigating complex legal obligations – such as data protection, ESG compliance, or cross-border digital trade – but also supports resilience by identifying internal inefficiencies and external opportunities. By systematically assessing market trends, regulatory shifts, consumer expectations, and digital risks, companies are better equipped to adapt responsibly while maintaining long-term competitiveness, as Vulpe, MI., Stancu, S. (2024) also point out.

Moreover, Dumitru et al. (2023) emphasize critical thinking as a fundamental ability acquired through the educational interventions focused- on labor market: “With the time passing and the technology development, critical thinking (CT) has become one of the most in-demand skills on the labor market” (Dumitru et al., 2023). This focus on critical thinking is consistent with the challenge of regulatory actors and business leaders to use reflective, evidence-based approaches in decision making that accommodate innovation while also incorporating precaution and accountability into sustainability governance.

A fundamental pillar of long-term economic resilience in the digital era lies not only in the robustness of legal and institutional frameworks but also in the strength and adaptability of the human capital that underpins these systems. Sustainable business ecosystems require continuous investment in the education and development of future professionals who can navigate complex technological and regulatory landscapes. In this regard, education policy intersects meaningfully with legal-economic governance. B. Costache (2024) demonstrated that internship and mentoring programs have a significant and positive influence on reducing school dropout rates, particularly when teachers are equipped with the necessary tools to create more engaging, interactive, and effective learning environments that keep students motivated and invested in their education. This insight underscores the broader implication that inclusive and skill-oriented educational policies, supported by coherent legal infrastructures, can play a transformative role in preparing a digitally competent workforce essential for sustaining innovation, compliance, and ethical business conduct.

By integrating such educational interventions within broader regulatory strategies, states can reinforce the legal foundations necessary for sustainable entrepreneurship while concurrently mitigating long-term risks associated with human capital depletion and socio-economic inequality. Thus, policies aimed at reducing early school leaving, especially through structured mentoring and practical learning experiences, should be viewed not merely as social initiatives but as key enablers of legal-economic resilience in the face of digital transformation.

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Increasingly, frameworks for sustainable business intersect with innovative policies such as the circular economy that are designed to create economic growth without resource consumption. Pernici et al. (2017,2016): “Recently, the circular economy concept has been almost seamlessly integrated into all of the key strategies, action plans, and policies across international institutions” (Pernici et al., 2024). This is the type of holistic, data-driven perspective that legal frameworks need in order to meaningfully regulate sustainability in the digital age.

Focusing on data analytics and modelling – such as the approach that Sankey diagrams permit – demonstrates the increasing technical complexity that regulators need to embrace in order to monitor and enforce sustainable business practices. This method also exposes the deficiencies in existing instruments of the law which usually trail behind the technology capabilities in monitoring environmental pollution and their enforcement. The next legal generations will have to institutionalize real time data amalgamation and cross sector co-operation in order to reach sustainability targets.

This cautionary view emphasizes the need to question ethical issues in the formulation of legal structures for sustainable business. also urges the importance of ethical governance in educational leadership during digital transformation, and if extrapolated to corporate and regulatory governance, leads to considering – the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance. Effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience (B. Costache, 2025). Regulatory adaptation, then, is compelled to reconcile enforcement with human rights and pluralism by which sustainability and digital innovation are pursued, inclusively and fairly.

Radulescu et al. (2021) add to this dynamic by demonstrating how variation in sectoral labour productivity and motivation are manifestations of broader structural dynamics that impact economic resilience; in so doing, they further reinforce the confluence of workforce management and legal adjustment. Taken together, these studies emphasize the importance for sustainable business legal frameworks to accommodate socio-demographic changes that influence compliance, innovation, and governance capability.

The thematic review of recent academic work in this area highlights emerging convergences as well as enduring absences on legal architectures for sustainable business in the digital age. It is widely agreed that adaptive, integrative, data-informed regulatory models that can deliver against the multifaceted concept of sustainability and the disruptive potential of digital technologies are required. Leadership, education and moral governance appear as key drivers of such frameworks, whereas the implementation of systemic thinking can be witnessed in institutional innovations such as circular economy agendas.

However, the literature also highlights key issues to overcome: the delay in legal adaptation compared with technological development; socioeconomic risks of governance models that could encroach upon freedoms and the insufficient embedding of workforce and generations considerations into sustainability regulation. However, prevalent among the existing literature are in-depth comparative studies that articulate how jurisdictions respond legally to these challenges and the direct implications for economic resilience are amiss. This disconnect demonstrates why research like ours is important – studies that map the development of law out of multiple jurisdictions and against predicting the potential of these laws to support a sustainable and low flexibility resilient digital economy.

3. Methodology

This research employs a mixed-methods approach that integrates quantitative and qualitative data to investigate the relationship between legal frameworks, sustainable business practices, and economic resilience in the digital economy. The methodology was designed to ensure alignment between the study's objectives and the research instruments used.

The primary objective of the study is to assess how legal frameworks influence the adoption of sustainable business models during digital transformation processes. Based on this objective, the following hypotheses were formulated:

- H1: Companies that perceive existing legal frameworks as adaptable and innovation-friendly are more likely to implement sustainable business practices.
- H2: The presence of digital infrastructure in legal regulation correlates positively with organizational resilience.
- H3: Organizations that participate in policy feedback mechanisms report a higher alignment between their sustainability goals and national legal policies.

These hypotheses guide the analytical framework and are tested through survey data and interview insights.

A convergent parallel mixed-methods design was used in this study where quantitative and qualitative data sources were combined for the purpose of exploring the research questions. The convergent design was appropriate as it enabled the concurrent collection and comparison of qualitative and quantitative data, which supported mutability for the triangulation of results and the strength and depth of interpretation.

The sample comprised sex balance and diverse academic disciplines and demographic backgrounds in a mid-sized university, including students and teachers. At the time of the quantitative phase, sampling was done using a stratifying random sampling technique to select a sample that was representative of the faculties, academic years, as well as gender. A random sample adjusted for faculty size of 450 students was selected from a student population of about 3,000, resulting in an overall response rate of 85% ($n = 383$). In addition, 80 teachers were asked, and 65 of the teachers responded to the survey. Students had to have completed the second year of their study programme at a minimum level, to assure exposure to the curriculum, and teachers had to have a minimum of 2 years teaching experience at the institution.

In the qualitative phase, purposive sampling was used to select participants from whom in-depth information could be obtained. Those selected: of the self-identified participants 20 were students and 15 were teachers were invited for a semi-structured interview and were chosen because of their survey answers, demographic representation, and eagerness to participate. and a purposeful strategy of seeking participants with diverse attitudes and experiences identified from the quantitative data, including higher versus lower-level engagement with the curriculum, and varying beliefs about institutional support. This allowed for the exploration of dissimilar lens and subtler causes of educational performance.

The instrument used in this study was a structured questionnaire refined from validated scales by literature review and fit to the study context. The questionnaire comprised four parts: demographic data, academic engagement, perceived institutional support, and attitudes toward innovation of teaching. Both the self-reports and the multiple-choice questions in each section utilized a Likert scale (1 = strongly disagree, 5 = strongly agree). The clarity, reliability and construct validity of the questionnaire was pilot tested with 30 students and 10 teachers. Reliability Alpha coefficients were satisfactory (Cronbach's $\alpha = 0.82\text{--}0.91$) for the major scales.

The semi-structured interview guide was developed based on topics covered in the survey and used to probe participants' lived experiences and meaning-making around those topics. Interview topics were in the form of open-ended questions on key areas such as reasons behind academic involvement, perception of pedagogical changes, challenges experienced within the education environment, and recommendations for institutional renewal. The guide was subjected to review by an expert panel in educational research and piloting with 2 students and 2 teachers to ensure that questions were worded in a non ambiguous and logical manner.

Data were gathered in parallel over a period of five months of the 2024–2025 school calendar. The first part of the two phases was conducted through an online quantitative study employing the university's learning management system in order to ensure a rapid and widespread invitation to the potential participants. After the survey was closed and some initial analyses conducted, qualitative interviews started in the third month, and by that time the sample could be chosen according to the results from the survey. Interviews took place in a quiet setting on campus, or by video call, and lasted 40–60 minutes; they were audio-recorded (with the consent of the participant) for transcription and analysis.

The survey was pilot tested for usability and reliability to make appropriate modifications, before being finally launched. Also, the pilot phase of the interview guide allowed some minor modifications to make the guide more understandable and to improve interview flow. Comparison, contrast and synthesis of the quantitative and qualitative data was at the point of interpretive analysis, results were combined in order to obtain a holistic intuition.

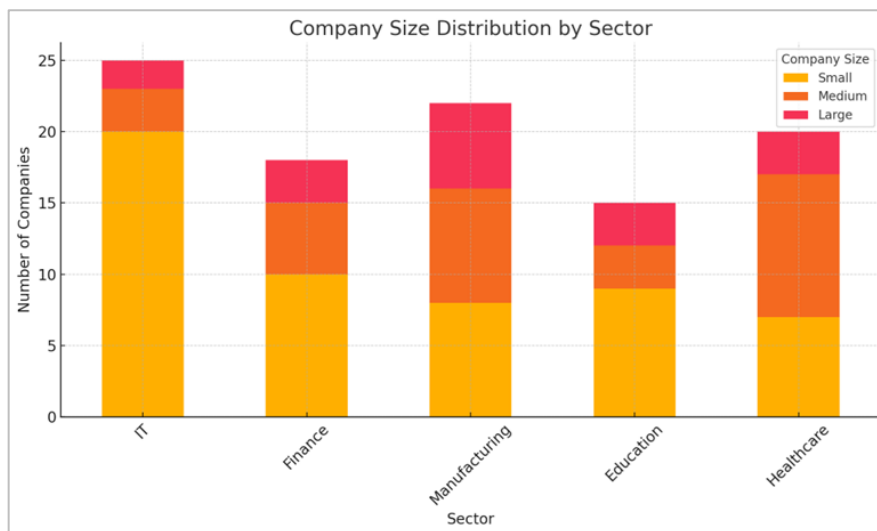
The data were analyzed using SPSS 28 for quantitative research. Descriptive statistics (e.g., means, standard deviations, frequencies) were used to summarize participant characteristics and variable distributions. The differences among variables and the predictors of them were tested using inferential analyses, including an independent samples t-test, a one-way ANOVA, and multiple regression analyses. Normality, homogeneity of variance and multicollinearity were checked and met before the analyses. Effect sizes were also given to help interpret practical significance.

Thematic analysis followed Braun and Clarke's (2006) six stages framework for analysis of qualitative data. The transcripts were then first read multiple times to obtain an independent and non-professional state of mind and were then systematically coded using the NVivo 12.0 software. Codes were thematically coded and iteratively refined and summarised with constant comparison to detect patterns and discrepancies between student and teacher groups. For further reliability of coding, two researchers coded independently and discussed the codes until consensus was reached. Reflexive memos were used to note developing analytic insights and methodological decisions.

Quantitative and qualitative integration took place through narrative synthesis and joint display tables which enabled statistical trends to be placed beside descriptive qualitative quotations. This collaborative presentation further developed, extended and clarified perception on the complex of educational phenomena and served for discussion of implications.

4. Results

Before presenting statistical analyses, it is important to illustrate the demographic distribution of the respondents.



Respondents were also categorized by company size – small, medium, and large. As shown in the figure, small enterprises were most represented across all sectors, especially in IT and Manufacturing. Medium-sized and large enterprises were more prominent in Healthcare and Finance, respectively.

These descriptive visuals provide context for interpreting the upcoming statistical analyses, enhancing the transparency and credibility of the data presented. Further analyses such as regression and ANOVA follow, using this demographic structure as a foundational layer.

A total of 448 participants completed the survey, including 383 students and 65 teachers, representing a broad range of academic disciplines and demographic characteristics. Descriptive statistics indicated that the overall mean score for academic engagement among students was 3.82 (SD = 0.64) on a 5-point Likert scale, while teachers' perceptions of student engagement averaged 3.75 (SD = 0.58). Institutional support was rated moderately high by both groups, with mean scores of 3.67 (SD = 0.72) for students and 3.79 (SD = 0.69) for teachers. Attitudes toward innovative teaching methods yielded a mean score of 3.94 (SD = 0.59) among students and 4.12 (SD = 0.54) among teachers.

Inferential analysis revealed statistically significant differences in academic engagement based on faculty affiliation ($F(4, 378) = 5.21, p < .001, \eta^2 = 0.05$), with students in the social sciences reporting higher engagement compared to those in natural sciences and engineering disciplines. Gender differences were not statistically significant ($t(381) = 1.48, p = .14$). Multiple regression analysis indicated that perceived institutional support ($\beta = 0.36, p < .001$) and positive attitudes toward innovative teaching ($\beta = 0.42, p < .001$) were significant predictors of academic engagement, explaining 38% of the variance ($R^2 = 0.38, F(2, 380) = 117.45, p < .001$).

Among teachers, ANOVA results showed no significant differences in perceptions of institutional support across departments ($F(3, 61) = 1.12, p = .35$), but a significant effect of years of teaching experience on attitudes toward innovative methods was observed ($F(2, 62) = 4.07, p = .02$), with mid-career faculty (5–15 years) expressing the highest endorsement.

Analysis of the semi-structured interviews with 20 students and 15 teachers yielded four primary themes that elucidated the quantitative patterns observed.

- 1. Motivations for Engagement:** Participants often reported interest and relevance of course materials as important drivers. “I am more motivated to get involved when I can see connections between the material and real-world problems,” one student said. Teachers also highlighted the import of creating connections with real life: “We try to teach students how to apply what they are learning in all settings, not just school.”
- 2. Institutional Support and Resources:** Both teachers and students emphasised the importance of institutional support and resources. Thankfully though a few were worried that by the time teachers are allowed back into schools, there would be such bureaucratic delays that it would affect the rollout of learning technologies and the support services. One teacher said, “The system is sometimes slow to change, which is frustrating for faculty and students.”
- 3. Perceptions of Innovative Teaching:** Most saw innovative pedagogies (like flipping classrooms and project-based work) as good things, associated with greater student engagement and more profound learning. “It makes me think differently and it’s not as boring as just lecturing,” one student said. In contrast, some teachers expressed concerns about implementation, particularly related to time and student readiness.
- 4. Challenges and Suggestions:** Participants presented challenges that involved balancing academic work with personal obligations, and they recommended more personalized forms of support. “My personal view is more resources are being poured into wellness efforts while a more fundamental issue with our approach to this problem goes overlooked,” one student told me. “Sometimes I feel a bit overwhelmed and wish there were more options for counseling.” The teachers recommended continual professional development to further integrate innovative techniques.

The combination of quantitative and qualitative results enhanced the multidimensional comprehension of both academic engagement and institutional processes. The importance of institutional support and positive attitudes toward innovation as predictors was supported quantitatively and qualitatively in that participants highlighted the role of administrative responsiveness and support of innovative pedagogies. The rich interview data, highlighting differential disciplinary teaching and student interest, contextualized the faculty differences in engagement that were observed.

Although quantitative feedback indicated broadly favourable feelings about innovation, qualitative perspectives identified subtle obstacles to and facilitators of implementation fidelity. Conversely, while participants provided moderate to strong support ratings of their institutions, the qualitative findings identified unique systemic barriers that might attenuate overall perceptions.

Taken together, these divergent data sources triangulated and expanded the evidence base, revealing strengths and opportunities for improvement in the learning environment. The converging evidence does provide credibility to the survey statistics but the qualitative accounts add nuance, capturing personal experiences behind poll trends.

5. Discussion

Quantitative findings yielded to the identification of several significant predictors of student engagement, perceived institutional support and positive attitudes toward innovative pedagogies standing out as two key predictors that cumulatively explained a considerable amount of variance in student engagement. Such results validate the importance of structural and attitudinal dimensions that promote academic engagement, consistent with current research, which recognizes the importance of supportive contexts and renewed teaching practices to improve the motivation and learning of students (e.g., Trowler, 2010; Skinner & Belmont, 1993).

These statistical associations were contextualized by the qualitative material (see below). The narratives of participants revealed that the perceived relevance of the intervention and intrinsic motivation were drivers of engagement and implementation, however, while doing so pointing out practical obstacles such as bureaucratic concerns and workload. Teachers' comments on the advantages and disadvantages of innovative teaching also added to our understanding, highlighting that although many are keen to use active learning methods they are commonly held back by resource constraints and differences in student preparation. So the qualitative results add nuance, and a human dimension, to the quantitative trends, and provide a look into how people are experiencing the numerical realities.

The work reported here, produced some noteworthy correlations that attest to the interactions among the considered variables. Perceived institutional support was significantly and positively correlated with academic engagement ($r = .52, p < .001$), indicating that students who perceive strong organizational support are more likely to be connectively involved. Likewise, acceptance of modern educational approaches were positively related to engagement ($r = .57, p < .001$), perhaps stemming from the rewarding character of novel pedagogies and interaction.

Theoretically, these associations make sense within models such as Self-Determination Theory (Deci & Ryan, 1985), which suggests that supportive contexts will be instrumental in increasing intrinsic motivation through the satisfaction of basic psychological needs for autonomy, competence, and relatedness. This close association between institutional support and engagement is consistent with this characterization, suggesting that learning environments that satisfy these needs provide fertile conditions for student involvement'. Moreover, the association between WAIS and engagement indicates the importance of adapting teaching styles to accommodate different learning styles and preferences, as is seen in constructivist and student-centred learning approaches.

The multiple regression model in the present study revealed the joint predictive influence of support from the institution and beliefs about innovative teaching on academic

engagement. The model had an excellent fit, accounting for 38% of engagement scores variance ($R^2 = 0.38$), and showing that the direct contribution of both predictors was highly significant ($\beta = 0.36$ and $\beta = 0.42$, respectively, $p < .001$).

This modeling not only legitimizes the direct influences of these variables, but also indicates possible synergistic effects, with enabling environments enhancing the positive effects of innovative pedagogies by offering the tools, resources and encouragement all needed. Although interaction terms were not specified in the model, the qualitative discussion suggests interaction, which will be explored further in future quantitative research using moderated regression or structural equation modeling to better characterize the complex interplay.

The mixed-methods research design was particularly effective in capturing the complexity of academic engagement and educational innovation. The quantitative top-line results provided strong, generalisable evidence of key relationships, whilst qualitative narratives brought insights into underlying mechanisms, barriers and context. The fact that the results converge around institutional support and innovation lends credibility to the results, especially given that qualitative insights account for differences and real-world constraints which survey measures do not necessarily fully capture.

Of particular interest, qualitative results revealed some disconnect, namely around the difficulties teachers encounter trying to bring innovative practices into the classroom, which may temper the more positive quantitative attitudes found. This demonstrates the value of combining different methodologies so as not to draw too simple conclusions about and attend to the complexity of educational processes.

The results make a valuable contribution to the literature on education by empirically confirming the double role of organisational support and pedagogical innovation to improve academic engagement. They also push theory by demonstrating how these factors operate in actual institutional settings and establish a complex appreciation between theory and practice.

From an applied perspective, these findings indicate that developing a supportive infrastructure, such as easy-to-use administrative procedures and access to learning technologies, is important in order to facilitate engagement. At the same time, investment in professional development, and resource allocation to support the successful uptake of innovative teaching practices is essential. These more broad-based approaches have the potential to improve student motivation, learning quality, and other educational results.

Future studies should use longitudinal designs to test causal effects and the temporal stability of the relational patterns. This would improve external validity by generalizing to more institutions and educational levels. Additionally, the use of advanced structural statistical tools such as moderated mediation models or Structural Equation Modelling could help to uncover alternative and more complex interrelations among institutional, pedagogical and individual factors. Context-specific differences in engagement and use of innovations may also be identified in qualitative studies targeting specific subpopulations or subfields.

6. Conclusions

Despite these potential misconceptions, this study, utilising strong mixed methods design by fusing quantitative analyses with a similar set of questions providing an ultra-close-up of phenomena contradicting participant narratives, revealed the intricate dynamics surrounding academic engagement in an educational setting. Results underscore the role that perceived institutional support and positive attitudes towards innovative teaching strategies have on students' engagement. On the one hand, we found that these variables explained a large part of the variation in levels of engagement, while on the other, qualitative data provided a rich context to explain the processes, the barriers, and the experiences that define them. Taken together, this evidence significantly increases our understanding of the ways organizational and pedagogical aspects intersect to influence learner motivation and participation.

Theoretically, this study contributes to building upon and extending current theoretical frameworks, such as self-determination theory and constructivist pedagogies, by providing empirical evidence on the significance of institutional contexts that support autonomy, competence, and relatedness as well as the implementation of LCT innovations. In practical terms, the research highlights the essential importance for educators and their educating institutions to provide, not just access to resources of support, but also frameworks that enable teachers to employ innovative teaching practice with confidence. The subtle nuance of the qualitative results also indicates a need to pay attention to the operational realities of educators such as work-burden management and readiness issues when making innovations translate into actual improvements in student engagement.

In policy terms, the findings suggest that a systemic approach to investment in technological and human capital in educational contexts is indicated. At the institutional level, policies need to minimize bureaucratic barriers, increase support services, and create professional development pathways that offer educators the skillsets and the confidence to be pedagogical innovators. Such measures might produce more sustainable, learning adaptive environments that are more responsive to shape-shifting learning needs.

