

Digitalization of Romania's Education Sector: A PESTLE Analysis

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Abstract. Digitalization significantly transforms the teaching profession paradigm and enhances the impact of digital learning environments. These online environments reduce physical distances and generate innovative educational activities, thereby contributing positively to higher student participation and intrinsic motivation. Furthermore, the current state of scientific literature underscores both the benefits and challenges brought about by the digital transformation of the education sector. However, despite the interest in the topic of digitalization, only a handful of studies have analyzed this process from an educational perspective. This article provides a comprehensive review of the existing literature, focusing on the role of political, economic, social, technological, legal, and environmental factors in shaping digitalization. The research methodology adopted is a thorough PESTLE analysis, which aids in understanding the interplay of these factors. The research questions are centered around how these factors influence the digitalization trajectory, with a particular emphasis on their impact on the employment and training of ICT professionals. The main findings reveal that the digitalization process in Romania's education sector is dynamic, influenced by various elements ranging from technological advances to policy changes. The implementation of digital solutions has revolutionized teaching methodologies, learning experiences, and administrative processes. The paper contributes to the field by offering valuable insights into the multifaceted process of digitalization in Romania's education sector. It also underscores the need for a holistic approach, considering all PESTLE factors, to successfully navigate the digital transformation journey in the education sector.

Keywords: education, digitalization, ICT, digital competences, digital literacy, digital divide, PESTLE

Introduction

The advent of digital technology has ushered in a new era of transformation across various sectors worldwide, with education being a prominent domain experiencing this paradigm shift. While most studies focus on SWOT analysis of the education sector, the originality of the current study resides in providing an overview of the impact of the six different macro environmental factors included in the PESTLE framework.

The digitalization trajectory is shaped by various factors such as political landscape, economic conditions, social dynamics, technological advancements, legal frameworks, and environmental considerations, especially their interplay and impact on the employment and training of ICT professionals (Panfil, 2017).

The digitalization of education in Romania, a dynamic process influenced by factors from technological advancements to policy changes, has seen the implementation of digital solutions revolutionizing teaching methodologies, learning experiences, and administrative processes (Nicolau et al., 2020). European regulations have significantly shaped Romania's digital education landscape by providing a framework for digital solutions adoption and setting standards for data protection, privacy, and digital rights, ensuring a safe digital environment for learners (European Commission, 2023c).

The importance of developing a digital-based behavior has been proved by the recent Coronavirus Pandemic that forced a sudden shift of human interactions to the online, due to its

benefits in terms of health security (Hudrea et al., 2023). However, the strategy adopted by each education system mainly depended on their level of digital maturity, as well as on their political context (McCarthy et al., 2023).

The paper will delve into the specific European regulations that have impacted the digitalization process and analyze how these regulations have facilitated or impeded the implementation of digital solutions in the Romanian education sector. The analysis will also consider the broader socio-political and economic context within which these regulations operate. The findings of this study could potentially inform policy-making, strategic planning, and implementation of digital initiatives in the education sector, thereby fostering a conducive environment for digital learning and innovation.

Literature review

Catalyst forces for e-learning

The area of digitalization of the public education sector is attracting growing attention due to the recent pandemic which forced educational institutions from all over the world to rapidly shift to digital learning environments. Furthermore, the numerous changes during the period of the pandemic, in conjunction with the spread of digital asynchronous and synchronous teaching, may have contributed to a reduction or even strengthening of differences between disciplines in terms of technology use and acceptance (Pumptow & Brahm, 2023).

In addition, Saikkonen and Kaarakainen (2021) highlight the universal possibility of the digitalization of education to result in an elevation of the significance of the teaching profession. As a result, conducting educational activities in a digital learning space has translated into a reshaping of the roles played by educators, meaning that they should primarily facilitate the students' access to a variety of digital resources, instead of simply lecturing (Bygstad et al., 2022). Furthermore, even though technology facilitates novel pedagogical and learning experiences through enhanced reality, virtual environment, hybrid reality, and digital or mixed instruction, numerous educational structures have not been able of incorporating fundamental digital technologies, encompassing access to gadgets, proficient educators, or Internet connectivity (McCarthy et al., 2023).

On the one hand, the way educational systems transform their pedagogical vision into executable tactics is shaped by their financial and political environments, as well as their digital sophistication (Panfil, 2017; McCarthy et al., 2023). Moreover, the study by Piroșcă et al. (2021) demonstrates the prominence of digital literacy, as this, in tandem with the exploitation of the Internet, bears direct implications on remuneration and wage structures between the EU-27 member states. Consequently, they show that it is of paramount importance for decision-making authorities to recognize the necessity of implementing efficacious policies within the educational sector aimed at amplification of digital competencies. On the other hand, the cluster analysis of Malkowska et al. (2021) demonstrates that the primary cause for the disparities in the evolution of the information society and digital economy within European nations is fundamentally attributed to a deficient degree of digital competencies and the inefficient exploitation of contemporary technologies in certain countries.

Aftermath of the pandemic

Regarding the recent pandemic, the forced digitalization of education unveiled many positive elements for both teachers and students that admit the beneficial part of e-learning, mainly consisting in the flexibility of courses, the possibility of attending courses from anywhere, the convenience of

operating in the domestic environment, the opportunity to develop new competencies related to ICT, the vast horizon of digital resources, or even the stimulation of imagination and innovation (Ionescu et al., 2020; Toader et al., 2021; Tănase et al., 2022; Pisica et al., 2023).

In contrast, the digital transformation of the educational act has only highlighted the digital divide, taking into account the lack of Internet connection of students from rural areas who were unable to attend online courses (Ionescu et al., 2020).

