Barriers and Solutions to the Integration of Digital Technologies in Schools: A Case Study of School Managers in Moldova

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Abstract. This paper presents the results of a study on the adoption and integration of Information and Communication Technology (ICT) in the Moldovan schools from the school managers' perspective. The Internet and digital devices are accessible by most people in Moldova. However, our literature review shows that their adoption and integration in schools is still low. This research adopts the case study method to examine the barriers as well as the solutions from the perspective of the school managers. Twenty school managers from different districts of Moldova participated in this study. A combination of interviews and questionnaires was used to collect data. The results show that the main barriers against the adoption and integration of ICT in the classroom include a lack of adequate and well-trained personnel, poor internet service, as well as high cost of access. The identified solutions include changes to the teaching curriculum to promote and support digital literacy, funding from the Government and external donors, and digital literacy training for the teachers and school managers. These findings provide valuable insights for school managers and policymakers on strategies to improve the adoption and integration of ICT in schools in Moldova.

Keywords. ICT, technology adoption, education, Moldova

1. Introduction

Over the last two decades, education increasingly adopted ICT. Technology can help diversify the students' learning experience in the classroom and help them immerse into knowledge [1-3]. Through technology, students learn in a new way and enhance their knowledge by visualization and deeper understanding [4]. When learning occurs through technology, student engagement improves [5, 6]. Promoting instant access to information through technology enhances students' engagement [7]. The student and the teachers can receive immediate feedback, which can prove useful, especially when the classrooms have a high number of students. The ICT tools for education are being developed at a tremendous speed, however, the adoption, integration, and application of these tools in the educational process in developing countries such as Moldova are still low [8, 9].

2. Technology Adoption in the Classroom

The main users of ICT in schools are the students and teachers. Most of the students embrace new technologies and have a positive attitude towards digital learning. The teachers, however, can be one of the main barriers to ICT adoption in schools [10]. As a result, the teachers were the central theme of the research on technology adoption and integration in the classroom [11-14]. According to Chen [15]"In a classroom, the teacher perceives and defines a teaching situation, makes judgments and decisions and then takes related actions". Therefore,

the teacher plays the most important role in the adoption and application of technology in the classroom.

To fully comprehend technology adoption and integration it is imperative to understand teachers' pedagogical beliefs and attitudes [16-19]. Some studies found that teachers adopt the technology in the teaching process at a slow pace [19-21]. Some of the research was carried out in developed countries, where the rate of digital inclusion and government support are high [22, 23]. Several authors discussed, categorized, and published the barriers to technology adoption and integration [18, 24, 25]. Most of them classify them into two groups [26, 27]. The barriers related to resources and the institutions are defined as "external". The barriers related to teachers and their attitudes are defined as "internal".

According to Ertmer [28], the first-order barriers (extrinsic to the teacher) are the lack of access to technology, insufficient time to plan for integration, lack of training, inadequate technical and administrative support. The second-order barriers (intrinsic to the teacher) are the beliefs about teaching and learning, the beliefs about computers and technology, the beliefs about classroom practices and routines, and the unwillingness to embrace change.

Tsai and Chai [29] proposed the third-order barriers that concern the teacher's ability to create and set learning experiences based on the students' needs and the learning context. They argued that the teachers' access to sufficient resources, facilities is as important as their own beliefs and positive attitude.

3. Motivation and Goal of the Study

In the last decades, there is increasing demand for jobs that are based on digital technologies.

According to the World Banks' Annual Report, there is vital to invest in people so that "everyone can fulfill her or his potential to thrive in the 21st-century economy" [30]. One of the recommendations of the "Connecting to Work" Report is that developing countries need to "bridge education to employment by developing skills for ICT jobs and promoting digital literacy using innovative models" [31]. Half of the world's population still lacks the skills and capabilities to fully, effectively, and equally participate in the global digital world [32, 33].

Achieving several of the United Nations Sustainable Development Goals, namely to "ensure inclusively and quality education for all and promoting lifelong learning" and reduce poverty, achieve gender equality and provide decent work and sustainable economic growth is directly related to closing the digital literacy gap [34, 35].

Introducing technologies in school learning starting with the primary level can help close the digital literacy gap and engage the students in technology throughout their education. This can be done only if the teachers adopt and implement the technologies in the classroom. Unfortunately, this doesn't happen in many developing countries [36-40].

The goal of this study is to examine why the use of technology in schools remains such an issue in the Republic of Moldova. The author employs a user-centered approach to study the barriers and potential solutions to them through the perspective of the school managers, who are also practitioners in the classroom. In addition, this study seeks to understand the environment and the culture in which the school managers are operating.

