

Problematic issues of digitalization of education in Eastern Europe

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Abstract. Digital technology permeates all aspects of life. During the pandemic, all countries in the world began to use distance learning methods through the use of digital platforms, classes, labs. Digitalization avoided the collapse of the educational system. The aim of the article is to analyze the processes of digitization of education in Eastern Europe. To achieve the goal of the article, the following tasks were set: to study the theoretical basis of the digitization of education, to analyze the trends in the digitization of education in Eastern Europe, to develop recommendations for improving the digitization of education. The article analyzed the ranks of the Network Readiness Index and the Global Digital Readiness Index in terms of the technological readiness of higher education institutions and students for distance education. The article offers a case study of the Ukrainian university for the implementation of an e-learning environment. The authors grouped countries from Eastern Europe according to their potential for digitizing education. For these groups of countries, the authors identified specific criteria. SWOT analysis of the digitization of education was conducted for the countries of Eastern Europe.

Keywords: digitization, distance education, technical provision, innovative economy, pandemic

1. Introduction

Digital transformation involves the transformation of all areas of public life under the influence of advanced innovative information and communication technologies (ICT), including in the education system, which is the foundation of an innovative economy and shapes its human potential. This determines the relevance of accelerating the digital transformation of education in the countries of Eastern Europe. The digital transformation of education is necessary to ensure that the educational process meets the needs of the labor market, increases the level of participation in these processes of educational institutions of all levels and other organizations of the educational system, as well as scientists, managers and specialists of government agencies, representatives of the private sector of business. Nevertheless, there are some problematic issues of digitalization of education, mainly: unequal access to the Internet of different kinds of

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families, the Internet cover of different regions and countries has different quality and level, lack of computers and laptops in some families etc.

The aim of the article is to analyze the processes of digitization of education in Eastern Europe. The object of the research is the digitization of education. The subject of the research is the process and potential of digitization of education in Eastern Europe.

The scientific novelty of the research is the grouping of the countries of Eastern Europe according to the potential of digitization of education.

The practical significance of the study is that the results of the article can be used by state authorities and universities in Eastern Europe to exploit the potential of digitization of education.

The research methods used in the article include literature analysis (a review of research to date in the field of digitalization of education) and taxonomic methods used to determine the development and potential of digitalization of education in the countries of Eastern Europe, according to the ranks of the Network Readiness Index and the Global Digital Readiness Index in terms of technological readiness of universities and students for distance education, as well as the method of SWOT analysis (according to the digitalization of education in Eastern Europe).

2. Literature review

The VOSViewer and SciVal tools were used to conduct a brief bibliometric analysis on the request “digitalization of education”. The array of publications for analysis was obtained from the Scopus database (<https://www.scopus.com/>).

Bibliometric analysis using the VOSViewer tool (base for analysis – 1408 articles for the period 2010–2020) (figure 1) made it possible to identify the main keywords that are most often found in scientific papers in connection with the direction of digitalization in education. The cluster “education” is of great interest for analysis, which links the terms “e-learning”, “virtual reality”, “augmented reality”, “decision making”, “sustainable development”, “economics” and, in fact, demonstrates the model of university development. in this direction. The relevance of considering this cluster is confirmed by a number of domestic works that are devoted to. In particular, digitalization of education in general [26], state regulation and management of the quality of education [15, 25], ensuring the quality of education in subject areas [14, 16], quality of education and sustainable development goals [1].

It should be noted that in the world the topic of digitalization of education is gaining momentum, as can be seen from the data in figure 2 (SciVal bibliometric analysis tool). However, the number of publications in comparison with other industries is insignificant, which confirms the relevance of studying various aspects of this direction.

Continuing the analysis, it is also necessary to address the topics that are most often associated with the request for digitalization of education (figure 3, SciVal bibliometric analysis tool). The combination of keywords shown in the figure that add up to topics (the figure shows top-1 % of topics by prominence, 2510 articles for the period 2011–2020 were used for analysis) leads the reader to the main promising (“breakthrough”) directions of the development of the digitalization model of education. These areas can be taken as general ones when creating a digitalization strategy for the educational process at the university.