As for the part of students and their teachers that attended online classes during the pandemic, the authors (Ionescu et al., 2020; Toader et al., 2021; Tănase et al., 2022; Pisica et al., 2023) conclude that the digital learning space enacted a series of negative aspects, such as: the absence/ poor connection to the Internet, the vast amount of time spent digitally connected, the challenge of sustaining motivation between students, the diminished significance of the assessment process, the absence of proper digital skills for many teachers, the establishment of a detached educational ambience, the increasing demand for electricity used by the electronic devices, and even a lack of effective participation to the online educational activities. Additionally, the study of Toader et al. (2021) raises the concern of the illicit appropriation of intellectual property through the unauthorized acquisition of pedagogical resources posted on educational platforms and their unauthorized dissemination on various online sites/platforms.

The role of teachers' ICT skills

The study of Nicolau et al. (2020) emphasizes that optimal student learning is achieved through the integration of interactive and personalized technology in teaching, utilizing virtual environments that mirror real-world scenarios. First of all, educational institutions must facilitate ICT use and promote positive attitudes towards the integration of digital technologies into the pedagogical act, given the positive correlation between school support and the frequency of ICT use during classes (Saikkonen & Kaarakainen, 2021; Cabellos et al., 2024).

In addition, the lack of teachers' digital skills, particularly those associated with the assessment of pedagogical practice (Basilotta-Gomez-Pablos et al., 2022), along with their convictions regarding their digital proficiency bear a positive correlation with their beliefs about the utility of ICT in pedagogy (Antonietti et al., 2022; Cattaneo et al., 2022). Furthermore, the results reported by other authors (Brevik et al., 2019; Lantz-Andersson et al., 2022; Nagel et al., 2023) highlight the great significance of vocation-oriented digital proficiency and transformative digital initiatives.

Students' ICT skills

While gender has no effect on the use of ICT among children, there are many factors that present a quantitatively noteworthy impact on the digital adaptation tendencies of learners (Titan et al., 2020). Hence, the substantial level of advocacy demonstrated by educators towards the application of digital competencies for scholastic objectives or for addressing routine challenges, in conjunction with the regular utilization of pedagogical software, amplifies the probability of cultivating digital conduct.

For instance, the multifaceted attributes of digital instruments, employed in the context of digital educational rooms functioning as a stimulating revision tool for Economics, allows its deployment towards an array of instructional objectives. This is largely due to its inherent malleability and interactive facets (Sanchez, 2023). Besides, the study of Handel et al. (2023) demonstrates that learners highly regard the competitive aspect, reward system, collaborative efforts, and creative expression in game-based learning activities that integrate digital materials

with physical activity. Thus, low socioeconomic status students are disadvantaged both at the beginning and during their schooling, due to the amplification of the digital gap between them and the rest of children (Dolean et al., 2019; Scherer & Siddiq, 2019).

Based on a review of the literature, it seems that very few studies addressed the impact of the political, economic, social, technological, environmental, and legislative factor on the digitalization of the Romanian education sector. In the current study, this gap in the literature will be addressed by focusing on the influence of each of the above-mentioned factors on the digital transformation of the education sector in Romania. In order to achieve this goal, the approach used in the current study is based on a PESTLE analysis. Consequently, for each of the PESTLE factors, a research hypothesis has been identified:

H_P : Government policies and regulations have a significant impact on the digitalization of education in Romania.

H_E : The state of the economy and fund allocation profoundly affect the digitalization of education.

H_S : Sociocultural aspects significantly influence the acceptance and success of digital education.

H_T : The technological infrastructure remarkably shapes the digitalization of education.

H_L : The legal framework substantially impacts the digitalization of education.

H_E : The learning environment notably influences the digitalization of education.

Armed with a comprehensive understanding of the political landscape, stakeholders can advocate for conducive policy frameworks and garner government support for digital education initiatives. Furthermore, insights into economic dynamics enable stakeholders to allocate resources judiciously, ensuring sustainable investment in digital infrastructure and educational technologies. Understanding societal trends equips stakeholders to tailor digital education programmes to resonate with the needs and preferences of diverse student populations, fostering inclusivity and equitable access to educational resources. Technological insights enable stakeholders to take advantage of cutting-edge innovations and digital tools to enhance pedagogical methodologies, enrich the learning experience, and foster digital literacy among students. Legal acumen enables stakeholders to navigate regulatory complexities and ensure compliance with data protection laws, safeguarding student privacy, and intellectual property rights. Environmental considerations prompt stakeholders to adopt sustainable practices in the implementation of digital education, minimizing ecological footprints and fostering environmental stewardship among students. By understanding these insights, stakeholders can make informed decisions and strategies for a successful digital transformation of the Romanian public education field.

Methodology

The primary objective of this research paper is to delve into the multifaceted dynamics shaping the digitalization trajectory within the Romanian education sector, with a concurrent aim of furnishing actionable recommendations to enhance its current landscape. In pursuit of this goal, a systematic PESTLE analysis has been meticulously executed.

The use of the PESTLE analytical framework facilitates a systematic examination of macroenvironmental factors that have a significant impact on the digitalization journey of the Romanian education sector. This qualitative approach provides a comprehensive assessment of strategic opportunities and potential risks inherent in the development of the sector. This analysis examines six different external dimensions, namely politics, economy, society, technology, law

and the environment, and explains the complex interactions between the different aspects of the socio-economic landscape of Romania and the digital transformation of its educational fields.