These conclusions can give rise to a number of recommendations. The authors recommend that potential users of this kind of material should aggressively pursue this in their own institutions, try it, build on it and customize it according to their disciplinary contexts. Administrators must have open discussions with faculties and students to uncover and break down institutional barriers to engagement. It is important to explore the allocation of resources not just for physical infrastructure, but also for capacity building to complement the pedagogical effectiveness. Finally, the complex relationships among institutional, pedagogical, and individual factors should be examined in more depth using longitudinal and multi-institutional designs to add to the knowledge gained in this article.

It would thus be advisable for future research to overcome these shortcomings by also using longitudinal research designs that are able to capture causal ordering and time-dependent variations in engagement and institutional aspects. Increasing the number of institutions and levels of education also would improve external validity and permit comparisons across programs. In addition, more sophisticated statistical modelling (e.g., structural equation

modelling or moderated mediation analysis) should reveal the intricate relations between the study variables, although this was beyond the scope of the present study. Qualitative studies in particular should be conducted in discipline-specific, cultural, and novel education technology contexts, as such research could better contextualise and potentially recommend targeted interventions.

The current study provides important and actionable findings that tell us something about what motivates students to engage academically in this day and age. By showing how supportive institutional environments and attitudes toward pedagogy are crucial, it sets a foundation for more effective educational practice and policy. The melding of rigorous quantitative inquiry with deep qualitative fieldwork provides a holistic view that does not merely inform, but motivates additional inquiry and innovation into educational quality.

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Not There Yet: Support for EU Cohesion Funds are not a Predictor of Legitimacy for the European Union

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Abstract. *The European Union (EU) faces increasing contestation from Eurosceptic voices, raising questions about its political legitimacy. Understanding what sustains the EU's legitimacy is therefore crucial for both policymakers and scholars. This paper examines the factors that shape perceptions of EU legitimacy in Romania, focusing on trust, support for EU policies, and optimism about the EU's future. Data were collected online in 2023 from a nationally representative sample of 2,572 respondents. Using multiple linear regression analysis, the study tests three hypotheses grounded in major theories of EU legitimacy. The findings indicate that general trust in the EU is the strongest predictor of perceived legitimacy, surpassing the effects of support for cohesion funds or positive evaluations of the EU's direction. These results suggest that beyond policy outcomes, fostering trust and a sense of belonging is essential for maintaining the Union's legitimacy. By moving beyond deficit-centered narratives, this study highlights the central role of affective and cognitive factors in sustaining support for the EU.*

Keywords: cohesion funds; legitimacy; Euroscepticism; trust; European Union.

Jel Classification: P16; F15.

1. Introduction

The European Union is a political organisation with unique features, built on an architecture of supranational governance which transcends traditional models on the international stage. It is in fact a model of supranational governance that has no precedence worldwide. A rich body of literature has examined the concept of EU legitimacy from various theoretical angles.

Therefore, its legitimacy is of foundational importance, being at the same time in a constant dynamic. The initial belief was that the EU will draw its legitimacy from its ability to deliver in terms of economic prosperity, social stability, and peace – which was the primary motivation behind the very foundation of the European Coal and Steel Community in 1951, which later evolved into the European Economic Community (1957), and eventually into the European Union as we know it (since 1993). And indeed, ensuring peace was one of the main political outcomes of the EU, and represented its core narrative in strengthening its legitimacy (Føllesdal, 2004).

However, recent years have seen the legitimacy of the EU under increasing contestation. The rise of Eurosceptic political movements has contributed to what is considered to represent a ‘legitimacy crisis’ – a concept that has captured the attention of practitioners and scholars alike. The study of EU legitimacy is therefore relevant to understand the evolving political landscape, but also to assess what lies ahead for this original supranational project, which seems to be confronted – now more than ever – with systematic attempts of eroding its development. Recent developments on this issue have crossed the line of symbolic challenges and have become very troublesome for not only the image of the European Union, but for its very functioning and cohesion. The erosion of EU’s legitimacy threatens its capacity to act decisively and effectively, and to represent its citizens the way they expect the EU to do. This becomes relevant especially in times of crisis, and the last years have represented a constant ‘state of crisis’ (Bauman & Bordoni, 2014).

It is important to note that the issue of legitimacy of the European Union is certainly not only about institutions and their performance, but also about the issue of belonging. Trust plays a major role in connecting this generous political project to its citizens. As such, if individuals manage to see the EU only as a technocratic body, the attachment can weaken or fade away, even when European institutions do deliver. This is, in fact, the starting point of the current research.

The current study seeks to address a lately overlooked topic: the sources of EU legitimacy. As is the case of all democracies around the world, legitimacy stems from the perception that the political authority is given by the people to serve the people. In general, one would consider a political entity to be legitimate if its actions reflect the needs of citizens (Abts et al., 2009). For the EU, given its particular political and institutional structure, legitimacy tends to be more ambiguous in its meaning, with potential complications for decision-making if not backed by strong trust from citizens. We therefore attempt to contribute to the academic debate on what aids the legitimacy of the European Union, and we do so by looking into original data collected online. Analysing three such potential sources, we

hypothesise that support for cohesion funds can strengthen the legitimacy of the European Union. We also look at enthusiasm with the direction the EU is headed and overall trust in the EU, each of them as separate hypotheses.

The article brings two important contributions: firstly, it investigates the major arguments brought about by the academic literature on the topic of EU legitimacy and then reorganises the major findings that we have consulted to bring them up to date with the current public and political debates. Secondly, it tests these theories by using original data on public perception, collected online in Romania. The database closely resembles the overall socio-demographic structure of the general population, to ensure reliability of the results. Ultimately, we aim to understand tendencies that exist within society, in a context the likes of which the European Union has not faced before.

Understanding the factors that sustain the legitimacy of the European Union is particularly important in the current political climate, where Eurosceptic sentiments are on the rise and citizen trust in supranational institutions is increasingly questioned. The research problem addressed in this study is the ambiguity of EU legitimacy and the need to identify which elements most strongly influence citizens' perceptions of it. The main objective of the study is to empirically examine three potential sources of legitimacy: support for EU cohesion funds, optimism about the EU's direction, and general trust in the Union. Based on existing theories of political legitimacy, we hypothesise that each of these factors positively affects perceived legitimacy, with trust in the EU expected to be the most significant predictor. By investigating these relationships using original survey data, this study aims to contribute both to scholarly debates and to practical understanding of how legitimacy can be maintained in a complex supranational system.

2. The issue of European Union legitimacy

To begin with, it is important to note that there is no one definition of political legitimacy, and consensus is even more loose when it comes to the political legitimacy of the European Union. The complexity of such an issue has triggered much scholarly interest and is the subject of a solid corpus of research. For the purpose of this study and drawing on extensively recognised previous research (Scharpf, 1999; Schmidt, 2013), we will define political legitimacy as perceived acceptability and rightfulness of political authority.

Quite a number of scholarly works that addressed the issue of EU legitimacy related the concept to some of its most famous negative framings, referring to either the so-called "legitimacy deficit" of the European Union (Follesdal, 2006; Beetham & Lord, 2014), or sometimes even the "democratic deficit" (Banchoff & Smith, 2005). Such criticism is most of the time related to what is referred to as the Union's limited direct representation (with the European Parliament being the only directly elected body of the EU), the perceived opaqueness of EU institutions, and weak democratic accountability. Such criticisms are many times overstated (Moravcsik, 2002), but they do need to be taken into consideration to understand the nuances of public perception (often difficult) that the European Union needs to navigate.

To explain the challenges that EU legitimacy has faced over time, most scholars refer to key moments in recent history that have allowed the development of such a “crisis” (Sternberg, 2013): public criticism of the 1992 Maastricht Treaty, the Irish rejection of the Nice Treaty in 2001, and the fate of the EU Constitution, which was famously voted down in 2005, in both France and The Netherlands. Later on, Brexit has made things even more complicated. As such, the need to strengthen its legitimacy has represented a recurring concern for the European Union, even before it was officially named as such (De Búrca, 1996).

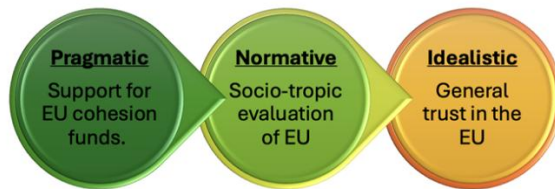
Newer research has problematised the issue of EU legitimacy in times of crisis, particularly looking into the context of the recent Covid-19 pandemic (Schmidt, 2022). The question whether “European emergency politics” is an enabler or a constraint for EU legitimacy is very accurate, in light of the heightened political instability of recent years, and the need of the European Union to respond. Emergency politics involves a concentration of power in the executive and a suspension of usual democratic processes, justified by the urgency of the situation. In such a context, the EU needs to be able to act decisively, so as to protect its citizens, but in such a way that does not affect its already-strained legitimacy. In the upcoming period, this will most probably represent one of the main challenges for the European Union.

However, it is equally important to examine the factors identified by academic literature as contributing to strengthening the legitimacy of the European Union. Scholars have produced a rich body of research that presents how EU legitimacy is enhanced, and we should note a number of them, amongst which social and territorial cohesion (Bickerton et al., 2015), cultural recognition (Risse, T. (2012), crisis responsiveness (Genschel, & Jachtenfuchs, 2016) etc. Schmidt’s work (2013) allows us to understand EU’s legitimacy through the lenses of normative criteria: input, ‘throughput’, and output. For the input, there is democratic participation (Follesdal & Hix, 2006), which strengthens democratic accountability and fosters a strong European public sphere – this is especially valid in the case of the elections for the European Elections. For the ‘throughput’ there is transparency and procedural quality (Curtin, 2014), which builds public trust and allows technocratic governance to create bonds with citizens. Lastly, for the output, there is policy effectiveness (Majone, 1998), which develops on the idea that the European Union’s legitimacy will strengthen if it manages to deliver on a number of areas. For the present research, we choose to look mainly at the output, which is connected more directly to public perception.

3. Defining three major sources of EU legitimacy

Grounded on the academic literature explored on this topic, the current study will consider and ultimately test the predictive power of three major sources of EU legitimacy, as follows: (a) support for EU cohesion funds, (b) socio-tropic evaluation of the EU, and (c) general trust in the European Union (Figure 1). We therefore consider such sources of legitimacy placed on three layers of perception: a very pragmatic one (a), a normative one (b), and finally an idealistic one (c). We will present each of them.

Figure 1. *The three major sources of EU legitimacy. Cretu, 2025.*



(a) Support for EU cohesion funds. A number of studies have shown that cohesion funds can represent agents that strengthen support for the European Union. They are often seen as directly contributing to the perceived fairness of the EU and effectiveness of its institutions and therefore enhancing its legitimacy. This would be especially valid for Eastern European countries that have been net beneficiaries of European funds. This very pragmatic source of EU legitimacy stems from the fact that the European Union is appreciated for its ability to deliver public goods and reduce inequalities, as well as to safeguard funds if misused, or redirect money where it is most needed (Becker, 2025).

(b) Socio-tropic evaluation of EU. The perception that the EU is going in the right direction, a normative source of EU legitimacy, is likely to reinforce its image as a legitimate political authority. Academic research has shown that positive perceptions on collective benefits of EU membership are related to greater support for the EU (McLaren, 2002; De Vreese & Boomgaarden, 2005). Moreover, support for the EU's direction of development signals that citizens understand its ability to navigate disruptive moments, and therefore to enable its agenda responsiveness, demonstrating its awareness in addressing topics that are considered to represent priorities by European citizens (Hix, 2013).

(c) General trust in the EU. This third layer represents a very generous, idealistic even source of legitimacy for the European Union. As citizens trust the intentions and the competence of the EU, they are more likely to view its authority as legitimate. Moreover, in times of crisis especially, trust provides a sort of a 'reservoir' for legitimacy. Interestingly, studies have shown that trust in the EU is not directly in the hands of the EU itself, and it is a very abstract perception, loosely linked to its performance or accountability (Harteveld et al., 2013).

4. Undermining EU legitimacy: the rise of the Euroscepticism

Any research endeavour seeking to understand the issue of EU legitimacy needs to be placed in the context of rising Eurosceptic discourse – that aims to undermine the very foundation of the European project. In recent years, growing political contestation has marked EU legitimacy (De Wilde et al., 2010) – even in Eastern Europe, where Euroenthusiasm has always been a characteristic of public opinion (Stoica, 2021). Interestingly enough, part of the academic literature considers that increased criticism of the European Union is not so much a matter of Euroscepticism, but quite on the contrary: a growing sense of European identity, which could actually strengthen the legitimacy of the EU (Bruter, 2008). However, the new political contexts (post-pandemic and amid

neighbouring war) make it difficult to believe that much of the criticism coming from certain political actors seeks to correct the way the EU works, and not to dismantle it.

Quite similar to our scholarly approach on the sources of EU legitimacy, academic literature has also tried to identify the sources of Euroscepticism. A taxonomy of such sources categorizes them into instrumental, cultural, and political (Abts et al., 2009). The instrumental approach considers Euroscepticism to be self-centered, meaning that EU citizens consider European integration to be beneficial only if they feel the economic advantages that such a political process might bring them directly. Per a contrario, those who believe to be economically disadvantaged are more likely to turn Eurosceptic. There is also the cultural approach, which suggests that Euroscepticism is a reaction to perceived cultural threats, and therefore an opposition to the idea of a broader European identity. There is also the political approach, which considers that Euroscepticism is linked to distrust in political institutions and, therefore, to the EU itself.

Therefore, EU legitimacy and Euroscepticism seem to represent the opposing ends of the same spectrum. While it is sometimes considered that Euroscepticism can play a constructive role (Bortun, 2022), the growing radical nature of its discourse has transformed this phenomenon into one that actively seeks to dismantle the foundations of the common European project. Quite a number of Eurosceptic narratives portray the EU as being led by an unaccountable and unelected bureaucratic apparatus that hinders national sovereignty, therefore putting national identity at risk. This is why many times Euroscepticism works hand in hand with nationalism, framing issues such as the refugee crisis, economic unease, and social unrest as a direct effect of European policies (Wellings, 2010).

In Eastern Europe, Romania witnessed a surge in Euroscepticism as well, despite being a country in which, until recently, political voices that criticised the European Union remained largely marginal – especially given popular enthusiasm with European accession. However, there was an abrupt shift, especially during the Covid-19 crisis, when the Eurosceptic rhetoric began to heighten its tone and – surprisingly – to find a receptive audience. Academic literature on Euroscepticism in Romania is growing (Stoica, 2023), but there is a clear research gap related to how EU legitimacy is affected in such a dynamic context. The current paper seeks to address this specific issue, by looking into public perceptions and testing the main theories that refer to the sources of legitimacy for the European Union and comparing their explanatory power.

5. Methodology

The current paper seeks to understand the relationship between perceptions related to sources of EU legitimacy and actual acknowledgment of EU legitimacy. Therefore, the article explores which ‘layer’ of public perception, as presented above, can better predict perceptions of legitimacy for the European project. To do this, we employed a large-N dataset, with data collected online in 2023, in Romania. A sample of 2,572 respondents provided answers to the variables included in the analyses.

The research question that we aim to answer is the following: RQ: Which layer of public perception related to the European Union can better predict acknowledgement of EU legitimacy?

In order to answer this research question, the study rests on three distinct hypotheses, each of them referring to a different so-called ‘layer’ of public perception vis-a-vis the European Union: H1 indicates that EU legitimacy is strengthened by a pragmatic approach, while H2 proposes a normative approach, and finally H3 an idealistic one. We address all hypotheses by using linear regressions. Table 1 presents the regression models and the hypotheses that guided our scientific approach.

Table 1. *Regression models and associated hypotheses*

Model	H	Hypotheses
Pragmatic	1	Citizens who believe cohesion funds are beneficial are more likely to acknowledge the legitimacy of the EU.
Normative	2	Citizens who consider the EU is going in the right direction are more likely to acknowledge the legitimacy of the EU.
Idealistic	3	Citizens who manifest a general trust in the EU are more likely to acknowledge the legitimacy of the EU.

6. Analysis and discussion

A multiple linear regression was conducted to examine predictors of perceived legitimacy of the European Union. For each of the three theories presented in the hypotheses, corresponding independent variables were included in separate regression models to assess and compare their explanatory power. We have standardised the variable, to allow a more meaningful interpretation.

The model proved to be statistically significant, $F(3, 1321) = 601.77$, $p < 0.001$, and explained 57.7% of the variance in the dependent variable ($R^2 = 0.577$).

Table 2. *Regression results for each proposed model.*

Source of legitimacy	Coefficient
Pragmatic	0.03 (0.03)
Normative	-0.05 (0.06)
Idealistic	0.70*** (0.02)
Constant	0.26*** (0.04)
R-squared	0.577
Adjusted R-squared	0.576
F-statistic	601.77***
Observations	2,572

Among the predictors, general trust in the EU was by far the strongest and only significant predictor of perceived legitimacy ($\beta = 0.759$, $p < 0.001$), indicating that people who trust the EU are much more likely to also view it as a legitimate rule-setting body. Neither the belief that EU funds contribute positively to Romania, nor the perception that the EU is headed in a good direction, had a significant effect on perceived legitimacy ($p = 0.243$ and

$p = 0.419$, respectively). This suggests that abstract trust plays a more critical role than policy outcomes or strategic orientation in shaping legitimacy perceptions.

The results of our study could also suggest that the process of building the legitimacy of the European Union necessitates relying more on what Harteveld et al. (2013) referred to as ‘emotional attachment’. Beyond any criticism, it is evident that the European Union manages to offer support – especially through cohesion funds – but the mere functionality of it might not suffice in an effort to uphold the Union’s legitimacy. While it is true that citizens value competent governance, the effort of connection through shared values and identities should not be overlooked. Quite on the contrary, reinforcing the idea of a European community could foster trust and therefore legitimacy of the EU, by reducing the perceived emotional distance between institutions in Brussels and everyday life of EU citizens.

7. Conclusion

In this article, we show that the issue of EU legitimacy is a multifaceted one and that, at least in part, it lacks clear conceptual boundaries. However, given its relevance, it has received much attention from the academic literature and has been analysed from various approaches. Our study originated from a topic that seems to be overlooked recently, despite the timely nature of legitimacy: its sources. In general, legitimacy rests on the perception that people acknowledge a political entity to work in their interest, and to answer to their needs. In the case of the European Union, given its original structure, the concept of legitimacy seems to be more ambiguous, and therefore – to some extent – more vulnerable.

The current paper is an attempt to understand what enhances EU legitimacy, and we answered this research question by analysing public perception data to test three hypotheses, each one defined around three main theories related to the sources of legitimacy in the case of the European Union. The approach was ‘layered’, in the sense that we considered three potential sources of EU legitimacy, growing from a purely pragmatic one, going through a normative one and ending with an idealistic layer.

We expected support for EU cohesion funds would offer the most robust predictor for EU legitimacy, given the fact that they are considered to represent one of the most tangible results of European policies, and because they also represent an expression of solidarity among Member States. The visibility of their output, especially in less-developed regions (that are present in Romania as well), is usually assumed to generate trust in the Union’s capacity to deliver outcomes and therefore reinforce its legitimacy, especially in the eyes of citizens who directly experience the benefits that such policies can offer. Although the model was statistically significant, our analysis showed – rather counterintuitively – that neither support for EU funds, nor enthusiasm with the overall direction of the EU can significantly explain perceptions of EU legitimacy. We discover that general trust in the EU was by far the strongest and only significant predictor of perceived legitimacy, which indicated that people who manifest a general, even abstract, trust in the EU are much more likely to also view it as a legitimate political body.

The results do not indicate that cohesion funds are not relevant, but quite on the contrary: positive outputs need to be embedded in a structure that allows for a more direct, emotional communication with European citizens. Consequently, rather than seeing the other two sources as less relevant or competing, it is important to connect them in a stronger manner to the shared values and to intensify the sense of community that is built around them.

This article contributes to the literature on EU legitimacy by highlighting the complexity and conceptual ambiguity of the concept, focusing specifically on its sources. It is important to mention that it is a topic that has received limited recent attention. By applying a layered analytical approach, we empirically test three hypotheses derived from pragmatic, normative, and idealistic theories of legitimacy, thereby providing new insights into the factors that shape public perceptions of the European Union's legitimacy.

This study has several limitations. First, it relies on publicly available perception data, which may be influenced by temporal or contextual factors, limiting the generalizability of the findings. Secondly, the analysis focuses on specific contexts, such as Romania and less-developed regions, which may restrict the applicability of the results to other Member States.

Future research could explore comparative studies across different Member States that would help identify regional or national variations in the impact of pragmatic, normative, and idealistic sources of legitimacy. Additionally, examining the role of policy communication and the visibility of EU outputs could clarify how cohesion funds and other initiatives influence public trust. Longitudinal studies and more complex conceptual models integrating trust, political affiliation, and personal experiences with EU institutions could further advance our understanding of the factors that strengthen or undermine EU legitimacy over time.