Thus, the data of bibliometric analysis provide a basis for finding optimal solutions for the

The chart displays the cumulative number of COVID-19 cases from 2011 to 2020. The 'World' series (red squares) shows a sharp increase starting in 2014, reaching 759 cases by 2020. The 'Europe' series (blue diamonds) also shows a significant increase starting in 2014, reaching 382 cases by 2020. The 'Ukraine' series (green triangles) remains at zero until 2020, when it reaches 12 cases.

Year	World	Europe	Ukraine
2011	0	0	0
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	155	56	1
2016	203	86	1
2017	330	156	1
2018	425	196	3
2019	638	301	7
2020	759	382	12

digitalization of education in the region, which is studied in this work.

3

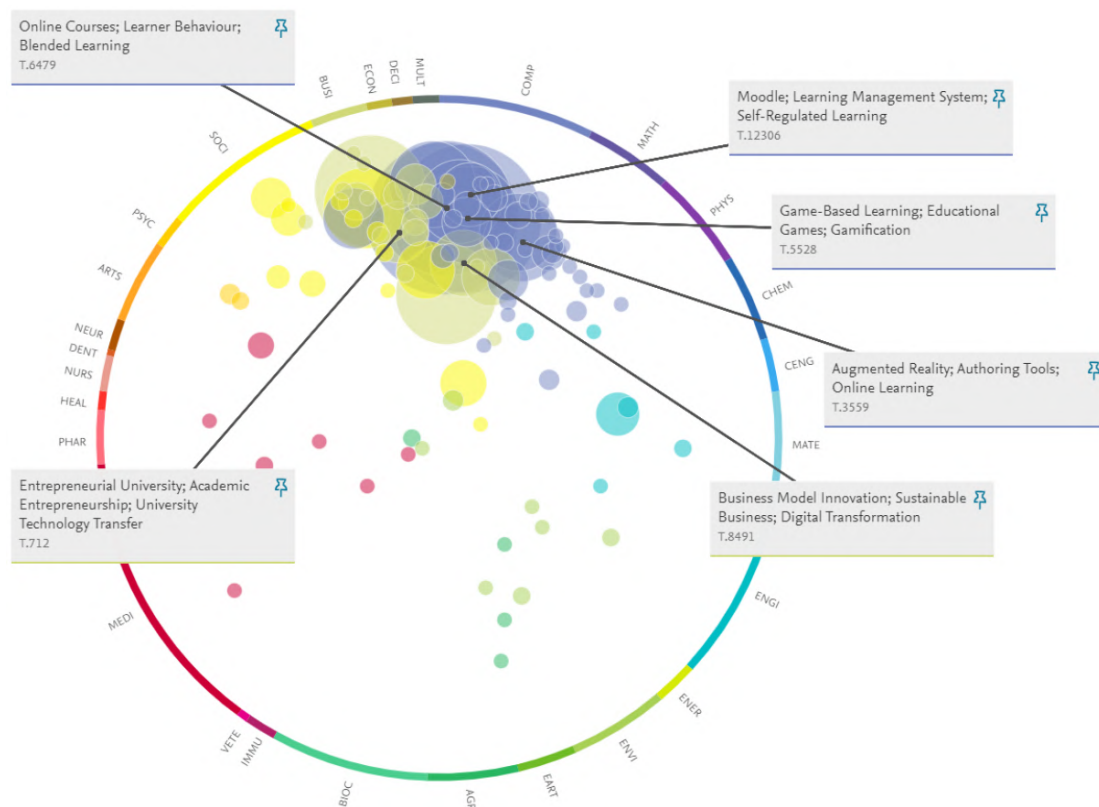


Figure 3: Top-1% of topics by prominence on digitalization of education.

students towards distance and online learning.

The digitalization of education in Eastern Europe was dealt with by Burwell and Fleck [3], Chitez, Rogobete and Foitoş [4], Orr, Weller and Farrow [17], Rogobete and Chitez [20]. These scientists have studied the strategies, models and phases of digitalization of education in Eastern Europe.

Despite the mentioned studies, the issue of comparing, grouping and highlighting the problems of digitalization of education in Eastern Europe has not been resolved. This led to the relevance of this research.

