





Cloud Technologies for the Creation of Open Educational Resources by Future and Practicing Teachers

Vladyslav Ye. Velychko¹^a, Elena G. Fedorenko¹^b, Ludmila V. Dolins'ka²^c
and Volodymyr V. Zavalnuk²^d

¹Donbas State Pedagogical University, 19 Batiuk Str., Sloviansk, 64122, Ukraine

²National University "Odesa Law Academy", 23 Fontanska Str., Odesa, 65009, Ukraine

Keywords: Educational Practice, Development of Electronic Educational Resources, Open Educational Resources.


Abstract: Practical training plays a significant role in the process of professional training of future teachers. An integral part of the training is the full participation of future teachers in the educational process of secondary education during the internship. The simulation of the professional activity of future teachers in two stages takes place. The first is seminars that provide practical skills in mastering the theory. Educational practice in secondary school is the next step in the practical testing of students' knowledge. During the internship in secondary schools, interns not only implement their own theoretical knowledge, but also increase the level of information competence one. During the period of epidemiological restrictions, the methods and means of e-learning were rapidly used. Electronic educational resources allow us to solve new challenges facing the education system. The change of the quality of e-learning tools and improving the methods of their application realized as soon well. The development of e-educational resources is a difficult task. One of the ways to solve this problem is to involve future teachers in this process during their initial practice. Future teachers have theoretical knowledge of information technology. They know how to use their theoretical knowledge. This is because e-learning in higher education school is actively implemented for many years. By the way, during the initial practice, future teachers have the opportunity to test the developed e-educational resources. Then, to make some adjustments. Our experiment on the creation of open educational resources by means of cloud technologies during the internship proved the possibility of solving an important practical problem. Analytical analysis of the obtained results allowed making a promising conclusion on the feasibility of developing the practice of developing open educational resources.


1 INTRODUCTION


The basis of informatization of education are information and communication technologies. It is a powerful tool for intensifying the educational process, its organizational processes and activities. The field of accessibility and acquisition of new knowledge, skills and abilities is expanding. The ultimate goal of open education and e-learning cannot be considered informatization and implementation of e-learning tools in the educational process. Modern educational practice needs tools not only for publishing and for storing educational resources. It is necessary to have a devel-


oped set of tools for teamwork with different materials (Semerikov et al., 2022). Such materials must meet clearly defined criteria within educational systems. Such systems both inside and outside educational institutions should be used. Not only do users need to have free access to resources. Users need to be able to work collaboratively with learning materials. Users should be able to modify materials, adapt them to the needs of their own educational activities. In fact, the ability to modify e-educational resources their quality will improve. This process provides new knowledge in e-learning. And this is a necessary condition for the creation of open education.

Today, the Open Content Initiative, or Open Educational Resources (OER), dates back to the 2000s, with initiatives from the University of Tübingen in Germany, the Massachusetts Institute of Technology, Hewlett Foundation. We will use a term that, in our

^a <https://orcid.org/0000-0001-9752-0907>

^b <https://orcid.org/0000-0002-1897-874X>

^c <https://orcid.org/0000-0002-8763-1977>

^d <https://orcid.org/0000-0002-1057-3852>

opinion, is more successful “Open Educational Resources” or “Open E-Learning Resource”. OERs are resources used to teach learning material. These teaching materials or research resources are in the public domain. These materials are free of intellectual property licenses. They are widely available for use or reuse for others.

2 THEORETICAL FOUNDATIONS OF THE STUDY

The development of open electronic resources is a complex and multifaceted problem. Specialists of various specialties are involved in the creation of electronic educational resources. Such specialists are specialists in such fields as learning theory, psychology, ergonomics, information and communication technologies, etc. (Lytvynova, 2018; Day and Erturk, 2017; Vakaliuk et al., 2020; Valko et al., 2020; Shyshkina and Marienko, 2020; Popel and Shyshkina, 2019; Kholoshyn et al., 2020; Nosenko et al., 2019; Nechypurenko et al., 2019; Markova et al., 2019). Wiley et al. (Wiley et al., 2017) formulated a number of questions about the process of creating and using open educational resources, such as:

- Do students assigned to create, revise, or remix artifacts find these assignments more valuable, interesting, motivating, or rewarding than other forms of assessment? Why or why not?
- Do students who make their assignments publicly available demonstrate greater mastery of learning outcomes or show more enthusiasm for their work than students assigned traditional assessments? Why or why not?
- Do students who openly license their work find additional learning benefits? Does openly licensed student work produce additional benefits to the broader community?
- Are there any drawbacks (real or perceived) that are voiced by students or faculty that participate in OER-enabled pedagogy?