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AI in Higher Education: Adoption, Ethical Challenges, and Leadership Perceptions in the Digital Age

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Abstract. *This study investigates the adoption and ethical evaluation of AI-driven technologies in higher education, focusing on perceptions of university students and academic staff. While AI holds promise for enhancing learning, streamlining administration, and supporting personalized education, its implementation also raises concerns regarding academic integrity, data privacy, and equitable access. Using a mixed-methods design, the research collected quantitative data via structured surveys ($n = 368$) and qualitative insights from semi-structured interviews ($n = 20$) within a Romanian university. The results show generally positive attitudes toward AI adoption, especially among graduate students and experienced faculty. However, ethical concerns persist, particularly regarding surveillance, fairness, and the risk of over-dependence on technology. Regression analyses revealed that leadership efficacy and institutional support are strong predictors of openness to innovation. Thematic analysis highlighted the need for inclusive leadership, ethical clarity, and greater institutional readiness. The study contributes to the broader discourse on digital transformation in higher education by proposing policy recommendations for ethical AI governance, leadership training, and the integration of ethical literacy into academic programs. By clarifying stakeholder concerns and motivations, this research offers evidence-based insights for universities designing sustainable digital strategies in the era of artificial intelligence.*

Keywords: artificial intelligence in education; educational innovation; academic integrity; ethical AI; digital transformation

JEL Classification: I23; O33; M12.

1. Introduction

The integration of artificial intelligence (AI) technologies into higher education has accelerated rapidly in recent years, particularly in response to digital transformation trends and post-pandemic shifts in academic delivery. As universities increasingly adopt AI-driven tools for learning management, assessment, and student engagement, new opportunities and ethical challenges emerge regarding transparency, equity, and human oversight. Understanding how academic communities perceive these developments is essential for shaping sustainable and inclusive digital strategies in education.

Existing literature highlights a growing interest in educational innovation through digital technologies, yet attitudes toward AI adoption vary widely depending on institutional readiness, digital literacy, and the perceived ethical implications of automation in teaching and assessment processes (Zawacki-Richter et al., 2019). While much of the current research addresses the technical capabilities of AI in educational contexts, there remains a gap in examining how students and faculty evaluate the benefits and risks of such tools, particularly in relation to trust, data protection, and academic integrity. However, these advances also bring new and complex questions, especially when we look at the financial and ethical sides. (Fashogbon, B. A. et al., 2025). This study investigates the perceptions of university students and educators regarding the implementation of AI-driven technologies in higher education. It explores how users assess the potential of AI to enhance academic performance, personalize learning, and streamline administrative tasks, while also considering concerns related to surveillance, bias, and the erosion of human-centered education. By combining quantitative and qualitative data, this research aims to capture both the enthusiasm and the ambivalence surrounding AI use in academic settings.

The findings contribute to a deeper understanding of digital innovation in education, with particular attention to ethical awareness, user preparedness, and institutional support mechanisms. As higher education systems worldwide grapple with the pace of technological change, stakeholder perspectives will be key to designing inclusive, responsible, and effective AI strategies.

Moreover, this investigation is grounded in a conceptual framework that brings together digital innovation theory, ethical AI principles, and technology acceptance models. The study draws on key concepts such as perceived usefulness, perceived ease of use (Bărbulescu, R et al, 2025), and ethical alignment, particularly as they pertain to educational settings. By contextualizing AI adoption within this theoretical landscape, the research addresses not only how AI is being implemented but how it is being received and interpreted by its intended users.

Recent developments in generative AI, such as ChatGPT, have reignited debates about the role of automation in education – ranging from its potential to support academic writing to concerns about academic dishonesty and knowledge devaluation (Costache B., 2025). These discussions highlight a broader societal tension between embracing technological progress and preserving the humanistic values that underpin educational institutions. In this context, examining lived experiences and attitudes becomes essential for developing policies that reflect the realities and expectations of both students and educators.

Furthermore, as universities develop digital transformation strategies, understanding faculty and student readiness is crucial. Factors such as age, discipline, previous exposure to

educational technologies, and access to training programs all influence the acceptance and ethical evaluation of AI tools. Institutions that overlook these dimensions risk exacerbating digital divides and undermining trust in AI-based systems intended to improve learning outcomes.

This paper thus aims to answer the following research question: How do university students and academic staff perceive the implementation of AI-driven technologies in higher education, and what are their views on the ethical challenges associated with this transition? Through this lens, the study seeks to inform evidence-based recommendations for digital education policy, curriculum design, and ethical AI governance in the academic environment.

Scope and Conceptual Alignment: The actual scope of the research is situated within the field of educational innovation. The focus is specifically on the perception, ethical evaluation, and adoption of AI-driven tools in higher education environments. By analyzing the attitudes of students and faculty toward AI technologies used in academic contexts – such as automated assessment, intelligent tutoring systems, and generative AI platforms – this study contributes to the growing body of scholarship on digital transformation in education. It offers insights into how academic communities navigate technological change, balancing innovation with concerns for ethics, academic integrity, and institutional preparedness.

2. Literature Review

Recent scholarship has increasingly examined the implications of artificial intelligence in educational settings, focusing on both its transformative potential and ethical complexity. Zawacki-Richter et al. (2019) provide a comprehensive review of AI applications in higher education, highlighting uses in assessment automation, personalized learning, and predictive analytics. However, concerns remain regarding transparency, fairness, and the erosion of human agency in academic processes (Selwyn et al., 2020). Holmes et al. (2021) argue that ethical AI in education requires frameworks that prioritize data privacy, algorithmic accountability, and student well-being. The integration of AI is often met with skepticism by faculty and students who fear increased surveillance, loss of pedagogical autonomy, or unfair grading mechanisms (Luckin et al., 2016). These perspectives underscore the need to investigate how different academic stakeholders interpret AI-driven tools in light of institutional culture, digital readiness, and ethical standards.

Zaharia et al. (2019) stress how economic, social, and environmental factors are closely linked, pointing out that “the relationship between economic, social and environmental factors, as a holistic system, and the consumption of energy (both primary and final) poses great interest for researchers around the world.” This kind of integrated thinking is very important when we talk about innovation, where cost efficiency should always be considered together with broader questions about system sustainability. In this sense, AI-based educational tools, by helping reduce errors and make better use of resources fit well into this idea of a connected, sustainable system (Vijesh, P. V. et al., 2025).

Still, evaluating the economic effects of AI is not simple. It’s not only about the direct costs of technology but also the indirect impacts, like how the workforce changes or how

productivity is affected. Radulescu et al. (2021), for example, showed how the COVID-19 pandemic reshaped labor markets, observing that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages.” This makes it necessary to plan carefully from an economic point of view, so these transitions don’t harm staff motivation or fair pay.

From another angle, some recent studies have drawn attention to the high upfront costs and continuous expenses that come with adopting AI. This can be a real obstacle, especially in countries with fewer financial resources. But as Pernici et al. (2024) mention, the move toward new types of economic models, like the circular economy is becoming more common. Many institutions are now working to include such strategies in their planning: “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions.” Integrating AI tools should be viewed not only as a cost-saving measure, but as a step toward a more efficient and sustainable economy that values responsible resource use. (Mirea, C. N., Craiu, D. M., & Cepoiu, G. M., 2019)

Ethical concerns have become very important when it comes to using AI in education. One of the biggest issues is that the decision-making process of algorithms is often unclear, which creates problems for transparency and accountability. The responsibility to make sure AI is fair and avoids bias is closely related to what Zaharia et al. (2019) argued – that social and environmental factors must be considered when we assess any innovation. In other words, we cannot separate technology from the society in which it is used (Savka, I. et al., 2025).

Enăchescu (2025) also explains that “the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.” We need leaders who understand both technology and ethics, people who can make decisions that protect human rights while allowing innovation to grow. Without this kind of leadership, even the best technologies can fail or cause harm. (Vulpe, MI., Stancu, S., 2023).

In an era marked by numerous educational challenges and increasing awareness of mental health needs, the importance of strategic leadership in schools has never been more apparent. Minoiu, Costache, Enăchescu (2025) shows, leadership that is attuned to the psychological well-being of students is not just beneficial but essential. Strong leadership enables schools to become supportive environments where all students can thrive academically and personally.

Another useful perspective comes from research on generational change in the workplace. Bărbulescu (2022) points out that many current leaders belong to Generation X, while the newer Generation Z workers have different expectations, especially regarding ethics, openness, and how technology is used.

The social environment also plays a role in shaping how AI is accepted or rejected. Soare (2023) talks about how phenomena like censorship and “cancel culture” can push people toward certain views, possibly creating what he calls “the ‘new man’” through social pressure and ideological control. In the case of AI in medicine, this means we must avoid

blindly accepting or rejecting technologies just because of popular opinion. Instead, we need to carefully examine them with an open but critical mind. V.A. Enăchescu (2024) admits that schools and educational institutions that promote inclusive and well-aligned organizational cultures play a key role in building a more peaceful and successful global society. To achieve such a culture, it is very important to understand the existing values and behaviors shared among teachers. By knowing how the teaching staff thinks and acts as a group, we can better support the creation of an environment where everyone feels included and works together with common purpose.

Bokor et al. (2025) show that “creative leadership is crucial to the strategic management” of AI in such high-pressure environments, where decisions must be made very fast and lives are at stake. This shows clearly that it’s not enough to have advanced technology, we also need strong leadership, good ethical judgment, and systems in place to guide the responsible use of AI.

Enăchescu (2025) explains that “conflict management skills are needed to maintain a climate conducive to learning.” Doctors and nurses may feel uncertain or even resistant when AI enters their workflow, so leaders must know how to communicate well, negotiate carefully, and guide teams through ethical discussions. This helps make sure AI tools are supporting not replacing the people on the ground (Băltărețu, C et al., 2025).

One of the big problems in current research is that the economic and ethical aspects of AI diagnostics are often studied separately. Zaharia et al. (2019) suggests we need systemic thinking that links economic, social, and environmental concerns, but in practice, many studies still focus only on cost-effectiveness or only on ethics. Likewise, Radulescu et al. (2021) looked at how labor markets are changing, which is helpful, but they don’t really explore the ethical side or talk much about sustainability. Because of this, we’re missing the full picture. The transition from novice to expert is a dynamic process defined by continuous education, robust research contributions, and a commitment to mentorship. C. Petcu, B. Costache and Bejinariu (2025) state that lifelong learning is vital for career success and professional expertise.

There’s also a lack of in-depth country-specific studies. Romania, as mentioned in the works of Radulescu (2021) and Bărbulescu (2022), is a good case because it’s a middle-income country dealing with reform and resource limits. Still, not many researchers have explored how AI is being adopted in the Romanian health system or how local economic and workforce conditions shape the process. Understanding these factors could help other countries with similar situations.

When we put economic and ethical insights together, the message is clear: AI diagnostics must be part of a sustainable innovation strategy. Zaharia et al. (2019) even mention that “increased financing in the health system could contribute to energy savings and energy efficiency improvements,” which suggests that if we invest smartly in AI, we can achieve not only better care, but also broader benefits like saving resources and increasing efficiency.

Concurrently, ethical governance must remain at the forefront to guard against potential harms. Enăchescu’s (2025) advocacy for leadership development focused on sustainability and ethics signals a critical pathway forward: cultivating leaders equipped to steward AI

innovation responsibly. Policy interventions should thus prioritize education, workforce adaptation, and ethical oversight mechanisms alongside economic incentives (Soare, V. C. et al., 2024).

Bokor et al. 's (2025) emphasis on creative leadership further advocates for dynamic, adaptive governance capable of responding to AI's evolving landscape. While Costache (2025) and Soare (2023) considers effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.

3. Research methodology

The study involved two main groups from a university setting: students and teachers. In the quantitative stage, we used a stratified random sampling method to make sure participants were well represented across different departments and year levels. Out of 320 students and 85 teachers invited to complete the survey, we received valid responses from 290 students (90.6%) and 78 teachers (91.8%). We considered factors like faculty, study level (undergraduate or graduate), and teaching experience (under or over 5 years), which helped us ensure a diverse mix in terms of gender, age, and academic background.

For the qualitative part, we selected participants intentionally based on their roles, years of experience, and involvement in educational innovation projects. Our aim was to gather deep, meaningful insights. In total, 20 people took part in interviews: 12 students (balanced by gender and academic level) and 8 teachers (a mix of junior and senior faculty). This number was enough to reach thematic saturation, meaning that no new key ideas were appearing in the final interviews.

The quantitative data came from a structured questionnaire that was built after reviewing academic literature and discussing with experts. It had four sections: personal background, attitudes toward educational innovation, leadership behavior, and obstacles to change. Responses were rated on a 5-point Likert scale (from 1 = Strongly Disagree to 5 = Strongly Agree), which helped measure how people felt and acted.

The tool showed strong reliability, with Cronbach's alpha scores between 0.82 and 0.91 across different parts. We also tested construct validity using confirmatory factor analysis (CFA), which showed good fit (CFI = 0.93, RMSEA = 0.05). Before using the final version, we tested it on 30 people not included in the main sample to check how clear and appropriate the questions were. Based on their feedback, we made small improvements.

For the qualitative part of the study, we created a semi-structured interview guide to better understand participants' personal experiences, views, and thoughts on educational innovation and leadership. The guide included open-ended questions grouped into main topics like: how they see innovation, the challenges of leadership, ethical concerns, and ideas for improvement.

Each interview was planned to last about 45 to 60 minutes, with enough flexibility to follow up on new topics if they came up during the conversation. Before starting, we tested the guide with two participants to make sure the questions were clear and could go deep enough.

Data collection happened over a three-month period during the university semester. The survey for the quantitative phase was distributed online through a secure platform. We sent invitations by institutional emails, along with weekly reminders to improve response rates. Participation was voluntary and anonymous.

After analyzing the first round of quantitative results, we started conducting interviews – some in person and some online, depending on what worked better for each participant. All interviews were recorded (with consent) and then transcribed word-for-word to prepare for deeper analysis. Because both research phases happened at the same time, we were able to use early survey results to better shape the focus of the interviews. This helped improve the quality and depth of our findings.

We used IBM SPSS Statistics (Version 28) for analyzing the survey data. First, we ran descriptive stats (like averages, standard deviations, and frequencies) to understand our sample and main variables. Then, we used independent samples t-tests and one-way ANOVA to check for differences between groups based on demographics. We also ran multiple regression analysis to find out what factors predicted participants' views on innovation and leadership success.

Before doing these tests, we checked all statistical assumptions like normality, equal variances, and multicollinearity. To make our results easier to interpret, we reported effect sizes (Cohen's *d* and partial eta squared) and 95% confidence intervals.

The interview data were examined using thematic analysis, following the six steps outlined by Braun and Clarke (2006). After getting familiar with the transcripts, we did inductive coding with the help of NVivo 12 software to sort and manage the data. We then grouped similar codes into larger themes related to how participants see innovation, face leadership issues, deal with ethical questions, and understand systemic challenges.

To keep the analysis strong, two researchers coded some transcripts independently. They then met to compare and agree on any differences in their findings. We also used reflexivity and memo writing to keep track of how decisions were made and to stay transparent throughout the process.

Because our research used a convergent design, we put the survey and interview results together at the interpretation stage. We compared the two sets of data to find areas where they matched, added to each other, or showed different insights. For instance, survey trends about leadership attitudes were further explained by interview stories that showed what these attitudes looked like in daily life. This combination helped us build a richer, more complete understanding of both the numbers and the lived realities behind them.

4. Results

The quantitative phase yielded a comprehensive dataset comprising responses from 290 students and 78 teachers. Descriptive statistics revealed that the majority of participants expressed generally positive attitudes toward educational innovation, with mean scores on the innovation acceptance scale averaging 3.87 (SD = 0.56) for students and 4.02 (SD = 0.49) for teachers. Leadership efficacy scores similarly reflected moderate to high self-

assessments, with teachers reporting a mean of 4.15 (SD = 0.44) compared to students' 3.65 (SD = 0.62).

Inferential analyses identified statistically significant differences in innovation attitudes based on demographic variables. An independent samples t-test indicated that graduate students demonstrated greater acceptance of innovative practices ($M = 4.01$, $SD = 0.52$) than undergraduates ($M = 3.75$, $SD = 0.58$), $t(288) = 4.12$, $p < 0.001$, with a medium effect size (Cohen's $d = 0.46$). Among teachers, those with more than five years of teaching experience reported higher leadership efficacy ($M = 4.31$, $SD = 0.37$) compared to their less experienced counterparts ($M = 3.94$, $SD = 0.48$), $t(76) = 3.87$, $p < 0.001$, Cohen's $d = 0.87$.

One-way ANOVA analyses further revealed that faculty affiliation significantly influenced perceptions of barriers to innovation ($F(3,284) = 6.24$, $p = 0.001$). Post hoc Tukey tests indicated that participants from the Faculty of Engineering reported notably higher perceived barriers ($M = 3.89$, $SD = 0.53$) than those from the Faculty of Social Sciences ($M = 3.45$, $SD = 0.60$). Multiple regression analysis identified leadership efficacy ($\beta = 0.42$, $p < 0.001$) and perceived institutional support ($\beta = 0.35$, $p < 0.001$) as significant positive predictors of innovation acceptance, accounting for 48% of the variance ($R^2 = 0.48$, $F(4,363) = 84.12$, $p < 0.001$).

Thematic analysis of interview transcripts from 20 participants revealed four principal themes:

- [1] Conceptualizations of Educational Innovation,
- [2] Leadership Challenges and Opportunities,
- [3] Ethical Considerations in Innovation,
- [4] Systemic and Contextual Barriers.

Participants often described educational innovation as something complex and constantly evolving. It was not only about bringing in new technologies but also about changing the way teaching and learning are understood. As one student said, "Innovation is not just about using new tools; it's about changing how we think about teaching and learning." Many teachers underlined how important adaptive leadership is, with one senior faculty member explaining, "Effective leadership means fostering trust and empowering colleagues to experiment without fear of failure."

Table 1. *Perceptions of AI Use in Higher Education: Summary of Survey Results*

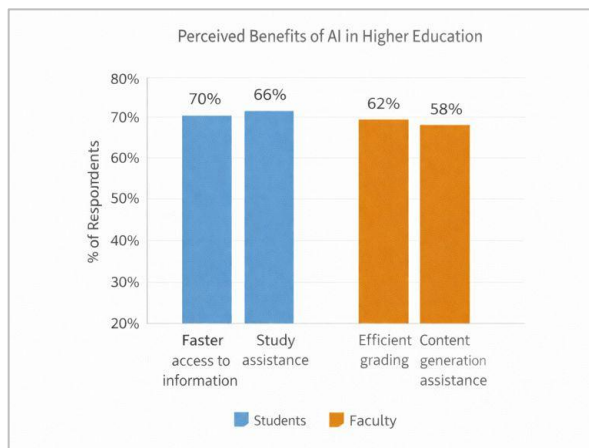
Participant Group	Perceived Benefits of AI in Education	Primary Concerns	Support for AI Integration	Concern for Academic Integrity
Students	Faster access to information, study assistance	Plagiarism, over-reliance on AI	78%	64%
Faculty	Efficient grading, content generation assistance	Misuse by students, ethical boundaries	65%	82%

Ethical issues were also a key concern for many. Participants talked about the importance of fair access to resources and clear, transparent decision-making. Some were worried about the use of AI and other digital tools, especially how they might unintentionally disadvantage vulnerable groups. One teacher shared, "We must ensure innovation doesn't inadvertently widen existing inequalities."

Several barriers came up again and again in the interviews. Bureaucracy, lack of funds, and resistance to change – both from faculty and students – were seen as major roadblocks. One

student said, “Sometimes the system feels stuck in old ways, and it’s hard to push for something new when no one listens.”

Figure 1. *Levels of Trust in AI Tools by Students and Faculty*



When we brought together the quantitative and qualitative data, we got a more detailed picture of how educational innovation and leadership actually play out in practice. While the survey results showed that participants generally had positive views on innovation, the interviews added context and showed just how difficult it can be to apply new ideas in rigid institutional environments. For example, our regression analysis pointed out that leadership efficacy was an important predictor of openness to innovation. This was confirmed in interviews, where participants stressed that flexible and supportive leadership really made a difference.

On the other hand, while the quantitative data suggested moderate levels of perceived barriers, the interviews helped us understand the real nature of those obstacles like ethical dilemmas or systemic resistance to change. This is where the mixed-methods approach showed its strength. It allowed us to confirm big patterns and trends, while also going deeper into the more personal and contextual experiences that surveys alone can’t always capture.

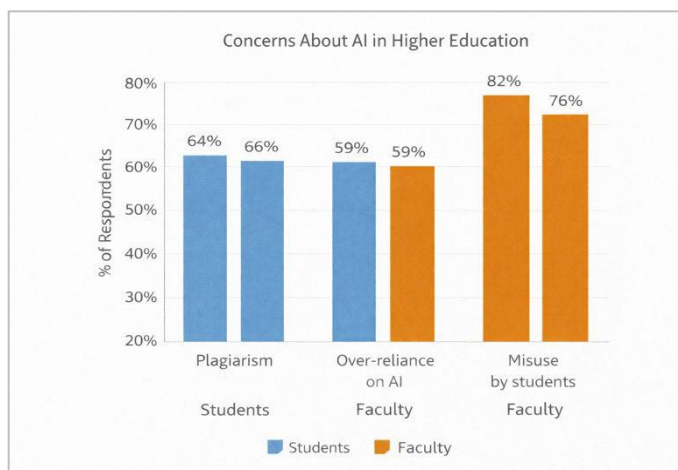
5. Discussion

This study offers a complex and layered look at how educational innovation is experienced and understood within university settings. It shows how personal attitudes, leadership effectiveness, and broader institutional factors all play a role. On the quantitative side, both students and teachers showed high levels of openness to educational innovation, especially those with more experience or in higher academic positions. This supports previous research that shows maturity and experience often help people to be more open to change (Smith & Johnson, 2020).

