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Analysis of the Main Factors for the Digitalization of Higher Education

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***Abstract*— The implementation of digital technologies and the global network impacts virtually all areas of life in the modern world. Higher education is no exception, and this requires an analysis of the entry of new technologies into education, as well as a review of existing strategic documents at the national and European level. The digital transformation is becoming a critical organizational strategy for survival and achieving competitiveness in higher education. The aim of the scientific paper is to identify the main factors influencing the process of digitalization and to mark the progress of the EU member states in this field. Descriptive and comparative analysis have been used in the study, applying quantitative data review. The analysis includes the political, socio-economic, organizational, educational and technological factors that influence the process of digitalization of higher education.**

Keywords — higher education, digitalization, factors, technologies

I. Introduction

The diffusion of new information and communication technologies, which we have witnessed over the past decade, leads to a completely new dynamic and complex reality within which political, economic and social development unfolds.

The implementation of digital technologies and the global network impacts virtually all areas of life in the modern world. Higher education is no exception, and this requires an analysis of the implementation of new technologies into education, as well as a review of existing strategic documents at the national and European level. Special attention is now being paid to appropriate curricula, programs and tools so that higher education institutions can meet contemporary national and global challenges and provide support in the field of digital technologies, as well as in the development and acquisition of digital competence.

The rapid introduction of information and communication technologies and the pandemic situation led to radical changes in the structure, organization and functioning of the higher education system and institutions [1,2]. The social distancing requirements imposed as a result of the global health crisis, have contributed to the increasing spread of learning in a digital environment, which has become an alternative to the face-to-face form.

The growing use of digital technologies by young people is seen as a major topic in 21st century and raises a number of questions related to the place of these technologies in modern life and their impact on the future [3,4]. The introduction of multimodal and digital technologies in the learning process is constantly increasing. These forms of knowledge transfer and means of communication are becoming common practice in university halls, combined with traditional educational technologies, such as lectures and the use of textbooks.

The process of digitalization of higher education rapidly evolved in the last years which caused a growing scientific interest to the topic [5-13]. There is vast research in the field of implementation of digital innovations in higher education, along with the factors affecting the process of digital transformation.

The inevitable development of the educational ecosystem and the change in service delivery and communication networks have caused the rapid implementation of technology and innovation [11]. The complex and interconnected nature of digital technologies enhance digital learning [5]. The lack of digital literacy represents an important challenge both for teachers and students [6,14-26]. Growing number of researchers study the emerging technologies like artificial intelligence (AI),

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virtual reality (VR), augmented reality (AR), Internet of Things (IoT), blockchain and their integration in the learning and teaching process [27-32].

The implementation of AI generated tools in higher education will transform the existing organizational models and involve a completely new approach to improve both the internal processes of course delivery and enhance the provisions of education quality while building new digital models for academic and administrative government.

II. Materials and Methods

The material includes a scientific review of the process of digitalization of higher education and the main factors influencing the process. The political, socio-economic, organizational, educational and technological factors have been reviewed. Descriptive and comparative analysis have been used in the study, applying qualitative and quantitative data review.

III. Results and Discussion

A. Definition of the main terms

The terms "digitization", "digitalization" and "digital transformation" are used interchangeably and it is necessary to distinguish between them (Fig. 1). The term "digitization" is defined as "the process of changing from analogue to digital format" [33] and is a purely technical process. "Digitalization" describes a distinct process (societal, operational or economic) and could be defined as "the process of using digital technologies and information to transform business operations" [34]. This definition could also be related to higher education. Bloomberg summarizes the three concepts as follows: "We digitize information, digitize processes and roles that define business operations, and digitally transform business and its strategy" [35].

Digitalization of education includes its modernization, reform and transformation, as well as solving problems and making decisions with the help of digital technologies [36].

Fig. 1. Concepts of digitization, digitalization and digital transformation.

Source: Massachusetts Institute of Technology (MIT)

According to researchers, digital technologies should be introduced in all areas of education, teacher training, educational infrastructure, methodology, teaching materials, as well as management at all levels and all sectors of the education system [37].

Digital technologies offer possibility for optimizing the learning process and improve the level of knowledge acquiring. Interactive tools support educators in introducing innovative approaches, including case studies, experimental and research work, simulation games, and more. The use of the listed methods leads to more efficient assimilation of information, development of "appropriate skills and work in an emotionally comfortable environment that stimulates motivation to learn, the birth of new ideas and creativity [38]".

The concept of "education 4.0" is related to the vision and future of learning and teaching, where "digital technologies, personalized data, open-source content, connectivity" [13] lead to innovative thinking and creativity. Increased awareness, computational thinking, digital learning and digital literacy for academics and students have to be fostered through relevant curriculum and operations.