Some answers to these questions can be found in (Velychko et al., 2021a,b). In particular, in Velychko et al. (Velychko et al., 2021a) the stages of development of open e-educational resources during the educational activity are offered. We conducted the study of the possibilities of creating open educational resources during the educational practice by means of cloud technologies in the future.

E-learning has made it possible to create and spread such a phenomenon as “Open Education”. The

advantages of the specifics and basic principles of open education are as follows:

- application of information and communication technologies;
- using of technologies of interaction between participants of educational process in synchronous and asynchronous modes;
- specially designed teaching aids that differ from traditional ones;
- network structures of organization and management of educational content, as well as the learning process;
- specific presentation of educational information, due to lack of control over the concentration of attention on educational material;
- specialized quality control of training, without which there can be no transition to the next stage of training or training material.

Thus, open education is fundamentally different from traditional. It is more in line with the goals, objectives and content of the information society. The main advantages of open education include:

- a) popularity and accessibility (open education has almost limitless opportunities for wide coverage of the population and territories, the organization of free access to information and educational resources);
- b) adaptability and flexibility (the open education system has a wide range of opportunities to adapt to changing environmental conditions. It is capable of significant transformations of all-important elements of the educational process)
- c) internationality and globalization (free functioning of the open education system outside state borders);
- d) planetary openness and availability of information and educational resources;
- e) modular structure and asynchrony (modular principle of constructing the content and organization of the educational process allows to form individual curricula and programs that best meet the personal needs of students, as well as spread over time various elements of the educational process);
- f) economic efficiency (educational results are achieved with less time, money and other resources compared to traditional approaches).

Based on the definition of the General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO) during the meeting in

Paris from 12 to 27 November 2019 at its 40th session the following was emphasized.

Open Educational Resources (OER) are learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others (UNESCO, 2019).

Open License is a standard way of granting, restricting the rights to use, transform, reuse, or distribute creative results (sound, text, images, multimedia, etc.). To protect copyright in environments where content (especially digital) can be easily copy and made available for public access without the author's permission, Open Licenses have been developed. Open licenses to help guarantee permission to copy and share in a structured legal form are expected. This approach is more flexible than it is today (when all rights automatically granted). Licenses in each case provide certain rights, exempting from the restrictions of traditional copyright. OER is an integral part of this process. OERs provide greater flexibility in the use, reuse, and adaptation of materials to local contexts and learning environments. In this case, the authors receive well-deserved recognition.

Licensing software or electronic educational resources allows you to grant usage rights. They are a mechanism for copyright protection. Licenses must have granted even when authors wish to provide their designs for use free of charge. This mechanism allows you to make no exceptions uses. Moreover, while there are free licenses for software such as the GNU General Public License, the Apache License, the Mozilla Public License, and others, Creative Commons (CC) licenses are typically for content that includes most e-learning resources. The Creative Commons initiative (founded in 2001) is a companion to the Open E-Learning Resource initiative. The main purpose of the organization is to help revive the public domain among creative works, which include electronic educational resources. Creative Commons promotes a collective goal focused on the information society. Creative Commons a web application that helps people grant their creative work open licenses or partially retain copyright has developed. At the same time, it licenses them as free uses, under certain conditions. Unlike the GNU General Public License or others, Creative Commons licenses are not intended for software, but for other types of creative work. Namely, the creation of websites, musical works, movies and videos, photographs, literary works, training courses, etc. The goal is to increase the content on the Internet, as well as open access

to educational material free and accessible. To this end, metadata has been developed that can be used by search engines and other online search applications. For example, photos that are free if you mention the original photographer, or songs that can copied, distributed or removed without any restrictions, or electronic educational resources.

Ukraine has a low culture of digital content consumption. An example of this is the significant percentage of unlicensed software use. The Software Alliance estimates that unlicensed software use in Ukraine in 2017 estimated at 80%, equivalent to \$108 million, with an average of 57% across Central and Eastern Europe (BSA, 2018). This culture of consuming digital content also applies to electronic educational resources. How the developed educational resources be protected from illegal use? This question is the most common of many colleagues. Technological tools to limit digital content operations exist, but they are unable to address this issue at a fundamental level. We believe that the introduction of comprehensive licensing of digital content will help address this issue. Compliance with open licenses should help shape the perception of licenses for digital content and the possibility of its use, depending on the license. In fact, the presence of a requirement for a mandatory license for digital content is an indicator of legal relations in the field of electronic educational resources, the civilized process of their creation, distribution and use.