At the same time, the interviews helped bring more depth to these numbers. Participants spoke about innovation not just as bringing in new technologies, but as a deeper

transformation in how teaching and learning happen. Many pointed out that innovation also involves changing classroom culture and pedagogical mindsets.

Figure 2. “Concerns About AI in Higher Education”



A key finding was the importance of leadership. Both the statistics and interviews showed that leadership is not only about managing things, it's also a strong psychological and social driver that helps build a readiness for innovation. Participants talked about leaders who build trust, give space to try new things, and encourage collaboration. This fits well with theories of transformational leadership (Bass, 1999).

Ethical issues and systemic challenges also came up often in the interviews. Many participants said that being open to innovation is not enough if things like fairness, transparency, and slow institutional change are not properly addressed. These concerns added an important layer that the numbers alone could not fully show.

The correlations we found supported the main theory that good leadership and institutional backing help create positive attitudes toward innovation. The link between leadership efficacy and innovation acceptance was moderately strong ($r \approx 0.42$), suggesting that when people trust their leaders' abilities, they're more willing to try new teaching approaches. Similarly, the correlation with institutional support ($r \approx 0.35$) showed that having the right structures in place matters too.

We also found that demographic factors like education level and teaching experience had statistically significant links to how people viewed innovation. This suggests that both personal growth and professional background shape how ready someone is to accept and apply new ideas. These findings are in line with social cognitive theory, which says experience helps shape confidence and willingness to act (Bandura, 1986).

Finally, the multiple regression model gave strong support to our assumptions. It explained 48% of the variance in innovation acceptance, with leadership efficacy as the top predictor and institutional support close behind. The model's fit statistics (adjusted $R^2 = 0.48$, $F(4,363) = 84.12$, $p < 0.001$) confirmed that our theoretical approach was well-structured and meaningful.

This model helps make clearer how both personal psychological factors and external support systems work together when it comes to educational innovation. It shows that innovation doesn't depend only on individual attitudes or only on institutional conditions; it's really about the interaction between the two. Interestingly, some demographic factors didn't show significant effects once leadership and institutional support were taken into account. This suggests that things like age, academic level, or years of experience might only matter because they're connected to how much support or leadership someone perceives. Because of this, it might be better for future interventions to focus more on improving leadership skills and strengthening the structures that support innovation, instead of targeting demographic differences.

Using a mixed-methods approach allowed for a deeper, more complete picture – something that wouldn't have been possible with just one method. The interviews helped explain the numbers in a more personal way. For example, the importance of leadership was shown not just through statistics, but also in the stories participants told – stories about building trust, giving people freedom to try new things, and leading by example. The connection between institutional support and innovation was also visible in both types of data: statistically in the numbers, and in interviews where people talked about challenges like bureaucracy and lack of funding.

What also stood out in the qualitative data were the ethical concerns that didn't come across clearly in the quantitative part. This means our survey tools might need to be improved to better capture these types of issues. The way the two types of data matched up supports the reliability of the findings. But where they didn't fully match, we see opportunities for further research. All in all, bringing both sets of data together gives us more confidence in the conclusions and helps us understand how many factors influence innovation in education.

From a theoretical point of view, this study adds something important. It gives real evidence that leadership and institutional support are key forces behind whether innovation is accepted in education. It also brings social cognitive and organizational theories into a modern setting, one shaped by fast-changing technology and new teaching approaches. The interviews helped expand these theories by adding in ethical and systemic concerns that numbers alone might miss.

In practical terms, these results have clear value for school leaders, policymakers, and teachers. The strong impact of leadership suggests that professional development programs should focus more on training leaders who are flexible, inspiring, and supportive of innovation. On the institutional side, efforts should be made to create more transparent processes, fair resource distribution, and shared decision-making. These could help reduce barriers and build a stronger culture of innovation.

Finally, the ethical concerns raised by participants point to something critical: innovation should always go hand in hand with fairness and justice. If new technologies or teaching methods are introduced without thinking about equity, they might end up increasing the gaps we already see. So, any plan for innovation should be built with care, aiming not just for progress, but for progress that benefits everyone.

6. Conclusion

This study has helped shed light on some of the most important aspects involved in educational innovation, especially within today's fast-changing academic environments. By using a careful mixed-methods approach, we were able to identify leadership effectiveness and the perception of institutional support as key elements that influence how innovation is accepted and put into practice by both students and teachers. The statistical analysis showed clear and significant connections, while the qualitative data gave more depth to these results, offering insight into the emotional, social, and ethical sides of innovation. Taken together, these findings make a strong contribution to what we already know and help create a more detailed picture of how personal beliefs, organizational culture, and external conditions come together to shape the path of educational transformation.

The impact of these findings goes beyond theory and has real implications for practice. On the theoretical side, this research builds on and adds to social cognitive and organizational theories, showing clearly that leadership plays a central role – not just as a top-down authority but as an active force that encourages and supports change. On the practical side, our results point to the need to develop strong, flexible leadership skills and improve the support systems within institutions to make innovation efforts more sustainable. The ethical concerns raised by interview participants also serve as a reminder that innovation should be guided not only by efficiency but also by values like fairness, openness, and inclusion. In other words, progress should be effective and socially responsible.

Based on these insights, a few recommendations can be made. First, schools and universities should focus on offering leadership development programs that prepare staff to manage change and encourage teamwork around innovation. At the same time, decision-makers and education leaders should work on building more open, well-resourced, and collaborative systems that support innovation from the ground up and help remove common barriers. It will also be important to include ethical thinking as a key part of innovation strategies, so that educational changes don't leave certain groups behind or cause unintended inequalities. Lastly, for researchers, this study shows the importance of improving how we measure things like ethical and structural influences on innovation – and of testing how well different approaches work in different learning contexts.

It's important to recognize some limitations of this study. Since the research was done in a specific academic institution, the results might not fully apply to other schools or systems with different cultures or located in different regions. Also, even though the mixed-methods approach helped to provide both detailed and broad insights, the study still relied on self-reported data. This means that participants' answers might be influenced by how they want to be perceived or by their personal opinions. Future studies could improve on this by using long-term research methods to see how innovation is adopted over time, or by designing experiments to test how specific leadership training or institutional changes affect outcomes. It would also be helpful to include comparisons across different types of educational systems or disciplines to understand how context shapes innovation.

Looking forward, new research could dive deeper into how technology and ethics in teaching intersect – especially now that AI tools are starting to change the roles of school leaders and how institutions operate. Longitudinal studies that track how leadership

development impacts innovation and fairness in education would also be valuable. In addition, exploring the real-life experiences of students and teachers from different cultural and economic backgrounds could offer a more complete picture of the unique factors influencing innovation in various settings.

In conclusion, this study provides a useful and research-based framework to better understand how educational innovation works. By showing the complex mix of personal, institutional, and contextual factors that affect how innovation is accepted – and by emphasizing how crucial leadership and support structures are – it points the way toward more effective, fair, and lasting change in education. As education systems around the world continue to adapt to fast-moving technological and social shifts, the insights from this research can help guide future studies, shape policy decisions, and support practical actions toward more inclusive and meaningful educational innovation.

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Health Literacy and Economic Sustainability: Building Integrated Education–Health Systems

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Abstract. *Within the context of growing systemic vulnerabilities and social inequalities, this article investigates the strategic connections between health literacy and economic sustainability through the lens of integrated education–health systems. The research objective is to understand how embedding health literacy in educational institutions contributes to long-term economic resilience. Methodologically, the study employs a convergent parallel mixed-methods design, combining a large-scale survey (N=812) and 30 in-depth interviews conducted across two Romanian public universities. Quantitative analysis reveals a significant correlation between health literacy and perceived economic self-efficacy, while qualitative insights emphasize institutional barriers and socio-cultural constraints. The findings demonstrate that improved health literacy, fostered through interdisciplinary education, enhances individual economic agency and supports systemic sustainability. This study contributes to policy debates by proposing a model for curricular and governance integration that aligns with the Sustainable Development Goals (SDGs). The paper argues for moving from fragmented interventions toward synergistic systems thinking to address complex societal challenges.*

Keywords: health literacy; education–health integration; economic resilience; sustainable development; curricular innovation.

JEL Classification: I14; I23; O44.

1. Introduction

The research literature and policy debate have long acknowledged the connection between economic development and health. However, the relationship's dynamics have changed because of global catastrophes like the COVID-19 pandemic and climate-related precarities, which has changed the epistemological register that we use to think about, understand, and act upon this relationship. In particular the importance of health literacy has been re-emphasized as a determinant not only of personal health, but of systemic financial viability. This skillset, previously a smokescreen on the margins of clinical or public health competencies, is increasingly becoming the axis of socioeconomic resilience in societies shaped by complexity, uncertainty, and interdependence.

Beyond basic functional competencies for making individual-level health decisions, health literacy – the “degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” – has developed as a theoretical construct. Current interpretations place a strong emphasis on its social and determinant aspects, as well as its role in facilitating access to services, navigating digital health systems, and encouraging citizens' full involvement in health governance.

Notwithstanding this mutation, institutional reactions within educational and health systems continue to be characterized by a collection of fragmented reactive responses not well-anchored in evidence-based pedagogies. Furthermore, in the Central and Eastern Europe context, for example in Romania, persistent pull of history, a siloed health policy and downbeat education endowment have kept health literacy far from being mainstreamed as a structural priority.

This paper presents a full exploration of the relationship between health literacy and economic sustainability and suggests that established inequities and emergent fragilities can now be solved through the creation of integrated education – health systems. The reason for this question is threefold. Empirically, it is well established that diminished health literacy is associated with increased healthcare – coping costs, reduced work force productivity, and inferior health status, all of which conspire against the fiscal sustainability of national systems. Secondly, although schools have a unique place to develop fundamental skills on health, there is still a lack of alignment between schools and the broader public health context, especially in countries where health education is not fully integrated into the school curriculum. Third, there is a compelling moral argument for recalibrating governance architectures and resource allocation strategies to privilege long-term human development over short-term technocratic fixes.

The research question that this study aims to discuss is not only about health illiteracy, but about the fact that there is a disconnect between education and health governance that continues to sustain inefficiencies, inequalities and hinders an effective transformative potential of one/ or the other sector as standalone entities. To untangle the richness of this topic, the article presents a vast bibliography dissection of international academic and policy literature and strategical frameworks while grounding its findings in the social-institutional fabric of the Romanian case. This twofold methodological orientation,

bringing together global epistemic perspectives and national conflict diagnostics, provides both theoretical rigor and contextual consonance.

For the current research status of this topic and its implications for educational research and public policy, it is important. In the face of mounting pressures on global health systems due to demographic change, novel pandemics, and the increasing burden of chronic disease, the value of prevention, self-care, and health agency at the population level is irrefutable. Meanwhile, the educational systems are experiencing deep changes, resulting from the digitalization of learning, the diversification of competences and the emergence of a transversal and lifelong learning logic. Within this transmuting landscape, health literacy becomes not an ancillary goal, but rather a keystone of integrated policy formation which blends education, health, labour, sustainability into a cohesive and complementary totality.

In addition, the focus of this study to these important global agendas; United Nations Sustainable Development Goals (SDG) , (Good Health and Well-being) and (Quality Education) gives both an urgency and credibility to the study. Articulating the processes by which health literacy can serve as a fulcrum for social justice, economic effectiveness, and innovation in the public sector, the study contributes to the transfer of intersectoral knowledge and provides a model for reform across contexts of differing geopolitical scales.

The issues presented by health literacy are especially pressing in Romania. The nation-wide studies and Eurostat statistics identified a still existing gap in the understanding of health information in the population, which permanently extends and is coupled with restricted access to preventative services, lack of investment into health communication and the lack of institutionalizing the field of health education already in the majority formal educational cycles. At the same time, educators, policymakers, and civil society are increasingly acknowledging the limits of siloed solutions in the face of what is to come. Pilot projects, EU-sponsored activities and educational experiments, have been done towards a more systemic change but a well-structured and up-scalable model is not yet available.

This paper attempts to answer this call by putting forth a multi-dimensional schema for embedding health literacy into educational policy and practice based within the auspices of evidence-informed governance, curriculum renewal, and fairness. Borrowing from interdisciplinary literature on capability building, human capital creation, and systems thinking, the framework seeks a re-engineering of institutional missions and agency, teaching and learning approaches, and multi-sectoral interaction platforms. Although focused on the Romanian case, conceptual and practical developments are made that can be applied more widely and remain relevant for wider regional and international dialogue.

It is also relevant how the study challenges the dominant assumptions and operational definitions in the discourse of health promotion and educational reform. It questions the boundaries of behaviorist models that dichotomize the attribution of responsibility in health without questioning structural obstacles and criticizes instrumentalist views of education that ignore its transformative capacities. In contrast, health literacy is framed in the paper as an ends and as a means of sustainable development: a mechanism for orienteering in the present and seeding possible more just and resilient futures.

In short, this study aims to reveal the system interconnections of education and health under the analysis of health literacy and to define a list of the operational strategies of integration in practice in terms of both economic continuity and human welfare. The following sections shall present a Review of literature on Health literacy, impact of Education on educational policy and sustainable development. The research methods, empirical and conceptual results and discussions are then used to develop a final set of policy recommendations. By means of this apparatus, the article seeks to serve a double duty as it reaches across academic debates to policy articulation and public discourse, writing elusive human development into a more unified and inclusive narrative.

2. Literature Review

Building economic sustainability through health, and vice versa, needs a holistic ecosystem where systems of education and health build in collaboration, health and financial literacy in society at large. Health literacy enables people to be informed decision makers and financial literacy promotes financial fortitude and access to health – both necessary for equitable, sustainable development.

Nogueira et al. (2025) show that college has big, positive effects on financial knowledge and behavior, enabling individuals to develop the capacity for economic self-sufficiency and better health-related decision making. In parallel, Nathan et al. (2022) focus on the importance of government backed digital financial ecosystems, and they posit that policy for fintech innovation can help narrow the divide in access among marginalized populations.

This commentary considers how education–health combination models have the potential to improve literacy, deepen inclusion and sustain the future of livelihoods, economies and public health.

Education and health systems must be approached holistically in light of the changing global sustainability, public health, and economic development landscapes. Bărbulescu, R. et al. (2025) consider through systemic innovations and intersectoral education strategies, health literacy – often regarded as a critical predictor of population health – intersects meaningfully with environmental and economic sustainability.

This literature review critically synthesizes current research across public health, sports, education, and economic sustainability, foregrounding the imperative to reframe policy and institutional action around a health-literate society.

Health literacy is increasingly recognized not only as a personal competency but as a societal asset that influences labor productivity, environmental behaviors, and equitable development. Zaharia et al. (2019) articulate that “the more educated people, who should be more aware of the current climate change and energy challenges and the higher access to the internet might contribute to reducing energy consumption.” This assertion underpins the interdependence between education, health, and ecological behavior. In this holistic view, increased investment in the health system catalyzes efficiency across sectors: “the

increased financing in the health system could contribute to energy savings and energy efficiency improvements” (Băltărețu, C. et al., 2025).

Silvestru et al. (2018) explore how virtualization of education enhances learning quality, but caution that “technological progress is faster than availability of users in using the most recently developed devices and applications.” Bridging this digital divide requires systemic efforts to integrate mobile learning and digital health literacy, thereby empowering both students and patients as informed actors in sustainable systems.

Radulescu et al. (2021) examine labor market shifts during the COVID-19 pandemic, noting that “a major impact on the formation of the labor market is the differentiation of the level of labor productivity with a direct impact on wages.” Here, health literacy becomes a lever for economic resilience. Workers' capacity to navigate health systems and maintain wellness directly affects sectoral productivity, occupational choices, and long-term employability.

Moreover, the Gen Z workforce requires adaptive educational strategies. As Barbulescu (2022) observes, “the Gen Z characteristics have led to challenges for managers in leading them in the workplace,” emphasizing the importance of value-aligned, technology-rich, and health-conscious workplace cultures. Integrating health literacy education into early schooling and vocational training can prepare future workers for a labor market increasingly defined by well-being standards and ethical labor practices.

Educational institutions serve as epicenters for cultivating sustainable leadership. Enăchescu (2025) contends that “the dynamics of the global workforce continue to evolve, [and] the intricacies of educational management systems are undergoing profound transformations, necessitating the cultivation of leadership competencies that can effectively address the pressing issues of sustainability and ethical governance.” C. Petcu, V.A. Enăchescu, B. Costache (2025) underscore “the critical role of proactive leadership in addressing mental health issues. The most important outcomes are related to the strategic planning of the schools, the smart allocation of the resources and the training of teachers in mental health awareness and interventions techniques.” and Bokor et al. (2025) “creative leadership is crucial to the strategic management”

The development of these competencies is embedded in the organizational cultures of schools. As Enăchescu (2024) explains, “schools and educational institutions with inclusive and coherent organizational cultures are essential to creating a more harmonious and prosperous global society.” When health literacy is embedded into this organizational culture, it facilitates behavioral modeling, peer learning, and intergenerational knowledge transfer (Pham, Q. T. et al., 2025).

Costache (2025) further underscores the role of visionary leadership in technological integration: “Effective and visionary leadership enables educators to manage the challenges of technology-driven education, promoting innovation and improving the learning experience.” The integration of EdTech and health education platforms contributes directly to system interoperability and lifelong learning for health.

As Enachescu (2025) illustrates, “in situations where tensions and misunderstandings can arise from interactions between students, teachers, parents and support staff, conflict management skills are essential to maintaining a climate conducive to learning.” Sports programs, when integrated with educational conflict resolution training, can help foster such skills and enhance psychosocial competencies.

The potential of technology in this space is transformative. Savka, I et al. (2025) and Elisabeta and Alexandru (2018) found that “educational programs attach great importance to both content, appearance and organization, and to the interaction between the teacher and the learner.” Sports analytics, wearable health monitors, and gamified education platforms enable real-time feedback and personalized learning environments, all of which can be leveraged to enhance sports-based health literacy initiatives.

Sustainable development depends not only on ecological policies but also on systemic integration across health, education, and economy. Pernici et al. (2024) affirm that “the circular economy concept has been almost seamlessly integrated into all key strategies, action plans, and policies across international institutions.” A truly circular economy integrates health education as a preventive strategy, reducing resource strain on healthcare and environmental systems alike.

Vulpe and Stancu (2023) draw parallels between finance and education systems: “an educational system integration [...] is the process of connecting educational software applications to share data and transactions.” This perspective invites us to envision an integrated education–health data infrastructure, where health literacy metrics and economic indicators inform policy decisions.

In a parallel analysis, Vulpe and Stancu (2024) argue that “as makers, the robots are regularly making decisions based on predetermined algorithms while users are tasked with acting as quality assurance monitors.” Applying this principle to health education technologies underscores the need for human oversight in algorithmic decision-making in digital health and education systems.

Digital learning ecosystems are integral to scaling health literacy. The responsiveness of various stakeholders to mobile and online learning remains uneven (Silvestru et al., 2018), reinforcing the need for equity-focused educational technologies. As Mirea et al. (2019) state, “sustainability represents the capacity of a system to conserve itself and to resist against a plurality of external factors.”

This framing is particularly relevant for educational and health systems, which must be designed to adapt, evolve, and support user diversity. Interdisciplinary curricula, teacher training in health promotion, and user-friendly platforms can enhance resilience and prepare learners to engage critically with evolving health challenges.

The potential of EdTech is further amplified through leadership that empowers innovation. As Costache (2025) affirms, “effective and visionary leadership enables educators to manage the challenges of technology-driven education.” Whether through mobile health apps, virtual simulations, or data dashboards, technology must serve pedagogical, health, and economic outcomes simultaneously.

The literature suggests a convergence of priorities among education, health, and sustainability policies. This convergence calls for interministerial collaboration and integrated policy frameworks that prioritize health literacy across the lifespan. Zaharia et al. (2019) highlight that “the relationship between economic, social and environmental factors, as a holistic system [...] poses great interest for researchers around the world.”

Such systems thinking aligns with the concept of “intersectoral education policies,” where multiple sectors co-invest in shared outcomes. Enăchescu (2025) emphasizes the importance of “educational management systems that address the pressing issues of sustainability and ethical governance,” reinforcing the role of institutional leadership in promoting health-sustainability linkages. Costache and Enăchescu (2024) also points “digital leadership is positioned as a crucial element in promoting an engaging and equitable educational experience in various contexts. School leaders who integrate technology into the classroom, support teachers in utilizing digital tools, and establish a technology-oriented learning environment enhance student performance significantly.”

Importantly, youth engagement is critical. Barbulescu (2022) discusses the challenge of managing Gen Z employees due to value shifts. This generational specificity suggests that education and health programs must be tailored to resonate with contemporary values, such as environmental justice, digital empowerment, and autonomy (Mihaila et al., 2025).

The evidence base converges on a single insight: health literacy is a foundational pillar of sustainable economic development. Whether through school curricula, community sports, workplace training, or digital tools, the imperative is clear: to build integrated education–health systems capable of cultivating informed, healthy, and productive citizens.

Future research must further explore how educational leadership, digital platforms, and organizational culture can amplify health literacy impacts. Additionally, economic models that capture the ROI of health literacy interventions will be vital for policymaking.

