DIGITAL TRANSFORMATION IN EDUCATION: A COMPARATIVE ANALYSIS OF MOLDOVA AND ESTONIA AND RECOMMENDATIONS FOR SUSTAINABLE FINANCING

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Abstract: This paper explores the digital transformation of education in Moldova, with a comparative analysis of Estonia's successful experience in this area. First, the article provides an overview of the current status of digital transformation in education in Moldova and identifies critical challenges in financing this process. Next, the Education Strategy 2030 in Moldova, which aims to improve the functionality of the educational system through the effective implementation of digital technologies to ensure the quality and sustainability of education, is discussed. The success factors of digital transformation in education in Estonia, including government support, high levels of digital literacy, a strong IT sector, and a culture of innovation and experimentation, are identified. Finally, the paper provides recommendations for financing digital transformation in education in Moldova, including allocating a specific portion of the state budget, seeking funding from international organizations and donors, and exploring opportunities for educational institutions to generate income. The implications for policy and practice and suggestions for future research are also discussed.

Keywords: digital transformation, education, Estonia, Moldova, financing.

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Introduction

Education is the cornerstone of progress and development in any nation. Recognizing this, the Government of the Republic of Moldova took a significant step by adopting the Strategy of Education 2030 on March 7, 2023 (Ministry of Education and Research, 2023). This comprehensive strategy signifies Moldova's commitment to enhancing the quality and relevance of its education system. It seeks not only to align Moldovan education with European Union standards but also to champion lifelong learning, social inclusion, and gender equality. The Strategy of Education 2030 encompasses the ambitious goals of developing a modern education system, elevating teaching quality, fostering digital literacy, and creating an inclusive learning environment.

Yet, a crucial question looms: How can these ambitious educational objectives be effectively realized in the digital age? Digital transformation emerges as a pivotal enabler, offering access to a spectrum of new technologies, tools, and resources capable of revolutionizing the teaching and learning processes (Petrusevich, 2020; Ronzhina et al., 2021). In Moldova, the financing of digital transformation in education assumes a pivotal role. It is the linchpin that ensures students have equitable access to modern technology and

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digital resources, thereby equipping them with the essential skills to thrive in the digital era. Furthermore, investments in digital transformation have the potential to enhance education's quality and efficiency, making it more accessible and inclusive for all learners.

This paper embarks on a compelling exploration of the critical nexus between education, digital transformation, and financing within the Republic of Moldova. We commence our journey by providing an overview of the Strategy of Education 2030, unveiling its core components and objectives. This strategic roadmap serves as the backdrop against which we evaluate the imperative of financing digital transformation.

Subsequently, we delve into an examination of the multifaceted benefits conferred by digital transformation in education. Beyond the mere integration of technology, we uncover how it can revolutionize pedagogical practices, empower learners, and pave the way for more equitable educational opportunities. In parallel, we navigate through the complex terrain of challenges and opportunities that materialize in the wake of digital transformation.

As our voyage progresses, we aim to provide policymakers and stakeholders with actionable recommendations. These insights encompass not only the necessity of financial commitments but also strategies for nurturing and sustaining the digital evolution in Moldovan education.

The core premise of this study lies in recognizing that the journey toward educational excellence is interwoven with digital innovation, and its success hinges upon prudent financial stewardship. We aspire to illuminate the path forward for Moldova, ensuring that every student has the opportunity to thrive in an education system that embraces the boundless possibilities of the digital era.

With this introduction set as the compass, our subsequent chapters will navigate through the intricacies of Moldova's educational landscape and embark on a comparative analysis with Estonia to glean valuable insights and lessons that can guide Moldova's transformative journey.

1. Methodology

This study employs a Comparative Literature Review Research Design to investigate the financing and implementation of digital transformation in education in the Republic of Moldova and the Republic of Estonia. The aim is to critically analyze and synthesize existing academic literature, policy documents, and reports to gain insights into the strategies, challenges, and successes related to financing and implementing digital transformation in education within these two countries.

Moldova and Estonia were chosen as case countries for this comparative analysis. The rationale behind this selection lies in the structural similarities they share as Eastern European nations, combined with their divergent experiences in digitalizing their education systems. Moldova is at an early stage of digital transformation, while Estonia is globally recognized for its advanced digitalized education system. This choice allows for a systematic exploration of different approaches to digital transformation within similar contexts.

Extensive analysis of policy documents, educational reports, and official publications from the Ministries of Education in Moldova and Estonia was conducted. This analysis provided crucial contextual information and policy insights.