By comprehensively evaluating these external dimensions, the PESTLE analysis furnishes valuable insights into the opportunities and challenges inherent in the digitalization journey of the Romanian education sector. This methodological approach serves as a robust instrument for informing strategic decision-making and policy formulation aimed at fostering the effective integration of digital technologies in education, thereby propelling the sector towards enhanced pedagogical outcomes and societal advancement.

Results

Political factor

In the context of the PESTLE analysis, the influence of government policies, regulations, and political stability on the digitization process is of paramount importance. Specifically in Romania, the government's dedication to digital education, its policies on data privacy and security, and its commitment to digital equity can significantly shape the pace and direction of digitalization.

Under the umbrella of the European Commission's 2021-2027 Digital Education Action Plan, the Romanian government has shown a strong commitment to the digital transformation of its education sector. This commitment is evidenced by the allocation of €881 million from its Recovery and Resilience Plan to this initiative. The goal of this investment is to enhance digital pedagogical skills, enrich educational content, and upgrade necessary equipment and resources (Government of Romania, 2021).

Following this, Romania sought assistance from the European Commission, which led to the Structural Reform Support Service awarding a grant to the Organization for Economic Cooperation and Development (OECD). This grant is designed to aid in the creation of a comprehensive set of policy briefs covering the four key thematic areas of the 'Educated Romania' project. These briefs are expected to offer valuable insights and recommendations that will augment the project's effectiveness and contribute to the overall enhancement of Romania's educational landscape. Moreover, the policy brief outlines three primary objectives that have yielded positive results in bridging performance disparities in different nations. These include enhancing levels of functional literacy, reducing instances of early school leaving, and implementing supportive measures to facilitate the reintegration of early school leavers into the educational system (OECD, 2016).

Subsequently, the 'Educated Romania' project proposes a series of objectives aimed at expanding access to high-quality education for all societal groups, particularly students from disadvantaged and underrepresented demographics. These objectives are scheduled for implementation by 2030. The project's overarching goal is to foster an inclusive educational environment that not only recognizes but actively addresses the unique challenges faced by these groups, thereby promoting a more equitable educational landscape (President of Romania, 2021).

Besides, the 'Educated Romania' project is further strengthened by substantial financial support from the National Recovery and Resilience Plan, amounting to 3.6 billion euros, and the Renovation Wave initiative, which contributes an additional 405 million euros. The latter specifically targets the refurbishment of state pre-university education units, with a primary objective of ensuring adherence to safety standards (Government of Romania, 2021).

In conclusion, Romania has made considerable progress in the reform of its educational system and the enhancement of academic achievements among students. However, the lack of a supportive environment for digital learning has resulted in Romania occupying the lowest position

in the hierarchy of the Digital Economy and Society Index (DESI) in 2022. This underscores the need for further efforts to integrate digital learning into the educational framework.

Economic factor

Economic conditions can also influence the digitalization process. The allocation of funds for digital education, the state of the economy, and the availability of financial resources for schools to invest in digital infrastructure are all crucial economic factors that need to be considered.

The repercussions of the Covid-19 recession, the scale of the 2021 economic recovery process, and the refugee crisis have had diverse negative impacts on the education sector. This field has seen its budget consistently reduced annually, reaching a low of 2.1% of GDP in 2023, much less than the average of 5.1% across OECD countries (OECD, 2023a). This is in spite of the stipulation in Article 8 of Education Law no. 1/2011, which mandated a minimum allocation of 6% of GDP (Education Law no. 1/2011, 2018). This highlights the challenges faced in aligning policy with practice in the educational sector.

From 2012 to 2020, the allocation of resources to educational institutions exhibited diversity across nations and educational tiers. Firstly, Bulgaria and Romania experienced the most substantial escalation in financial support for non-tertiary institutions (OECD, 2023a). This corresponds with shifts in resource distribution among different educational levels. In Romania and an additional five countries (Bulgaria, Colombia, the Czech Republic, Israel, and the Slovak Republic), the expenditure for non-tertiary levels surged considerably, by 40% or more (OECD, 2023a). Conversely, Figure 1 illustrates that the financial backing for tertiary institutions in Romania advanced at a more measured rate, marking an increase of 19%.

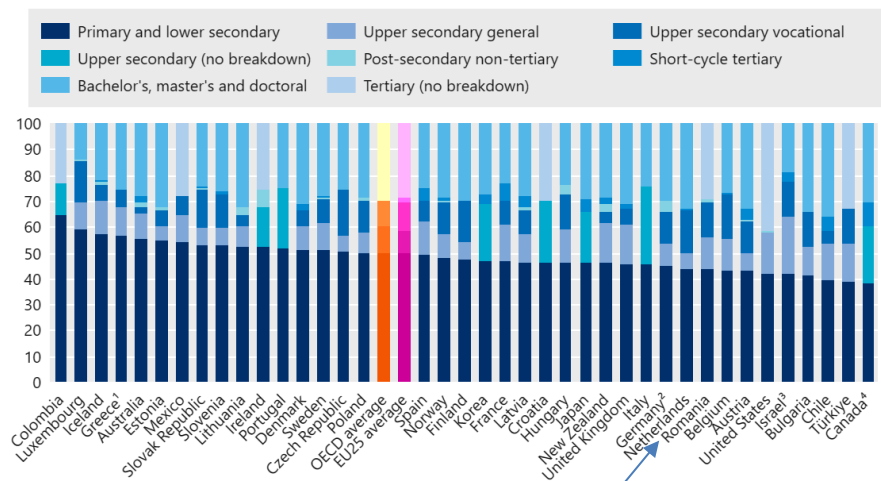


Figure 1: Total investment on primary to tertiary education in OECD countries, by level of education in 2022

Source: OECD, 2023.