3. Cases of digitalization of education in Eastern Europe

The total quarantine and the abrupt conversion of educational institutions to distance learning in March 2020 revealed some of the problems with the digitization of education in the countries of Eastern Europe.

Since the beginning of the quarantine, higher education institutions in Ukraine were not fully prepared for online education, they used only certain elements of online education. And online teaching methods needed development and clear regulation. During the interviews

in May–June 2020, most HEIs noted that their institutions used certain elements of online education before the quarantine and relied heavily on the Moodle system. In addition, the development of online education had a specific date and was a response to the demands of time or circumstance. Thus, some online courses were introduced for students of the displaced HEI's (HEI's who were resettled from Donetsk and Luhansk region [22]).

Nevertheless, online training courses on digital platforms, online courses, were established in the first month. In addition, the session, certification and even passing the state exams in the summer of 2020 were held online.

It is worth noting that Ukrainian universities have positive experience with online accreditation.

Distance education, new requirements for the educational process have become a challenge for the educational system. The pandemic has affected the habitual lifestyles of students, their families and teachers, caused economic and social consequences, exacerbated a number of socio-economic problems, including:

- Equitable access to education (disparity in families' provision of distance education resources and unequal access to quality Internet);
- Provision of educational services for children with special educational needs (children with certain pathologies are not able to receive educational services at a distance);
- other socio-economic problems caused by the pandemic.

Technical assistance component – access to high-speed Internet almost mirrored the situation shown in figure 4. The survey was conducted in such a way that 41% of the respondents believed that all or almost all teachers have access to the Internet, while only 7.4% of the respondents confirmed a similar level of provision for students. The percentage of “majority (75%)” responses was also high and was 45.9% for participants in the educational process and 36.2% for teachers.

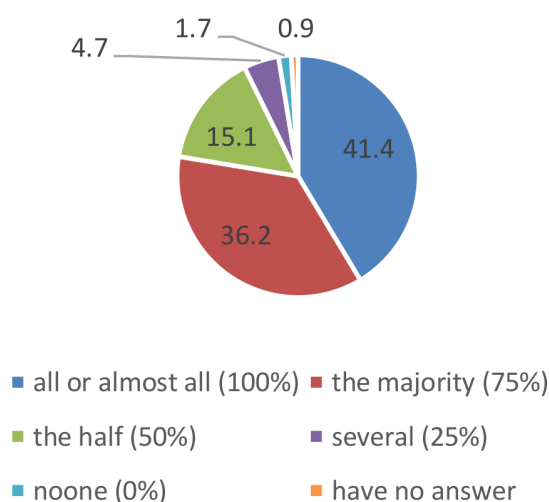


Figure 4: Survey of Ukrainian respondents “How many teachers at your institution have access to high-speed Internet”.

Thus, the survey showed problems in the technical equipment of participants in the educational process.

The Ministry of Education and Science of Ukraine in May 2021 prepared a draft Concept of Digital Transformation of Education and Science for the period until 2026 [7], which is a strategic document with a state vision for the development of these industries and solving the problems of their development.

Unlike Ukraine, in the Republic of Belarus the digital transformation of processes in the education system, which includes updating the content of training specialists for various areas of the real sector of the economy and the educational process of training teachers, is carried out in two main areas:

1. The digital transformation of the educational process to form a corresponding infrastructure in educational institutions and transform the management in the educational system. It must provide the following:

- the access of all participants in the educational process to digital technologies that improve the educational process;
- the use of distance learning technologies and popularization of the principle of lifelong learning;
- the improvement of the educational process through the harmonious implementation of achievements in the field of ICT;
- reference and information support for all participants in the educational process;
- unification and systematization of disparate information resources required in educational activities;
- the adaptation of the content of educational programs in view of the development of students' competences in the field of information technology;
- the use of electronic educational resources and the possibilities of modern didactic methods based on ICT in the educational process;
- improvement of the system of provided electronic educational services;
- digital documentation and analytics of the results of the educational process.

The Republic of Belarus is ready for the digital transformation of the educational process, as informatization is practically completed in it. The educational system currently includes more than 9 thousand students.