A comprehensive review of academic literature and research papers related to digital transformation in education, public policy, and comparative education was undertaken. This secondary data aided in developing a theoretical framework and contextualizing the findings.

Statistical data on education indicators, ICT infrastructure, and educational expenditures were collected from reputable sources such as UNESCO, Eurostat, and national statistical agencies. These data sets enabled the quantification of certain aspects of digital transformation.

The qualitative data gathered from policy documents and the quantitative data, including education statistics, were analyzed using a thematic analysis approach. Themes related to financing mechanisms, policy implementation, digital infrastructure, and challenges were identified and compared between Moldova and Estonia. Descriptive statistics were used to provide a quantitative context for the findings.

The research adhered to ethical guidelines, ensuring the proper citation of sources and the use of publicly available data.

This study acknowledges several limitations, including potential biases in policy documents, limited generalizability of findings beyond Moldova and Estonia, and the reliance on secondary data sources, which may not always capture the nuances of policy implementation.

2. Literature Review

Digital transformation in education encompasses the integration of technology into teaching and learning processes (Morozov & Kozlov, 2019). Within the context of Central and Eastern Europe (CEE) and transition countries, digital transformation holds particular significance due to the region's historical and structural characteristics. This process involves the strategic utilization of digital tools, platforms, and resources to enrich the learning experience and enhance educational outcomes (Shutikova & Beshenkov, 2020). These digital tools encompass a wide spectrum, including online learning platforms, educational software, digital textbooks, and mobile devices.

The imperative of digital transformation in education has grown significantly in recent years, particularly in the aftermath of the COVID-19 pandemic. The pandemic underscored the urgency of digital readiness in educational systems, enabling schools and universities to sustain teaching and learning activities through remote modalities (Balkan Green Energy News, 2021).

Digital transformation in education offers multifaceted advantages within CEE and transition countries (Zaripova, 2021). Firstly, it can expand access to education, a particularly relevant consideration for students residing in remote or underserved regions

where traditional education infrastructure is limited. Secondly, it holds the potential to elevate the quality of education by facilitating personalized and interactive learning experiences, thereby enhancing student engagement and comprehension. Thirdly, it empowers educators by equipping them with tools and resources to augment the efficacy of their teaching methods. Fourthly, digital transformation fosters digital literacy among students, a critical skill set for their future in the digital age. Finally, it can contribute to cost reduction by replacing conventional textbooks and classroom materials with digital resources, which can be particularly pertinent in resource-constrained environments.

Financing digital transformation in education presents a formidable challenge, especially in the context of developing countries in CEE and transition regions (Dung & Tri, 2021; Kopp et al., 2019). To address this challenge, various financing strategies have been proposed and implemented. These strategies encompass public-private partnerships, funding through grants from international organizations, and innovative financing mechanisms like impact bonds. Additionally, governments can allocate resources from their education budgets to support digital transformation initiatives.

Several countries have successfully executed digital transformation initiatives in their educational systems, offering valuable insights for CEE and transition countries (Department for Education, 2019; Department of Education, 2021). For instance, Estonia, a CEE nation, stands out with one of the world's most advanced e-education systems, featuring a fully digitalized curriculum and comprehensive online learning platforms (e-Estonia, 2022). Singapore, although not in the CEE region, provides a noteworthy example with substantial investments in technology and the establishment of a national digital literacy program for all students (Tan et al., 2017; Watermeyer et al., 2022). Rwanda demonstrates another approach, where the government has collaborated with private sector entities to distribute cost-effective tablets to primary school students (Tomaszewski et al., 2015). These international case studies offer crucial insights into the successful implementation of digital transformation initiatives in education, shedding light on strategies that can be adapted to the unique context of CEE and transition countries.

While acknowledging the significance of digital transformation in education, this literature review delves into the specific context of CEE and transition countries, emphasizing both the benefits and financing challenges. Moreover, the review draws upon international case studies to offer a practical perspective on implementing digital transformation in education within these unique contexts.

Analysis of the Education 2030 Development Strategy in Moldova

Primary The Education 2030 Development Strategy in Moldova aims to improve the functionality of the educational system through the effective implementation of digital technologies to ensure the quality and sustainability of education (Ministry of Education and Research, 2022). However, the strategy needs help in promoting new media, open resources, and technologies in education, including the ineffective application of ICT in education and its modest provision with modern educational software. This is caused by

the lack of prioritization of computerization/digitization of education in policy documents, insufficiency of mechanisms for implementing computerization standards of education, lack of mechanisms for evaluating and certifying digital skills of employees in the education system, focusing initial and ongoing training efforts of education sector employees on "digital literacy" and less on "digital pedagogy," lack of a systemic vision of the equipment and software products used in educational institutions of all levels.

