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FINANCING THE DIGITIZATION OF EDUCATION IN THE REPUBLIC OF MOLDOVA: THE EDUCATION 2030 STRATEGY AND THE OPPORTUNITIES OF BLOCKCHAIN TECHNOLOGY

ANDRONIC ADRIAN²⁰

Abstract: *The financial support for implementing technology and innovating the education process is becoming increasingly relevant and changing its content. New, complex financing mechanisms are emerging. In the context of the growing costs of education activities, when state budgets are cut, a mix of emerging financing methods in the field under consideration acquire a key role. Currently, there are several obstacles to the digitization of education: the agglomeration of the education sector with fragmented ICT solutions, a fact that prevents the implementation of unitary digital supports intended for computer-assisted training and, informational educational management; the inefficient learning and educational management and the lousy use of material and financial resources intended for the digitization of the education sector; the low capacity of the education sector to return to normality after a possible pandemic or other crises; the slow expansion of lifelong learning, especially in the development of distance learning.*

In this paper, we aim to evaluate the financing digitization of education in the Republic of Moldova, from the perspective of past actions, the plans included in the Education 2030 Strategy, and the opportunities offered by the blockchain. We used online research, literature review, and interviews with implementers and experts in education and education technology. We concluded that the digitalization of education in the Republic of Moldova is possible with significant financial investments not only from the state, but also from other stakeholders, which predetermines the development of new approaches and tools included in the financial mechanism of the education system.

Key words: *education, financing, digitization, blockchain, Moldova.*

JEL CLASSIFICATION: I22, I25, O33.

INTRODUCTION

The adaptation of the education and training system to technological evolution is a complex process, necessary for the preparation and improvement of human resources and an essential element of the development, modernization and innovation of society (Jobirovich, 2021; Wells & Claxton, 2002). The use of new digital technologies is the direct way to make school more attractive for students, more adapted to their needs and lifestyles, more effective in developing skills, generating lifelong education (Ronzhina, Kondyurina, Voronina, Igishev, & Loginova, 2021).

Currently, the impact of digital transformation on society and the labor market, as well as on education and training systems, is increasingly evident. From this perspective, the digital transformation in education is driven by advances in connectivity, the widespread use of digital devices and applications, the need for individual flexibility and the acute demand for digital skills (Van Laar, Van Deursen, Van Dijk, & De Haan, 2017).

The pandemic has reconfigured educational practices from "face-to-face" interaction to the online environment, an aspect that has generated a series of reflections that have put into focus the

²⁰ Ph.D Student, email: andronic.adriano@gmail.com
ORCID: 0000-0001-6645-146X

fact that teaching, learning and emerging technology can must be considered holistically the future of digital education (Onyema et al., 2020).

Despite the fact that Moldova has a developed digital infrastructure (the degree of coverage of the country's territory with 4G - 98%), well-placed e-Gov services, ICT sector with an accelerated development (7% contribution to the GDP), the COVID-19 pandemic highlighted the need to accelerate the digital transformation in the Republic of Moldova (Botezatu, 2021).

In this paper, we aim to evaluate the financing digitization of education in the Republic of Moldova, from the perspective of past actions, the plans included in the Development Strategy “Education 2030”, and the opportunities offered by the blockchain. We used online research, literature review, and interviews with implementers and experts in education and education technology.

After a short introduction, in Section 2 we describe general context of education in the Republic of Moldova and the existing issues. In Section 3 we go through the digitization of education in Moldova and implemented projects. We present and analyze the education expenditure and planned actions and budget for de digitization of education in Moldova in Section 4. We discuss the blockchain-related opportunities for education in the Republic of Moldova in section 5. Finally, we summarize the findings and implications in Section 6.

1. The general context of education in the Republic of Moldova

Although in the last two decades the economy of the Republic of Moldova has evolved: from 2010 to 2019 the average annual GDP growth rate was about 4.5%; GDP per capita at purchasing power parity, in constant prices, increased from 2,813 USD in 2000 to about 6,725 USD in 2019, compared to the countries of Central and Eastern Europe, it still remained at the lower level (National Bureau of Statistics of the Republic of Moldova, 2022b).

In this context, the role of the education sector as a determining factor of the sustainable socioeconomic development of the country will increase, which implies the need for a systemic approach to educational policies.

In recent years, the natural increase of the population in the Republic of Moldova is negative, especially in the rural areas. According to National Bureau of Statistics data, in 2014 the number of the population with usual residence was 2.869 million inhabitants, and at the moment it is 2.640 million (National Bureau of Statistics of the Republic of Moldova, 2022d). The demographic decline is caused by the decrease in the birth rate, the high level of mortality, and the massive emigration of the population.