Furthermore, the OECD report (2023a) shows that the total expenditure per student from ages 6 to 15 averages around USD 112,000 across OECD countries. While some countries (Austria, Denmark, Iceland, Luxembourg, and Norway) allocate over USD 150,000 per student during these years, this figure falls below USD 50,000 in Romania, Colombia, and Turkey.

Additionally, the allocation for pre-primary education per child in Romania saw an annual growth of 7% from 2015 to 2020. Despite this increase, it still represents one of the lowest per-child expenditures, with less than USD 5,000. In contrast, the average annual expenditure per child in both public and private settings in OECD countries stood at USD 10,200 in 2020 (OECD,

2023a). Also, the proportion of national resources allocated for children aged 3-5 who are enrolled in early childhood education and primary education constitutes merely 0.3% of GDP in Romania, whereas the averaged allocation among the OECD countries stands at 0.6% of GDP.

Moreover, government sources directly provided 84% of the funding for primary to tertiary educational institutions on average across OECD countries in 2020, with private sources contributing 15%. Still, the contribution from private sources to the expenditure on educational institutions remains less than 2% in Romania (OECD, 2023a).

Finally, there is a strong correlation between educational spending and student performance established for economies where the total expenditure per students, spanning all primary and secondary academic years from ages 6 to 15, was less than USD 75 000, and an increase in educational spending is linked to improved performance in the PISA mathematics examination (OECD, 2023b,c). However, the total expenditure for educational purposes per student, from age 6 to 15, in the context of Romania is equivalent to almost USD 38 900 in 2022.

Social factor

Sociocultural influences on the digitalization of the Romanian public education sector include the acceptance of digital learning space and means by teachers, students, and parents, the level of digital literacy, and the societal emphasis on education. All these factors can notably shape the success of digitization efforts.

Due to the fact that many education systems around the globe face the struggling challenge of overcoming the inability to attract motivated and qualified staff, the only efficient solution for determining the best performing students to choose the teaching profession is increasing teachers' financial incentives (European Commission, 2023a). Consequently, a significant shift in the remuneration of educators was observed, which was instigated by a three-week strike in May 2023. Subsequent to the first comprehensive strike in the education sector since 2005, the government implemented a series of measures to augment the base salary in this sector (European Commission, 2023b). Additionally, they introduced supplementary remunerations for specific categories of staff. Consequently, there was an average increase in salaries by approximately one-fourth, with novice teachers experiencing a substantial rise of 31.7%. Moreover, educators were bestowed with annual career bonus vouchers, projected to be disbursed until the year 2027, with the European Social Fund Plus (ESF+) expected to partially subsidize these bonuses. It should be noted that, beginning January 2024, the salary structure in the education sector has increased by 13% instead of 20% as the government promised after the teachers' strike in June 2023, while another 7% should be added this year in June.

Furthermore, according to the Education and Training Monitor 2023 (European Commission, 2023a) almost all key indicators of education from Romania have slowly progressed from 2012 to 2023, but are still too far from EU-average or level targets for 2030 (Table 1).

Table 1. Key indicators of education from Romania compared to EU-level, 2012-2022

EU-level targets	2030 target	Romania		EU	
		2012	2022	2012	2022
Participation in early childhood education (from age 3 to starting age of compulsory primary education)	≥ 96%	84.1%	75.6%	91.8%	92.5%
Low achieving eighth-graders in reading digital skills	< 15%	40.4%	40.8%	19.7%	22.5%
Low achieving eighth-graders in maths digital skills	< 15%	47%	46.6%	22.7%	22.9%
Low achieving eighth-graders in science digital skills	< 15%	41.4%	43.9%	18.2%	22.3%
Early leavers from education and training (age 18-24)	< 9%	17.8%	15.6%	12.6%	9.6%

EU-level targets	2030 target	Romania		EU	
		2012	2022	2012	2022
Exposure of VET graduates to work based learning	≥ 60% (2025)	-	8.4%	-	60.1%
Tertiary educational attainment (age 25-34)	≥ 45%	23.6%	24.7%	34.1%	42%
Early leavers from education and training (age 18-24, native)	-	17.8%	15.6%	11.3%	8.3%
Upper secondary level attainment (age 20-24, ISCED 3-8)	-	79.8%	82.3%	80.1%	83.6%
Tertiary educational attainment (age 25-34, native)	-	23.5%	24.6%	35.4%	43%
Share of school teachers (ISCED 1-3) who are 55 years old or over	-	19.4%	16.9%	23.4%	24.5%
Public expenditure on education as a percentage of GDP	-	2.9%	3.2%	4.9%	4.8%
Public expenditure on education as a share of the total general government expenditure	-	7.9%	8.1%	9.8%	9.4%

Source: Author's own contribution using Eurostat database.

First of all, only six EU member states (France, Denmark, Sweden, Belgium, Spain, and Ireland) have attained the 2030 target of 96% participation in early childhood education, while Romania (75.6% in 2022) is among the other five countries (including Greece, Croatia, Bulgaria, and Slovakia) having reached the lowest participation in ECEC (European Commission, 2023a).

Secondly, Romania's national program, backed by a EUR 500 million budget from the Recovery and Resilience Facility, aims to reduce early school leaving. Over 1,400 schools received grants for teaching and support activities, with an additional call for projects in 2023. An early warning tool has been expanded to identify at-risk students, with training provided for 45,000 teachers (European Commission, 2023a).

Moreover, the average share of 25-34 year-olds possessing a tertiary qualification experience marks an unemployment rate of 4.9% among OECD countries, whereas in Romania the rates of unemployment among younger adults with tertiary education are less than a half of those of their counterparts who have achieved upper secondary or post-secondary non-tertiary education (OECD, 2023a).