The implementation program consists of priority action directions, including creating new contexts and favorable environments through the interconnection of didactic and information technologies, providing educational institutions with equipment and program products, and professional training of teaching staff from the perspective of effective use of digital tools (Ministry of Education and Research, 2022). Additionally, the strategy seeks to harness the potential of digital technologies/tools to enhance the quality of teaching, learning, and assessment and develop and implement digital monitoring and evaluation tools to make the educational system more efficient. The digitization of the learning recognition system in different contexts is also promoted to promote educational progress, career management, distance learning, lifelong learning, and academic mobility.

The strategy outlines a budget plan to equip at least 80% of academic units with equipment, software, and other information and communication technologies according to national equipment standards for each level of education and type of unit. The planned budget for this objective is 516,540.4 thousand MDL for 2023, 516,031.5 thousand MDL for 2024, and 516,031.5 thousand MDL for 2025, with a total implementation cost of 1,521,603.4 thousand MDL (Ministry of Education and Research, 2022).

Another specific objective is to ensure the initial and continuous training of 100% of employees in the education sector regarding the development of digital skills and the implementation of education computerization standards. The planned budget for this objective is 124,362.0 thousand MDL for 2023, 9,445.7 thousand MDL for 2024, and 0.0 thousand MDL for 2025, with a total implementation cost of 35,414.9 thousand MDL (Ministry of Education and Research, 2022).

Digital transformation in education in Moldova presents opportunities to improve the educational system's performance based on digital technologies. However, there are challenges regarding the slow progress of promoting new media, open resources, and technologies in education and the inefficient application of ICT in education. These challenges can lead to obstacles in implementing modern pedagogies based on constructivist learning, inefficient use of material and financial resources intended for the computerization of the education sector, and impediments in expanding education throughout life, especially in the development of distance education. Additionally, children may be exposed to existing risks in the online environment, including cyberbullying and the proliferation of irresponsible behaviors in this environment.

The Education 2030 Development Strategy in Moldova presents a comprehensive approach to integrating digital technologies into the education system (Ministry of Education and Research, 2022). The strategy aims to improve the functionality of the

educational system by implementing effective digital technologies that will ensure the quality and sustainability of education.

The strategy recognizes that the slow progress of promoting new media, open resources, and technologies in education is a significant challenge in Moldova. The lack of prioritization of computerization and digitization of education in policy documents, the insufficiency of the mechanisms for implementing the computerization standards of education, and the lack of mechanisms for evaluating and certifying employees' digital skills in the education system are some of the causes of this slow progress.

The strategy also identifies several consequences of these challenges, such as obstacles in the implementation of modern pedagogies based on constructivist learning, inefficient use of material and financial resources intended for the computerization of the education sector, and impediments in the expansion of education throughout life, especially in the development of distance education.

To address these challenges, the Education 2030 Development Strategy in Moldova has identified several priority directions of action, such as providing educational institutions with equipment and program products, professional training of teaching staff, and implementation of management information systems at all levels of the educational system.

However, implementing the Education 2030 Development Strategy in Moldova faces several challenges. One of the significant challenges is the need for more funding to implement the strategy. For example, the planned budget for equipping at least 80% of academic units with equipment, software, and other information and communication technologies, according to national equipment standards for each level of education and type of unit, is over 1.5 billion MDL (Ministry of Education and Research, 2022). Similarly, the planned budget for ensuring the initial and continuous training of 100% of employees in the education sector regarding the development of digital skills and the implementation of education computerization standards is over 35 million MDL (Ministry of Education and Research, 2022).

Another challenge is the need for more infrastructure to support the implementation of the strategy. For example, access to reliable and high-speed internet in some parts of the country can help implement digital technologies in the education system. Additionally, the lack of digital literacy among some teachers and students can challenge the effective use of digital technologies in the education system.

Overall, the Education 2030 Development Strategy in Moldova presents an ambitious and comprehensive plan for integrating digital technologies into the education system. While the implementation of the strategy faces several challenges, its successful implementation can significantly improve the functionality of the educational system and ensure the quality and sustainability of education in Moldova.