Educational institutions of various levels, educating more than 2 million students, including 51 higher education institutions. The educational process is provided by about 250 thousand teachers. The following data testify to the introduction of ICT in the education system. ICT is used in educational institutions of all types and kinds at all levels of primary, special and supplementary education. Almost all primary and secondary schools, lyceums, high schools, higher, secondary technical and vocational education institutions have computer classes or separate computers to support the educational process.

In 2018, 97.8% of educational institutions had access to the Internet, including 91% of institutions with broadband access. More than 90% of teachers (excluding computer science teachers) use or are willing to use ICT in their professional activities [23]. Higher education is also one of

the “digital leaders” – the sectors of the economy that use information and communication technologies most intensively. Thus, in 2016, among the organizations of the Republic that run higher education programs, 96.6% used e-mail and had local networks, and 98.3% had access to the Internet and their own website [11, p. 21].

All educational institutions use or have the ability to use Internet services and Internet services: e-mail, remote access to Internet resources, interaction with information systems and resources, etc. The renewal and (or) increase in the number of computer equipment in educational institutions continues. Most educational institutions operate automated management systems that collect and process information about students, teachers, parents, material and technical base, and the organization of the educational process. There are a number of nationwide systems that allow automated collection and processing of statistical information in the field of education.

A department-wide document management system and a Business Automation and Electronic Document Management System DELO have been implemented to ensure electronic document management. Electronic copies of textbooks are posted on the website National Educational Portal. Modern competitive services developed by both public and private companies have been introduced and used: Progress monitoring services, knowledge gap filling services, access control services, payment services and services with additional educational content in electronic form. Since 2012, most of these services have been used in educational institutions and educational authorities.

2. Digital transformation of processes accompanying education (introduction of distance education, new educational methods and practices, the number of specialties in IT, new educational standards “University 3+”) [23].

The development of distance education, which is an integral part of the digital transformation of higher education, as it provides an opportunity for lifelong learning for all citizens of the country with access to the Internet, as well as for foreign citizens interested in distance learning in the higher education institutions of the Republic [2].

Currently, there are distance learning programs in five higher education institutions. Belarusian State University of Informatics and Radioelectronics is considered a leader in the country in the development of distance education, but even there, in the 2017/18 academic year, distance education was available for only 22.2% of specializations (12 out of 54) [13].

Digitization of higher education in Poland is more developed than in other Eastern European countries. Kozminski University, Lodz University of Technology, Warsaw School of Economics and the Jagiellonian University are universities with different educational profiles combining exemplary use of digital tools in scientific, administrative and research activities. All four universities were the first in Poland to be awarded in the Most Innovative Universities Program and to receive the title of “Microsoft Cloud University” [19].

Despite the fact that Poland has more experience in distance education than Ukraine and Belarus, some important problems appeared in 2020 and 2021:

- insufficient supply of computers to participants of the educational process (97% of households have at least one computer, but many of them have difficulties because computers have to be shared by siblings, etc.) [6]
- reduced bandwidth of connection and limited amount of monthly data transfer;

- lack of digital skills among teachers (85% of teachers reported that they had very little experience in using the tools needed for distance education, and only 5% of them described their skills in this area as "very good". Only 8% of students believe that teachers are very well prepared for online learning, and 62% of them consider distance learning ineffective) [6].

Thus, the problems of digitization of education in Poland are similar to Ukrainian and Belarusian problems.

4. Problems of digitalization of education in Eastern Europe

The main problems of digitization of education in Eastern Europe:

- inadequate preparation of teachers for distance education (use of methods of cyber-pedagogy, work on online platforms, underdeveloped digital skills);
- management problems (insufficiently developed digital competences among representatives of the management of educational institutions);
- lack of technical equipment in educational institutions (virtual classrooms, electronic laboratories, etc.);
- lack of quality Internet connection among individual participants in the educational process in connection with their place of residence;
- insufficient provision of individual computers for all participants in the educational process;
- lack of methodological support for distance learning courses (workshops, lectures, etc.).