Further, Romania managed to surpass the OECD average ratio of 80% of adults participating in non-formal education and training engaged in at least one job-related activity, with more than 90% of Romanian adults having participated in courses related to their professional activity (OECD, 2023a). In addition, Romania has also surpassed the OECD average (10%) with more than 25% of all first-time participants having chosen a master's long first-degree programme. Similarly, the share of Romanian females graduating tertiary STEM is 40%, which is above the OECD average of 33%.

Taking into account the strong correlation between educational spending and student performance, the static evolution of 15-year-old student performance in PISA over the last 5 years only shows that education funding has not been adequate for social needs. Figure 2 illustrates that in the domain of mathematics, there was a decrease in average scores compared to the data from 2012 and 2015. However, the disciplines of reading and science demonstrated consistent performance with the results of all PISA assessments conducted since 2012. As a result, the overall trajectory in these two subjects since 2012 can be classified as static, indicating no significant improvement or decline (OECD, 2023b, c).

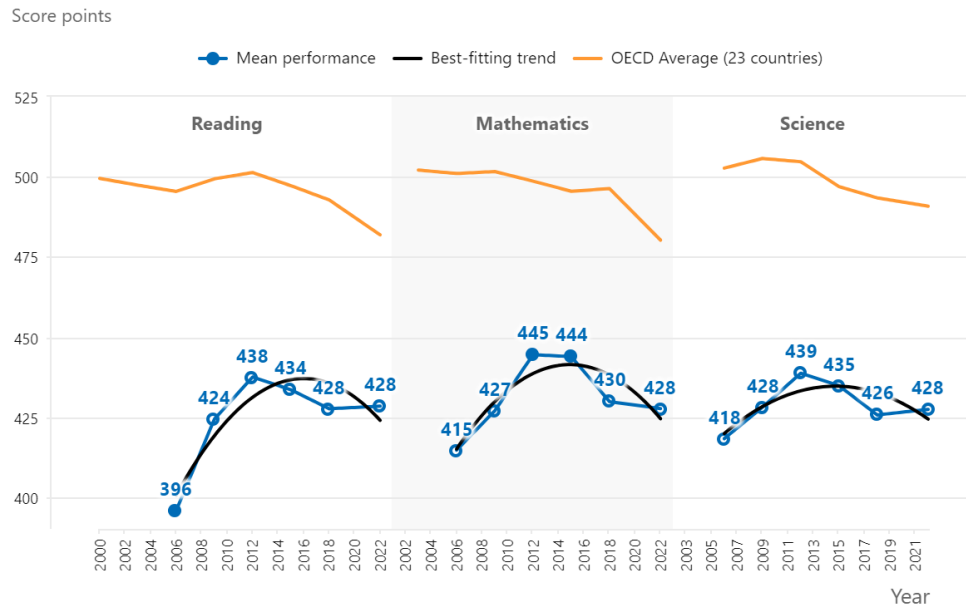


Figure 2: The evolution of Romania's performance in reading, mathematics, and science compared to the OECD average, between 2006 and 2022

Source: OECD, PISA 2023b, c.

Moreover, the PISA index, a measure of economic, social, and cultural status, facilitates the stratification of students into quartiles within each nation and economy. In the context of Romania, students in the upper quartile of socio-economic status significantly outperformed those in the lower quartile in mathematics, with a score difference of 132 points (Figure 3). This gap exceeds the average OECD score difference of 93 points between these quartiles, indicating a pronounced socio-economic impact on educational performance in Romania (OECD, 2023b,c).

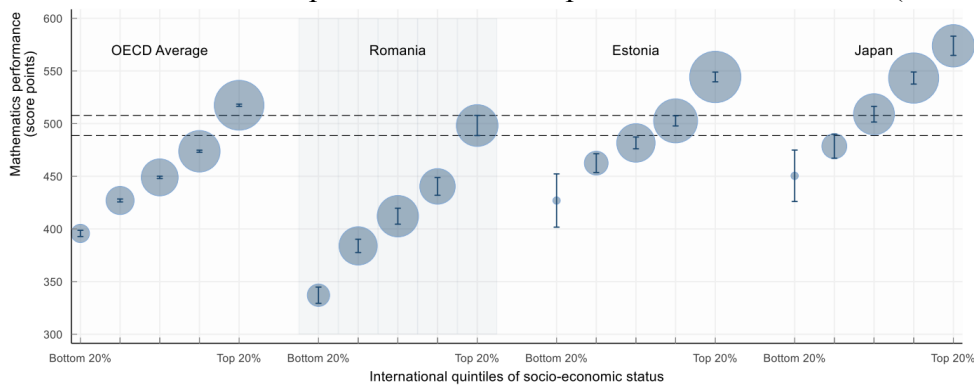


Figure 3: The ratio of students' mean performance in mathematics according to their socio-economic status in 2022

Source: OECD, PISA 2023b, c.

During the latest period (2018 to 2022), the disparity between the top-performing students (top 10% in scores) and the lowest-performing students (bottom 10% in scores) remained relatively stable in mathematics and reading, but expanded in science (Figure 4). In the realm of mathematics, the performance of both high-achievers and low-achievers was consistent with previous levels.

