

Analyzing the Digital Education Revolution

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Abstract – With the development of information-communication technologies (ICTs) the educational system experiences gradual digitalization. Due to the COVID-19 pandemic this process has been intensified and it became an imperative aspect of future education. Educators and students had to adapt to the new ICT-based education system. This transition to this new digitalized system is not complete and government institutions as well as educational institutions have to yet develop a sustainable long-term strategy. Now, in this paper the digital education revolution is analyzed. The main goal of the paper is to identify the challenges and barriers of education digitalization. Additionally, future trends in the digital education revolution are addressed. The paper provides a thorough insight into the dynamics of how the digitalization of education affects educators and students as well. The paper provides significant insight and presents an adequate basis for future research in the domain of education digitalization.

Keywords: *education, digital education revolution, strategy, future trends*

1. INTRODUCTION

In the last two decades there is process of transformation of education. More precisely, with the advancement of modern information-communication technologies (ICTs) teachers and professors face challenges and they are under increasing pressure when it comes to teaching with digitally enhanced methods [1]. This may be due to the lack of adequate technical skills as well as due to the lack of adequate equipment for online teaching. The digital education revolution focuses on improving skill in the domain of standardized testing, numeracy, and literacy. Further, such digital education revolution includes the implementation of national professional accreditation standard and national curriculums. Such improvement to the education system can contribute to country's productivity and competitiveness [2]. Therefore it can be argued that the process of education digitalization is becoming an imperative when it comes to creating skills and adequate knowledge that will create value on the market, effectively contributing to the competitiveness of the country.

Furthermore, Internet of Things (IoT) brings a new approach to education and learning. IoT

alongside with other technologies such as mass distribution and storage of teaching material, digital publishing, 3D distance teaching, remote experimental teaching, virtual classrooms, control over digital resources etc., have the potential to improve the concept of traditional education as well as to enhance the teaching process [3]. When the COVID-19 pandemic is taken into consideration, online learning and modern ICT application in education as well as the overall digital reform of education is becoming an imperative. Such reform includes the implementation of flexible and active online platforms [4]. When teachers introduced laptops in their science classes for senior students as a push forward in the digital education revolution, a few contradictions appeared. The first included barriers to innovative science. Next, there were issues when it comes to maintaining adequate connectivity with the school and classrooms. The third contradiction rose from the differences between students' and teachers' expectations. The final contradiction included the changes in overall classroom management [5].

In this paper the concept of digital education revolution is reviewed. The main goal is to identify and analyze the potential positive and negative outcomes of education reform in the "spirit" of digitalization. The paper analyzes the framework of digital education, the process of digitalizing education and future trends in the domain of digitalizing education. In addition, guidelines and propositions for improving the process digitalization and the existing digital systems are proposed. The paper includes four main sections (excluding the Introduction, and Conclusion sections). The first section presents the framework of digital education. In the second section the concept of education digitalization is addressed. The third section analyzes future trends in the domain of education and the use of ICTs for teaching and learning. Finally, in the fourth section the guidelines and proposition for improving the process of digitalization of education are discussed.

II. THE FRAMEWORK OF DIGITAL EDUCATION

In developing countries, the digital education revolution faces barriers, as traditional teaching methods prevail. The digitalization of education involves the integration of users and platforms on personal computers, smartphones and other devices. There are set of technologies that encapsulate the framework of digital education. These emphases are technologies that aim at redefining the process of teaching and learning through the implementation and application of various modern ICTs; attempts at reshaping the learning and teaching process through the adaptation and effective change of learning resources; technologies which aim at improving the teachers', or better say educators', knowledge, their skills and approach to teaching; set of technologies which aim at improving the learning environment (classrooms, conference rooms, online classrooms etc.) [6]. Technological advancement as the cornerstone of education digitalization, represents the driving force of development. Alongside with the worldwide COVID-19 pandemic, the rapid development of ICTs have exponentially increased the speed of education reform and the process of digitalization of various aspects and levels of educations.