In recent years, external migration had an obvious dynamic, registering at the end of 2014, 271,611 thousand, and at the end of 2016 – 300,916 thousand citizens. According to official estimates, in 2021 approximately 352 thousand people over the age of 15 were working abroad (National Bureau of Statistics of the Republic of Moldova, 2022d). At the same time, according to the estimates of the International Organization for Migration, in 2019, the number of Moldovan migrants reached 1 million people (Government of the Republic of Moldova, 2020).

At the same time, according to reports of the United Nations Population Fund, by 2035 the country's population could decrease to two million, of which every third person would be over 60 years old (United Nations Population Fund, 2022).

Migration, accompanied by changes in the fertility rate and family composition, led to the considerable decrease of the school population (National Bureau of Statistics of the Republic of

Moldova, 2022c), the disappearance of some small schools, which became the rule, to the education of students in incomplete families, to the phenomenon of school dropouts and, consequently, to a low level of education quality.

The COVID-19 pandemic has considerably worsened the state of health of the population, including the state of psychological health. Although in the last 20 years the health status of the population of the Republic of Moldova has registered certain improvements, life expectancy has increased in a comparative aspect 1996-2021: from 63 to 66.8 years for men and from 69 to 75.1 years for women (Government of the Republic of Moldova, 2020), however, at this chapter the Republic of Moldova is placed below the regional standards.

The spectrum of health problems faced by adolescents and young adults is very diverse. Such phenomena as smoking and excessive consumption of alcoholic beverages, the high rate of HIV infection among young people and pregnancy among teenage girls, poor psycho-emotional health, diseases, the epidemiological situation generated by COVID-19 strongly affect the functionality of the education system and its development prospects (Ministry of Education and Research of the Republic of Moldova, 2022).

The family and the educational institution are determining factors of children's education. According to recent data, over a third of teenagers have at least one parent working abroad and about 10% of teens have both parents working abroad. In this context, the state's attention to the family as a primary factor in children's education must be one of the priority perspectives of social policies. The educational system must offer all children the same opportunities for learning and development regardless of their family and socioeconomic background.

Since the economy and primarily the agricultural sector is extremely vulnerable to climate change: drought, heavy rains, hail, insufficient drinking water, etc., there is an urgent need for resilience education.

2. Digitization of education in the Republic of Moldova

The education system faces the problem of inefficient application of ICT in education and of ensuring the education process with educational software (Government of Moldova, 2021).

Due to poor access to the Internet, insufficient financial means allocated for the computerization of the education sector and, sometimes, their improper use, the availability of ICT means in educational institutions remains to be low, a fact that creates difficulties for the implementation of computer-assisted training and educational management computerized, including if, compared to a statistical average, one computer returns to 9 students (National Bureau of Statistics of the Republic of Moldova, 2022a).

The lack of a functional management in the digitalization of education process is attested: the procurement of digital equipment, without including appropriate software, including system software; use of unlicensed software; reduced practice of subscribing to system software, to general application software, but also to educational software developed by specialized companies and publishing houses (Ministry of Education and Research of the Republic of Moldova, 2022).

During the last few years, several actions have been undertaken with the aim of "digital literacy" of teaching staff and pupils/students, which allows the use of equipment, computer programs, computer networks, digital communication infrastructure, etc.

The degree of capitalization of digital skills in the teaching-learning-evaluation process remains a problem, but also the insufficient ability to effectively use the latest generations of

interactive multimedia educational software. Surveys reveal that about 79% of teachers believe that the use of the means provided by information and communication technology contributes to a large and medium extent to increasing the level of development of students' skills and that about 70% of them highlight the importance of ICT for improving learning results (Ministry of Education and Research of the Republic of Moldova, 2022). At the same time, about 40% of pedagogues show a reserved attitude towards the impact of information technologies, which signals significant delays in the digitization of education.

A series of initiatives already support the integration of digital tools at all levels of the education system in Moldova: Tekwill in every school (Tekwill, 2022), Clasa Viitorului (Clasa Viitorului, 2022), the National Digital Literacy Program of teaching staff (Ministry of Education and Research, 2022b), as well as the online education platforms studii.md and invat.online, etc.

Although 18 higher education institutions offer studies in the field of IT, there is a shortage of personnel in this field (Tekwill, 2020), partly explained by the exodus of young people. Another imbalance noted is the poor representation of girls and women in the sector: only 4.6% of girls choose to study in STEM fields (science, technology, engineering and mathematics) and only 19% of digital employees are women. Programs such as GirlsGoIT aspire to encourage and help girls get involved in IT activities. Taking measures that would ensure a balance in gender equality in all schooling programs is imperative (Ministry of Education and Research of the Republic of Moldova, 2022).