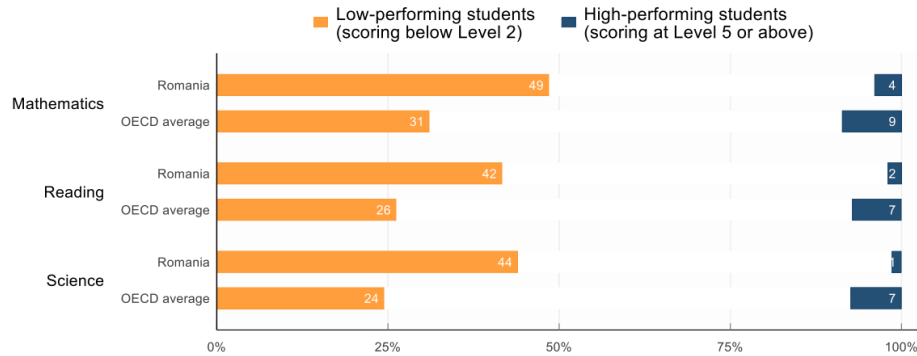


Figure 4: The distribution of Romania's top and low-performing students in reading, mathematics, and science compared to the OECD average, between 2006 and 2022

Source: OECD, PISA 2023b, c.

Also, in an academic comparison to the year 2012, the percentage of students who did not meet the minimum proficiency threshold (Level 2) experienced a surge of seven percentage points in the field of mathematics. Conversely, the proportion in reading remained relatively stable, exhibiting no significant fluctuations. Furthermore, there was an upswing of six percentage points in the realm of science (OECD, 2023b,c).

Technological factor

The state of technology and its impact on the digital transformation of education in Romania is another crucial aspect to consider. The availability of digital learning tools, the rate of technological advancement, and the infrastructure for high-speed internet are key technological factors that can affect the digitization process.

One important determinant of the digital transformation in the education sector is the extent to which digital technologies are incorporated by businesses and e-commerce, a facet quantified by the Digital Economy and Society Index. Regrettably, the analysis of data depicted in Figure 5 reveals that Romania registered the most inferior performance in the integration of digital technology into its economy in 2022, as reported by the European Commission (DESI, 2022). This highlights the challenges faced by the country in leveraging digital technologies for economic growth.

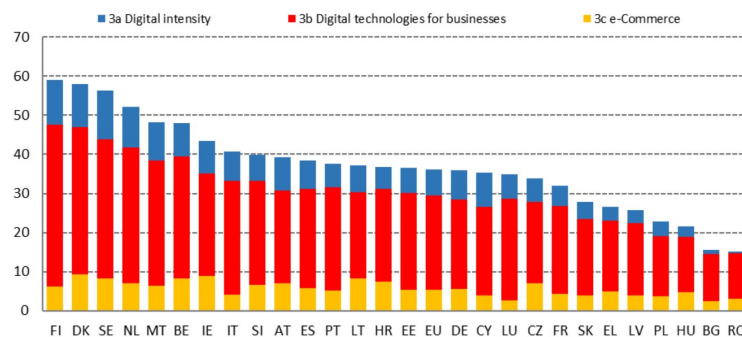


Figure 5: Incorporation of digital technology according to DESI 2022

Source: European Commission, DESI 2022.

A second significant determinant of the digital shift in the Romanian education sector is the availability of digital public services. Even though the European Interoperability Framework

provides specific guidance on how to implement interoperable digital public services, Romania has yet been able to set up effective solutions for improving e-governance platforms. As a result, only 20% of Romania's public services incorporated digital solutions (Figure 6).

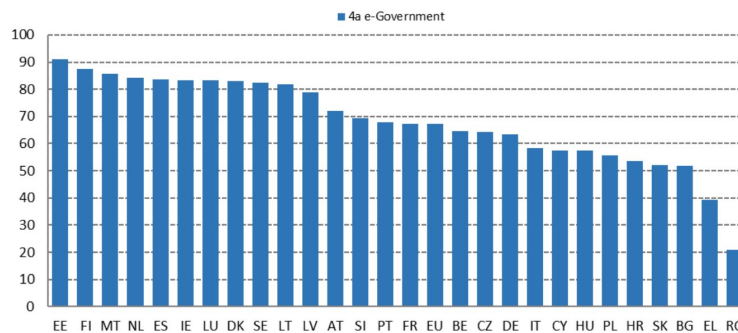


Figure 6: Integration of digital public services according to DESI 2022

Source: European Commission, DESI 2022.

Given the detrimental effects of the pronounced digital exclusion evident in rural areas and households, Romania's economy is perceived as an "outlier" due to the underutilized digital potential for a more extensive digital transformation process.

Subsequently, the National Recovery and Resilience Plan, initiated on June 1, 2021, outlines a multitude of targets within the educational sector that are set for completion by 2030. These targets are designed to facilitate the digital transformation of the educational system and include the following: outfitting 909 computer laboratories in vocational and technical schools, instituting 10,000 laboratories and school offices, and establishing 1,175 SMART LABs; cultivating digital competencies in 100,000 educators; refurbishing 6,176 school IT labs; instituting a network of 200 eco-friendly schools and equipping them with 1,800 electric mini transit buses; and dispensing non-competitive grants aimed at curbing and mitigating school dropout rates for 2,500 educational institutions (Government of Romania, 2021).

Furthermore, the procurement of resources for the digital transformation of education during the pandemic included the distribution of tablets after students had already returned to classrooms. This equipment not only failed to meet the standards for high-quality digital education, but also represented a significant misallocation of funds (Pup, 2022). This underscores the need for more strategic planning and execution in the digitization efforts within the education sector.

These initiatives underscore the commitment to leveraging digital technologies to enhance educational outcomes and reduce disparities, particularly among disadvantaged and underrepresented groups. The ambitious timeline set for these objectives, with a target completion date of 2030, reflects the urgency and importance of these educational reforms in shaping the future of Romania's educational landscape.