As the above analysis has shown, the countries of Eastern Europe have similar problems in providing digitalization of education. Let us analyze the ranks of the Network Readiness Index (NRI) and the Global Digital Readiness Index in terms of technological readiness of universities and students for distance education (table 1, table 2).

According to the NRI rating of the studied countries, Czech Republic and Poland have the highest position – 28 and 33. Also, in terms of technology development, Czech Republic takes 26th place. Ukraine and Belarus occupy similar positions on the NRI – 64 and 65. Belarus has advantages in terms of access to technology and content. Ukraine has an advantage in future technologies.

According to table 2, all Eastern European countries have the Accelerate stage of digital readiness. The highest Global Digital Readiness Index in Czech Republic – 15.78. The country is adapted to the digitalization of education. Next in terms of indicators are Poland and Slovakia. Belarus and Ukraine have a low-tech adoption rate, which characterizes demand for digital products / services. Thus, the index confirms the presence of the problem of the availability of devices and Internet use among the participants of the educational process.

Table 1

Network Readiness Index ranks in 2020 [8, p. 32, 33, 19].

Countries	NRI rank	NRI score	Technology (Pillar) Rank	Technology Sub-pillars			Income group
				Access	Content	Future Technology	
Belarus	65	49.16	68	58	41	134	Upper-middle-income
Ukraine	64	49.93	62	79	46	53	Lower-middle-income
Poland	33	61.80	36	32	34	60	High-income
Bulgaria	46	55.03	43	50	33	78	Upper-middle-income
Czech Republic	28	66.33	26	33	20	32	High-income
Hungary	39	60.05	31	21	32	44	High-income
Moldova	71	47.09	74	56	66	126	Lower-middle-income
Romania	49	51.14	46	18	48	82	High-income
Slovakia	35	60.78	34	38	37	37	High-income

5. Potential of digitalization of education in Eastern Europe

The above analysis allowed the authors to group the countries of Eastern Europe according to their potential for the digitalization of education. Authors have highlighted specific criteria (table 3).

Thus, authors proposed 3 groups of Eastern European countries according to their potential for digitalization of education with their indicator. Also, it is necessary to mention that this potential correlates with countries' income group.

In our opinion, in order to activate the digitalization of education, it is necessary to expand public-private partnerships with the participation of manufacturers and suppliers of advanced information and communication technologies that have prospects of application in the educational process in higher education institutions of countries.

In the future, the digitalization of education will ensure the development of digital competences for all participants in the educational process, the formation of ecological and digital awareness among students [21], the adaptation of educational programs to changing socio-

Table 2

Global Digital Readiness Index scores in 2019 [5].

Countries	Score	Stage	Tech adoption (3)	Tech infrastructure (4)
Belarus	12.95	Accelerate	1.21	1.68
Ukraine	11.47	Accelerate	1.09	1.02
Poland	14.94	Accelerate	1.31	2.03
Bulgaria	13.72	Accelerate	1.12	1.84
Czech Republic	15.78	Accelerate	1.30	2.12
Hungary	14.13	Accelerate	1.23	1.89
Moldova	11.65	Accelerate	1.10	1.37
Romania	13.34	Accelerate	1.10	1.71
Slovakia	14.44	Accelerate	1.36	1.78

Table 3

Grouping Eastern European countries according to their potential of digitalization of education.

Group	Countries	Indicators	Income group
High potential for digitalization of education	Czech Republic, Poland, Slovakia, Hungary	NRI rank ≤ 40 , Global Digital Readiness Index scores ≥ 14	High-income
Middle potential for digitalization of education	Romania, Bulgaria	$41 \leq \text{NRI rank} \leq 60$, $13 \leq \text{Global Digital Readiness Index scores} < 14$	High-income, Upper-middle-income
Lower-middle potential for digitalization of education	Ukraine, Belarus, Moldova	NRI rank > 60 , $11 \leq \text{Global Digital Readiness Index scores} < 13$	Lower-middle-income, Upper-middle-income

economic conditions and the scientific and technological revolution, and the development of an innovative economy.

