Experience of use of electronic educational resources by Ukrainian teachers during the distance learning due to the COVID-19 pandemic (March-May 2020)

Maryna Zhenchenko[1], Oksana Melnyk [2], Yaroslava Prykhoda[3] and Igor Zhenchenko[4]

[1] *Taras Shevchenko National University of Kyiv, 60 Volodymyrska Street, Kyiv, 01601, Ukraine*
[2] *Institute of Educational Content Modernization, 36 Metropolitan Vasyl Lypkivskii Street, Kyiv, 03035, Ukraine*
[3] *Taras Shevchenko National University of Kyiv, 60 Volodymyrska Street, Kyiv, 01601, Ukraine*
[4] *Borys Grinchenko Kyiv University, 18/2 Bulvarno-Kudriavska Street, Kyiv, 04053, Ukraine*

Abstract

The introduction of distance learning in Ukrainian schools during quarantine due to the COVID-19 pandemic has updated the study of use of different types of electronic educational resources by teachers to ensure qualitative distance learning. The online survey of 576 teachers in March–May 2020 determined that the introduction of quarantine due to the COVID-19 pandemic was a catalyst and motivated 12% of the surveyed teachers to start using electronic educational resources to provide the distance learning for students during the lockdown. The analysis of electronic educational resources recommended by the Ministry of Education and Science of Ukraine for use in all schools of Ukraine made it possible to identify areas of educational activity that are insufficiently provided with electronic textbooks and electronic training manuals that have passed the state examination. The results showed that in 2016–2019, electronic textbooks were developed only in some subjects of the 1st, 2nd grades of primary school and 5th, 6th grades of middle school. None of the 5 electronic textbooks developed for high school has passed the examination of the commissions. The electronic manuals that have passed the examination of the commissions also cover only certain subjects, mainly for primary and middle schools. The lack of certified educational and demonstration, control electronic educational resources, which teachers actively used during distance learning, is compensated by teachers with the help of electronic educational resources, developed by other teachers and posted on the YouTube channel or platform Na urok and also self-developed electronic educational resources: presentations, video lessons, tests and interactive exercises.
The effective ways to overcome the problem of providing teachers with qualitative electronic educational resources can be: 1) resumption of the program of development at the expense of the state of high-quality electronic textbooks for different classes and subjects in accordance with the gaps identified in the study in providing students with educational electronic educational resources, which have passed the state examination;
2) creation of a state register of self-developed by teachers open electronic educational resources and the development of criteria for assessing their quality;
3) development of a national platform of electronic educational resources, which would place e-textbooks and manuals that have passed the state examination, and independently developed by teachers demonstration, game, control or other types of electronic educational resources, which meet the quality criteria for content and technical implementation.

Keywords
distance learning due to the COVID-19 pandemic, electronic educational resources, electronic textbook, electronic manual, informatization of education.

Introduction

The introduction of electronic educational resources (EERs) in the educational process allows to implement models of distance and blended learning, lifelong learning, enrich forms and methods of learning, expand its content, automate the management of educational institutions, develop subject, scientific, information and digital competencies of participants of educational process, to modernize the education sector in the context of the development of the digital economy of Ukraine.

The current Regulations on electronic educational resources determines EERs as "learning tools on digital media of any type or placed in information and telecommunications systems that reproduce using electronic technical means and used in the educational process" and emphasizes that EERs "are created to ensure the modernization of the educational process, providing equal access to participants in the educational process, regardless of place of residence and form of education" [1].

EER can exist as an "indivisible educational object" [2, p. 9], but mainly it is a set of educational objects. In the works of foreign scholars, "there is a growing recognition that educational resources are not discrete "learning objects", but amalgams from several resources, each with its own characteristics, interconnected by complex relationships" [3, p. 14].

According to the Ukrainian legislation, some types of EERs must be examined and considered by the relevant commissions (subject and technical) to get a conclusion "Approved for use in the educational process" or "Recommended by the Ministry of education and science of Ukraine", which gives the right to use them outside of one educational institution. Subject commissions consider the content of EERs, the technical one examines the compliance of EERs with design and ergonomic, technical requirements and the quality of their functioning.

Ukrainian scientists have studied various aspects of development, evaluation and implementation of EERs in school education of Ukraine, in particular: effectiveness of education with electronic educational game resources in primary school (V. Bykov, S. Lytvynova, O. Melnyk); evaluation criteria of EERs (S. Lytvynova), experience of using EERs in secondary school within the framework of general education digitalization in Ukraine (I. Vorotnykova); practices of information and communication technologies application and use of EERs in primary school (O. Melnyk); statistics, functionality and quality problems of electronic textbooks developed for the state order in 2018–2019 (A. Antokhova, L. Iliychuk, M. Zhenchenko, O. Melnyk, V. Miroshnychenko, I. Zhenchenko); structural and organizational procedural characteristics of EERs design (O. Balalaieva), etc. All these studies concerned the use of EERs as an element of blended learning.