Legal factor

The legal framework surrounding digital education, including laws regarding data protection, intellectual property rights in the context of digital content, and regulations on online learning, is another important aspect to consider in a PESTLE analysis. The impact of labor legislation on the process of digitization, particularly with respect to the employment and professional development of Information and Communication Technology (ICT) specialists, is noteworthy. In the year 2021, the European Union witnessed approximately 180,000 students completing their education in the

ICT sector, which constituted 4% of the total graduates, as per the data from Eurostat. Interestingly, Romania emerged as one of the countries with a significant proportion of female ICT graduates, equaling Ireland with a 4% share. This underlines the gender dynamics within the ICT educational landscape in these countries.

Additionally, the newly adopted pre-university education law in the summer of 2023 (Law 198/2023) enhances support for rural and disadvantaged schools, including increased funding and resource-sharing through school consortia. Teachers in these areas can fulfil their norms through various educational activities and receive a one-time bonus of five minimum gross salaries. These nationwide measures, backed by the Recovery and Resilience Facility (RRF), also include substantial investments in infrastructure to improve working conditions and attract more teachers (European Commission, 2023b). However, it should be noted that more than a half of EU member states do not offer financial rewards for teachers in disadvantaged schools (European Commission, 2023a).

Moreover, the Pre-University Education Act (198/2023) stipulates the establishment of a student's individual educational portfolio. This portfolio will encompass all of the student's diplomas and certificates and will serve as a tool for tracking academic achievement. Furthermore, the same legislation grants high schools the prerogative to organize an additional admission session for the ninth grade. This provision potentially exacerbates disparities between students originating from socio-economically advantaged backgrounds and those from less privileged circumstances.

Furthermore, Romania is among the few OECD countries to have applied specific measures for Ukrainian students with special education needs (OECD, 2023a). For instance, local administrations have backed the establishment of "educational centers" in numerous schools nationwide, enabling Ukrainian children to utilize the educational platforms offered by the Ukrainian Ministry of Education. Additionally, educators have been given the chance to participate in "Teaching and Learning in Difficult Times," an online course provided by the British Council in partnership with UNICEF and the International Organisation for Migration, aimed at assisting children impacted by the emotional distress induced by conflict.

In relation to tertiary education, the Higher Education Act No. 199/2023 has reclassified the field of Computer Science, removing it from the STEM (Science, Technology, Engineering, and Mathematics) category. This reclassification has significant financial implications, as it precludes faculties associated with this discipline from accessing an enhanced funding allocation of 133%, which is specifically earmarked for STEM disciplines. Furthermore, commencing from the academic year 2023-2024, there will be an extension in the duration of doctoral studies from the previous duration of three years to an extended period of four years. Concurrently, universities will be obligated to provide a minimum of 50% of the requisite internship positions for their student body. This legislative change underscores the evolving dynamics of higher education and the increasing emphasis on practical, industry-relevant experience within the academic framework.

Regarding the financing of education expenses, at the level of the national pre-university and higher education system, with all its components, this represents annually a minimum of 15% of the consolidated general budget expenditures according to the new laws of pre-university and higher education (198/2023 and 199/2023). Also, it should be mentioned that the Education Law no. 1/2011 provided for a budget allocation of 6 percent of GDP. However, in mid-December 2023, the government adopted a budget allocation of 4.3% of GDP for the field of education, representing a significant increase from the previous allocation of 2.1% of GDP, but education still remains an underfunded field compared to regulatory targets.

Environmental factor

First, Romania has committed since 2015 to adopt the 2030 Agenda for Sustainable Development, which encompasses 17 sustainable development goals, of which the fourth goal targets "Quality Education" and assumes ensuring that all students acquire the knowledge and skills necessary for promoting sustainable development. As a result, the first modification of the pre-university school year structure was implemented starting with the year 2016 by adopting the national program "Different School", which involves carrying out extracurricular and out-of-school activities that address transversally education for sustainable development for 5 consecutive days.

An important measure adopted by the Romanian Ministry of Education, following the proposal of the Romanian Council for Green Buildings (RoGBC), was the modification of the academic year structure through the implementation of the Green Week beginning with the 2022-2023 school year. During this week, pre-university students carry out activities that subscribe to the theme of environmental protection, without being graded or evaluated by the teaching staff.

Another significant measure that illustrates the influence of the environmental factor on the education system in Romania was the introduction of the optional subject "Ecological Education and Environmental Protection" for the fifth, sixth and seventh grades of the gymnasium level, starting with the 2023-2024 school year. Although the reform of educational resources is one of the three 2030 Romanian pillars of the National Strategy for Sustainable Development, ecological education is not a mandatory discipline in the national curriculum for pre-university education.

Furthermore, the recent pandemic highlighted the impact of the digital environment on both educators and students. Although environmental factors are typically associated with physical environmental factors, in the context of digital education, this could refer to the learning environment. This includes the shift from traditional classrooms to virtual learning spaces, the impact of this shift on student health and well-being, and the sustainability of digital learning solutions. Unfortunately, the abrupt transition from traditional to online education was negatively influenced by numerous variables that characterized the Romanian education system at the time of the establishment of the national state of emergency: the lack of digital skills of teachers, poor development of technological infrastructure, inoperability of digital devices in the absence of adequate maintenance, lack of internet connection for both students and teachers who were forced to ensure a quality educational process connected from home, the inability of students to connect with the camera turned on, etc.

Last but not least, Romania has committed to developing a network of green schools and acquiring green buses through the National Recovery and Resilience Plan (PNRR). Therefore, the creation of a green school infrastructure benefits from 225 million euros and must be completed by the end of 2025. However, the process of transforming a traditional school into a green circular school is a long and winding one, given that Romania counts only three green schools in the 2023-2024 school year, two of which have been modernized within the Efficient Romania program, supported by OMV Petrom.