The digital transformation of higher education is closely related to acquiring and improving the digital competence of both, students and teachers. Digital competence is an extensive holistic concept that encompasses technological skills in a broader perspective.

According to the European Commission "digital competence" refers to "effectively and critically use information and technology for training, self-development and active participation in society [39]". The conceptual reference model of the digital competence is presented in Fig. 2.

The DigComp framework 2.2. encompasses five different areas:

- Information and data literacy;
- Communication and collaboration;
- Digital content creation;
- Safety;
- Problem solving.

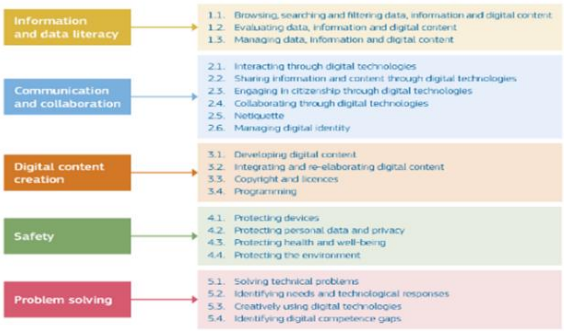

Fig. 2. The DigComp Conceptual reference model [40].

Source: Joint Research Centre

The set goal of the European Commission is that "by 2030 at least 80% of all adults will have basic digital skills and that there will be 20 million specialists in the field of information and communication technologies in the European Union" [41].

With regard to the rapid technological development, as well as with the trend of ever-growing internationalization of higher education, the introduction of digital learning will

turn into a common practice. In view of the need for digital transformation of higher education, it is necessary to review the factors related to this process.

B. Factors for digital transformation of higher education

- Political factors

Digital technologies have enormous potential to help increase the quality, equity and effectiveness of higher education. Realizing the full potential of digitization requires a rethinking of the policy framework, including ways of funding, additional training and quality assurance. An adequate strategic framework of digitization, monitoring and ensuring quality education is needed.

The EU Digital Education Action Plan 2021-2027 [42] has two main priority areas - promoting the development of a highly effective digital education ecosystem and improving the digital skills and competences needed for digital transformation. Clear steps to achieve the priorities thus defined are also indicated. The renewed Digital Education Action Plan contributes to the European Commission's priority - "Ready for the Digital Age" - and is a key factor in realizing the vision of building a European Education Area by 2025 [42].

At national level, a Strategy for the development of higher education in the Republic of Bulgaria for the period 2021-2030 was adopted, as well as an Operational Plan for its implementation [43], which foresees the creation of digital curricula and new interactive digital resources. It is also planned to introduce modern, flexible and effective forms of training. In view of the digital transformation, all curricula and programs must be completely changed by 2029. The Operational Plan also envisages the inclusion of practical disciplines in artificial intelligence (AI), augmented reality (AR) and artificial reality (VR); a significant increase in electronic distance learning programs is also planned. To provide the necessary technical equipment that will be used in interactive and digital learning, funding is provided under the Program for Scientific Research, Innovation and Digitalization for Smart Transformation 2021-2027, as well as from the budgets of higher education institutions.

The European Commission's vision for Europe's digital transformation by 2030 is set out in the Communication "Digital Compass: The European Roadmap for the Digital Decade" and the governance framework put in place to achieve the digital goals - "Road to the Digital Decade".

It is necessary to take measures regarding the implementation of the Action Plan in the field of digital education (2021-2027) and to support the sustainable and effective adaptation of the European education and training systems to the digital era. The same measures are also necessary for the application of the Strategy for the Development of Higher Education in the Republic of Bulgaria 2021-2030 and the Operational Plan for it.

Digital transformation affects every aspect of people's lives, providing enormous possibilities for "a better quality of life, innovation, economic growth and sustainability, but it also creates new challenges for the structure, security and stability of societies and economies" [42]. As the digital transformation accelerates, the European Union outlines "how its values and fundamental rights should be applied online in the recently adopted European Declaration on Digital Rights and Principles for the Digital Decade [42]".

- Socio-economic factors

Competition among higher education institutions

Competition among higher education institutions is a significant factor influencing the introduction of digital technologies into the educational process. The modern environment is characterized by ever-increasing and intensifying competition between universities, and it is imperative for higher education institutions to adapt to changes through digital transformation. This would also lead to a wider presentation of higher education institutions on the international educational scene and the attraction of talented students from all over the world.

Education costs

Expenses represent a factor that significantly influence the digitization of higher education by reducing them while maintaining the quality of education. Cost reduction is associated with digitization in higher education, and academics see e-learning technologies as the best innovation to reduce training costs [44]. Various authors point out that the transition to digital technologies in higher education can invert the cost curve [45].