4. Participants and Research Methods

Data was gathered from twenty public school managers (from different districts) from the Republic of Moldova during September 2021 via phone interviews. Most of the school managers have at least fifteen years of teaching experience.

To explore the barriers with the school managers, the case study approach was chosen.

Case studies are valuable for investigating complex ideas in exploratory research and developing new ones for future study [41]. They are also useful in capturing more contextual information and "lived realities", especially important in studies like education [42].

In this case study the author formulated two research questions:

- "In your opinion, what are the top ten barriers to the successful integration of ICT in the educational process in your school?"
- "Please suggest a solution to the barriers you mentioned in the previous question".

The data from the school managers were examined by thematic analysis. The responses were divided into first and second-order barriers and discussed in the following section.

5. Findings and Discussions

6.1. First-order Barriers

The school managers identified the first-order barriers, divided into three categories. The society-related barriers were unstable government and government policies, unstable educational curriculum, poor funding from the government, lack of materials and relevant gadgets, the high cost of facilities, the lack of good quality internet service, and poverty. The family-related barriers were parental misconceptions, poor educational background of the students, social vices. The school-related barriers were institutional barriers, lack of maintenance, and unconducive environment, inadequate time in the classroom, insecurity.

5.2.1. Society-related Barriers

The instability of the Moldovan government and its policies, the underfunding of education, the lack of minimum conditions like constant electricity and heating in schools, low quality, or insufficient broadband for the Internet access of the students are among the barriers resident in the society. The school managers believe that the government plays the most important role in the integration of ICT in the classroom.

In the Republic of Moldova, in the academic year 2021- 2022, the network of general primary and secondary education comprises 1231 units, consisting of 99 primary schools, 786 gymnasiums, 338 high schools, and 8 schools for children with disabilities in intellectual or physical development. At the beginning of the 2021/22 academic year, 336.7 thousand students were enrolled in general primary and secondary education. In terms of distribution by area of residence, 54.2% of students study in urban areas and 45.8% in rural areas. Of the total units, 98.1% belong to the public sector; 74.3% of the institutions operate in rural areas [43].

Given most of the schools are public, the government's policies and financing shape their educational practices. Although in the past decade various government cabinets have admitted the importance of providing adequate financial and technological support to education, the allocated budget has remained one of the lowest in the world, most of it going for the payment of teacher's salaries [44, 45]. By 2022, the estimated expenditures of the National Public Budget on education will reach 820 million USD [46]. The amount allocated for education in Moldova does not comply with the recommendations of the Organisation for Economic Co-operation and Development [47].

5.2.2. School-related Barriers

Most of the state schools' environment is not conducive for the adoption and application of digital technologies. Creating an enabling environment is crucial. Lim and Khine [48] consider that the classroom environment is both complex and dynamic, the teacher is the key in integrating innovative tools or practices in the process of teaching. For the ICT to

be successfully integrated the schools must be safe, equipped with computers, have consistent electricity and heating, and access to broadband Internet for every student.

At the beginning of the 2021-2022 academic year, out of 1231 primary and secondary general education institutions in the Republic of Moldova, 1214 units carried out the educational process in their premises, and 17 institutions in rented space. Out of a total of institutions, 1018 are in standardized classrooms, and 213 - in refurbished classrooms.

The task of school managers to ensure the necessary conditions is becoming more and more complicated because the schools depend financially on each enrolled student, but their number has been decreasing for several years. The principal of the high school in the village of Chircăiești, Căușeni, says that in such conditions, the financing per student is no longer a fair solution and consequently many of the school's needs are still postponed: "The class is ten students, or the class is 35 students, it must be heated anyway, it must be lit anyway. It is not so fair that according to the number of students the funding is allocated. Yes, we try, based on the financial means, we make optimizations, we closed one floor at a time, we closed some classes. You can't do lessons with illustrative material if the wind blows and, in 2018, we put an end to all this. "

In most of the educational institutions, which have their classrooms in old buildings, the maintenance and repair expenses absorb a good part of the budget. School managers say they would prefer to equip the classroom with teaching materials, renew the book fund, and activities that would involve and interest students, but for now these needs are gradually being met at a low level.

General and secondary education institutions have 37.0 thousand computers used for educational purposes (or about 23% more than in the 2020-2021 academic year), of which 18.1 thousand (48.9%) are connected in the common school network, and 31.4 thousand (84.9%) have an Internet connection. At the same time, 20.1 thousand computers are used by students, 15.9 thousand by teachers and a thousand computers are used in libraries. Compared to the 2020-2021 academic year, both the number of computers used by students (by 17.5%) and by the teaching staff (by 31.4%) increased [43].

According to a study on the economic and social impact of the COVID-19 pandemic, developed by UNDP Moldova, about 150 thousand students did not have access to education during the restrictions due to lack of necessary equipment, knowledge, or Internet connection of students or teachers [49].