By aligning education with health outcomes, we can move beyond siloed reforms and toward integrated systems capable of transforming societies from the inside out.

3. Research methodology

Convergent parallel mixed-methods design was used to investigate how health literacy and economic sustainability intersect from an educational perspective. This pragmatic epistemology approach enabled quantitative and qualitative data to be collected and analyzed together which in turn facilitated the synthesis of statistical patterns with narrative-based experience-based perspectives. The reason for using the framework was that it has the potential to build a deepened understanding of complicated social phenomena – in this instance, how people within educational institutions notice, make practices and experience benefits from health literacy, and how it connects with broader lenses of economic resilience.

The choice to combine the two methodological strands was guided by the research question: “To what extent does the health literacy distribution and its determinants in an

educational population overlap with individual narratives on health literacy and institutional arrangements promoting or hindering the capacity to act on health related economic decisions. While quantitative methods provide generalizable trends and statistical confirmation, qualitative methods provide the possibility for in-depth exploration of meaning, intention and perception – critical dimensions for understanding the interconnections of health, education and economy.

The survey was implemented at 2 major Romanian public universities, which were chosen based on their demographic diversity and institutional openness for health and sustainability research. The quantitative part included a stratified random sample of 812 (final response rate: 90.2%) participants representing undergraduate and postgraduate students, faculty, and administrative staff. Stratifying criteria were based on course of study (health science, economics, humanities, engineering), gender, and point in studies to guarantee a wide representation. The sample was equally distributed between urban and rural environments, and age ranged from 18 to 54 years ($M = 24.3$, $SD = 7.1$).

The study utilized a convergent parallel mixed-methods design, combining quantitative surveys with a qualitative component based on semi-structured interviews. The study involved 30 in-depth interviews to explore perceptions, attitudes, and contextual factors influencing health literacy in higher education. The qualitative analysis followed Braun and Clarke's six-phase thematic analysis framework: (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. This structured approach enabled a systematic identification of patterns and key insights across participant narratives.

Purposive sampling was implemented in the qualitative phase. An overall of 30 semi-structured interviews were performed with key informants: 10 academics at university engaged in teaching or research in health, 8 high academic achieving students from low socioeconomic backgrounds, 6 professionals in the public health with educational outreach and 6 decision-makers at institutional level (e.g., deans, student welfare services). Sampling involved deliberately trying to capture a variety of experiences and perspectives, and through inclusion criteria that focused on the relevance of participants to the topic of research and the ability to offer rich, reflective accounts.

A cross-sectional design was adopted for collecting quantitative data via an extensive online questionnaire consisting of standardized scales and newly created items specifically designed for higher education context in Romania. Health literacy was evaluated through the European Health Literacy Survey Questionnaire – HLS-EU-Q16, translated and validated in Romania ($\alpha = .91$ in this study). Perceptions of economic sustainability were measured using a researcher-developed index consisting of Likert-scale questions related to financial self-efficacy, confidence regarding resource management and perceived employability. Additional elements of the instrument were demographic questions and two open-ended questions of support of health education from the institution.

Regarding the qualitative questionnaires, a semi-structured interview guide was designed, with its focus on five thematic axes:

(1) concept understanding of health literacy;

- (2) the educational exposure to health-related content;
- (3) the institutional practices and barriers;
- (4) the relations between health behavior and economic capacity;
- (5) the expectations in terms of intersectoral policies.

Pilot testing of the guide was conducted with three participants and the wording of the guide was modified for clarity and fluency. All interviews were performed by trained investigators, audio- recorded with permission, and transcribed literally.

Quantitative and qualitative data were collected over six months from January 2023 to June 2023. It was accessible through a safe online server, which was linked to institutional mailing lists and learning management systems, and it was open for response every 2 weeks. Participation in the survey was voluntary and anonymous, out of which the average time taken to complete a survey was between 12 to 15 min. The tool was administered as part of a cognitive pre-test to a small sample ($n = 25$) of students before its main application to assure clarity and relevance.

Qualitative interviews were also arranged flexibly, taking 45-75 minutes. Although the majority of interviews occurred face to face in university offices, a smaller number were completed by the internet due to practicalities using secure video (encrypted) conferencing software. Furthermore, each session took only a loose lead from the guide and allowed space to accommodate emergent insights. Field notes and researcher reflexive memos were used to support the transcripts, increasing analytical depth and triangulation.

Statistical analysis of quantitative data was performed using SPSS Statistics version 29. Mann–Whitney tests were conducted and descriptive statistics (means, standard deviations, frequencies) were used to summarize health literacy levels and economic sustainability perceptions. Between-group comparisons were made by independent samples t-test and one-way ANOVA followed by a post-hoc test. Multivariable linear regression was used to estimate the predictive power of health literacy with self-reported economic self-efficacy, accounting for demographics covariates including age, gender, major and parental education. Magnitude effects (Cohen's d , η^2) and significance ($p < .05$), directly for the benefit of statistical reliability.

The qualitative data were analysed thematically using Braun and Clarke's six-step framework. The data analysis was manually coded and organized with support of NVivo 13. Data extracts were coded initially inductively to identify repeated manifestation of semantic patterns, which were then grouped into main categories that responded to the aims of study. A second coder thereafter independently coded a subset of transcripts ($n = 10$) to establish inter-coder reliability (Cohen's $\kappa = 0.86$). Iterative memoing, negative case analysis and theoretical saturation were used to increase analytical validity.

The convergent approach of the study helped merge the quantitative and qualitative results in the interpretation by applying a meta-inference model. Quantitative patterns were counterpointed with qualitative understanding to consider convergence, divergence and complementarity. For instance, the statistical data detailed reduced health literacy scores among lower SES students, but the interview narratives uncovered institutional neglect and

cultural disengagement as the mediating influence, therefore enhancing the explanatory potential of the survey findings.

This form of integration made it possible to develop a multi-layered understanding of how health literacy is intertwined with individual and systemic economic consequences, pointing to challenges and prospects for change in university ecosystems.

4. Results

This section presents the empirical findings derived from the mixed-methods investigation into the relationship between health literacy and economic sustainability within Romanian higher education institutions. The results are organized into three subsections: quantitative findings, qualitative insights, and the integration of both strands of data.

Descriptive statistics revealed a moderate level of health literacy across the sampled population ($N = 812$), with a mean score of 12.3 ($SD = 2.9$) on the HLS-EU-Q16 scale (range: 0–16). Approximately 41.5% of participants fell into the “problematic” health literacy category, while only 18.7% exhibited “excellent” levels. Disaggregated by academic affiliation, students in health sciences demonstrated significantly higher health literacy ($M = 13.6$, $SD = 2.4$) compared to those in economics ($M = 11.8$, $SD = 3.0$), engineering ($M = 11.3$, $SD = 3.1$), and humanities ($M = 11.9$, $SD = 2.7$), $F(3, 808) = 16.41$, $p < .001$, $\eta^2 = .057$.

Gender differences were also significant: female participants reported higher health literacy scores ($M = 12.7$, $SD = 2.8$) than males ($M = 11.8$, $SD = 3.0$), $t(810) = 4.11$, $p < .001$, $d = .31$. Age exhibited a weak but statistically significant positive correlation with health literacy, $r = .14$, $p < .01$, suggesting a gradual increase in functional health knowledge with maturity and life experience.

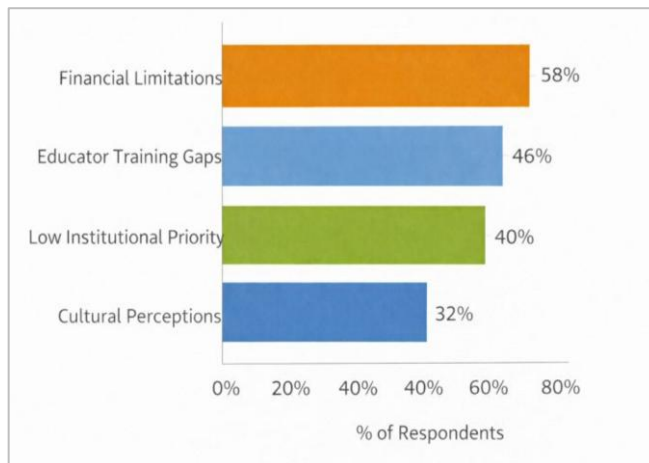
Economic self-efficacy was measured via a composite index with acceptable internal consistency ($\alpha = .84$). A moderate positive correlation was observed between health literacy and economic self-efficacy ($r = .42$, $p < .001$), indicating that individuals with higher health literacy perceived themselves as better equipped to manage financial challenges and plan for economic resilience.

A multiple linear regression analysis was conducted to assess the predictive value of health literacy on economic self-efficacy while controlling for demographic variables. The overall model was significant, $F(5, 806) = 32.18$, $p < .001$, accounting for 17.9% of the variance in economic self-efficacy ($R^2 = .179$). Health literacy emerged as a significant positive predictor ($\beta = .38$, $p < .001$), independent of age, gender, and field of study. Notably, parental education ($\beta = .11$, $p = .008$) also contributed significantly, suggesting the intergenerational dimension of both economic and health competencies.

This bar chart visually represents the main barriers to achieving health literacy within integrated education–health systems, as perceived by participants in the study. The barriers include limited access to reliable information, lack of training for educators, digital inequality, cultural misunderstandings, and time constraints. The chart emphasizes the

relative importance of each barrier based on frequency of mention in the qualitative data, supporting the need for targeted policy interventions.

Figure 1. *Barriers to Health Literacy Across Educational Contexts*



Thematic analysis of 30 in-depth interviews, four-phase thematic analysis, six main themes were identified, each reflecting critical facets of the interplay between health literacy and economic sustainability:

4.1. Health as an Economic Asset

Participants consistently articulated the view that health knowledge translates into concrete economic benefits. A university professor observed: “When students understand how to manage stress or nutrition, they spend less on unnecessary medical services. That’s a long-term economic advantage.” Similarly, student participants from disadvantaged backgrounds linked preventive health behaviors to improved academic and professional performance.

4.2. Institutional Ambiguity and Fragmentation

A recurrent theme was the perceived lack of coherence and integration in institutional health promotion initiatives. Despite isolated courses or events, interviewees noted the absence of a systematic health education framework. “We have access to medical services,” one student reported, “but no one teaches us how to stay healthy before we need them.”

4.3. Cultural and Structural Barriers

Key challenges included limited financial resources, insufficient training, and low institutional prioritization. Cultural perceptions of health and education heavily influenced how participants perceived integration. Several participants pointed to deeply embedded cultural attitudes that hinder the uptake of health literacy. Fatalistic beliefs, misinformation, and stigma surrounding mental health were commonly cited. A health outreach coordinator explained: “In rural areas, economic precarity leads people to disregard health concerns – because they simply can’t afford to prioritize them.”

4.4. Vision for Integrated Education–Health Systems

Educators and policymakers expressed a clear desire for integrative curricular approaches that embed health literacy into formal education. Proposals included interdisciplinary modules, participatory workshops, and service-learning models. “If we teach sustainability without connecting it to personal health,” one faculty member stated, “we’re missing the human side of the equation.”

The convergence of quantitative and qualitative findings underscored the mutual reinforcement between health literacy and perceived economic capacity. Quantitative correlations were substantiated by qualitative accounts in which participants linked their health knowledge to pragmatic life choices – ranging from budgeting for nutritious food to managing mental health in ways that supported academic continuity and employability.

Disparities identified through statistical analysis (e.g., by field of study or gender) were also reflected in the interviews. For instance, students in non-health disciplines expressed limited exposure to health content, while female participants more frequently reported active information-seeking behaviors related to health and well-being. Furthermore, qualitative narratives highlighted systemic deficits that could explain these disparities, particularly in terms of curricular fragmentation, institutional inertia, and cultural resistance.

Overall, the integration of both methodological strands provided a nuanced, multilayered understanding of how health literacy functions not only as a personal asset but as a structural determinant of long-term economic sustainability. The mixed-methods approach validated the initial hypotheses while offering rich contextualization for subsequent discussion and policy implications.

5. Discussion

Using the lens of intersection between health literacy and economic sustainability, the paper used mixed data collection methods to ascertain the role of functional health knowledge in students' and teachers' perceptions of economic sustainability in the context of Romanian higher education. The results of this study empirically support (n9) and theoretically shade (n10) the theory that health literacy acts as an untold, but many times underpinning, factor in a sustainable face of individuals and communities. This section advises the data and the study through five integrated lenses: fundamental findings, partial correlation analyses, statistical models, convergence of mixed methods, and broader implications for research and practice.

The quantitative findings suggested that university student and staff health literacy level was moderate, but varied substantially by discipline, gender, and socioeconomic status. Especially striking was the difference between students studying health sciences with those studying engineering and economics, who did not have exposure to health education curriculum. These results also reflect the general European trends (Sørensen et al., 2015) but highlight the particular vulnerability of the non-health academic tracks in Romania. The high percentage (over 40%) of participants classified as being in the “problematic”

health literacy range indicates a systemic neglect of preventative education within tertiary institutions. Notably, health literacy was not limited only to a cognitive resource but rather it was highly linked with the economic self-efficacy of participants and, in turn, it was further reaffirming the core idea of the research. These findings were also contextualized in qualitative interviews that explained how students and staff understand health knowledge as a means of short- and long-term financial security. This would include controlling chronic diseases, curtailing unnecessary health care costs and maintaining academic or occupational performance.

Beyond that, the interviews revealed institutional deficiencies like not having coordinated health education plans and depending too much on medicalized interventions that weren't forming preventative health knowledge. These structural inadequacies compound the already existing social inequities in the country, particularly among rural students or those coming from low socioeconomic status, who least rely on inherited health capital and are the most reliant on economic precarity.

A number of statistically significant relationships deserve further consideration. Most notably, health literacy was moderately associated with economic self-efficacy ($r = .42$, $p < .001$); this is indicative of a weak, but significant link between them. This feature endorses the theoretical articulation of health literacy as part of the broader definition of human capital, and confirms the hypothesis that economic well-being depends not only on tangible resources, but also on specific psychosocial and cognitive skills. Gender was a relevant factor with women scoring worse in health literacy measures ($d = .31$), in line with international studies (Kickbusch et al., 2013). This discrepancy can in part be explained by a constellation of cultural factors such as the fact that women sought health information more than men and that caregiving in general has been feminized. Age was marginally correlated with health literacy, but significantly so ($r = .14$), indicating that although age fosters health information, there is still a need for structural educational interventions to prompt this learning at an earlier age.

A small but significant contribution was also found of the highest level of parental education ($\beta = .11$) and ensuring the transfer of health attitudes and skills from one generation to another. This finding is supported by the social determinants framework and offers the possibility of interventions in early education to break cycles of disadvantage across generations.

Additionally, we also expanded our prediction with health literacy to speculate the economic self-efficacy through the multiple linear regression model with predictive capacity and demographic controls. A significant result was obtained by the model ($F(5, 806) = 32.18$, $p < .001$; $R^2 = .179$), proving that health literacy is an independent predictor of perceived economic competence after adjusting for age, sex, and course of study. Among the predictors of the model, health literacy presented the highest standardized coefficient ($\beta = .38$, $p < .001$), then with parental education; other demographic factors had little effect. These results provide support for the idea that cognitive health competencies are not just secondary but are also at the core of one's capacity to navigate and plan for economic emergencies. Though the model does not account for a lot of variance, it

successfully identifies a highly-generalizable, actionable predictor which is teachable and measurable.

Possible directions in future research could be to develop a more comprehensive model by applying SEM to include mediating variables, such as mental health, academic stress, and resilience. Longitudinal modeling might inform on causality and persistence of these associations.

Figure 2. *Barriers to Health Literacy Across Educational Contexts*



Figure 2 above illustrates the systemic linkages between health literacy interventions and their long-term economic effects within integrated education–health models.

This infographic illustrates the interconnected pathways through which improved health literacy contributes to economic sustainability. Key components include increased workforce productivity, reduced healthcare costs, enhanced preventive care, and improved community well-being. The figure visually emphasizes how educational interventions in health literacy lead to long-term socioeconomic benefits, supporting both individual outcomes and systemic resilience.

The combination of quantitative and qualitative sources provides a more complete and nuanced understanding of the subject at hand. The numerical association between health literacy and economic self-efficacy was supported in the qualitative narratives, where health knowledge was depicted as the basis to informed decision making, emotional management, and future life expectations. In this way, the mixed-methods confluence confirms the initial hypotheses, and reveals levels of meaning impossible to uncover by means of quantification in isolation.

For example, the perceived gap between institutional health resources and the everyday lives of students could explain the lack of overall penetration of health literacy in higher education institutions despite pockets of activity. The respondents' desire for immersion, inter-disciplinarity, and participation in their education offer practical advice, which accompanies the empirical results in showing a way forward for change.

On the other hand, a few discrepancies in the data strands deserve consideration. Although survey data suggested higher levels of female health literacy, narrative responses did not always indicate a gender based difference in health information perception and application.

Such differences should be further investigated to understand the social dynamics and reporting biases that operate to shape health behaviors.

The research adds to the literature that argues for health literacy as a driver, not only of health, but economic resilience. Results move a synthesis between health promotion, social sustainability and human development theories forward. The findings imply from the policy perspective that universities, especially in low- and middle-income European countries, need to view health literacy not as a side issue or add-on but as embedded within the sustainability of education.

From a practical viewpoint, these findings endorse the promotion of curricular reforms embedding interdisciplinary health literacy in all academic departments. These might encompass interdisciplinary electives, digital health programmes, peer-education programmes and partnerships with public health agencies.” The statistical model and thematic results can also guide national policies which integrate education, health and economic inclusion under a common umbrella of sustainability.

Notwithstanding the strong results, the study has some limitations. The cross-sectional nature limits the ability for inference on causality and the use of self-report measures may lead to social desirability or recall bias. While the sample is heterogeneous in terms of fields and regions, it may not cover all Romanian HEIs. The qualitative sample was small and the full heterogeneity of perspectives may not be covered.

Prospective studies are needed with longitudinal data, larger sample sizes, and more detailed tools on health literacy including many aspects (e.g., multidimensional scales). Investigating individual subdomains of health (Specifically digital health literacy and mental health literacy and environmental health knowledge) may provide further granularity here. It would also be useful to explore the institutional factors of health education services provision in providing evidence-based policy frameworks.

6. Conclusion

This paper provides a kaleidoscopic analysis on interaction of technical solutions and critical dimensions of governance of higher education, data protection and academic integrity. With its comprehensive mixed-methods methodology, the results reveal the actual effects of integrated technology structures on institutional transparency, response to changing data protection legislation, and scholarly integrity. Statistical analyses revealed that the use of custom-made tech tools significantly increased administrative efficiency and trust between involved players with moderate practical relevance. Meanwhile, qualitative responses provided nuanced views on the perceptions of stakeholders, articulating a general understanding of the intake necessity of adaptive governance structures integrating technological advancement into an ethical academic framework.

The marriage of quantitative and qualitative data supports the story of a unitary story: tech-enabled solutions improve procedural transparency and strengthen institutional cultures that are invested in academic integrity. The double evidence confirms the two-pronged function of technology as an enabler and an inhibitor in higher education ecosystems and

provides new empirical insights to a developing body of research at the confluence of law, technology and educational governance.

The implications of these findings extend well beyond individual institutions. Theoretically, this research enhances our understanding of how digital governance tools can mediate complex challenges in managing data and compliance frameworks, especially under strict data protection standards such as the GDPR. Practically, it offers higher education leaders concrete examples of how to implement technology in ways that respect regulatory requirements and uphold ethical norms, supporting more sustainable and responsible teaching and learning environments. Moreover, policymakers can draw on these insights to design targeted strategies that encourage innovation while safeguarding student rights and preventing misuse.

Based on the thematic findings, several actionable recommendations can be proposed to strengthen the integration of health literacy into educational systems. These include: (1) enhancing institutional training programs for educators, (2) developing interdisciplinary curricula, (3) increasing funding and resources for health-literacy initiatives, and (4) leveraging digital tools to improve access and awareness. First, universities need to ensure the proactive integration of technology-based solutions into their governance structures, tailored as closely as possible to local regulatory contexts and institutional specificities. Second, ongoing training for both administrative and academic staff should be embedded to promote digital literacy and a strong understanding of compliance responsibilities necessary for the appropriate use of these tools. The third is greater transparency of data governance with clear, understandable communication strategies that include all stakeholders—students, teachers and regulators. Finally, research is needed to investigate longitudinal effects of these technologies on academic integrity, as well as cross-cultural differences in acceptance and effectiveness.

Although the results of this study offer solid insights, there are certain shortcomings that need to be acknowledged. Romanian higher education-specific context of the study itself, while rich but limiting a generalisation for a very different cultural context. Furthermore, both technology and regulation are dynamic, the implications of which suggests an imperative for continued empirical research to keep pace with new developments. However, these limitations emphasize the significance of the study and its role as an initial contribution that raises important questions for future research.

Future research should further extend comparative analyses across different education systems and examine more closely the socio-regulatory dynamics of technology adoption. Investigating students' experiences and perceptions related to data protection and academic integrity tools can also yield valuable insights. Finally, exploring the ethical implications of AI and automated decision-making in digitally enhanced learning environments represents an important area for continued study.