OER-Enabled Pedagogy is based on a student-centered approach to learning. The originality of our learning experience is that in the learning process students are involved as creators of open content development using 5R permissions (retain, reuse, revise, remix, redistribute). In essence, 5R permissions coincide with the four levels of freedom free software and the corresponding practice of its application in educational activities (Velychko et al., 2018). In their study, David Wiley and John Hilton identified the relationship between the types of tasks and the end results of their performance (table 1) (Wiley and Hilton III, 2018). According to these scientists, the results of one-time tasks are important only for students, and therefore, other participants in the educational process can not use the results. Nevertheless, the results of authentic tasks, due to the specifics, can be useful not only to their authors but also to other users. The results of construction tasks, according to the authors of the study, can be made public and reach a wider audience. Ongoing tasks public and licensed openly must made. Renewable tasks provide an opportunity to create open educational resources that meet the requirements of 5R.

Open educational resources should not only have

the appropriate licenses, but also the location (link) where they can be downloaded and downloaded, provide an assessment and describe the experience. Most of the open educational resources are stored in appropriate repositories. Examples of open educational resources repositories include Open Discover Space (<https://portal.opendiscoveryspace.eu>), MERLOT (<https://merlot.org>) and OER Commons (<https://www.oercommons.org>).

Unfortunately, there are no repositories in this area in Ukraine. Universities, institutes of postgraduate pedagogical education, city and regional departments of education form their own repositories. Such Repositories are local and do not gain widespread popularity in the educational environment. Despite this, the pedagogical community in Ukraine is uniting. Opportunities for improving and expanding professional competencies on such open educational platforms as EdEra, Vseosvita, "Na urok", Prometheus, etc. are expanding. Thus, skills in working with open educational resources during the period of study of students in higher education institutions should be acquire. In this context, future teachers have a special advantage. Their responsibility here to society is obvious.

Practical training of future teachers is one of the important stages of the educational process. One of the basic components of practical training of future teachers is, in fact, educational practice in secondary schools – schools, colleges and more. On the one hand, during the internship the future teacher is ready to implement the acquired theoretical skills. On the other hand, they gain practical experience. And this allows you to form the holistic competencies of the future teacher. In the period of sanitary restrictions caused by biological threats, the role of information and communication technologies is growing. This is especially important during the internship. During such challenges, the exchange of experience and learning materials takes place through communication between students, mentors and trainees, between trainees and practice leaders, and directly between trainees. The possibility of collegial activity opens up. Effective results are those that collectively are performs. The result is such electronic educational resources that can be used by the general community. Such practical activity aims to increase the level of formation of information, communication, organizational competencies of students.

What are the opportunities for joint work on the creation of electronic educational resources? First, practical acquaintance with the means of sharing digital content; second, the practical use of cloud technologies; third, conducting a critical analysis of the

suitability of certain cloud technology services for the development and creation of electronic educational resources.

Some teachers use open educational resources only as teaching aids. However, another group of teachers involves future teachers in their creation and exchange during training. For example, in the Digital Futures in Teacher Education (DeFT) project, practicing teachers, future teachers and educators participated on an equal footing in the study of digital literacy. They jointly developed open educational resources that were used in the study of digital literacy in high school (Gruszczynska et al., 2013). A similar experience of creating open educational resources in a study by Tur et al. (Tur et al., 2016) was describe. The study involved three groups of future primary school teachers studying at the University of the Balearic Islands. During the course, future teachers had to create open educational resources, which was a testament to their technical skills. The survey showed an overall positive impact on students' perceptions of such developments, the creation and use of open educational resources. However, during the analysis of their answers there were some inconsistencies and nuances.

Kim (Kim, 2018) considered the issue of preparing future teachers for the use of open educational resources and the practice of using open educational resources in educational activities. In particular, the author cited the following principles of training future teachers: 1. It is necessary to involve those teachers who care about the problem of open educational resources, who use different approaches to solving the problem. 2. There is a need to promote the deepening of cognitive processing of educational material by future teachers. 3. Give broad autonomy to future teachers in the process of developing open educational resources. 4. Peer interaction should be encouraged and maintained to improve lesson planning outcomes. 5. Interaction with peers should be encouraged to improve lesson planning outcomes.