Comparative Analysis of Moldova and Estonia

In this section, we conduct a comparative analysis of the digital transformation efforts in education between Moldova and Estonia. Estonia, recognized globally as a leader

in digital innovation, has made significant strides in integrating technology into its education system. On the other hand, Moldova is in the early stages of implementing digital technologies in education, with a specific focus outlined in the Education 2030 Development Strategy. To provide a clear overview of the differences and similarities, the results of this analysis are presented in the Table 5.1. This table highlights key aspects of digital transformation in both countries, including the timeline of digital integration, government support, digital literacy, infrastructure, innovation culture, and teacher training. By examining these factors, we aim to illustrate the varying degrees of progress and challenges each country faces in their respective digital transformation journeys.

Estonia's advanced digital transformation in education, driven by government support, digital literacy, IT sector engagement, innovation culture, infrastructure development, student-centered learning, comprehensive teacher training, and collaboration among educators, contrasts with Moldova's current challenges. Moldova can learn valuable lessons from Estonia's success to enhance its own digital transformation.

Table 5.1. Comparative Analysis of Moldova and Estonia

Aspect of Digital Transformation	Estonia	Moldova
Digital Integration Timeline	Early adopter since the 1990s (Aru-Chabilan, 2020)	Early stages, as outlined in the Education 2030 Development Strategy (Ministry of Education and Research, 2022)
Government Support	Strong government support with funding and policy emphasis on innovation (Loogma et al., 2012)	Limited prioritization of computerization/digitization in policy documents (Ministry of Education and Research, 2022)
Digital Literacy	High levels among students and teachers (Kattel & Mergel, 2019)	Need for improved digital skills among education sector employees (Ministry of Education and Research, 2022)
Infrastructure	Well-developed digital infrastructure with high-speed internet access in schools (Põldoja, 2020)	Significant investments required to meet national equipment standards (Ministry of Education and Research, 2022)
Innovation Culture	Encouragement of innovation and experimentation (Põldoja, 2020)	Challenges in promoting new media, open resources, and technologies (Ministry of Education and Research, 2022)
Teacher Training	Comprehensive programs including digital tools and resources (Põldoja, 2020)	Limited focus on digital skills training (Ministry of Education and Research, 2022)

Source: Elaborated by the author

Lessons from Estonia for Moldova:

- *Government Support:* Moldova should prioritize government support for technology integration in education, including funding and policies promoting innovation.
- *Digital Literacy:* Enhance digital literacy among both students and teachers in Moldova.

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- *IT Sector Engagement:* Actively involve Moldova's IT sector in developing digital tools and resources for education.
- *Innovation Culture:* Foster a culture of innovation and experimentation among Moldovan educators to encourage innovative teaching methodologies and tools.
- *Policy Prioritization:* Ensure Moldova's education policy documents prioritize computerization/digitization and establish effective mechanisms for implementing education computerization standards.

Additionally, Moldova can draw inspiration from Estonia's e-governance and digital technologies in public services, which have enhanced efficiency, transparency, and accessibility (Kattel & Mergel, 2019). Moldova can apply similar approaches to improve the delivery of education services, such as online student registration, electronic record-keeping, and digital assessment systems. Estonia's emphasis on digital security and privacy can provide a model for Moldova to ensure the safety and protection of sensitive information in its digital education system. Moldova can benefit from studying Estonia's holistic approach to digital transformation and adapting its successes to the Moldovan context.

Financing the Digital Transformation of Education in Moldova

In Moldova, the Ministry of Education, Culture, and Research is responsible for financing education (Manole, 2019, 2020). The government allocates funds for education through the state budget. These funds are distributed to educational institutions based on various factors, such as the number of students and the level of education. Additionally, educational institutions can generate income through tuition fees and other activities (Manole, 2020; Manole & Țurcan, 2021).

The current financing system for education in Moldova faces several challenges:

- The funding allocated to education is often insufficient, resulting in a need for more resources and infrastructure.
- The distribution of funds is only sometimes transparent and equitable, with some regions and institutions receiving more funding than others.
- There is a significant dependence on external funding and grants, which may need to be more sustainable in the long term.
- There needs to be more investment in digital technologies and infrastructure, which is necessary for the digital transformation of education.

There are several options for financing the digital transformation of education in Moldova. One option is to allocate a specific portion of the state budget to support developing and implementing digital technologies in education. Another option is to seek funding from international organizations and donors that support education and digital transformation projects. Educational institutions can also generate income by selling educational products and services, such as digital textbooks and online courses.