The transition to distance learning during quarantine through the pandemic COVID-19 actualizes the study of practices of the use of different types of EERs by Ukrainian teachers to ensure quality distance learning.

Foreign researchers have actively studied the opinion of teachers, students, parents on the organization and quality of distance learning during the COVID-19 pandemic in schools around the world: Canada [4], Chinese [5], Indonesia [6], Italia [7] et all. Among the "results of e-learning implementation barriers" the problems of providing students with EERs were also indirectly mentioned. Thus, "Descriptive results of e-learning implementation barriers" in Indonesia among "School Level Barrier" defines "Textbooks are not in line with e-learning use" and "Because of workload, I do not have enough time to prepare e-learning materials." [6, p. 5].

The scientists of the Institute of Information Technologies and Learning Tools of the National Academy of Pedagogical Sciences of Ukraine conducted an online survey on March 27 – April 4, 2020 on the needs of teachers to improve their professional skills in the use of digital tools and ICT in the quarantine due to the COVID-19 pandemic. The survey was all-Ukrainian, anonymous, with 430 teachers. The results of this survey are published in the article of I. Ivaniuk and O. Ovcharuk "The response of Ukrainian teachers to Covid-19: challenges and needs in the use of digital tools for distance learning" [8]. This study focused on electronic platforms and means of communication.

Therefore, the objectives of our study were fourfold:

1. Analyze of the use of EERs by Ukrainian teachers and the impact of the introduction of distance learning through the COVID-19 pandemic on this process (March–May 2020).

2. Identify the types of functional EERs that are most often used by teachers during distance learning due to the COVID-19 pandemic.

3.   Investigate the level of providing teachers with EERs that have passed the state examination and were approved (or recommended) for use in the educational process in all schools of Ukraine.

4.   Identify which types of EERs teachers have developed independently to ensure qualitative distance learning during the pandemic through COVID-19.

The study is limited to March-May 2020, as in Ukraine the national lockdown was announced in general secondary education institutions only twice: from March 12 to May 22, 2020 and from January 8 to January 24, 2021. The article was prepared in January 2021, so teachers' survey on use of EERs during the second nationwide lockdown is a part of our plans for further research.

Research methodology

The study was realized in several stages. In the *first stage* of the research the literature on the topic was analyzed, the range of scientific works, which covered the results of all-Ukrainian or local surveys of teachers on the introduction of ICT in the education system and indirectly addressed the problem of Ukrainian teachers using different types of EERs, was determined. Based on the analysis, a range of topical research questions was identified and the questionnaire to interview teachers was developed.

In the *second stage*, a survey of Ukrainian teachers was conducted to find out their opinion on the specifics of the use of EERs to organize effective distance learning during the quarantine due to the COVID-19 pandemic (March–May 2020). The study involved 576 teachers (393 middle and high school teachers and 183 primary school teachers) from 22 regions of Ukraine and Kyiv, with 73% of surveyed teachers living in cities, 17.7% in villages, and 9.3% in towns. The method of "convenience sampling" was used to form the sample; the initial group of respondents was selected randomly by posting the questionnaire on the thematic pages of teachers in the social network Facebook, in groups of teachers in Viber, etc.

The *third stage* involved the collection of data on EERs, which passed the state examination, developed for Ukrainian schoolchildren. The main sources of data were the minutes of the Commission on informatization of educational institutions for 2016–2019, prepared by the staff of the Digital Education and ICT Department of the Institute of Educational Content Modernization (IECM) and materials of the Electronic register on the provision of stamps and certificates of the Ministry of Education and Science of Ukraine (MESU), posted on the official website of IECM. The 2016–2019 years have been chosen for analysis, as the authorization is granted for five years, which is why the analyzed EERs are currently used in the educational process during the quarantine in March–May 2020. This made it possible to get an answer to the question identified in the analysis of the results of the survey why Ukrainian teachers use EERs which have passed the state examination not very often.

In the *fourth stage* the collected empirical data were generalized and systematized with the help of general scientific methods of analysis, synthesis, generalization, comparison. Mathematical methods were used to process empirical data. Graphic methods were used to build diagrams, charts and tables. The descriptive method was useful at the stage of describing the research results. The comparative method made it possible to see the results in the context of research conducted by other scientists.

Results

Impact of the quarantine due to the COVID-19 pandemic (March–May 2020) on use of EERs by Ukrainian teachers

The results of our online survey of Ukrainian teachers conducted in March–May 2020 showed that the number of teachers who use EERs in the educational process is gradually increasing: 38% of surveyed teachers have systematically used EERs in the last 5 years, 18.2% – in the last 2–3 years and 2.7% – in the last year. Slightly more than a quarter of respondents (28.6%) used EERs occasionally as needed, and only 0.5% said they did not use EERs because they did not have the appropriate skills to work with them (Figure 1).