3. Education expenditure in the Republic of Moldova

In the period 2016-2021, the share of public expenditure on education in GDP increased from 5.3% to 6.1%, and decreased to 5.5% in 2021. At the same time, the share of public expenditure on education in the total of National Public Budget expenditures experienced fluctuating developments for the same period: after an increase from 17.7% recorded in 2016 to 18.4% in 2021, the value of this indicator, under the impact of the COVID-19 pandemic, decreased to 16.6% in 2021 (Ministry of Education and Research of the Republic of Moldova, 2022). The increase in the share of public expenditure on education in GDP, compared to the decrease in their share in total national public budget expenditure, is explained by the much more pronounced reduction of GDP, compared with the reduction of the National Public Budget expenses over the same time interval.

Although in absolute terms the public expenditures related to education have grown constantly (from 8.558 million MDL in 2016 to 13.398 million MDL in 2021), however, the investments made in recent years have not been able to cover the needs of a sector that aims to train the competitive labor force in the context of the global economy (Ministry of Education and Research of the Republic of Moldova, 2022).

In the structure of public expenditures for education, in 2020 the highest share was held by secondary education: 5917 million MDL or 49%, followed by early education and primary education: 3590 million MDL or 30%, professional technical education: 1052 million MDL or 9%, higher education: 1,073 million MDL or 8% (Ministry of Education and Research of the Republic of Moldova, 2022).

One of the sensitive challenges with a strong financial impact is the inefficient use of the project capacities of educational institutions as a result of the decrease in the number of pupils/students. Consequently, the constant increase in funding from the state, accompanied by the decrease in the number of pupils/students, frequently causes an exaggerated increase in unit costs,

without a corresponding improvement in the quality of the educational process (Ministry of Education, 2019).

Investments in education, which do not ensure a high level of quality and functionality of the education system, will not ensure the sustainable development of the economy or society in general, being one of the main vulnerabilities. Without an adequate salary, the attractiveness of the teaching profession will remain low, regardless of the quality of professional training (National Trade Union Confederation of Moldova, 2022).

a. Planned expenses for de digitization of education in the Republic of Moldova

The Development Strategy “Education 2030” aims to improve the functionality and quality of the educational system through the effective implementation of digital technologies to ensure the quality and sustainability of education (Ministry of Education and Research of the Republic of Moldova, 2022). Out of the 84,3 million USD planned expenses for 2022-2026, 7,9 million USD (see Table 1.) must come from the development partners of the Republic of Moldova, namely the European Union, European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), Council of Europe Development Bank (CEB), Central European Initiative (CEI), United Nations, German International Cooperation Agency (GIZ), the United States Agency for International Development (USAID), the Swedish Agency for International Cooperation and Development (SIDA), the Development Agency of the Czech Republic, the Austrian Development Agency (ADA), the Swiss Agency for Cooperation and Development (SDC), UNDP Moldova, and others (Ministry of Education and Research, 2022a; Ministry of Education and Research of the Republic of Moldova, 2022).

Table 1. Planned expenses for de digitization of education in the Republic of Moldova, thousands USD²¹

Type	2022	2023	2024	2025	2026	National Public Budget	Other Sources
Equipping at least 80% of educational units with equipment, software and other information and communication technologies, according to national equipment standards for each level of education and type of unit.	1145,71	1807,68	39108,92	39108,92	0,00	81171,23	1440,34
Ensuring the initial and continuous training of 100% of employees in the education sector regarding the development of digital skills and the implementation of	1622,51	0,00	266,73	0,00	0,00	1889,24	5248,85

²¹ Average USD/MDL exchange course for 2022: 1 USD = 18,7456 MDL.

education computerization standards.							
Developing the institutional capacity of 95% of educational institutions in the creation, use and evaluation of digital learning tools.	391,47	391,47	391,47	35,57	8,89	1218,86	1249,93
Development and implementation of higher education programs with distance learning.	2,55	2,55	2,55	2,55	2,55	12,75	0,00
Total	3162,24	2201,70	39769,67	39147,04	11,44	84292,07	7939,11

Source: Ministry of Education, Development Strategy “Education 2030” (Ministry of Education and Research of the Republic of Moldova, 2022).

The implementation costs include current and administrative expenses, non-financial assets related to educational institutions, the cost of actions, such as organizing events, training, national and international evaluations, carrying out research and studies, etc.

Table 2. List of activities and the required amount of financing from other sources, included in the Development Strategy “Education 2030”, thousands USD

Project	Thousands USD
Development of the management information system in higher education	1440,34
Elaboration of the Methodology for the certification of the digital skills of teachers and managers	26,67
Certification of teachers' digital skills	4638,93
Certification of the digital skills of management staff	631,25
Updating/developing the Distance Learning Methodology, based on the quantitative and qualitative results of recent studies/research and the need to resize the competence to learn to learn in online conditions; "Quality online education for every child"; "Education never stops."	22,95
Implementation of a unified e-admission system in order to make this process more efficient in higher education	1226,95

Source: Ministry of Education, Development Strategy “Education 2030” (Ministry of Education and Research of the Republic of Moldova, 2022).