In order for the digital education reform to take place in an effective and efficient manner, the concept of digital education governance is a crucial element that manages the changes in the educational system. The digital education governance takes up the role of managing, monitoring, evaluating and defining standard for individuals and institutions in the process of implementing and applying digital systems in teaching [7]. Without digital education governance, there would be chaos regarding the intensity and direction of education digitalization. As this process is dynamic, there must be strong control mechanisms put in place in order to reduce dissipation from the main goal, and that is an effective educational system (fully digitalized and scalable). The control mechanisms further require clearly defined policies. Focus areas of digital education policies include infrastructure, leadership and governance practices, collaboration and networking, content and curricula, and teaching and learning practices [8]. In the same study it was noted that even though the digitalization of education can improve the learning and teaching process, if overall poor teaching is conducted, then there is practically no technology which can compensate such drawback. This practically means that the digitalization of educational systems requires not only human resources in the form of educators, but

skilled and learning-ready human resources (educators, consultants, teachers on all levels of education).

When it comes to a broader view on digital learning which can include one or several concepts and approaches. These approaches may include adaptive learning, blended learning, e-textbooks, virtual classrooms, open education resources, mobile learning, and online personalized learning [9]. Human resources have to improve their knowledge in the noted domains of approaches in order to increase the probability of positive outcome of education digitalization. Online learning platforms which present the core of online and digital education may include one or more approaches and they can fulfill various learning and teaching roles (sharing, distribution, hosting, improving, etc.). Further, on Figure 1, a simplified overview of the digital education revolution process framework is presented.

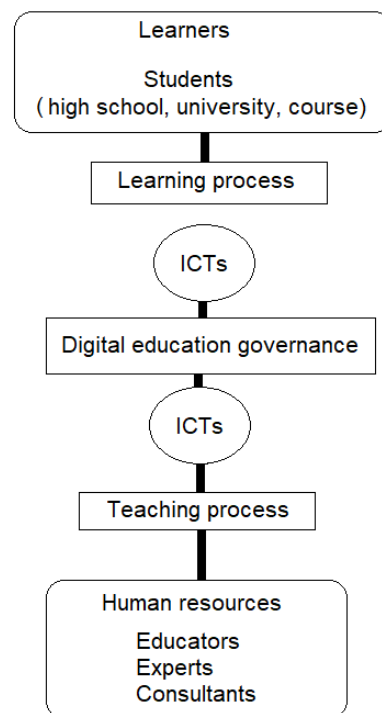


Figure 1. Simplified education digitalization framework

As seen on Figure 1., digital education governance is at the center of the digitalization process. Both from the teaching and learning process standpoints ICTs are the main element that connect educators and learners.

It is important to note that digital education modelling in the context of governance, can be driven by complex social, economic and even

political agendas. Therefore, the digitalization of education shouldn't be accepted narrowly as an instrument which only brings prosperity, but rather it is necessary to promote critical assessment as well. Through this critical assessment the integrity of digital educational systems would be secured [10].

III. DIGITALIZING EDUCATION

As noted earlier the rapid development of ICTs and Industry 4.0 bring a new paradigm on multiple frontiers. One of those frontiers is education. The data and research conducted by previous researchers [11] indicated high mean values when participants were interviewed regarding the application of digital learning. More precisely, the participants evaluated that the use of mobile phones, desktop computers and tablets made learning easier and more efficient. Now, this is one aspect of the digitalization process, and it can be viewed as a positive outcome of digitalizing education systems. However, the concept of the whole digitalization process is not that simple. There are surely negative effects as well. For example, there is lack of sufficient face-to-face time spent with students. In addition, the process of adaptation of educators as well as students to new online platforms is not instant nor it is "smooth". Therefore, when discussing the digitalization of education, the complexity and the sheer amount of factors that affect the learning and teaching process has to be addressed. More precisely, The process of digitalization of education can't be pinpointed to clearly defined actions, but rather it involves the dynamic synergy of governance, ICTs, and educational institutions alongside with educators and learners.

Further, when it comes to distance learning in Serbia, a developing country, the number of accredited undergraduate and graduate courses at universities in 2016 was 1.85%. It was expected that by 2020 this number would increase, however this is not yet the case [12]. It is evident that the process of education digitalization is not an ready-to-roll-out solution and that varies across countries. Organizing the process of education digitalization requires, as noted earlier, and effective digital education governance. This element of the digitalization process can experience bottlenecks, especially in countries where there is a lack of strong initiative and skilled experts in the domain of education and ICTs.

Furthermore, the main criteria for distance learning accreditation and standardization include scientific criteria, pedagogical, methodological and didactical criteria, ethical and moral criteria,

language barriers, technological and graphical criteria, and security criteria. It can be argued that these represent the basis for distance learning and the devices, which are used for distance learning should fulfill the specific requirements of the noted criteria [13]. Besides the noted criteria, digital repositories will be a necessity. In these repositories teaching and learning resources would be stored [14]. In addition the repositories would include functions such as search, remote-access, editing and managing information, and interface personalization [15].