The introduction of the quarantine during the COVID-19 pandemic has been a catalyst and

motivated teachers to use EERs more actively. Thus, 12% of teachers surveyed did not use EERs in working with students at all before the quarantine and only after the introduction of the quarantine during the COVID-19 pandemic they began to use EERs for distance learning (Figure 1).
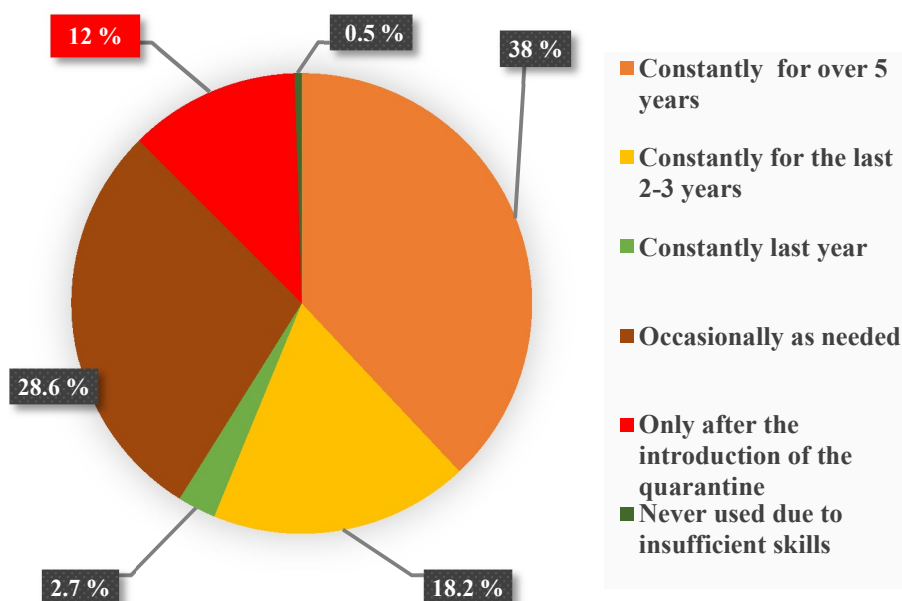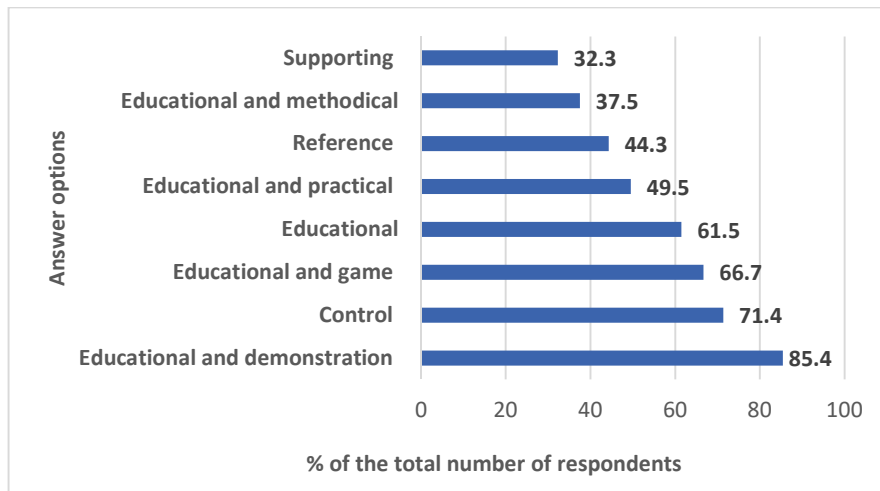

Figure 1: Use of EERs by the Ukrainian teachers before and during the quarantine due to the COVID-19 pandemic.

Types of EERs by functional purpose used by the teachers during the distance learning

According to the functions in the educational process EERs for educational purpose can be divided into:

1.   Educational (electronic copy of a printed textbook, electronic textbook (e-textbook), electronic training manual (e-manual).

2.   Educational and methodical (electronic educational and methodical manual, electronic methodical recommendations, etc.).

3.   Educational and practical (electronic workshop, electronic simulator, collection of virtual laboratory works, electronic workbook).

4.   Educational and game (electronic educational games, electronic educational game resources);

5.   Educational and demonstration (electronic visual aids, audio-visual works, electronic didactic demonstration materials, etc.).

6.   Control (electronic tests, electronic banks of control questions).

7.   Reference (electronic directory, electronic dictionary, electronic encyclopedia);

8.   Supporting (electronic chrestomathy, electronic collection of normative documents, electronic bibliographic indexes of scientific and educational literature, electronic scientific publications, electronic diary, electronic register, etc.) [9, p. 132–133].