Discussion

Although this study offers a comprehensive examination of the digital transformation in the Romanian education sector, it is not devoid of certain limitations. The temporal scope of the research, confined to the past 15 years, may not encapsulate the entirety of the digitalization trajectory. The reliance on secondary data sources, such as Eurostat and European regulations, could potentially introduce inherent biases. The use of the PESTLE framework, despite its robustness, may inadvertently oversimplify the intricate interplay of factors influencing digital

transformation. The emphasis on European regulations might eclipse the potential impact of national or local policies. Future research endeavors could address these limitations by broadening the temporal scope, incorporating primary data, employing more complex analytical frameworks, and considering a more diverse range of influencing factors.

Conclusion

The digital transformation of the Romanian education sector, examined through the lens of a PESTLE analysis, has unfolded a complex interplay of factors that have shaped its current state. This concluding section aims to summarize the key findings and implications of this study, setting the stage for future research directions.

Regarding the influence of the political factor on the digitalization of the education sector, it is evident that Romania has made significant strides in reforming its educational system and improving the academic performance of its students. Despite these advances, the country grapples with the challenge of creating a conducive environment for digital learning. This shortcoming is reflected in the ranking in the Digital Economy and Society Index (DESI) in 2022, where it occupies the lowest position. This stark reality underscores the urgent need for concerted efforts to integrate digital learning into the educational framework, thus fostering a digitally inclusive and innovative learning environment.

Also, the economic factor plays a pivotal role in the digitalization of education in Romania. The OECD (2023b,c) has established a strong correlation between educational spending and student performance for economies where the total expenditure per student, spanning all primary and secondary academic years from ages 6 to 15, was less than USD 75,000. An increase in educational spending is linked to improved performance in the PISA mathematics examination. However, in the context of Romania, the total expenditure for educational purposes per student, from age 6 to 15, is equivalent to almost USD 38,900 in 2022, which is significantly lower than the threshold identified by the OECD. This suggests that an increase in educational spending could potentially enhance the digitization process in the Romanian education sector by improving the quality of digital learning resources, teacher training in digital pedagogies, and the provision of digital infrastructure. Therefore, economic investment in education is a critical factor influencing the pace and effectiveness of digital transformation in Romania's education sector.

Additionally, the social factor significantly impacts the digitalization of education in Romania. The country exhibits a higher-than-average percentage of females graduating in tertiary STEM fields at 40%, surpassing the OECD average of 33%. This suggests a positive trend towards gender inclusivity in digital education. However, the static performance in reading and science disciplines, as evidenced by consistent PISA results since 2012, indicates a stagnation in educational advancement. This underscores the need for social interventions, such as enhanced digital literacy programs and inclusive digital pedagogies, to improve these outcomes and further drive the digital transformation in Romania's education sector.

Moreover, the technological factor has had a significant impact on the digitalization of the education sector in Romania. Despite the country's potential, Romania's performance in integrating digital technology into its economy was the lowest in 2022, as reported by the European Commission (DESI, 2022). The lack of effective e-governance solutions has resulted in only 20% of public services incorporating digital solutions. This digital exclusion, particularly pronounced in rural areas and households, has led to Romania being perceived as an "outlier" in terms of its underutilized digital potential for a broader digital transformation process. The procurement of resources for the digital transformation of education during the pandemic was poorly timed and

executed, with tablets being distributed after students had already returned to classrooms. The influence of the technological factor on the digitalization of education in Romania is thus a critical issue that requires immediate attention and action.

Furthermore, legal factors have played a pivotal role in the digitalization of education in Romania. The country has made strides with a significant proportion of female ICT graduates, matching Ireland's 4% share. The pre-university education law (Law 198/2023) has increased support for rural and disadvantaged schools. However, it also allows high schools to hold an additional admission session for the ninth grade, potentially widening socio-economic disparities. In addition, the Higher Education Act No. 199/2023 reclassified Computer Science, removing it from the STEM category, which restricts these faculties from accessing enhanced funding. Despite the Education Law no. 1/2011 stipulating a 6% GDP allocation for education, the government allocated only 4.3% in December 2023. These legal factors highlight the complexities in Romania's educational digital transformation.

Finally, environmental factors have significantly influenced the digitalization of education in Romania. Initially, the "Different School" program was introduced, which promoted sustainable development through extracurricular activities. Subsequently, the "Green Week" was implemented in the 2022-2023 academic year, encouraging students to engage in environmental protection activities. Despite these efforts, ecological education is not a mandatory discipline, even though it is a pillar of the National Strategy for Sustainable Development. Concurrently, the transition to online education during the national state of emergency was negatively impacted by various challenges. In response to these issues, Romania, through the National Recovery and Resilience Plan (PNRR), has committed to developing green schools and acquiring green buses. However, progress has been slow, with only three green schools established by the 2023-2024 school year. This situation underscores the need for a more integrated approach to environmental education in the digital transformation process.

Future research on the digitalization of education in Romania should focus on understanding the barriers to effective integration of digital and ecological education. It is crucial to investigate the reasons behind the slow progress in establishing green schools and the challenges faced during the abrupt transition to online education. Recommendations include making ecological education a mandatory discipline and improving the timing and execution of resource procurement for digital transformation. Additionally, policy changes could be explored to ensure that all disciplines, including Computer Science, have access to enhanced funding. Lastly, more strategic planning is needed to ensure that digital solutions are effectively incorporated into public services, particularly in rural and disadvantaged areas. These steps could help Romania fully realize its digital potential and create a more inclusive and sustainable educational landscape.

Statements

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