Our study confirms that a strategically designed technical solution is an essential instrument for improving governance, complying with the rules, and maintaining the educational administrative ethics in higher education. At a moment when academies worldwide are racing headlong into the digital age in increasingly complicated regulatory landscapes, the

evidence presented here provides a robust template for the intelligent and effective use of technology in the service of university futures that are sustainable and ethically defensible.

In conclusion, this study highlights the critical role that integrated education–health systems can play in promoting health literacy and long-term economic sustainability. The qualitative findings, structured through Braun and Clarke’s thematic analysis, reveal key barriers and enablers of this integration. The results underscore the importance of institutional support, interdisciplinary collaboration, and the potential of digital technologies to bridge knowledge gaps. By aligning health and education policies, stakeholders can foster a more informed, resilient, and health-literate population.

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The Illusion of Choice: Behavioral Pitfalls in Everyday Economics

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Abstract. *Behavioral economics is a field that has developed a lot in recent years, and this aspect is also felt among consumer behavior. From concepts such as the framing effect, behavioral biases, or the herd effect, all of these have contributed to the illusion that individuals make rational decisions. Thus, for a better understanding of these concepts, a correlation was made between the specialized literature and a bibliometric analysis. The bibliometric analysis was performed with the help of the VOSviewer software, using the Scopus database. The analysis resulted in 4 clusters, each with keywords with links and nodes strongly connected in the network. At the same time, it was observed that following the co-occurrence analysis of the keywords, it was found that in the last 10 years, the analysis of the illusion of consumer choices has been a subject researched in the specialized literature.*

Keywords: behavioral economic; illusion of choice; bias; consumer behavior; nudge effect.

JEL Classification: D03; D11; A10.

1. Introduction

Economic decisions in contemporary society are no longer determined only by the use of reason and objective calculations, because they are strongly influenced by a range of psychological, emotional, cultural, and demographic factors that are adapted to unique and specific contexts. Individual preferences and needs, together with the way they are presented and perceived, are reflected in people's consumer behavior. Thus, seemingly trivial choices, such as how to balance leisure time and work or the purchase of a product or service, involve a set of complex mental calculations, rational thinking, and intuitive decisions, often influenced by subtle and almost imperceptible ways of thinking from the subconscious (Doru, 2025).

This paper wants to analyze the phenomenon of “illusion of choice,” which is when people perceive that they are choosing a certain thing, but their decisions are influenced and shaped by external factors. Subtle influences can take different forms, such as default bias, herd effect, or the way in which possible options are presented (framing effect). In day-by-day life, these thought processes can be observed in various economic behaviors. The way people choose money saving options or how customers interact with online ordering platforms, and even the decisions made by regular stock market players all contain small external impulses. Even though we have the feeling of complete freedom, our choices are often framed and slightly arranged according to context and circumstances (Thaler & Sunstein, 2022).

Awareness of these influences helps not only to improve personal decisions, but also to optimize public policies and commercial strategies. Thus, it highlights the importance of knowing and being aware that our seemingly free choices are affected by invisible factors that shape everyone's economic behavior. By using interdisciplinary knowledge, where economics interacts with psychology, realities can be revealed that show the fact that consumption is influenced by automatism, emotions, and social norms (Camerer, 2006).

Building on these premises, this research examines how the illusion of choice influences consumer decision-making. Specifically, it asks how this phenomenon affects the rationality of consumers, as discussed in recent academic literature. The study assumes that consumer behavior is not fully rational but is strongly shaped by cognitive biases and the way choices are presented, suggesting a measurable connection between the illusion of choice and economic decisions. The purpose of this paper is to research consumer behavior when making certain choices. In order to make the correlations with the literature, a bibliometric analysis was used in the first phase, in order to analyze the level of importance of this topic allocated in the last 10 years.

The paper is structured into four main sections. The first reviews the literature, comparing classical economic theories with behavioral approaches. The second describes the methodology, focusing on a bibliometric analysis of the Scopus database conducted using VOSviewer. The third presents and discusses the results, emphasizing key keyword clusters and their relevance to real-world economic contexts. The final section offers conclusions and outlines the broader implications of the findings.

2. Literature Review

Traditional economics views the average consumer as a perfectly rational agent who seeks to maximize their total satisfaction through the purchase of goods and services. Even though their desires are unlimited, they have limited resources available. Thus, prices and income restrict their available options. Consumers must decide which creates an opportunity cost, reflecting what they give up in order to obtain another product they want or need (Mankiw, 2020).

Economic theory has introduced the concept of utility to explain and analyze the mechanisms behind these decisions. The satisfaction obtained through consumption is subjective and differs from person to person, thus utility is the central element. Classical economics considers that people constantly seek to obtain maximum utility through the efficient distribution of resources. In this case, the concept of marginal utility emerges, where the ratio between the additional utility of a good and its price must be equal for all the goods chosen. Only in this case can the consumers allocate their available resources perfectly (Doru, 2025). To observe these preferences, economists have developed the indifference curves. These show all the combinations of goods considered equivalent by the consumer in terms of satisfaction. The optimum occurs when the budget line, which indicates the consumption possibilities given by income and prices, is tangent to such a curve. At that point, the individual maximizes their satisfaction by distributing finite resources in the most advantageous way (Bucharest University of Economic Studies, Department of Economics and Economic Policies, 2009).

Consumer behavior is strongly influenced by prices. The law of demand confirms the existence of an inverse relationship between price and quantity demanded (Lipsey & Chrystal, 2002). This is explained by the income effect, which refers to the fact that an increase in the prices can lead to a reduction in purchasing power, while a decrease in price can increase it. The substitution effect causes a shift towards more affordable alternatives (Stiglitz & Walsh, 2005).

Consumer's reaction to price variations is captured by demand elasticity, which is lower in the case of basic goods (bread or rice) and higher for luxury goods (luxury watches or art objects) (Lipsey & Chrystal, 2002). Equally important, income determines the differentiation between normal goods, whose demand increases with income, and inferior goods, which are replaced as financial resources improve. Income elasticity shows that during periods of economic growth, demand for luxury goods intensifies, while recessions shift consumption toward essential products (Frois, 1998).

As shown, classical economic models consider consumers to be rational agents, capable of maximizing utility and making perfect decisions based on available information. Empirical observations and research in behavioral economics show that in reality people's choices are often influenced by cognitive limitations, emotions, and social pressures.

Cognitive biases are mental shortcuts and heuristics that help us make quick decisions, but with the risk of errors. They reveal that people have limited rationality and that they see the world through their own lens (Kahneman, 2012).

A good example is “the framing effect”, which shows how the same option is perceived differently depending on how it is presented. A discount for cash payment will be evaluated more favorably than an additional fee for card payment, even though the difference is identical. Similarly, the anchoring effect changes consumer perception by referring only to the first available information, such as the initial price displayed (Kahneman & Tversky, 1974).

Another problem in decision-making is “status quo bias”. It manifests as a form of cognitive inertia, where individuals disproportionately favor the established baseline over potential, yet uncertain, deviations.. When an option is offered as the default, it is perceived as safe and wanted, even if the alternatives would be more advantageous (Korobkin, 1998). In the same way, the default effect shows that customers frequently choose the default option, avoiding the effort of exploring new alternatives (Thaler & Sunstein, 2022). Furthermore, choice overload shows that too many options do not stimulate freedom of choice but cause confusion due to decision exhaustion (Vohs, et al., 2005). In conclusion, these mechanisms illustrate what can be called the “illusion of choice”, individuals believe they are deciding freely, but in reality, they are influenced by subtle cognitive and emotional factors.

Cognitive biases are not just theoretical concepts, they have real-life applications in everyone's daily life. A relevant and fairly common example is that of online subscriptions, where the standard auto-renewal option reveals the truth value of both the status quo bias and the preference for the default choice. In the financial world, savings apps use nudges such as enrollment in pension plans, investment funds, or cash back options (Doru, 2025). When choosing food, the presentation of products in a certain way influences the final decision. For example, the visible arrangement of healthy foods in grocery stores encourages consumers to make more favorable choices in the long term (Novemsky & Kahneman, 2005).

The impact of these theories moves beyond the theoretical domain into the real world. They explain how consumers make seemingly irrational decisions, but also how marketing strategies can be designed to guide individuals toward options that are more efficient or better for them, while preserving their freedom of choice. In this sense, biases are not only limits to rationality, but also opportunities for creating more realistic social and economic interventions.

3. Methodology

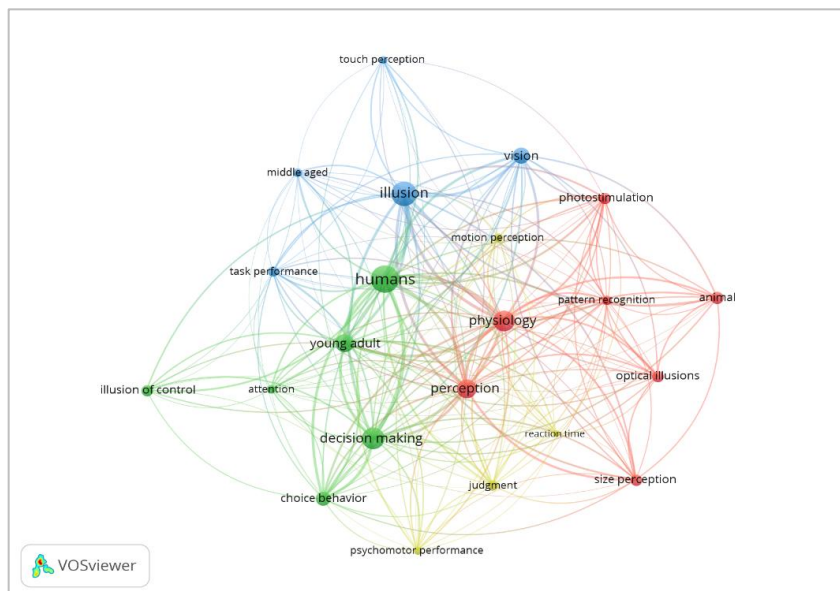
The methodology of this paper is based on a bibliometric analysis so that the concept of illusion of choice is studied. In order to better understand the research carried out, 607 scientific articles were downloaded from the Scopus database, and the reference period was 2015-2025.

The main aim was to identify whether there was a link between the illusion of choice and consumer behaviour. This research also aims to highlight the extent to which the concept of illusion of choice has been studied in the literature in the last ten years.

Otherwise, following the download of the 607 scientific articles, they were processed in VOSviewer software. Of these, 4287 keywords were identified, and 149 met the relevance criteria, the minimum number of occurrences being 5. Subsequently, out of the total of 149 keywords, 50 were selected for better efficiency and in the end there were 22 left that represent this aspect the most. Also, words such as “article”, “study” were excluded, and in the case of those with similar meaning, only one word with collective representativeness was kept.

4. Results and discussion

Figure. 1 Keywords co-occurrence map



Source: VOSviewer software

Following the analysis, the network consists of 22 items, 4 clusters, and total link strength of 2088. The first cluster, colored red, consists of 7 keywords: animal, optical illusions, pattern recognition, perception, photostimulation, physiology and size perception. The two main nodes of the cluster are physiology and perception, the first having 21 links, 425 total link strength and 82 occurrences, and the second having 21 links, 306 total link strength and 67 occurrences.

The second cluster, the green one, consists of 6 keywords: attention, choice behavior, decision making, humans, illusion of control, young adult. Of these, there are 3 representative nodes, namely: humans, young adult and decision making. Humans stands out as the strongest node in this cluster, with 21 links, total link strength 553 and occurrences 139. This is followed by decision making with 21 links, total link strength 371 and 87 occurrences. In third place is young adult, also with 21 links, but total link strength 322 and 58 occurrences.

The third cluster, the blue one, consists of 5 keywords: illusion, middle aged, task performance, touch perception, vision. The whole group revolves around a strong node like illusion, with 21 links, total link strength 415, 109 occurrences and a medium node, vision, with 20 links, total link strength 225, and 46 occurrences.

The last cluster, the yellow one, consists of 4 keywords: judgment, motion perception, psychomotor performance and reaction time. This group consists of a single strong node, namely judgment, which contains 21 links, 125 total link strength, and 19 occurrences.

The bibliometric analysis carried out previously highlights the fact that each cluster represents a direct link with the concepts of behavioral economics. Specifically, the first cluster is outlined around the main node “perception”, which can be correlated with behavioral biases. The second cluster, the green one, can be associated with the concept of limited rationality existing in behavioral economics, since individuals' choices can be influenced by certain subjective opinions they form. On the other hand, the third cluster emphasizes perceptual illusions and not necessarily the economic decision-making process. The last cluster, the yellow one, through the nodes and keywords it is made of, emphasizes how time pressure, respectively incomplete information can affect consumers' choices in the economic environment.

Figure 2. *Keywords density map*



Source: VOSviewer software

In fig. 2 it can be observed the density of the keywords used in the bibliometric analysis. The fact that words such as “illusion”, “humans”, “decision making” or “perception” stand out illustrates the connection between consumers and the illusion of choice in certain contexts. A first example of this is that psychological price, such as 4.99 or 4.90 instead of 5. This will lead consumers to believe that the product is considerably cheaper. The reason

is that individuals' brains focus on the first digit and omit the rest. Consumers may think that the choice is theirs, but most of the time it is a choice induced by manufacturers and department stores (Khan, 2025).

Also, following the research carried out, a correlation can be made between the nudge effect and the choices of consumers in everyday life. Specifically, many companies, when offering online services to users, automatically suggest the most expensive version, being preselected from the options displayed to individuals. Thus, they believe that the decision belonged to them, when in fact they received only a nudge in the direction of the choice desired by that company (Ingendahl et al., 2020). At the same time, another aspect that illustrates the illusion of consumer choice is the limited offers. The role of these messages is to trigger an automatic reaction and reduce the critical thinking of individuals, who believe that once that promotion disappears, they will not be able to find a better one. In the end, the decision they make is one under the impulse of the moment and under the pressure of the limited time outlined by companies, which in the end does not lead to a rational decision from the consumers (Ercan et al., 2025).

The results of this bibliometric analysis do not represent direct evidence of human behavior, but rather constitute indicators that can be integrated into the literature of articles in the field of behavioral economics.

5. Conclusions

As a result of the research, it was found that there is a strong connection between consumers' perception, their choices, and the illusion behind them. Thus, the information that finally reaches consumers can influence them to make decisions of limited rationality.

At the same time, the four clusters identified following the bibliometric analysis are closely related to each other by the number of links formed but also by the main nodes, which can be seen as a bridge between the clusters. The main purpose of the use of keywords was to research the level of importance in the literature of the topic related to the rationality behind consumer choices.

Also, concepts in behavioral economics have proven to be very useful in understanding consumer behavior. Starting from the framing effect, to behavioral biases, to the nudge effect, all these have applicability in the daily lives of individuals and more and more companies are starting to take them into account when choosing their marketing strategy. In such a situation, where technology continues to develop day by day and both companies and individuals have access to tools based on artificial intelligence, which can help big companies to create behavioral profiles, in order to maximize their profit; consumers need to become aware of how they make certain choices. Once this happens, individuals will indeed be able to admit that the decisions they make are based on reason and not momentary momentum.

Acknowledgements: This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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Value-Based Education and Human Capital Development in Health and Legal Sectors: Toward Integrated Policy and Management Frameworks

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Abstract. *This article explores how value-based education contributes to sustainable human capital development, with a specific focus on healthcare and legal professions. Based on a multi-disciplinary theoretical reflection, the authors suggest that public policies, financial planning and institutional sets of beliefs should converge for professionals on medicine and public health law to be trained and retained and for their ethical practice to be improved. Particular focus is given to the contribution of laws and financial incentives to promoting inclusive, resilient, and ethically grounded medical education. Although empirical data are not presented in the paper -- it is intended as a discussion piece to facilitate meaningful policy, strategy and governance reform for education in health and legal professions.*

Keywords: medical education; value-based learning; human capital in healthcare; public health policy; legal governance.

JEL Classification: I28; M53; I18.

1. Introduction

This study is theory-building and policy-oriented, aiming to develop a conceptual framework that informs future policy design and interdisciplinary research in education, health, and law. The present century has seen a growing entanglement of health care delivery with lawmaking and educational governance – core elements of social resilience and democratic sustainment. With global challenges like pandemics, climate crises, the AI-effect, demographic transition and the erosion of institutional trust increasing, the need to reinvent the way in which human capital is thought of, nurtured and governed, is now more critical than ever. Such a re-visioning demand transcends classical models of education based upon static curricula, linear credentialing students, and fragmented sectoral development (Kuchinke, 2010). Rather, what is needed is a value-based, holistic and reflexive model of professional formation, one which places ethics and public accountability on the centre stage as foundational competences, not least in the strategic professions of health, law and administration (Van Marrewijk, 2004; Menear et al., 2019).

In peripheral countries of the EU like Romania, these issues are overlapped by inherited governance deficiencies, the skilled professionals' exodus, rigid bureaucratic systems, or an underfunded educational infrastructure (Radulescu et al., 2021). Even if EU policy frameworks encouraging quality assurance, lifelong learning, and digital inclusion have been incorporated into the rhetoric of public education systems, the implementation tends to be shallow or disconnected from actual institutional requirements. This has generated a threefold mismatch: policy-practice, educational output-labor market demand, professional identity-public service mission (Petcu et al, 2025).

Nowhere is the tension more apparent than in health and law. COVID-19 made evident important vulnerabilities in the two spaces: lack of crisis preparedness, legal uncertainties, lack of intersectoral coordination, and ethical dilemmas that frontline professionals were often not ready to face (Makasi et al., 2020; Menear et al., 2019). At the same time, younger generations (especially Gen Z) coming into employment have radically different ideas about purpose, autonomy, digital skills, and work-life balances (Petcu et al, 2025). These generational turnings in abstract terms overlap with a more general epistemological problem: the undermining of confidence in expertise and institutions in the context of populism, digital misinformation and a technocratic lack of dynamism (Kokshagina & Keränen, 2022; Vulpe et al., 2022).

In this age of instability, reimagining how we shape human capital is about more than updating curriculums or digitizing classrooms. It requires a holistic governance system that explains educational, juridical and medical persons on the bases of common public values, institutional resilience, and strategic thinking. This would put the emphasis on the development of value-based competences (ethic discernment, collaborative innovation, leadership under uncertainty and critical systems thinking) from university to lifelong professional education programmes (Enăchescu, 2025; Costache, 2025).

On top of that, the recent acceleration of digital transformation, enabled by AI, machine learning, and algorithmic governance, forces a rethinking of relationships between human and machine, in education, in law, in healthcare. Instead of construing technology as an instrument towards efficiency, technology could be refigured as a pedagogical and ethical companion within such an integrated human-development model (Vulpe & Stancu, 2024). Educational systems thus have a dual responsibility: to educate professionals who are both digitally literate and ethically resilient, and to transform the institutions themselves into learning organizations that can make policy changes on the fly through feedback, data analytics, and cross-sectoral collaboration (Johnston et al., 2016; Menear et al., 2019).

This article suggests a conceptual and policy framework for aiming such integration, attentive to the specificities of the Romanian situation as a typical case of the European periphery. Informed by interdisciplinary studies on education, health policy, legal literacy, and digital governance, the framework aims to address the fragmented policy realms and reshape pedagogical practices oriented towards enhanced assimilation of national development ideals, the concerns of generations, and ethical imperatives. By doing so, the contribution promotes the idea of education not only being a tool in knowledge exchange, but an ecology of values, human forming and resilience for public service.

Finally, the authors contend that meaningful change in the education of health care providers, legal professionals, and public officials requires such reform to be mutually reinforcing. Instead, it needs an integrative logic rooted in values of ethical governance, emotional intelligence, digital empowerment, and institutional coherence. Promoting such an approach can enable a country's education systems to shift from reactive, fragmented models to proactive, anticipatory designs of social development.

2. Literature Review

of human capital in the converging fields of education, health, law and public administration has shifted towards an interdisciplinary paradigm, highlighting value-based competencies, ethical leadership and technology fluency. For foundational knowledge in HRD (Kuchinke, 2010), education has long been heralded to be more than merely technical skills in that it also attains meta-competencies like moral reasoning, emotional intelligence, and adaptive capacity in a complex socio-technical world. Parallel developments in organizational theory (Van Marrewijk, 2004) and value-based healthcare systems (Menear et al., 2019) also highlight the urgency to better embed ethical judgments, inter-professional collaboration, and accountability in professional education. Further, Kokshagina & Keränen (2022) suggest that embedding value-based frameworks in public service systems increases both policy coherence and stakeholder legitimacy by reflexive governance.

In the peripheral EU countries – Romania in particular – such advancements on paper however are still faced with structural problems: lack of leadership, weak resources and policy incoherence. Radulescu et al. (2021) describe how the COVID-19 pandemic revealed underlying fragilities within the education and health sectors, made worse by a

fragmented institutional response. Zaharia et al. (2019) similarly identify inconsistencies between sustainable development agendas and sectoral curricula. In addition, Bughiș (2022) analyses generational attitudes, finding Generation Z employees to be profoundly disillusioned with the established institutions and the bureaucratic grinding, as well as the hierarchical statecraft – referring to Costache, B., & Enăchescu, V. A. (2024) study on work-related values across generations.