To summarize the results of the study, a SWOT analysis of the digitalization of education for the countries of Eastern Europe was carried out (table 4). SWOT analysis is a model for forming an information base and developing on its basis the most effective option for managing socio-economic processes (including the digitalization of education). It is assumed that SWOT analysis is used to assess the situation under conditions of uncertainty and to regulate individual parameters. In this case, the regulation of parameters is understood as the correction of the values of control parameters for the implementation of the optimal development scenario at a certain segment of the planning period.

5.1. E-learning environment: Ukrainian University's case

As an example, let us present the case of Sumy State University (Ukraine) on the creation of an e-learning platform based on its own unique developments. The e-learning environment is shown in figure 5.

Table 4

SWOT analysis of the digitalization of education for the countries of Eastern Europe

Strengths	Weakness
– highly qualified teachers; – state support; – relevant regulatory framework	– low digital competencies among participants in the educational process (85% of teachers reported that they had very little experience in using the tools needed for distance education); – lack of methodological support for distance courses
Opportunities	Threats
– development of the digital economy; – development of distance education; – the future of technology; – creation of the Eastern European University with Artificial Intelligence	– different level of provision of families with means for distance learning and unequal access to high-quality Internet; – lack of technical equipment of educational institutions (NRI score: 47-69)

The e-learning ecosystem includes various tools for the implementation of distance, e-learning and blended learning, platforms for creating educational materials, a platform for massive open online courses, a repository of educational materials. The developer of educational materials works autonomously, without involving technical services in the software implementation of the project in the process of creating a package of tasks. In the process of creation, only the developer communicates with consultants of various levels. After agreeing on the content, the materials are reviewed and posted in open or closed (directly for course students within the university) access; programmers implement only non-trivial tasks within the framework of educational courses (interactive elements, virtual and augmented reality, etc.) (figure 6).

As part of the implementation of various models of electronic learning, they are constantly being improved on the basis of feedback from developers of educational materials, reviewers, programmers, and listeners. As an example, the questionnaire of a survey of developers of educational materials of the Mix platform (blended learning) in 2021 is given.

The advantages of the Mix platform:

- all teachers and students are in a single learning space;
- the ability to control the educational process in real time;
- the platform is synchronized with the unified information system of the university;
- systematic support from the university;
- the opportunity for teachers to work collectively both in the creation of materials and in virtual classrooms;