The most popular among teachers are educational and demonstration EERs (electronic visual aids, presentations, video lessons, etc.). They were chosen by 85.4% of surveyed teachers in response to the question "*What types of EERs (by functional purpose) do you use in your professional activities during distance learning due to the COVID-19 pandemic most often?*" In second place there are control EERs (71.4%), followed by educational and game (66.7%), educational (61.5%), educational and practical (49.5%), reference (44.3%), educational and methodical (37.5%), supporting (32.3%) (Figure 2). The total number of answers exceeds 100%, as teachers could choose several answers at once.

Figure 2: Answers to the question "What types of EERs (by functional purpose) do you use in your professional activities during the distance learning due to the COVID-19 pandemic most often?"

Ukrainian teachers' use of qualitative EERs that have passed the state examination

To the question, "*Which EERs do you use the most often in your professional work during the distance learning due to the COVID-19 pandemic?*" only 29.3% of the surveyed teachers chose the answer "more often those which have passed the state examination of MESU", 46.9% of teachers use EERs developed by other teachers and posted on the Internet, 20.8% – EERs developed on their own. However, 3% of respondents stated that they use different EERs: EERs approved by MESU, developed on their own, created by colleagues and presented for free access (Figure 3).
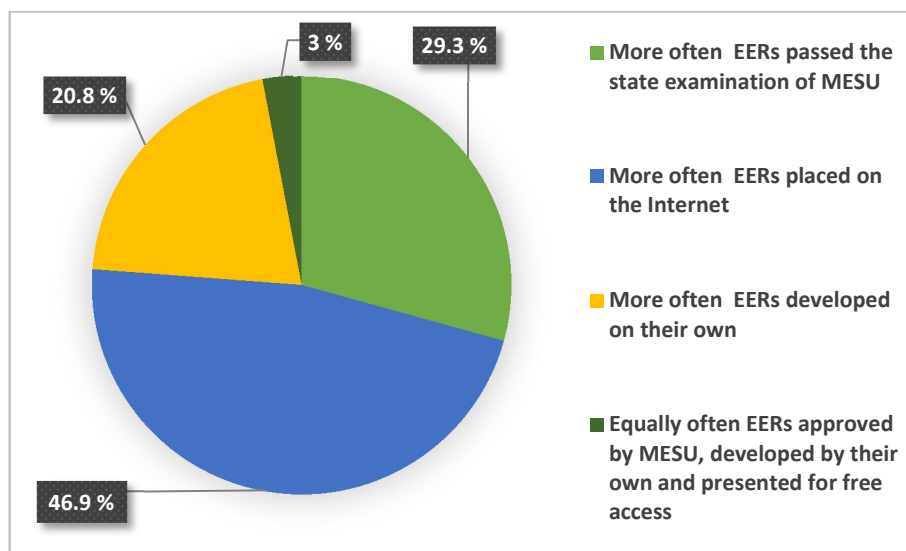
Figure 3: Answers to the question "Which EERs do you use in your professional work during the distance learning due to the COVID-19 pandemic most often?"

The obtained data showed the low level of use of EERs, which passed the state examination, and caused necessity of the study of the level of teachers' provision with qualitative EERs that were approved (or recommended) for use in the educational process in all schools of Ukraine.

In order to determine the number and types of EERs that have passed the state examination, the materials of the Electronic register of educational literature and equipment approved or recommended by MESU posted on the official website of IECM and the minutes of the Commission on informatization

of educational institutions for 2016–2019, prepared by the staff of the Digital Education and ICT Department of IECM were analyzed. The analysis showed that in 2016–2019 the developers submitted for examination only 137 EERs for educational purposes, among which were approved or recommended for use in the educational process a little less than a half – 64 EERs (47%). As shown in Table 1, mainly educational EERs (e-textbooks and e-manuals) were submitted for the state examination.

Table 1
Number of EERs approved or recommended of MESU for use in the educational process

Types of EERs	Years				
	2016	2017	2018	2019	Totally
Educational	5	10	7	22	44
Educational and methodical	1	6	1	1	9
Educational and practical	-	-	-	1	1
Educational and game	-	1	1	-	2
Educational and demonstration	1	1	2	1	5
Control	-	-	-	-	-
Reference	-	-	-	-	-
Supporting	1	1	1	-	3
Totally	8	19	12	25	64

To identify the gaps in providing Ukrainian students with recommended and approved EERs, 23 e-textbooks and 21 e-manuals recommended and approved by MESU in 2016–2019 were analyzed. It was analyzed for which forms and in which subjects they were developed.