The results of a study by Kimmons (Kimmons, 2014) revealed the following points. First, this is what is valuable for improving the literacy of teachers with open education K-12. The need to overcome various misconceptions to support the large-scale development of open education literacy in K-12 has also proven. In addition, proponents of open education must recognize that all teachers, regardless of the time of study: a) are willing to innovate, b) use open resources, c) openly share their achievements. Open pedagogy is becoming increasingly popular as a teaching method to reduce authoritarianism in the classroom while learning. It allows to involve students in pedagogical testing to obtain the initial re-

sults of pedagogical work.

To study the impact of open pedagogy on motivation, Werth and Williams (Werth and Williams, 2021) conducted interviews with first-year students of the College of Four-Year Humanities. The survey was conducted after the end of the semester project in the framework of the pedagogical approach described above. The evaluation of students' responses was conducted using the theory of self-determination, in particular on the styles of motivation regulation, which were demonstrated by the research participants. The results showed that students are influenced by various forms of external motivation during a project based on open pedagogy. Incidentally, autonomous forms of regulation were more common than controlled regulation.

Cloud technology services have both advantages and disadvantages. We further highlight those that are critical to the objectives of our study on the application of cloud technologies. The advantages of using cloud technologies include:

- it is not necessary to have your own powerful computers (this is relevant for solving the problem of providing educational institutions with modern computers);
- the problem of using unlicensed software is solved (this is relevant for solving the problem of insufficient funding for the payment of licensed software);
- mobility of resource use (open possibility to work from any suitable point of the network if the necessary communication channel is available);
- the possibility of joint work on documents (which is relevant for solving the problem of organizing collective work on joint projects at a distance).

The disadvantages of using cloud technologies in educational activities are:

- dependence on Internet connection (stability of broadband access is critical for collaboration on documents);
- not every cloud application provides the ability to save the results in a user-friendly form on the desired media (the difference between data formats in cloud applications and desktop software versions sometimes requires data reformatting and loss of original quality);
- there is a risk that the service provider will stop providing cloud services (such problems occur quite often when using free services).

Moreover, if the advantages of using cloud technology services in full must be used, then to overcome

the shortcomings must be prepared as follows: a) have an alternative source of Internet connection; b) use open data formats; c) keep backup copies of your own data. The concept and phenomenon of joint activities are actively studied by psychology and pedagogy. In the process of studying such a concept as "joint activity", attention should be paid to two aspects: 1) substantive activity; 2) the process of building relationships between people involved in activities and communication. The main "unit" of the analysis of joint activities and its collective subject is the interaction of participants in joint activities.

At the heart of the dynamic concept of joint activities is a conceptual "triangle", which combines three areas:

- 1) subject-oriented interaction (interaction aimed at changing the subject of joint activities),
- 2) subject-oriented interaction (interaction aimed at changing the characteristics of the individual subject of joint activities),
- 3) organizational-oriented interaction (interaction that changes the ways and style of performing activities).

Much attention is paid to the impact of joint activities on intellectual development, the formation of social intelligence and social competence of the subject of education. For all the development of the concept of "joint activities", the organization of such activities in terms of development of technical means that specifically support and strengthen the joint nature of activities is not considered. In this context, the concept of "joint network activity" is a further development of the concept of "joint activity", including special network tools.

Joint networking requires its design based on the following conditions:

- the availability of new pedagogically sound technical means of joint activities on the Internet, which open up opportunities to expand the range of programs, objects, data and communications;
- the availability of new organizational forms and scenarios of educational network activities, focused on the creation of a social network by participants in joint activities.

3 RESEARCH RESULTS

Educational pedagogical practice as a type of practical activity of students aimed at solving various pedagogical problems should be considered. The specificity of this activity is that it identifies with the professional

activities of teachers. At the same time, educational pedagogical practice is a form of professional training in a higher education institution, the purpose of which is:

- to deepen and consolidate the theoretical knowledge that the student received at the university, and learn to apply this knowledge in practice in educational work with students;
- to equip students with the ability to observe and analyze the educational work carried out at school with students;
- to prepare students for lessons with the use of methods that enhance the cognitive activity of students;
- to develop and consolidate in students a love for the teaching profession, to encourage the desire to study advanced pedagogical experience and improve their pedagogical skills.