The strategy also provides objectives that cannot be achieved without the identification of additional funding sources. The financing of the uncovered expenses will be assumed at each stage of budget planning, depending on the framework of available resources. Part of the uncovered expenses will be able to be financed by mobilizing additional external assistance (Affairs & Communications, 2014).

4. Blockchain-related opportunities for education in the Republic of Moldova

As the world grows increasingly digitally advanced, the education industry is positioned for disruption (Lubis, 2019). The EdTech industry is benefiting students and teachers for over two decades, accelerating the modernization of education (Weller, 2018). The emerging technologies like blockchain can now significantly speed up the process and significantly influence teaching and learning. The Artificial Intelligence (AI), machine learning (ML) and the distributed ledger of blockchain are gradually replacing the textbooks (Shah, Patel, Adesara, Hingu, & Shah, 2021).

Smart contracts, often used on blockchain, can help educators in developing courses on a blockchain (Palma, Vigil, Pereira, & Martina, 2019). After satisfying the necessary prerequisites, the course is automatically taught and can proceed at its own pace. The teachers and students can sign a smart contract, containing the limitations of a certain assignment, the due date and the grading deadline.

The immutable ledger technology of the blockchain creates a chronological record of current events that can be used for tracking student attendance, showing a comprehensive report card, displaying student transcripts and notifying students, parents and other stakeholders of their progress (Bhaskar, Tiwari, & Joshi, 2020). Students can turn in assignments using blockchain without the fear of misplacement. They can receive their certificates, degrees and diplomas digitally, in a hassle free and organized manner (Castro & Au-Yong-Oliveira, 2021).

The most significant use cases for blockchain are crypto and tokenization. The educators can motivate their students when they perform well or complete a major by rewarding them with cryptocurrencies. Students can be incentivized by their academic institutions to repay their student debts on time. The teaching-learning process can be changed for good by the gamification component of tokenization's teaching methodology (Manini, 2019).

The student tuition payment is a process that involves students, parents, banks, foundations, government agencies, lenders and many university departments. The blockchain can streamline this process, lowering the expenditures and even the tuition rates (Mihus, 2020).

The blockchain technology can provide universal access to open educational resources and can support lifelong learning. The affordable and secured sharing of these resources is enabled by the blockchain. Moreover, the students from all over the world can take courses and pass examinations and be assessed by the educators through the blockchain (Liang & Zhao, 2020).

The Moldovan government can exploit blockchain technology to finance a part of the education process, to empower educators to motivate learners during classroom hours and after school, to allow every student from all over the country to join, contribute and learn.

Given the existing gaps in the Moldovan education, described in the previous paragraphs, the new education platform based on blockchain can provide a gamified learning engine, merit-based incentives for educators (thought token economics), direct teacher interaction, and an immutable proof of records for future employers. The platform can also include 3rd party integration: premium content, employers, advertisers and sponsors using blockchain infrastructure.

From the list of activities and the required amount of financing from other sources, included in the Development Strategy “Education 2030” (see Table 2), five can be funded and implemented with the use of blockchain technology. As a result, they students will get paid tokens to learn, will benefit from engaging learning sessions, will have a credible and personalized record of achievement and will get social feedback from teachers and other students. The teachers will get paid tokens to teach through their personalized credible track record and can gain popularity and recognition. They can also get tokens for pro-bono work with the students. The educational system will be properly

managed at all levels and the corruption will disappear in time. The employers will have the chance to access the candidate’s track records and achievements. They will be able to follow the achievements of potential candidates and build specialized training programs for them. The selected advertisers can create brand recognition or implement social campaigns. The sponsors can support financially individual talents or courses for students.

CONCLUSION

This paper is the first that examines the financing of digitization of education in the Republic of Moldova, from the perspective of past actions, the plans included in the Development Strategy “Education 2030”, and the opportunities offered by the blockchain.

The sustainable growth of the economy and the well-being of the Moldovan people must be ensured by a coherent national education system, in which all institutions and organizations, as well as the whole society (family, community, professional groups, mass media), will support the process of training and personality development in various contexts, throughout life.

Improving the functionality and quality of the educational system is possible through the effective implementation of digital technologies to ensure the quality and sustainability of education. The digitalization of education in the Republic of Moldova is possible with significant financial investments not only from the state, but also from other stakeholders, which predetermines the development of new approaches (using blockchain and AI) and tools included in the financial mechanism of the education system.

The limitations of this study represent viable directions for future research. A comparative analysis between Republic of Moldova and other European countries can determine if the blockchain technology is relevant in European context. This paper sets the stage for further research of the implementation of the blockchain technology in education in the Republic Moldova.

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