Among the 23 e-textbooks that received "Recommended for use in the educational process", 74% are e-textbooks for primary school (the 1st and 2nd grades) and only 26% – for middle school (the 5th and 6th grades), in particular:

- 12 e-textbooks for the 1st grade students: 5 e-textbooks "I explore the world", 3 e-textbooks "Art", 3 e-textbooks "Mathematics" for 1st grade, 1 e-textbooks "Ukrainian. Primer";
- 5 e-textbooks for the 2nd grade: 2 e-textbooks "I explore the world", 3 e-textbooks "Art";
- 2 e-textbooks for the 5th grade: 1 e-textbooks "Introduction to History", 1 e-textbooks "Labor";
- 4 e-textbooks for the 6th grade: 3 e-textbooks "Geography", 1 e-textbooks "World history. History of Ukraine" [10, p. 732, Fig 5].

None of the 5 e-textbooks developed for high school has passed the examination of the commissions [10, p. 732].

It should be noted that 23 e-textbooks that passed the state examination in 2019 are currently not available to teachers, as they have not been purchased from publishers at public expense.

The e-manuals passed the examination of the commissions also cover only certain subjects, mainly primary and middle schools, in particular, they have been developed for the 1st grade in music and mathematics, for the 2nd grade – in the course "I and Ukraine", for the 5th grade – in "Computer science", for the 6th grade – in "Ukrainian" and "History of the ancient world", for the 8th grade – in "Ukrainian literature" (Figure 4).
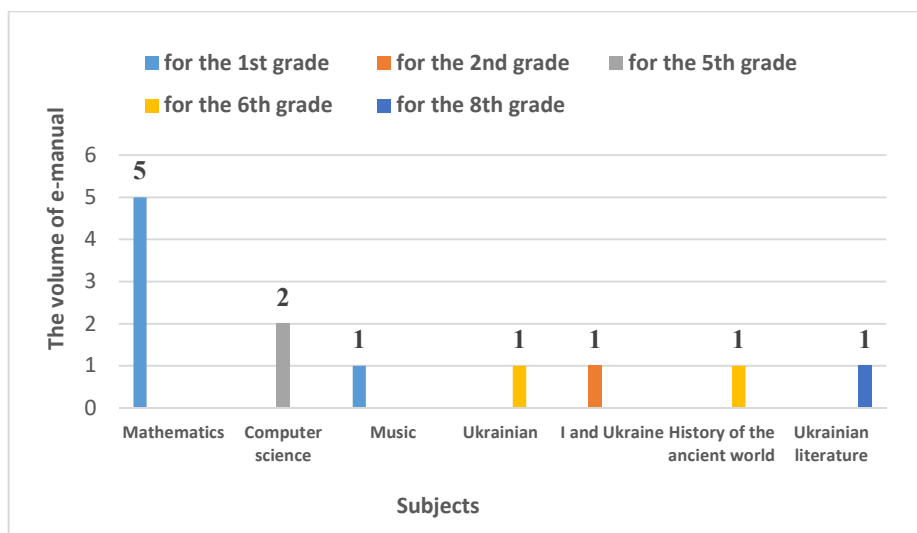
Figure 4: Number of e-manuals approved for use in all schools (based on the analysis of the Electronic register on the provision of stamps and certificates of MESU and the minutes of the Commission on informatization of educational institutions, 2016-2019)

Some e-manuals are designed for use within some years of study, for example: "Natural science" for grades 1–2, "English" for grades 1–6, "Computer science" for grades 8–9, "Computer science" for grades 9–10, "Computer science" for grades 10–11 (Figure 5).
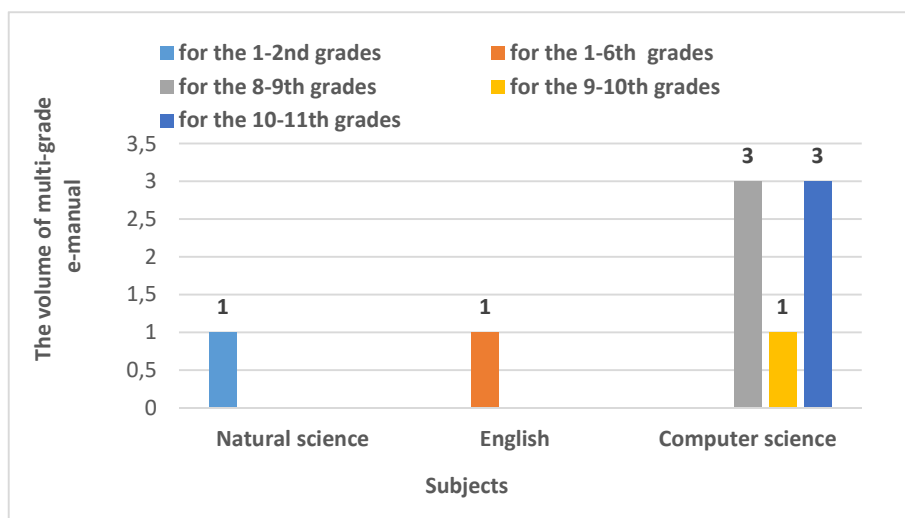
Figure 5: Number of electronic multi-grade e-manuals, which were approved for use in all schools (based on the analysis of the Electronic register on the provision of stamps and certificates of MESU and the minutes of the Commission on informatization of educational institutions, 2016-2019)