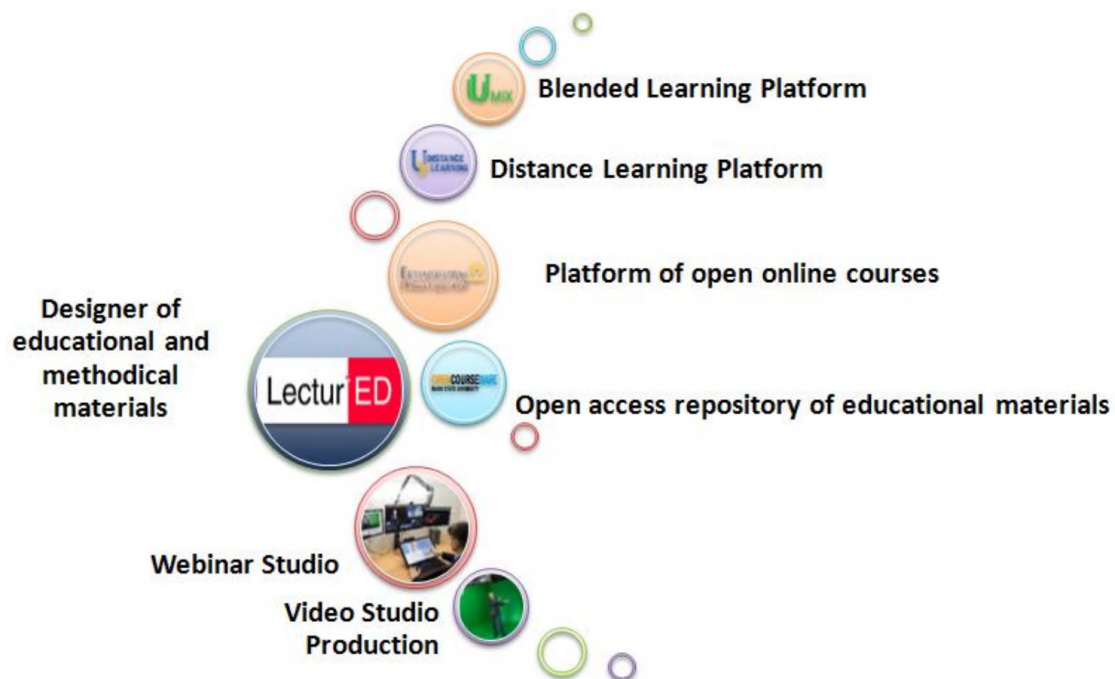


Figure 5: E-learning environment: Sumy State University case (Ukraine) [24].

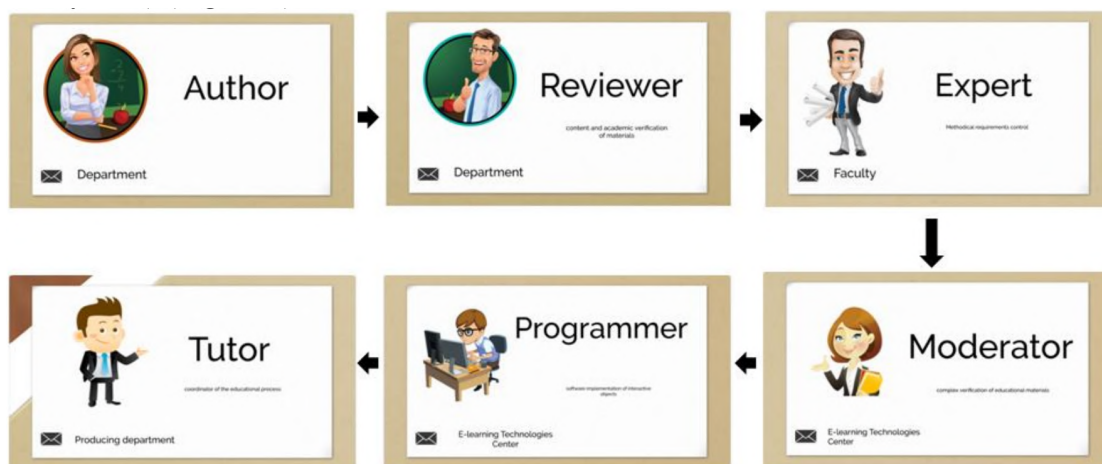


Figure 6: Algorithm for creating educational materials [24].

- unified tools simplifies the use of the platform for all users;
- automatic connection, control, archiving;
- the ability to manage user registration, define roles, manage content;
- creation of virtual classes, adjustment of the necessary parameters.

Disadvantages of the Mix platform:

- instability of work;
- inconvenient interface for working with mobile devices;
- insufficient functionality to provide the necessary activities;
- difficulty in settings;
- inconvenient interface for working with a personal computer;
- insufficient level of technical support for users;
- excessive openness and transparency for control by the university.

Measures to improve the Mix platform:

- integration with services for webinars (Meet, Zoom, Microsoft Teams, etc.);
- integration with plagiarism testing services;
- mobile version with chat;
- integration with additional services of ACS “University”.

6. Conclusions

Thus, Eastern Europe countries can be divided into three groups according to their potential for digitizing education.

The pandemic COVID-19 has led to the active digitization of countries around the world, including the countries of Eastern Europe. Despite certain problems and unpreparedness for sharp digital transformation of education in these countries, in the first year of the pandemic it was possible to establish distance education with lectures, seminars, workshops, tests, exams and diplomas.

The implementation of the goals of the digital transformation of education, overcoming the existing problems will make it possible to carry out the digital transformation of teacher education on the basis of new e-learning models and move from a closed university system to an open, distributed and maximally flexible system, depending on the willingness to adapt to the changing needs of society.

In order to accelerate the digital transformation of processes in the educational system, it is advisable to create experimental educational institutions with the most complete set of ICT services possible, in order to evaluate their effectiveness in detail and subsequently implement them in all educational institutions.

The prospect of further digitalization of the educational system of these countries is the creation of an Eastern European University with artificial intelligence based on a partnership between the state and business.

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