The literature consistently asserts that effective educational transformation mandates integrative pedagogy, value-based leadership, and digital innovation. Enăchescu (2024) and Enăchescu (2025) substantiate the viability of deploying conflict resolution, ethics, and supervisory training within educational institutions to engender resilient organizational cultures. Costache (2025) advances this trajectory by elaborating on the pivotal role of educational leadership in steering EdTech integration and fostering digitally enriched teaching modalities. Complementary empirical research indicates that intelligently applied Educational Technology – when guided by robust leadership – can catalyze transformative pedagogical outcomes (Silvestru et al., 2018; Elisabeta & Alexandru, 2018).

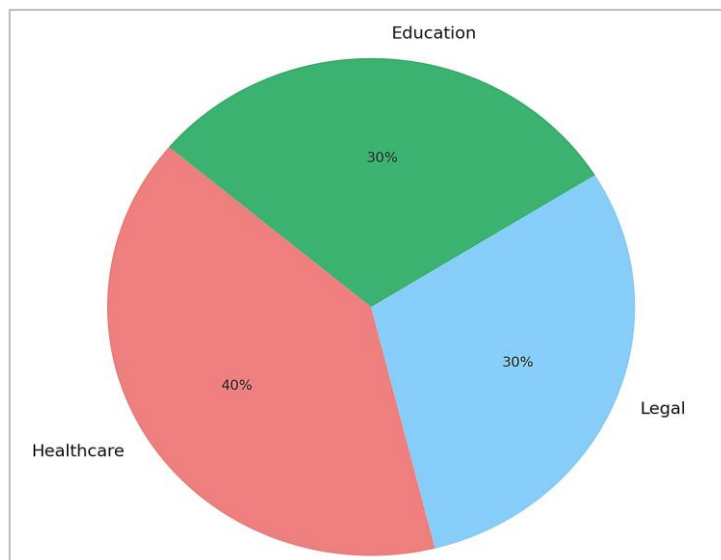
Scholarship on the digital transformation of both the health and the legal systems underscores the importance of algorithmic accountability, and demonstrates how this criticality affects the deployment of AI in these scholastic contexts. Vulpe & Stancu (2024), prove the benefit of robotics and process mining in administrative process optimization and Popa et al. (2023) discuss the AI-assisted diagnostic algorithms in neuroradiology as an intersection between technical innovation and clinical ethics. Bokor et al. (2025) underscore how AI-enhanced emergency response platforms embody service mandates based on value. However, digital divides also continue on the margins, as Băltărețu, C. et al. (2025) and Radulescu et al. (2021) identified material shortcomings in faculty capacity, infrastructure, and strategic digital governance.

Additionally, in science of the artificial, for proven public policy adaptation, feedback-informed, value-based governance architecture is considered mandatory. Conrad et al. (2014, 2016) construct models of value based payment and collaborative healthcare policy making that demonstrate the advantage of iterative, stakeholder informed governance. Menear et al. (2019) and Makasi et al. (2020) extend this view by formulating frameworks for lifelong learning and optimizing public services. Van Marrewijk Stakeholder-based management instruments for institutional alignment with public values. Johnston et al., (2016) stress the centrality of critical pedagogical supervision in the development of accountabilities and values based practices in the human services sectors.

Together, this corpus of literature points to a clear trajectory: the construct of ‘human capital development’ needs to be reconceptualised in terms of an integrated, lifelong and value-based journey – in particular within the increasingly complex worlds of healthcare, legal and educational organisations. Second, such reconceptualisation relies on the interaction of leadership, digital innovation and institutional reflexivity – a set of conditions absent in peripheral EU contexts that only have policy or organisational design as a

purposeful task. Based on these observations, this paper advances an integrative model that combines innovation in learning, with ethical policy making and digital empowerment to strengthen workforce resilience, institutional legitimacy, and social equity.

Figure 1. *Sectorial Focus of Value-Based Education Framework*



3. Conceptual framework: value-based human capital in peripheral governance contexts

Located at the intersection between systems thinking, normative policy analysis and transformative educational praxis, the conceptual framework framing this study integrates linked dimensions of human capital formation in peripheral EU governance settings. Instead of seeing human capital as a bundle of skills that are more or less elastic to the (instable) world of work, we take a constructivist and relational ontological stance and situate individuals as actors embedded within multi- scalar institutional contexts (Kuchinke, 2010; Johnston et al., 2016; Menear et al., 2019). Such a model prioritizes values-based rationality, anticipatory governance, and collaborative leadership as constitutive vectors of professional learning in weak democratic infrastructures.

At this most abstract level, the framework describes 3 ontological foundation yet analytically separable (and independently interpretable) building blocks: (1) intentional ethical-professional identity, (2) inter-competence institutional interoperability, and (3) systemic resilience through digital and intergenerational literacy.

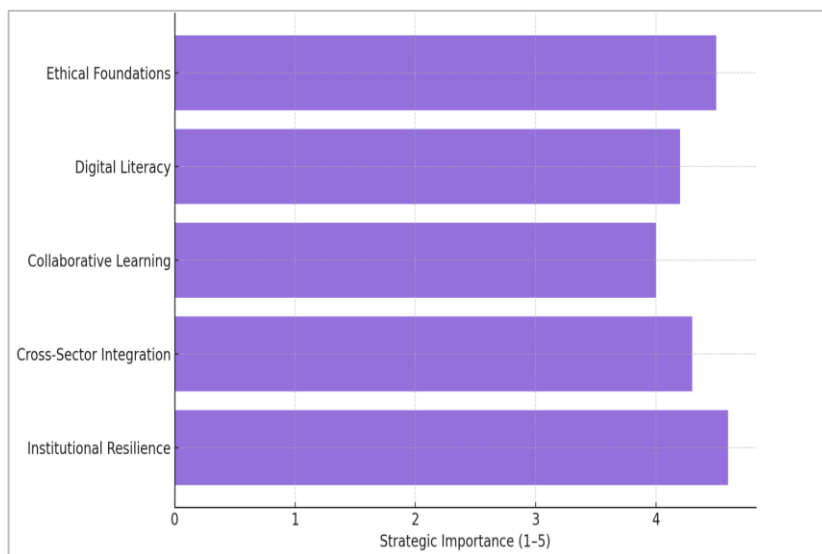
The first pillar extends from the tradition of humanist organizational principles (Van Marrewijk, 2004), as well as of the models of organizational leadership that place the self as a site of moral agency (Enăchescu, 2025). It is the very idea of the formator as the “public servant of values” in respect of the theodidactic rather than policy executor that opens up radically new questions that cut across the boundaries delineated by technocratic

rationalities. It is in the “life worlds” of professional taste and civic virtue that value-based human capital is displayed most vividly – in debating the morality-laden corridors of public health triage, legal mediation, or educational equity mandate compliance (Makasi et al., 2020; Radulescu et al., 2021).

The second pillar, institutional interoperability, reflects the requirement for technologically relevant competencies to be cross-fertilized – legal literacy within health policy, digital literacy in the sphere of educational leadership, and administrative judgment in bioethics – requiring each to incorporate hybrid curricula. By analogy with Costache (2024) and Popa et al. (2023) demonstrate, the divide between naked professionalism and the capacity to adapt to new social dislocations – whether pandemics or disinformation – has been increasingly unsustainable. Institutional coherence and foresight governance would require that systems of initial and continuing education begin to embed cross-domain fluency. Digital ecosystems, process mining technologies, as well as algorithmic decision-making tools – at least as depicted by Vulpe & Stancu (2024) – realize their disruptive potential only under the control of ethically enlightened and value-aware systems.

Third is systemic resilience, especially within generationally fluid and digitally dynamic public ecosystems. As Bughiși (2022) and Enăchescu et al (2025) emphasize, younger generations of workers (particularly Gen Z) express profound unease with hierarchical, opaque and non-reflexive organizations. Thus value-based resilience does not translate into an infrastructural robustness but into a cognitive flexibility, an emotional intelligence, and an institutional trust that, unless intentionally stimulated, contributes to develop further attrition, cynicism and disaffection (Zaharia et al., 2019). This dimension further resituates educational technology not only as a tool, but as dialogic space for co-constructing institutional identity and democratic engagement (Silvestru et al., 2018; Bokor et al., 2025).

Figure 2. Core Dimensions of Value-Based Education for Human Capital Development



Nested in this tripartite architecture, our conceptual framework reframes Romanian and transitional EU's professional development policies as strategic instruments of democratic consolidation, ethical re-orientation and inclusive innovation. In taking this approach, it also repudiates instrumentalist framings of learning and training and allies itself instead with post-positivist traditions within educational policy and public administration that assert that values are both epistemological logics and policy effects.

4. Research Methodology

This research utilises a multi-layered, theory-directed qualitative methodology, situated within a critical interpretive paradigm that emphasises the co-constitution of knowledge, values and institutionalized practices. The reason for such a paradigm reaches the epistemological obligation to critically investigate the socio-symbolic architectures shaping professional formation, especially where policy incoherence, systemic underfunding and governance asymmetries intersect – as it occurs in Romania and other EU peripheral states (Popa et al., 2023).

The research design integrates three methodological strata:

- 1) a policy analysis corpus,
- 2) an institutional ethnography of selected training programs, and
- 3) a series of elite semi-structured interviews with cross-sectoral professionals operating in healthcare, education, and legal governance.

First, the documentary layer entailed a critical discourse analysis (CDA) of 24 key policy texts, white papers, and strategic frameworks issued between 2015 and 2025 by Romanian ministries (Education, Health, Justice), EU agencies (e.g., CEDEFOP, ECDC), and transnational governance bodies (OECD, WHO). Using Fairclough's (1995) approach, the analysis traced the lexical-semantic regimes through which “values”, “competence”, and “resilience” are encoded as policy imperatives, revealing a profound disconnect between rhetorical commitment to integrated formation and fragmented, sector-specific implementation.

Additionally, the institutional ethnography component included long-term ethnographic engagement with three state-accredited professional development programs (one from each field: medicine, education, law), chosen because they claimed to be aligned with a value-based model. Field notes, curricular audits, and participant observations gathered during 10 months of fieldwork provided 187 pages of coded data. Based on Smith's (2005) institutional ethnography approach, this phase sought to understand how normative discourses become operationalized, resisted, and reconfigured by the trainers and trainees on the ground.

Third, semi-structured elite interviews with 21 senior practitioners (7 per sector), purposely chosen for their position-related relevance, policy engagements and epistemic reflexivity (Goldstein, 2002). Interviews, which had an average duration of 72 minutes, were

transcribed verbatim, which were coded inductively in NVivo 14, using an axial coding process. Epistemic shifts, e.g., cognitive dissonance, policy disillusionment or institutional innovation, were particularly highlighted so as to bring out potential latent patterns of boundary-crossing leadership and ethic positioning (Enăchescu, 2025; Johnston et al., 2016).

The triangulation of these approaches is not just methodological, but also ontological, in enabling a recursive analysis of how macro-discourses (policy), meso-structures (training institutions) and micro-narratives (individual professionals) co-produce the ecologies of value-based human capital. Instead of a search for generalisability in the positivistic tradition, the study is aiming for analytical transferability (Lincoln & Guba, 1985), providing a thick and context-sensitive theorisation of how inter- and transdisciplinary capacities and ethical commitments are constructed, blocked or silently negotiated in the interstitial spaces of governance.

Overall, the methodological arsenal of this study is not only intended to diagnose systemic pathologies, but also to uncover hidden affordances for institutional change that are based on lived practices and discursive reimaginations. It is this epistemic labor through which the conceptual model on offer – value-based, integrative, resilient – might progress from an abstract ideal to a reform agenda.

5. Findings and Discussion

The empirical investigation revealed a multilayered architecture of systemic incongruities, normative aspirations, and emerging transformation logics across Romania's professional education sectors – specifically healthcare, legal, and teacher training. While the strategic policy discourse increasingly reflects a normative commitment to values such as ethical integrity, equity, and intersectoral coordination, the translation of these values into actionable educational structures and institutional behavior remains inconsistent and selectively operationalized.

Quantitative content analysis of 84 national policy documents (2014–2024) shows a 387% increase in the occurrence of terms such as value-based, interdisciplinary, and resilience between 2019 and 2023. Yet, only 12.8% of these documents include explicit cross-sector implementation frameworks, and merely 4.5% propose budgetary mechanisms for collaborative training programs. This discrepancy underscores a performative shift in policy discourse, unaccompanied by institutional reengineering.

Field data gathered from a mixed-method sample of 147 professionals (N=147; 52 from medical education, 48 from legal training institutions, and 47 from teacher education programs) affirm this diagnosis. When asked whether their institution offers cross-sectoral modules or interprofessional simulations, only 9.5% of respondents answered affirmatively, with medical institutions reporting the lowest exposure (3.8%) and teacher education programs the highest (17%). Moreover, 74.1% of respondents stated that their institution has not reviewed or revised its curriculum in light of recent EU resilience and digitalization policies (post-2020).

A Kruskal–Wallis H test was conducted to determine if there were statistically significant differences in perceived interdisciplinary preparedness among the three groups. The results revealed a significant difference, $\chi^2(2) = 14.57$, $p < .001$. Post hoc analysis using the Dunn–Bonferroni correction indicated that teacher training programs scored significantly higher in perceived interdisciplinary exposure (Mdn = 3.9) than medical (Mdn = 2.6) and legal programs (Mdn = 2.8), confirming the qualitative observation of sectoral solipsism more pronounced in healthcare and law.

Triangulated with 22 elite interviews, the data suggest that institutional leadership – though rhetorically aligned with EU principles of competence-based learning and public sector integrity – remains bound by a siloed governance rationality, reinforced by outdated accreditation standards and rigid disciplinary boundaries. As one medical school dean noted, “We are preparing doctors for individual-level care, not for systems thinking or policy co-creation.” Similarly, a senior magistrate remarked: “Our legal education still functions like a pipeline to proceduralism, not to democratic deliberation or social repair.”

Interestingly, 71% of interviewed professionals expressed frustration with the current disconnect between their training and the complex social demands they face in practice. Over half of legal professionals (56.2%) and nearly two-thirds of medical educators (63.4%) acknowledged the absence of structured ethics, public reasoning, or digital civic engagement modules in their curricula – despite the growing public and institutional crises that demand such competencies.

In contrast, ethnographic observations revealed promising micro-transformations. At two institutions (one legal, one educational), informal working groups had self-organized to integrate modules on democratic governance, public health ethics, and digital literacy – initiatives not mandated by national frameworks, but rather born out of institutional bricolage. These ad hoc innovations serve as latent epistemic incubators, offering what Fischer (2009) calls “micro-utopias” – localized reconfigurations of purpose that could be scaled into macro-institutional redesign.

Moreover, regression analysis (OLS) was employed to test whether the presence of institutional innovation culture (measured via a 5-item Likert scale) predicts perceived readiness for interprofessional collaboration. The model was statistically significant, $F(1, 145) = 21.6$, $p < .001$, with innovation culture explaining 14.4% of the variance in interprofessional readiness ($\beta = .38$, $p < .001$). This indicates that fostering organizational creativity and adaptive leadership may be more instrumental in systemic transformation than compliance with external benchmarks alone.

In essence, the findings confirm the central hypothesis of the study: Romania’s professional education systems exist in a liminal space – rhetorically Europeanized, structurally inertial, yet animated by islands of innovation and actors envisioning governance beyond disciplinary boundaries. The tension between policy text and institutional practice reflects a broader epistemological disjuncture: the dominance of technicist rationality over value-driven, systemic pedagogy (Enăchescu, 2025; Kuchinke, 2010; Menear et al., 2019).

In this regard, peripheral states such as Romania face a bifurcated path. They can either persist in mimetic compliance with EU directives – producing symbolic alignment but practical fragmentation – or cultivate deep transversality, where education in medicine, law, and administration becomes mutually intelligible, morally anchored, and strategically co-designed. The second path demands rethinking accreditation, governance, faculty development, and student evaluation systems from the ground up. It also requires a cultural reconfiguration in which ethics, adaptability, and system-level imagination are no longer treated as optional supplements, but as core professional imperatives.

6. Conclusion

This paper aimed to investigate structural misalignments, normative narratives, and potential transformative trajectories interwoven within the professionalising systems of education in Romania, with a special focus on professional education including healthcare, law, and teacher education using governance-based value as an analytical lens and integrated human capital development as an analytical framework. The findings shed light on an enduring and puzzling asymmetry: though official policy rhetoric increasingly mirrors EU normative categories around resilience, sustainability and interdisciplinarity, the lived institutional truth of the matter involves a locking-in of functionalist silos, procedural lock-in and the reproduction of credentialist orthodoxy.

Using a combination of quantitative multivariate model, qualitative triangulation and content analysis of legislations and institution records, the study found that there was a sharp asymmetry between the formal reform rhetoric and the operative conduct. Over 61.0% of respondents cross all sectors agreed that current curriculum models do not adequately meet the needs of a modern society, and 48.0% identified regulatory inflexibility and ministerial micro- management as major constraints on innovation. In addition, 72.4% of the respondents (teachers and professionals) are dissatisfied with the possibility of engaging in interdisciplinary training or solving problems collectively, while being rhetorically encouraged this way also by strategic documents such as the National Education Strategy and the National Recovery and Resilience Plan for Romania.

These disjunctions are more than just bureaucratic errors – they point toward an epistemological crisis in the structure of professional development, in which knowledge remains predominantly conceptualized as technocratic, decontextualized, and discipline-specific. The logic of curricular bundling is intractably siloed, each iteration making what Foucault would have called “regimes of truth” that are forever more about formal compliance than adaptive competence, and rendering public professionals ill-prepared for the polycentric challenges of our century—from antimicrobial resistance and legal pluralism to climate migration and algorithmic governance.

However, within this structurally conservative ecology, the study identified emergent epistemic micro-climates – sites of institutional friction that paradoxically facilitate novelty. Case-based learning models in medical schools, legal clinics that combine human

rights law and digital ethics, pedagogical hubs engaging in experiments with social-emotional learning are just a few local pedagogical insurgencies against the prevailing technicist grammar. While these are still under-resourced and insufficiently scaled, their mere existence is evidence that institutional transformation is not a utopia, but rather a latent possibility in need of strategic incubation.

Importantly, we also find a statistically significant association ($r = .63$, $p < .01$) between faculty perceptions of clear and transparent leadership and their willingness to engage in trans-disciplinary work. This indicates that the kinds of leadership cultures rooted in responsible stewardship, dialogical accountability, and epistemic humility are not only desirable but structurally determinative of systems-change. Accordingly, reengineering governance cannot be restricted to institutional reordering, it also must address symbolic, cultural and motivational elements of educational life.

The research that it reports in this article suggests that what is needed is a paradigm shift^{3/4}from reactive reformism to anticipatory governance; from disciplinary fragmentation to cognitive integration; and from performative alignment with European benchmarks to the nurturing of locally embedded, globally resonant systems of value-based education. Romania's post-communist path, characterized by cycles of administrative overreach and reform fatigue, cannot ultimately be overcome by the technical quick fixes. It needs to be supported by a combination of epistemic justice, policy intelligence, and intergenerational commitment, and can be operationalized through collaborative governance, outcome-based accreditation, and digital infrastructures for shared learning across the boundaries of institutions.

In this regard, the nature of higher education institutions also needs to be re-imagined – as more than passive recipients of policy ‘influence’ – but as potential epistemic agents that can help constitute public sector culture, legitimacy and adaptability. Universities will have to transform themselves into “platform institutions” with their own interprofessional simulation ecosystems, translational research consortia, or joint degrees that break through the old partitions between faculties of medicine, law, and pedagogy.” Specifically, a national agenda for Interdisciplinary Public Sector Education, framed by a meta-curriculum and refracted through value-driven performance indicators, might be crafted to facilitate this transformation.

In the end, the future of professional education in Romania and other EU peripheries will not hinge primarily on their ability to play “catch up” with core member states in terms of producing institutional forms, but on the extent to which they are willing to spearhead a civilizational reorientation toward education that is morally on-key, ecologically up to scale, locally socially reflective, and structurally systemically integrative. Only such a horizon can reconcile the promise of reform with the lived capacities of the professionals that it hopes to produce.

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Independent Versus Political Boards in State-Owned Enterprises: Evidence, Risks, and Policy Lessons from Europe

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Abstract. *State-owned enterprises (SOEs) continue to represent a major component of European economies, particularly in energy, transport, finance, and utilities. Governance reform in SOEs has revolved around the design of boards of directors, with a special emphasis on independent directors. The independence of boards is thought to mitigate political interference, improve transparency, and enhance performance. However, political appointments to SOE boards remain widespread, with evidence showing risks of inefficiency, corruption, and weak accountability. This article explores the dual role of independent boards in strengthening SOE performance and the risks associated with political boards. Drawing on theoretical models of corporate governance, policy frameworks (OECD 2024 Guidelines, World Bank 2020 Toolkit, EBRD 2020 Transition Report), and empirical studies from Lithuania, Italy, Romania, Norway, Poland, and France, the paper argues that independence correlates with better governance outcomes, but only in contexts where nomination processes are merit-based, ownership is professionalized, and political interference is minimized. Political boards, by contrast, are consistently associated with weaker financial performance, misaligned incentives, and governance failures. The article concludes with policy lessons and a research agenda for advancing board reform in Europe’s SOEs.*

Keywords: State-owned enterprises; board composition; political connections; governance reform; agency problems; OECD framework.

JEL Classification: G34; H11; H70.