To solve the problem of providing teachers with e-textbooks and e-manuals, it is necessary to resume the program of developing at the expense of the state qualitative e-textbooks for different grades and subjects in accordance with the gaps identified in the study.

The first step in this direction and response to the problems that arose during the first national lockdown was the development and launch of the educational electronic platform All-Ukrainian School Online by MESU in December 2020. There are the video lessons, tests, materials for independent work in 18 basic school subjects for the 5–11th forms students on the platform. All educational content corresponds to the current state educational programs, and its quality is checked by the Ukrainian institute of quality of education. The list and topics of courses are proposed by the Ministry of Education

and Science of Ukraine", stated in the description of the platform [11]. However, the quality and ease of use of EERs by teachers and students hosted on the All-Ukrainian School Online platform requires a separate all-Ukrainian study.

Use of EERs independently developed by teachers

The lack of recommended and approved educational and demonstration, control EERs (Table 1), which are especially popular among teachers (Figure 2), they compensate with EERs developed on their own. Thus, to the question, "*Do you develop your own EERs? If yes, which ones (you can choose several options)*" 86.5% of the interviewed teachers stated that they developed presentations, 77.6% – electronic tests, 61.5% – interactive exercises, 38.5% – video lessons and 28.6% – electronic crosswords, puzzles (Figure 6).
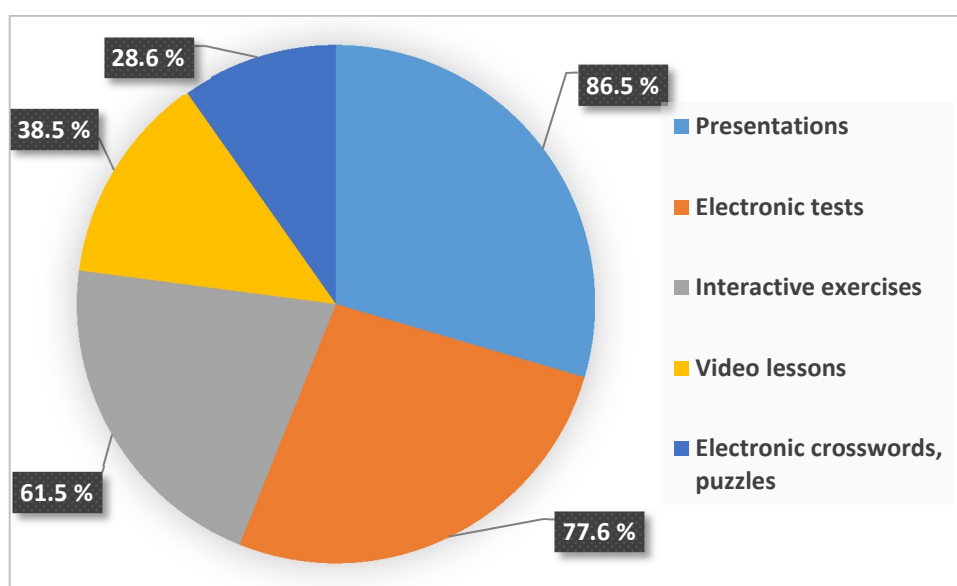
Figure 6: Answers to the question "Do you develop your own EERs? If yes, which ones (you can choose several options)"

The situation that there are no control EERs, which have passed the state examination, can be explained by the fact that data banks of control questions, electronic tests are mostly developed by teachers themselves using various platforms (Classtime, ClassMarker, Easy Test Maker, Google Forms, Kahoot, Moodle, Na urok, etc.). They are used locally within a certain educational institution that does not require experts' evaluation and obtaining the approval of MESU.

The teachers also actively use EERs developed by other teachers, published on YouTube or on specialized platforms created to share experiences between teachers (Vseosvita, Na urok). Thus, to the question "*Which EERs (developed by other teachers or placed on the Internet) do you use in your professional work during the distance learning due to the COVID-19? (you can choose several options)*" 76% of them said that used video lessons on the YouTube channel, 71.9% – EERs, posted on the educational platform *Na urok*, 3.5 % – EERs, posted on the educational platform *Vseosvita*.