High-speed internet access in study classes, as well as the integration of digital technologies in schools in the Republic of Moldova, are essential for the continuity and efficiency of the current study process, but also the long-term development of competent professionals. According to the data presented in the Integrated Management System in Education, 16,575 students and 212 teachers stated that they do not have access to the Internet [50].

One of the school managers stated: "If we go online, I tell you that I don't know what it will be. Why give the student a laptop if he doesn't have internet? Simple. What will he/she do with it? Play games? Some of the pupils are from the neighboring village, which is over the hill in the center, in the cradle. Not even a cell phone picks up a signal there. Please tell me, what should be done with these laptops? ..... Crack the nuts?" [51].

5.2.3. Family-related Barriers

The digital divide can also be caused by the presence or the lack of computers at home [52, 53]. In the Republic of Moldova, the insufficient number of computers in schools is like the situation of the families, especially in the rural areas. The main reason is the lack of financial means to purchase them.

Most of the school managers consider that having a laptop at home, in addition to using one at school would increase the adoption of the ICT in education. However, many families believe the time spent in front of the computers at school is sufficient for their children, and the sole responsibility of education resides on the teacher's shoulders.

Some parents believe that owning a laptop at home does not help their children, because they might get distracted by computer games or even get involved in cyber-crimes. Many believe a smartphone is enough for their child.

Also, there are a lot of families where parents work abroad, and the children are left with the grandparents. Unfortunately, among the elder generation, digital literacy is low, and they do not see the future in digital technologies. Many families involve children in agricultural work and household duties from an early age, limiting their access to digital technologies and knowledge in general.

6.2. Second-order Barriers

The school managers identified five second-order barriers divided into two categories. In the first category "Beliefs about computers and technology", were the attitudes and beliefs of teachers and other relevant stakeholders, the misinformation, and poor orientation about computers. In the second category, "Competence and digital literacy" were included the failure to apply/use digital tools properly, the lack of well-trained personnel, the laziness of teachers.

5.2.1. Beliefs About Computers and Technology

The adoption and integration of technology in the classroom by the teachers are directly impacted by the information they possess regarding technologies and their pedagogical beliefs [54-56]. The main determinant of the teachers' readiness to adopt and integrate ICT in the educational process is their personal beliefs about the usefulness of digital technologies.

The availability of computers, support from the school management, and government policies regarding the digitalization of education are not important unless the teachers are willing to adopt the ICT in the classroom.

Some of the teachers think the traditional methods are the best and the computers are just a waste of time, others are even afraid to break them [11, 57, 58]. The belief that the use of the computer is not for any "serious" teaching process and the fear of being held responsible if students damage the computers during their class, make the teachers avoid using them at all [59, 60].

5.2.2. Competence and Digital Literacy

In the academic year 2021-2022, teachers and managers in primary and secondary education were 26.5 thousand people (or 1.5% less than the previous year of study), including 3.4 thousand people – staff management (12.8%) and 23.1 thousand people – teaching staff (87.2%).

The distribution of teachers and management by age groups reveals that an important share is held by those aged 50-59 (26.8%), being practically at the level of the 2020-2021 academic year, while the share of teachers and driving young people under the age of 30 decreased by 0.5%, and those aged 60 and over increased by 0.6%.

Female teachers have a share of 86.8%, female management staff being 92.5%. More than half of the teachers and management have seniority in pedagogical work of 20 years and over (56.9%).

Previous research has shown that in developing countries, especially in the countryside the teachers lack the necessary skills and competencies to integrate the ICT in their teaching process [61-63]. Some researchers mentioned that this could be a major barrier in the digitalization of education [61, 64, 65].

In this study, the school managers pointed out the lack of training and expertise for using the new technologies in the teaching process. They added that most of the older teachers also lack confidence in using computers.

Digital education is a compulsory subject for primary school students in all educational institutions in the country. The initiative, launched in 2018, aimed to teach children about computers, technology, and robots, to cultivate their passion for STEM education, and to encourage them to choose one of the professions of the future. The program was launched following the signing of a Memorandum of Understanding on the development of digital education in general education between the Ministry of Education, Culture and Research, the Ministry of Economy and Infrastructure, the National Association of ICT Companies, and the Tekwill project [66].

Between July 26 and August 20, 2021, approximately 1,200 teachers from all over Moldova attended the "Digital Education" training program so that in the fall, they could develop students' computer skills, technologies, and robotics and develop a passion for information technology [66].

In Moldova, the Ministry of Education together with the colleges of education and local administration are yet to integrate the ICT in their teacher training programs.