Generational differences

The majority of current, and especially future students, belong to the so-called digital generation. Learning with the help of new technologies will be closer to their way of obtaining knowledge, acquiring skills and developing competences. At the same time, the flexibility in the educational process will increase, the efficiency of work in the classroom and outside will be improved, and there will be greater opportunities for active engagement of students, use of innovative methods and the student-centred approach to learning.

Social inclusion

The digital environment allows the inclusion of certain categories of disadvantaged people - e.g. people with physical or other disabilities, as well as students who live in remote settlements and do not have the opportunity to attend the chosen higher education institution. Achieving digital transformation would ensure equal access to higher education and democratization of higher education. Learning in a digital environment also helps to avoid possible discrimination based on age, race or physical disabilities.

- Organizational factors

Organizational culture

University culture significantly influences the introduction of digitization in the learning process. The

socio-technical perspective, technological leadership and learning outcomes are relevant. Various studies have observed the tendency for positive organizational cultures to provide adequate support and encouragement for the use of technology in the learning process.

Organizational effectiveness

As a result of the digital transformation within higher education institutions, an increase in the efficiency of interaction between individual structural units within a given university is observed.

- Educational factors

Quality assurance

The quality of higher education can be understood as a set of specific opportunities of the higher education institution and the degree of their implementation. Improving the quality of higher education is a major strategic goal in Bulgaria, as everywhere in the world, great attention is paid to issues of improving the quality of higher education with regard to the digital transformation.

The concept of quality assurance in the field of higher education in a broad sense is understood as a balanced compliance of higher education with diverse needs, goals, requirements, norms (standards).

In order to make use of the full potential of digitalization, it's necessary to consider the adoption of new policy framework, including ways of public funding, further training and quality assurance. An adequate strategic framework for ensuring quality education in digital environment is needed.

Digital competence of academics

Digital competence of academics has enormous impact on the digitization in higher education and is related to the synchronization of students' educational needs, their personality traits, curricula, learning process management and digital competence. With a view to introducing effective digital integrated training, it is necessary to prioritize the development of the academic staff and the increase of their technological competence.

Digital competence of students

Students' digital competence significantly influences the introduction of new technologies in education by harmonizing digital learning methods, intercultural interaction and equal access to higher education. Considering the critical importance of students' digital competence, it is necessary to make decisions at the political level and take the necessary measures to increase it, with a view to successful technological adaptation.

- Technological factors

Diffusion of technologies

The introduction of new technologies significantly influences the digitization of higher education through the integration of creativity, smart devices, augmented reality and the use of the "flipped classroom" method.

Infrastructure

The availability of adequate infrastructure has an impact on the process of digital transformation of higher education. Information technology infrastructure has a direct positive effect on the successful introduction of digital educational technologies [46].

Learning platforms

A number of higher education institutions have already begun to modernize their educational process, introducing the use of e-learning systems (platforms). The options available to universities when choosing a platform are ever greater. Both free and paid e-learning systems and platforms for conducting virtual lectures and classes are available. A system unique to the relevant higher education institution, specially developed for its needs, could also be used.

Data security and privacy protection

In view of the strict regulatory provisions on cyber security and protection of personal data, higher education institutions must invest in additional measures to protect information and data in the context of the introduction of digital technologies in the educational process and digital transformation. It is also necessary to pay attention to the protection of information, as this applies to e-learning platforms, existing learning materials, tests, sensitive information, as well as to internal communication in the organization.

The various factors affecting the digitalization of higher education are summarized in Table 1.

Along with the factors influencing the process of digitalization of higher education, there are still some challenges that need to be faced in order to utilize the full potential of the information and communication technologies.

TABLE 1 CLASSIFICATION OF THE FACTORS AFFECTING THE DIGITALIZATION OF HIGHER EDUCATION

Number	**Type of factors**	
	General	***Specific***
1.	Political factors	European strategic documents
		National strategic documents
2.	Socio-economic factors	Competition among higher education institutions
		Education costs
		Generational differences
		Social inclusion
3.	Organizational factors	Organizational culture
		Organizational effectiveness
4.	Educational factors	Quality assurance
		Digital competence of academics
		Digital competence of students
5.	Technological factors	Diffusion of technologies
		Infrastructure
		Learning platforms
		Data security and privacy protection

D. CHALLENGES AND FUTURE PERSPECTIVES IN THE PROCESS OF DIGITALIZATION OF HIGHER EDUCATION

The introduction of digital technologies in higher education globally began decades ago and varies significantly across higher education systems, as evidenced by the large amplitudes in the indicators of online learners in the higher education systems of OECD countries [47]. When digital technologies were initially introduced, their use was still limited. Many teachers in higher education institutions used existing systems only to publish curricula, distribute teaching materials and assignments, and maintain semester assessment information, while students received access to teaching materials, announcements, or assessment information.