Public-private partnerships are also a viable option for financing digital transformation in education. The government can partner with private sector companies to

invest in digital infrastructure, software, and other technologies needed for education. In return, the private sector can access a pool of educated and skilled labor for their businesses.

Crowdfunding is another option for financing digital transformation in education, where individuals and organizations can contribute to a particular project or initiative. This approach can be used for smaller-scale projects or initiatives, such as purchasing new technology or software for a specific school or classroom.

Lastly, education savings accounts or vouchers can also be used to finance digital transformation in education. Parents can use these accounts or vouchers to pay for educational expenses, including digital technologies, and have more control over their children's education. In addition, this approach can increase competition among educational institutions and promote innovation in the sector.

To ensure sustainable financing for digital transformation in education in Moldova, we recommended that the government prioritize this area in its policy documents and allocate a specific portion of the state budget to support it. Additionally, partnerships can be established with international organizations and donors that support education and digital transformation projects to secure additional funding. Educational institutions should also explore opportunities to generate income by selling educational products and services, such as digital textbooks and online courses. Furthermore, innovative financing mechanisms, such as public-private partnerships, can be explored to finance digital transformation projects in education.

We also recommended that the government establish clear guidelines and criteria for allocating funds for digital transformation in education, to ensure that the funds are distributed efficiently and effectively. This can involve identifying priority areas for investment, such as teacher training in digital skills, development of digital content, and infrastructure improvement. In addition, the government can incentivize private investment in digital transformation projects in education by providing tax breaks and other forms of support.

Another recommendation is to establish a monitoring and evaluation system to track the progress and impact of digital transformation in education projects. This can involve establishing performance indicators and benchmarks to measure the effectiveness of the initiatives and conducting regular evaluations to identify areas of improvement.

Finally, it is essential to ensure that the financing options and mechanisms are accessible and equitable for all educational institutions, including those in rural and underserved areas. This can involve providing targeted support to these institutions, such as subsidies or grants, to ensure they have the resources to participate in digital transformation projects.

Conclusions

This study has undertaken a comprehensive comparative analysis of digital transformation in education in Moldova and Estonia, with a particular focus on examining the critical financing aspects. The findings shed light on key differences and lessons that

can inform educational policy and practice in both countries, as well as offer insights applicable to other contexts.

Estonia stands out as a global leader in digital transformation, boasting a well-established system for the integration of digital technologies into education. In contrast, Moldova is in the nascent stages of its digital transformation journey, exemplified by its Education 2030 Development Strategy.

One of the core takeaways from this analysis is the identification of success factors that underpin Estonia's achievements in digital transformation in education. These factors encompass strong government support, a high level of digital literacy among educators and students, a robust IT sector's active involvement, and a culture that fosters innovation and experimentation in pedagogy.

For Moldova, these findings offer valuable lessons. The study underscores the critical importance of government support, the need for the systematic development of digital literacy among education sector stakeholders, and the encouragement of an environment conducive to innovation.

While these findings emphasize the disparities in digital transformation progress between the two countries, they also highlight the broader implications for policy and practice in the field of education. Moldova's current financing system for education is revealed as inadequate for the ambitious goal of digital transformation. In response, the study suggests a multifaceted approach to financing, which includes specific budget allocations, seeking external funding from international organizations and donors, and exploring income generation avenues within educational institutions.

In the broader scholarly context, this study contributes to the ongoing discourse on digital transformation in education. It underscores the significance of contextual factors, governmental support, and digital literacy in shaping the pace and success of digital integration in educational systems. Furthermore, it reinforces the idea that digital transformation in education should be underpinned by robust financing mechanisms, a principle applicable not only to Moldova and Estonia but to other nations navigating similar transitions.

The study's main contribution lies in its synthesis of empirical evidence from Moldova and Estonia, offering a nuanced perspective on the challenges and opportunities that digital transformation presents to education. By formalizing the research question and situating the findings within the broader academic dialogue, this study advances the conversation on digital transformation in education and provides valuable insights for future research endeavors in the field.

As an evolving area of inquiry, the next phase of research could delve deeper into the impact of digital transformation on student learning outcomes and evaluate the effectiveness of various financing mechanisms. Additionally, extending the comparative analysis to include other countries in the region would enrich our understanding of the barriers and enablers of digital transformation in diverse educational contexts.

This study serves as a stepping stone in the exploration of digital transformation in education, offering practical guidance for policymakers and educators in Moldova and beyond, while also contributing to the growing body of knowledge in the field of educational technology and its multifaceted implications.

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