6. Solutions Proposed by School Managers

After identifying the barriers, the school managers proposed solutions to encourage the integration of ICT in the classroom educational environment. These solutions involve three types of stakeholders: government, teachers, and school management.

6.1. Government

Solid infrastructural requirements drive the adoption and integration of ICT in the classroom [65]. The school managers identified essentials like electricity, internet, computers, and comfortable spaces. The government must allocate enough funds to make sure all the schools have the proper infrastructure for ICT use in the classroom.

The Ministry of Education and Research must develop policies that highlight the importance of enhancing teaching with technologies and stipulate practical ways to motivate the teachers to adopt the ICT in the classroom. In addition, the curriculum must be updated and extended to make sure the ICT is a part of the teaching process as well as the school management.

Apart from the standard courses offered by the Institute of Continuous Education (Methodology of preparing the modern multimedia lesson, computer-assisted assessment, conducting school experiments in digital laboratories, the technology of using interactive whiteboards), the Ministry of Education and Research must commission additional courses to encourage all the teachers to attend specialized workshops and seminars to make them feel more comfortable using ICT and developing their digital teaching content for using in the classroom. Given the consequences of the ongoing pandemic, the Ministry of Education and Research must strengthen teachers' skills as they move from traditional teaching to "reverse classroom", which involves online teaching and learning.

6.2. School Management

The school management must use the support from the government and provide a motivating environment for the teachers to adopt the ICT in the classroom. The way this adoption takes place is as equally important as the funding from the government.

The change that comes from introducing the ICT in the classrooms must be managed by the school principals. According to Ritchie and Rodriguez, the school management is

responsible for "providing and selling the vision to the community, obtaining resources such as time, personnel, knowledge, materials, and facilities, and providing encouragement and recognition for teachers successfully making the transition" [67]. The school management must create "the role of a technology leader – someone who is comfortable with ongoing change and can keep themselves abreast with products, procedures, policies related to digital technologies while supporting and empowering teachers to adopt technology" [67].

Finally, the teachers recommended that other teachers who have practical knowledge of digital tools should be encouraged to train their colleagues who do not have these skills. This community of practice may help reluctant and slow adopters share their concerns, increase their confidence and efficacy, and eventually make them willing to integrate digital technologies in their teaching practice. The school management has the responsibility for using the support of the government in providing an enabling environment for teachers to adopt and integrate digital technology in the classroom. Although funding is vital to technology adoption and integration, the manner and process in which this adoption and integration take place are equally as important. School management is responsible for driving and managing the change that comes with introducing technology-enhanced learning. Ritchie and Rodriguez [46] highlight various methods through which the school management can support the process of technology adoption. This includes "providing and selling the vision to the community, obtaining resources such as time, personnel, knowledge, materials, and facilities, and providing encouragement and recognition for teachers successfully making the transition" [46]. The school management should also create "the role of a technology leader – someone who is comfortable with ongoing change and who can keep themselves abreast with products, procedures and policies relating to digital technologies while supporting and empowering teachers to adopt technology" [46].

The school managers also recommend that all the teachers who have enough knowledge and practice in using ICT in the classroom should be motivated to train their colleagues, organize workshops improve other teachers' digital literacy and skills. Learning from colleagues could help them feel less reluctant to try new ways of teaching the subjects and increase their confidence in front of the students. The younger teachers should support the older ones in making the first steps into using ICT in the classroom.

6.3. Teachers

The teacher is the central actor in the teaching process, therefore is up to them to maximize the support from the government and the school management in successfully integrating the ICT in the classroom. The lack of skills of the teachers should also be addressed by committing to continuous skills development that would make them comfortable using the new technologies and saving their time in the process of student assessment and result reporting. First, they must understand the value the technology brings to the teaching process and the learning opportunities it gives to the students to be prepared for the jobs of the future. Second, the teachers must understand that to stay competitive and grow professionally and personally they must embrace the new educational technologies.

7. Conclusion

This paper examines the main barriers and solutions to the integration of ICT in the classroom from the perspective of school managers. The society-related barriers were unstable government and government policies, unstable educational curriculum, poor funding from the government, lack of materials and relevant gadgets, the high cost of facilities, the lack of good quality internet service, and poverty. The family-related barriers were parental misconceptions, poor educational background of the students, social vices. The school-related

barriers were institutional barriers, lack of maintenance, and unconducive environment, inadequate time in the classroom, insecurity. The intrinsic barriers related to beliefs about computers and technology and competence and digital literacy. The proposed solutions are aimed at the government, school managers, and teachers. This study is focused on the Republic of Moldova and is based on the feedback from 20 school managers. Further research can approach quantitatively all the school managers in primary and secondary education as well as vocational training institutions. The insights drawn from this paper can be compared to other developing countries and the results can be used to improve the level of ICT adoption in schools.

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