The pandemic situation led to a sudden need for timely digitalization of higher education, forcing educational institutions to make a rapid transition to online learning. Providers of e-learning platforms had to respond to the fundamental change in the requirements of teachers and students. The use of virtual classrooms increased by 3600% in March 2020 and by 9000% at the end of September 2020 [48]. This outcome was mainly driven by the massive transition to e-learning platforms and online courses.

The abrupt transition to virtual learning in different countries has been accepted patiently and flexibly by teachers and students, although neither has perceived the experience as satisfactory. Teachers are dissatisfied with the lack of consultation with management during the transition to distance learning, as well as the increased workload in developing online learning materials and the students' need for more support in the virtual learning process.

A study conducted by the European Students' Union shows that students prefer face-to-face interaction with teachers [49]. As a result of the extraordinary and rapid transition to distance learning, many students perceived it as incomplete and unsatisfactory. Lectures and practical classes were not always replaced by an online equivalent. Other challenges were related to a significant increase in workload and assignments, the lack of a good internet connection, suitable learning space and adequate learning materials.

Similar problems were identified in a study conducted among 400 students, synthesizing the following negative aspects of e-learning [50]:

- often distance learning consists of publishing learning materials and an asynchronous form of learning or broadcasting a lecturer's lecture;
- limited access to high-speed Internet;
- communication is often interrupted by excessive use of Internet services or insufficient technical support in higher education institutions;
- many students use mobile devices during their studies, where the possible functions differ from those of computers with a screen;
- not all students have access to paid programs that are required to complete various assignments. In cases where licensed software products are used in higher education institutions, students cannot use them outside the educational building;
- many students report an increased number of assignments and hours spent in front of the computer;
- learning becomes an independent process; students encounter difficulties in understanding the educational material;
- teachers require the use of a camera during exams, but not all students have one on their home computers;
- students are worried about their ability to successfully absorb knowledge in the new format; it is also more difficult for them to participate in online discussions;
- real communication with teachers and colleagues is not taking place;
- decreased motivation for learning at home is observed;
- it is difficult for students to learn on their own and they lack real communication with the teacher;
- the time difference must also be taken into account in synchronous e-learning and the participation of students from different time zones.

The analysis of the above-mentioned challenges in the digitalization process illustrates the necessity of adequate measures application, considering the provisions of the Action Plan in the field of Digital Education (2021-2027) and in support of the sustainable and effective adaptation of the education and training systems of European countries to the digital age. The same measures are also needed at national level aiming at implementation of the Strategy for the Development of Higher Education in the Republic of Bulgaria 2021 - 2030 [43] and its Operational Plan.

Higher education systems are expected to undergo a process of increasing digitalization in the planning of the educational process, the teaching and learning process, assessment and educational statistics. An adequate response to the need for a more effective and widespread use of digital technologies will require higher education institutions to create a new generation of educational environments. The digital educational environment of the near future must be adapted for the use of mobile devices, offer conditions for better group work during the educational process and support interactive classrooms. Teachers will have more complete access to student statistics and will be able to better identify their educational needs and the difficulties they encounter; they will have better assessment options and improved models for

continuing professional development in the use of the digital educational environment.

The challenges facing the digitalization of higher education worldwide include the need for significant investments in hardware and software and sufficient time to train academic staff in the application of new technologies. Educational institutions still need to make use of the full potential of the information and communication technologies to create a more flexible and rich educational process. Higher education institutions need to guide the process of digitalization, so as to ensure that the services provided by educational technology providers meet the needs of teachers and students.

IV. Conclusion

In the present article have been examined some of the mainstream research concepts regarding the digitalization of higher education. The main factors influencing the process of digitalization were identified, including political, socio-economic, organizational, educational and technological factors. Some of the challenges in the process have been analyzed along with the future perspectives.

In conclusion, we can point out that there is a significant difference between the development of the educational ecosystem and the ecosystem of digital technologies. Like any other ecosystem in nature, the educational ecosystem needs balance to be sustainable. The pandemic situation has shifted the focus on digital technologies behind e-learning, with too little attention being paid to people and teaching methods. Data and technology are just tools, but the focus should be on the people in the system. If we limit ourselves to using technology to copy traditional pedagogical approaches, it will not serve the students well. A complete revision of the used training methods and the possibilities of new technologies should be done.

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