For an effective digitalization of education to take place, governments, institutions and even local communities should aim at developing a technological infrastructure for distance learning, adapting curriculums for online learning, permanently developing new curriculums which would answer to the needs of the job market, researching and developing new laboratories and online classroom concepts for effective distance learning [16]. In the next section, future trends in the domain of education digitalization and overcoming challenges in the process of education digitalization are discussed.

IV. FUTURE TRENDS AND OVERCOMING CHALLENGES

It can be argued that future trends in education will include the standardization and accreditation of Massive Open Online Courses (MOOCs) and Small Private Online Courses (SPOCs). This kind of online learning environment has to include a framework for motivating students in an intrinsic manner. This framework includes the creation of feeling of belonging thus increasing the feeling of participation and commitment; adaptive learning and creating moderate challenges for students in order to provide adequate value; a manageable and controllable learning environment where students can personalize their learning interface; the possibility for competition between participants; and timely updates of teaching resources. Besides this framework, the teaching staff has to have charisma, competence, and consistency [17].

Furthermore, the digital education revolution brought up the question of digital literacy and the concept of digital citizenship. To acquire such "citizenship" there would be standardized test in digital literacy put in place. This would require skills and knowledge for navigating across the digital world [18]. If the fourth industrial revolution - Industry 4.0 is also considered, then there is a clear

"picture" when it comes to ICT application in education. Namely, the quality of education has to increase in order to increase the knowledge and skills of workers in Industry 4.0 [19]. Namely, the era of Industry 4.0 requires higher levels of ICT knowledge in various domains. Hence, people have to possess adequate knowledge and higher base knowledge when aiming at a job opening. Therefore, improved curriculums are becoming a necessity, not for the sake of digitalization, but for the sake of future potential employees, which face difficulties in multiple industries. Another important factors of improved education is the notion that the mass spread of education around the world has been proven to increase overall cognitive performance of the population. There is also sound evidence that schooled individuals have more pronounced neuro-development [20].

Furthermore, Big Data Technology (BDT) which aims at optimizing education by analyzing, detecting and predicting learners' behaviors. Through such analysis, risk of failure can be reduced and personalized approaches to teaching can be defined [21]. This modern ICT approach and other similar advanced ICTs will become the new norm when it comes to conceptualizing and defining curriculums in the digital education revolution.

V. GUIDELINES AND SUGGESTIONS

Based on the analyzed literature in the domain of education digitalization and modern ICT application in curriculums, the following guidelines and suggestions for improving the overall education system in the Republic of Serbia in accordance with the digital education revolution, are proposed:

- a unique and scalable online platform should be developed for the majority of educational institutions;
- integrated curriculums on faculties should be considered in order to reduce the need for extensive face-to-face communication between the educator and learner;
- accreditation of newly formed educational systems should be supervised by a formed digital governance institution;
- educators should improve lacking knowledge and skills when it comes to online teaching;
- start a nation-wide project for enabling every student on all levels of education to attend online classes;

- develop a unified platform for effective reporting on the situation in individual educational institutions;
- implement digital platforms for reducing bureaucratic procedures in educational and governing institutions.

Overall, the main guideline and suggestion is to increase efficiency of digital education governance while maintaining integrity and education quality. Educators and learners have to actively participate in the process of digitalization and to acquire the necessary skills and knowledge for effective distance learning solutions. The government should actively and strategically plan for the mass adoption of online learning and online teaching, by providing support for households and educators.

VI. CONCLUSION

This paper analyzed the digital education revolution and the process of education digitalization. The main goal was to identify challenges and barriers of education digitalization and to discuss guidelines and suggestions for an effective education digitalization process on a national level. Based on the conducted review of literature in the domain of digital education revolution and the process of education digitalization, it can be concluded that it presents a complex concept that requires synergic actions from the government, educational institutions, and educators and learners as well.

The main limitation of this paper is the lack of an empirical study. However, the goal of the paper was to review and analyze the main aspects of the digital education revolution and the process of education digitalization, thus the limitation is not severe. For future research it is recommended to conduct an empirical study in educational institutions. The study should include educators and learners as well as members of digital education governance teams. This way a more thorough insight can be achieved. For now, this current paper provides a solid basis for future research in this domain.

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