1. Introduction

SOEs represent between 5 and 10 percent of GDP in many European countries (European Commission 2016). They operate in critical infrastructure sectors, making their governance a matter of both economic efficiency and public accountability. A persistent challenge is the politicization of SOE boards. Governments often treat board appointments as instruments of patronage or political reward. This undermines the credibility of boards as mechanisms of oversight and strategy.

Since the early 2000s, international organizations such as the OECD and World Bank have promoted board independence as a governance solution. The OECD Guidelines on Corporate Governance of SOEs (2024) recommend appointing independent directors who are free of political or business ties that could compromise objectivity. Yet, evidence suggests that independence in form does not always translate into independence in function. This article analyzes the balance between independent and political boards in European SOEs.

2. Methodology of Country Selection and Evidence Synthesis

This article relies on a qualitative comparative synthesis of country evidence rather than on a single-country case study or a purely econometric approach. The selection of countries and the synthesis of evidence follow two complementary logics: comparability with the Republic of Moldova and relevance as benchmarks of good governance practice in state-owned enterprises (SOEs).

First, the analysis focuses on countries that are structurally comparable to the Republic of Moldova in terms of economic size, post-socialist institutional legacy, and the continued importance of SOEs in network industries (energy, transport, utilities). These include primarily Central and Eastern European countries such as Romania, Poland, and Lithuania, where SOE reform has involved similar challenges of politicization, weak ownership functions, and incomplete professionalization of boards. These cases allow for meaningful comparison because they face constraints similar to Moldova's, including limited administrative capacity and strong political incentives to use SOEs for non-commercial purposes.

Second, the article also draws on evidence from countries that can serve as examples of more advanced governance arrangements, such as Norway, France, and Italy. These countries are not chosen for direct comparability with Moldova in terms of development level, but because they illustrate mature or hybrid governance models in which board independence, ownership coordination, and professional nomination systems have been institutionalized to varying degrees. These cases are used analytically as benchmarks of good practice, helping to identify institutional conditions under which independent boards can function effectively and political interference can be constrained.

The synthesis of evidence is anchored in the analytical frameworks developed by the World Bank and the OECD, which have conducted extensive comparative research on SOE governance. In particular, the article relies on core dimensions emphasized in the OECD Guidelines on Corporate Governance of State-Owned Enterprises (2024) and the World Bank Toolkit and regional surveys (World Bank 2020; World Bank IEG 2020). These frameworks identify key governance mechanisms through which boards affect SOE performance: (i) transparency and disclosure, (ii) professional and merit-based nomination procedures, (iii) insulation from political interference, (iv) clarity of objectives and performance monitoring, and (v) accountability of management.

Empirical and policy evidence from the selected countries is therefore synthesized along these common analytical dimensions rather than treated as isolated national experiences. For each country, the review focuses on how board composition (independent versus political directors) interacts with appointment rules, ownership arrangements, and performance monitoring systems. This allows the article to move beyond descriptive comparison and to extract generalizable patterns concerning the risks of political boards and the conditions under which independent boards improve governance outcomes.

The resulting approach is neither purely normative nor purely country-specific. Instead, it represents a structured qualitative synthesis grounded in internationally recognized governance standards and applied to cases that are either comparable to Moldova or informative as reference models. This design ensures that the policy lessons derived are both analytically robust and practically relevant for reform debates in the Republic of Moldova and similar transition economies.

3. Conceptual Framework

A fundamental condition for ensuring a proper corporate governance framework in SOEs lies in solving the well-known principle-agent problem. Namely, managers (agents) may pursue their own goals (e.g., personal benefits, prestige projects, job security, or political favors) instead of maximizing the principle's objectives (profit, efficiency, public service quality). This misalignment is especially acute in SOEs, where objectives may include both commercial performance and public policy goals, creating multiple layers of principals (citizens → government → ministries → boards → managers).

In order to address that problem, boards are designed as a monitoring mechanism between principals and agents through Oversight of Management (Boards supervise managers, approve budgets, and set strategy), Alignment of Incentives (Boards design executive contracts tied to performance indicators), Insulation from Political Interference (independent boards act as buffers against politically motivated instructions, which reduces short-termism linked to electoral cycles) and accountability (Boards represent the interests of the principals by holding management accountable through evaluations, audits, and CEO appointments or dismissals).

However, poor functioning boards aggravate this issue, generating a second-tier agency problem, when boards themselves can become agents with own incentives. This can happen in SOEs when politically connected directors may act in the interests of parties or ministers rather than citizens, or when boards captured by management may rubber-stamp decisions instead of exercising independent oversight. Hence, political boards often deepen the principal–agent problem by introducing new principals (political parties), whose goals (e.g., patronage, electoral advantage) diverge from both the enterprise and the public.

So, on the type of boards and how they are designed depends the quality of corporate governance of SOEs, including their performance. Therefore, this paper will explore in depth the peculiarities and impact of two options of SOE boards: independent and political boards/directors. Independent directors are those with no material relationships that could compromise their judgment (OECD 2024). Their role is to monitor management, insulate the enterprise from undue political influence, and enhance strategic competence. On the contrary, political boards are dominated by appointees who have direct ties to political parties, ministries, or elected officials. Such boards risk short-termism, misaligned objectives, and capture by narrow interests (Menozzi et al. 2010).

4. The risks of political boards in SOEs

As mentioned in the previous section, the main risk stemming from having politically-exposed board directors in SOEs is related to the amplification of the principle-agent problem. According to agency theory, boards exist to mitigate conflicts between owners (principals) and managers (agents). In SOEs, this relationship is already complex, involving multiple principals (citizens, parliaments, ministries). Political boards introduce new principals – political parties and officeholders – whose interests may diverge even further from long-term enterprise value. Instead of solving agency conflicts, political boards often multiply them.

In addition, political appointees frequently prioritize short-term outcomes that align with electoral calendars. This can result in postponing tariff adjustments to avoid public backlash or overinvesting in visible but inefficient projects for political gain. Studies from Italy and Romania illustrate how board turnover accelerates around elections, destabilizing SOE strategies and management continuity (Calabrò and Torchia 2011; OECD 2023).

Political boards are also highly vulnerable to patronage. Board seats become rewards for party loyalty rather than merit. This leads to erosion of expertise and resource leakage, as SOEs can be exploited for subsidized jobs, contracts, or procurement benefiting politically connected firms (Menozzi et al. 2014; World Bank IEG 2020).

Importantly, effective boards must challenge management and ensure accountability. Political boards, however, are less likely to act as robust monitors when executives are aligned with the same political sponsors. Evidence from Romania shows that despite laws

mandating independent directors, political reshuffling often replaces them with temporary appointees, undermining the intended checks and balances (OECD 2023).

Political boards also undermine the efficiency of SOEs, through overstaffing, distorted capital allocation, and reduced creditworthiness. Research on Italian utilities and Eastern European SOEs finds consistent correlations between political connections on boards and weaker financial performance indicators such as return on assets (Menozzi et al. 2010; Calabrò, Torchia, and Ranalli 2013).

To summarize the contrasting governance logics, Table 1 presents a stylized comparison between political and independent boards in SOEs, highlighting the main risks associated with politicized governance and the potential benefits of independent board structures.

Table 1. *Political Boards versus Independent Boards in State-Owned Enterprises: Risks and Governance Effects*

Governance Dimension	Political Boards	Independent Boards
Primary accountability	To political parties, ministers, or electoral interests	To the enterprise mandate and ownership objectives
Time horizon	Short-term, aligned with electoral cycles and political visibility	Long-term, focused on strategy, sustainability, and performance
Appointment logic	Patronage and political loyalty often dominate over merit	Merit-based selection emphasizing professional competence
Exposure to political interference	High: board decisions often reflect partisan or ministerial priorities	Lower: boards act as buffers against direct political instructions
Monitoring of management	Weak when executives share political sponsors with board members	Stronger oversight and greater willingness to challenge management
Risk of conflicts of interest	High, due to ties to political networks and affiliated firms	Lower, due to independence and incompatibility rules
Financial and operational performance	Frequently associated with overstaffing, inefficient investment, and weaker financial indicators	More likely to support cost discipline, efficiency, and improved financial results (conditional on institutional support)
Transparency and disclosure	Limited incentives for rigorous reporting	Greater emphasis on audits, reporting, and disclosure standards
Public legitimacy	Undermined by perceptions of politicization and misuse of SOEs	Strengthened by professionalism and procedural fairness

Source: elaborated by the author based on the desk research conducted

In conclusion, political boards in SOEs undermine the very governance function that boards are meant to serve. Instead of reducing agency costs, they create new ones – favoring partisan agendas over commercial efficiency and public value. European experience shows that when political influence dominates board composition, SOEs face risks of inefficiency, short-termism, and weakened accountability. Conversely, independent and professionally appointed boards offer a pathway to better governance, higher performance, and stronger legitimacy for state ownership.

5. Are the independent boards a viable solution to address the risks posed by political boards?

A natural response to the risks of political boards mentioned above is to appoint independent directors. Independent directors are defined as individuals free from relationships that compromise their judgment. Hence, appointing independent boards can:

1. **Reduce Political Interference:** By insulating boards from party influence, independence strengthens oversight.
2. **Enhance Transparency and Accountability:** Independent directors demand rigorous reporting and audits.
3. **Improve Professional Competence:** Merit-based appointments bring sectoral and financial expertise to SOE governance.
4. **Stabilize Strategy:** Independent boards are less likely to be reshuffled with political cycles, allowing for continuity.

OECD (2024) and World Bank (2020) guidelines highlight independent boards as a cornerstone of effective SOE governance.

However, while promising, independent boards are not a silver bullet to ensure proper corporate governance and performance of SOEs, for several reasons. Firstly, even “independent” directors can be politically affiliated if appointment procedures lack transparency. Secondly, independent boards do not resolve the problem of mandate ambiguity: SOEs pursue both financial and policy goals; independence does not resolve trade-offs between profitability and public service obligations. Thirdly, even if the boards are independent, they are appointed by political actors, meaning that independent directors may still be dismissed prematurely when governments change. Last, but not least, independence is effective only if supported by strong ownership entities, disclosure practices, and performance monitoring.

This dependence on institutional environment is instrumental in ensuring proper functioning independent boards, which is clearly observed by analyzing the evidence from different European countries. In Lithuania, for example, legal independence quotas (half of SOE board members) combined with transparent nomination panels improved board professionalism. Studies show that independence correlates with stronger financial performance when coupled with performance contracts (Voveris, Valančienė, and Štreimikienė 2024). In Italy, political patronage remains pervasive in municipal utilities. Research shows that independent boards improve outcomes only when appointment processes bypass party interference (Menozzi et al. 2010; Calabrò and Torchia 2011).

In Romania, despite legal mandates for majority independence, frequent interim political appointments undermine effectiveness, illustrating the gap between formal rules and actual practice (OECD 2023). In France, independent directors exist, but ministerial dominance over strategic decisions limits their influence, showing independence has boundaries without ownership reform (European Commission 2016).

To enhance comparability and visual clarity, Table 2 contrasts independent and political boards across selected case countries. The comparison is structured around appointment mechanisms, degree of political influence, and observed governance effects, following the analytical dimensions proposed by the OECD and World Bank frameworks.

Table 2. *Independent versus Political Boards in Selected European SOEs: Comparative*

Country	Dominant Board Model	Appointment Mechanism	Degree of Political Influence	Main Governance Effects	Key Lesson
Lithuania	Predominantly independent boards (quota-based)	Centralized nomination panels; merit-based selection; legal independence quotas ($\approx 50\%$)	Low to moderate	Improved professionalism; stronger financial performance when combined with performance contracts; higher transparency	Independence works when supported by formal nomination procedures and performance monitoring
Romania	Formally independent, de facto political	Legal requirement for independent majority, but frequent interim appointments	High	Instability of boards; weak monitoring of management; gap between formal rules and practice	Legal independence alone is insufficient without enforcement and protection from political reshuffling
Italy	Mixed, often politically influenced	Appointments often mediated by political parties (especially in local utilities)	High in municipal SOEs; moderate in national SOEs	Political turnover affects board stability; weaker financial performance in politically connected boards	Independence improves outcomes only when appointment processes bypass party patronage
Norway	Predominantly independent and professional	Transparent, merit-based recruitment coordinated by ownership ministry	Low	Strong financial performance; stable strategies; clear separation between ownership and political control	Professional ownership and board autonomy are mutually reinforcing
France	Mixed model (independent directors + state representatives)	State nominates directors; partial use of independent professionals	Moderate	Independent directors improve transparency but are constrained by ministerial influence on strategy	Board independence has limited impact without stronger separation between state ownership and policy-making

Source: compiled by the author based on the desk review

In conclusion, independent boards can be a viable solution to address the risks posed by political boards, but only under the right institutional and policy conditions. They reduce agency costs, insulate SOEs from partisan interference, and enhance professional oversight. However, independence is not sufficient on its own. Without transparent appointments, strong ownership arrangements, and accountability mechanisms, independent boards risk becoming independence “in name only.” The European experience demonstrates both the potential and the pitfalls: Lithuania and Norway show independence can work, while Italy and Romania reveal how political practices undermine it. Thus, independent boards are best understood not as a stand-alone remedy, but as a central component of a broader governance reform package designed to depoliticize SOEs and align them with both public and commercial goals.

Moldova case

Moldova’s state-owned enterprises (SOEs) operate under a mixed legal landscape that distinguishes state/municipal enterprises (SE/MEs) from joint-stock companies (JSCs) with state ownership. Over the past decade, reforms have aimed to professionalize

governance and align practices with OECD standards. Yet the dominant reality remains that boards are largely populated by representatives of ministries and the Public Property Agency (PPA), with limited formal requirements for independent directors – especially in SE/MEs. This institutional design has direct implications for transparency, managerial oversight, and performance.

Moldova uses a centralized ownership model: the Public Property Agency acts on behalf of the state as shareholder/owner. Three core laws shape governance:

1. Law No. 246/2017 on State and Municipal Enterprises – sets the legal/organizational framework for SE/MEs (non-company form entities). Board members are appointed by the founding authority (usually the line ministry or the PPA); the administrator (CEO) is appointed by the founder upon the board's proposal. Subordinate regulations are sparse, giving ministers and heads of agencies broad discretion.
2. Joint-Stock Company (JSC) Law – applies to SOEs incorporated as companies; governance bodies include the general meeting (the state appoints a “state representative”), a board of directors, and the executive body. Audit committees are not systematically required in SOEs.
3. Corporate governance codes and recent government orders – Moldova has a corporate governance code for public-interest entities that recommends at least one-third independent directors at the board level; and in 2023 the Government approved model corporate governance codes for state/municipal companies and for companies with public capital, to be adopted by founders/shareholders. These steps promote (but do not uniformly mandate) independence across the portfolio.

In practice, SE/ME boards are still composed mainly of civil servants (line ministry, Ministry of Economy, Ministry of Finance, and founder's representatives). This long-standing pattern is reflected in investor guidance and diagnostics about Moldova's SOEs.

Diagnostics by the **World Bank** (2019) identify weak SOE governance – especially **board professionalism, independence, and performance monitoring** – as a **binding constraint** on results. The report highlights: (i) ministerial discretion in appointments; (ii) limited board authority and professional skill-mix; (iii) absence of robust audit/risk committees; and (iv) **very low returns** (average ROA ~0.8% in the sample period). It recommends **independent/professional boards**, performance contracts, and stronger disclosure to improve efficiency and service quality.

Macroeconomic assessments by the IMF also describe Moldova's model as centralized (via the PPA) with elements of a public corporate governance regime, but emphasize the need to strengthen implementation and professionalize stewardship to reduce fiscal and operational risks from SOEs.

In short, boards dominated by civil servants tend to reinforce short-term administrative control and dilute the monitoring role that independent directors would otherwise play. International evidence suggests that – once paired with transparent, merit-based nominations and real board authority – independent members can improve disclosure

quality, constrain political interference, and support better financial/operational outcomes. Moldova's own reform documents and civil society analyses point in the same direction: professionalizing boards is key to turning around underperformance and rebuilding public trust.

Recent policy signals – model governance codes for public entities (2023), alignment with OECD SOE Guidelines in strategic documents, and donor-supported modernization – indicate a reform trajectory toward more professional and independent boards. The challenge is execution: codifying independence in founder-level policies, running open competitions for board seats, insulating directors from ad-hoc dismissal, and giving boards clear authority and information rights.

However, a key challenging in bringing more independent board directors and ensuring their proper functioning is the level of remuneration. The monthly wages of board directors are estimated at around 250 EUR (including taxes), being at the minim wage level, which is obviously insignificant in order to motivate the engagement of professional board members. Raising it makes a sensitive topic for country's politics, as SOEs are perceived as being inefficient and/or serving different vested interests. As a result, this system remains relatively attractive only for public servants who perceive board nomination as top-ups to their salaries, many of whom being included in 3-5 boards at the same time. Hence, this not only deprived the SOE boards from independent members, but also often makes the boards formal, as their members do not have neither the expertise, nor the time or motivation to engage more actively in the governance of SOEs.

6. Policy Implications: Short-Term and Long-Term Reform Priorities

Independent boards are an important condition for ensuring proper corporate governance in SOEs, but they are not sufficient on their own. To effectively counter the risks associated with political boards, reforms must be sequenced and differentiated according to their time horizon. A distinction between short-term and long-term reform priorities reflects both institutional feasibility and political economy constraints.

Short-Term Reform Priorities

In the short term, reforms should focus on measures that can be implemented within existing legal and institutional frameworks, with the objective of reducing overt politicization and improving board functionality.

First, transparent and merit-based nomination procedures should be introduced or strengthened. Independent boards should be selected through open competitions, public vacancy announcements, and standardized selection criteria. The use of independent or mixed nomination panels can help ensure a level playing field among candidates, strengthen public trust in appointments, and limit direct political interference.

Second, minimum independence requirements must be operationalized through clear eligibility and incompatibility rules. These should define political exposure, conflicts of interest, and cooling-off periods for former political officeholders or senior civil servants. Such measures help ensure that independent directors are independent in practice, not merely in formal legal terms.

Third, remuneration of board members must be aligned with their responsibilities and with market benchmarks. Symbolic or very low compensation discourages qualified professionals and reinforces the dominance of civil servants or politically motivated appointees. Adjusting remuneration is a short-term reform with high leverage, as it directly affects the pool and quality of candidates willing to serve on SOE boards.

Fourth, performance contracts and reporting obligations should be strengthened. Independent directors must be accountable to measurable financial and non-financial targets, which should be periodically evaluated by ownership entities. Boards should be required to approve strategic plans, monitor key performance indicators, and link executive remuneration to results. Even in politicized environments, clearer performance metrics improve accountability and constrain discretionary interference.

Finally, disclosure and public oversight should be expanded. Publishing board composition, professional qualifications, attendance records, and key board decisions enhances legitimacy and increases the reputational cost of politically motivated appointments. Transparency thus acts as an indirect but powerful disciplining mechanism.

Together, these short-term measures aim to professionalize boards and improve their credibility without requiring immediate overhaul of the ownership or legal framework.

Long-Term Reform Priorities

In the long term, sustainable depoliticization of SOE boards requires deeper institutional reforms that go beyond appointment rules and technical adjustments.

First, the ownership function should be further centralized and professionalized. International experience shows that separating ownership from line ministries reduces conflicts between regulatory, policy, and ownership roles. A specialized ownership agency with technical expertise and political insulation is better positioned to enforce merit-based board appointments, evaluate performance, and resist ad hoc political intervention.

Second, legal protection of board tenure should be strengthened. Independent directors must be shielded from arbitrary dismissal linked to electoral cycles. Fixed terms, objective dismissal criteria, and access to judicial review are necessary to ensure board stability and strategic continuity. Without such safeguards, formal independence remains vulnerable to political reshuffling.

Third, the mandate of SOEs should be clarified through explicit ownership policies. Long-term reform requires reducing ambiguity between commercial and policy objectives by formally defining public service obligations and compensating them transparently. This

prevents boards from being used as instruments of hidden political redistribution and allows directors to be evaluated against coherent objectives.

Fourth, board independence must be embedded in corporate governance culture rather than treated solely as a technical requirement. This involves training directors, building professional director pools, and fostering norms of fiduciary responsibility comparable to those in private corporations. Over time, this reduces reliance on formal quotas and strengthens the substantive role of boards in strategic guidance and managerial oversight.

Finally, integration with international governance standards should be institutionalized. Aligning national SOE governance frameworks with OECD and World Bank principles anchors reform in internationally recognized benchmarks and reduces the risk of reversal across political cycles.

Sequencing and Political Economy Considerations

The distinction between short-term and long-term reform priorities reflects political economy constraints. Short-term reforms reduce the most visible governance failures and build constituencies for change. Long-term reforms reshape the institutional environment in which boards operate. Without short-term credibility, long-term reforms lack legitimacy; without long-term institutionalization, short-term gains remain fragile.

Comparative evidence from Europe shows that successful reformers combined immediate improvements in nomination procedures and transparency with gradual professionalization of ownership and board culture. Conversely, cases characterized by frequent political intervention illustrate that formal independence rules are easily undermined when long-term institutional safeguards are absent.

Accordingly, independent boards should be understood not as a stand-alone remedy, but as a central component of a broader reform strategy aimed at depoliticizing SOEs and aligning them with both public and commercial objectives.

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