The number and need for control EERs posted on the platform Na urok has increased significantly during the distance learning due to the COVID-19 pandemic. For example, the developers of the project Na urok in early June 2020 announced that during the quarantine in March–May, teachers asked students to perform 2,169,391 online tests created using the platform. At the beginning of April 2021, this number has increased to 4,260,575 tests [12].

It should be noted that, unlike multimedia interactive e-textbooks and e-manuals submitted for the state examination, EERs developed by teachers are mostly separate electronic objects (text files, presentations, video lessons, and exercises). The quality of such EERs is not checked by anyone, it is determined by the number of views and downloads by teachers, likes by users, and so on.

To overcome these problems it needs to *create a state register of qualitative of self-developed EERs, which would be systematized, available to teachers open EERs*. This will allow teachers to access all EERs from a single resource, and experts to develop criteria for assessing the quality of self-developed EERs. The criteria for assessing the quality of EERs can be based on the criteria developed within the EDCITE (Evaluating Digital Content for Instructional and Teaching Excellence) project and published in the article Kui Xie, Gennaro Di Tosto, Sheng-Bo Chen, Vanessa W. Vongkulluksn "A systematic review of design and technology components of educational digital resources" [13]. It should be taken into account the requirements for e-learning resources proposed in the "Handbook on Facilitating Flexible Learning During Educational Disruption: The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak" [5, p. 9, 21-22].

The first steps in this direction were taken in 2016, when in accordance with the Order of MESU of 12.01.2016 № 9 "On systematization of experience in the use of electronic educational resources" [14] a catalog of authors' educational resources of Zaporizhia region was developed [15], information on the use of own open electronic educational resources to provide distance learning in Kyiv schools was collected [16], however, the information received from different cities and regions has not been systematized and published as a single register of EERs.

Discussion

The article by Kalinina et al. [17] provides information on EERs, approved by the Commission on Informatization of Educational Institutions for use in the educational process in 2013–2017. However, this paper lists the approved EERs without their analysis, which does not allow identifying the features of providing Ukrainian teachers with certified EERs as elements of the system of distance school education.

Our results, compared to the results of the first all-Ukrainian study on the implementation of ICT and the use of EERs in education, conducted in 2014–2015 by the Institute of Innovative Technologies and Educational Content of MESU, and partially published in the article by O. Melnyk [18], demonstrate an increase in the number of teachers who use EERs and the trend of using EERs, which have not passed the state examination and were not approved by MESU over the last 5 years. Thus, in 2014–2015, as noted by O. Melnyk, "only 12% of primary school teachers used EERs systematically, more than half of respondents (65%) did so sporadically, almost 13% did not use EERs due to lack of experience, technical opportunities or desires, 8% said that the school was not provided them with such resources, 3% did not use EERs because they did not see their need. The study showed that 45% of the surveyed teachers used resources approved by MESU and almost 41% of respondents used resources taken from the Internet" [18, p. 98]. Such a comparison is quite conventional due to the difference in the quantity and quality of the respondents, as only primary school teachers (931 from rural areas and 358 from urban ones) took part in the 2014–2015 survey. To obtain more representative results, it is necessary to conduct similar surveys systematically and at the national level. This approach will allow us to see in the dynamics the problem of the use of EERs by Ukrainian teachers and respond quickly to the needs of teachers in EERs to provide quality blended and distance learning.

Conclusion

The results of our online survey of Ukrainian teachers conducted in March–May 2020 showed that almost 60% of teachers systematically used different types of EERs in their teaching activities in offline and blended learning. The introduction of quarantine during the COVID-19 pandemic became a kind of catalyst and motivated 12.5% of surveyed teachers to start using EERs for the first time to provide distance learning for students during the lockdown in March–May 2020.

To provide distance learning, teachers used mainly educational and demonstration EERs, control, educational and game, and educational EERs. Only 29.3% of the surveyed teachers used EERs, which have passed the state examination of MESU, 46.9% of the teachers used EERs developed by other teachers and posted on the Internet, 20.8% – EERs developed on their own. This situation is explained by the low level of provision of teachers by EERs that have passed the state examination. The analysis of electronic educational resources recommended by MESU for use in all schools of Ukraine showed

that only 23 e-textbooks and 21 e-manuals were recommended or approved by MESU in 2016–2019. The e-textbooks were developed only in some subjects of the 1st, 2nd grades of primary school and 5th, 6th grades of middle school. Multi-grade e-textbooks in Computer science have been developed for high school. The e-manuals that have passed the examination of the commissions also cover only certain subjects, mainly for primary and middle schools.

The lack of certified educational and demonstration, control EERs, which teachers actively used during distance learning, is compensated by teachers with EERs, developed by other teachers and posted on the YouTube channel or on the platform Na urok and also self-developed EERs: presentations, video lessons, tests and interactive exercises.

In our opinion, the effective ways to solve the problems identified during the study of providing teachers with qualitative EERs are:

1. Development at the expense of the state of high-quality e-textbooks for various classes and subjects in accordance with the gaps identified in the study in providing students with educational EERs, which have passed the state examination.

2. Creation of a state register of open EERs self-developed by teachers and the development of criteria for their quality.

3. Development of a national platform of e-learning resources, which would include e-textbooks and e-manuals that have passed the state examination, and independently developed by teachers demonstration, game, control and other types of EERs, which meet the quality criteria for content and technical implementation.

References

[1] Ministry of Education and Science of Ukraine, On approval of the provision on electronic textbook, 2012. URL: https://zakon.rada.gov.ua/laws/main/z1695-12.

[2] DSTU IEEE Std 1484.12.1:2006, Information technologies. Metadata for learning objects (IEEE Std 1484.12.1:2002, IDT), Derzhspozhyvstandart Ukrainy, Kyiv, 2008.

[3] P. Barker, L. M. Campbell, Metadata for learning materials: an overview of existing standards and current developments. Technology, Instruction, Cognition and Learning 7 (3–4) (2010) 225–243. https://www.researchgate.net/publication/ 228802531_Metadata_for_learning_materials_An_overview_of_existing_standards_and_cu rrent_developments.

[4] J. Aurini, S. Davies, COVID-19 school closures and educational achievement gaps in Canada: Lessons from Ontario summer learning research. Canadian Review of Sociology/Revue canadienne de sociologie 58 (2021) 165–185. doi.org/10.1111/cars.12334.

[5] R. H. Huang, D. J. Liu, A.Tlili, J. F. Yang, , H.H. Wang, Handbook on Facilitating Flexible Learning During Educational Disruption: The Chinese Experience in Maintaining Undisrupted Learning in COVID-19 Outbreak, Smart Learning Institute of Beijing Normal University, Beijing, 2020.

[6] F. Scarpellini, G. Segre, M. Cartabia, M. Zanetti, R. Campi, A. Clavenna, M. Bonati, Distance learning in Italian primary and middle school children during the COVID-19 pandemic: a national survey. BMC Public Health 1035 (2021). doi.org/10.1186/s12889-021-11026-x.

[7] A. Almanthari, S. Maulina, S. Bruce, Secondary school mathematics teachers' views on e-learning implementation barriers during the COVID-19 pandemic: The case of Indonesia. Eurasia Journal of Mathematics, Science and Technology Education 16(7) em1860 (2020). doi. org/10.29333/ ejmste/8240.

[8] I. Ivaniuk, O. Ovcharuk, The response of Ukrainian teachers to Covid-19: challenges and needs in the use of digital tools for distance learning. Information Technologies and Learning Tools 77 (3) (2020) 282–291. doi: 10.33407/itlt.v77i3.3952.

[9] M. Zhenchenko, O. Melnyk, Y. Prykhoda, I. Zhenchenko, Publishing and Pedagogical Approach to the Problem of Electronic Educational Resources Typologization. Printing and Publishing 1 (79) (2020) 121–141. doi:10.32403/0554-4866-2020-1-79-121-141.

[10] M. Zhenchenko, O. Melnyk, V. Miroshnychenko, I. Zhenchenko, Electronic Textbooks for Ukrainian Education: Statistics, Models of Development, Quality Problems. CEUR Workshop proceedings 2732 (2020) 721–733. http://ceur-ws.org/Vol-2732/20200721.pdf.

[11] All-Ukrainian school online, 2021. URL: https://lms.e-school.net.ua/.

[12] Na urok, 2017. URL: https://naurok.com.ua/test.

[13] K. Xie, G. Di Tosto, S. Chen, V. W. Sheng-Bo, V. W. Vanessa, A systematic review of design and technology components of educational digital resources. Computers & Education 127 (2018) 90–106. doi.org/10.1016/j.compedu.2018.08.011.

[14] Ministry of Education and Science of Ukraine, About systematization of research of electronic educational resources, 2016. URL: https://drive.google.com/file/d/0B3m2TqBM0APKVUxfYi1oYmIyUGc/view.

[15] Catalog of author's educational resources of Zaporizhia region, 2018. URL: https://bit.ly/3fOcwkW.

[16] Electronic educational resources of Kyiv: Questionnaire, 2018. URL: https://sites.google.com/a/kubg.edu.ua/eor-m-kieva/.

[17] L. Kalinina, V. Lapinsky, O. Kitaytsev, V. Kosyk, O. Melnyk, Informatization of education. Status and prospects of implementation. School Director 9–10 (825–826) (2018) 7–16. https://core.ac.uk/download/pdf/159118762.pdf.

[18] O. Melnyk, Analysis of the results of the All-Ukrainian study of the application of information and communication technologies in primary school, Pedagogical Search 4(27), 2015, 95–99.