Epidemiological limitations and widespread use of distance learning make adjustments in the process of practical training of future teachers. Until now, it was a good practice to gather from time to time in a higher education institution and discuss with classmates and methodologist's problematic issues of educational practice, share experiences, adjust their theoretical knowledge and more. Today requires communication and common tasks at a distance. To solve this problem, it is necessary to use information and communication technologies and means of joint activities. The best solution to this problem is the widespread use of cloud technology. This is quite effective for the preservation of accumulated data and for communication between participants in educational activities. Using cloud technologies, we get the opportunity to establish communication and joint activities to work in groups.

Based on the above provisions on joint activities, the benefits of using cloud technologies and the need to develop and create open electronic educational resources (Velychko et al., 2022a,b), a program of educational pedagogical practice for future teachers of mathematics, physics and computer science was developed. The peculiarity of the program is that the creation of electronic educational resources to the obligatory results of educational pedagogical practice has been added. The subject of electronic educational resources was limited to the topics of training sessions conducted by trainees. The following two requirements applied to e-learning resources, the first of which is collective resource development. The second requirement was to publish the developed electronic educational resource under an open license, ie the final product must be an open electronic resource.

Tasks offered to students of educational programs 014 Secondary education (mathematics), (physics), (computer science) of the Faculty of Physics and Mathematics of Donbas State Pedagogical University. These students underwent training and production practice in general secondary education institutions of Donetsk, Kharkiv, Luhansk and Dnipropetrovsk regions provided for three areas of activity: the creation of joint electronic educational resources, information visualization, and online organizational platforms. Consider what tools to perform the tasks have been analyzing.

The use of presentations, even in dynamic systems, does not provide an opportunity to engage students in active learning. Quite different opportunities are providing by whiteboards, thanks to which in the online learning format the participant of the educational process takes part in discussing problems, solving problems, etc. We selected and offered 10 cloud services to create training material for the training session (table 1). Before conducting the classes, the trainees had to get acquainted with the proposed list, explore the functions and capabilities of each of these cloud facilities and create training materials for the class. For comparison, the trainees prepared the teaching material in the form of a presentation and demonstrated it to the students, while the students performed the tasks on paper. After the lesson, students were interviewed. It was found out which of the proposed options the students liked the most. The survey of the class showed that 70.0% of the surveyed students out of 374 who took part in the survey preferred the lesson where the "white board" was used.

The systems presented in table 2 were studied to visualize information and create interactive content. Visibility is one of the benefits of electronic educational resources. The development and creation, even of static, e-learning resources is one of the tasks of e-learning. The limited space available for inspection requires the use of scrolling presentation technologies. Accordingly, the method of their application should change, in contrast to the fact that students see a large paper poster. The constant use of the same templates, design styles, etc. in educational activities leads to a loss of visual interest in educational material. Using a variety of design styles, fonts, icons, etc. increases students' visual activity. Each of the proposed systems has its own unique design style. Even having created infographics in different cloud services based on common data, we get fundamentally different digital products.

Practitioners faced the problem of downloading created digital objects to their own device. At the same time, their integration into other objects created

Table 1: Whiteboard cloud services.

Name	Free usage	Localization	Download object	Embedding in systems
Padlet.com	freemium	Yes/Partly	No	Yes
Linoit.com	free	No	No	Yes
Idroo.com	free	No	Yes	Yes
Miro.com	freemium	No	Yes	Yes
Whiteboardfox.com	freemium	No	No	Yes
Jamboard.google.com	free	Yes	Yes	Yes
NoteBookCast.com	free	No	No	Yes
Conceptboard.com	freemium	No	No	Yes
Groupboard.com	freemium	No	No	Yes
Classroomscreen.com	freemium	No	No	Yes

by cloud technology applications took place without hindrance. This problem arose because the cloud technology services we considered, at the beginning of its establishment, most of them offered their resources free. Increasing their popularity, most cloud services have moved to the financial model “Free - Premium” (Freemium), where some services on a free basis and some on a commercial basis are provide. As a rule, on a commercial basis, offer to upload your own data to the user’s device. However, for each of the applications, we were able to obtain a digital object created by us on our own computing device by third-party methods.

The created means of visual presentation of data during the training activities of trainees were use. In addition, the interns invited students to create their own posters, charts, graphs, illustrations, etc. in computer science classes and outside classroom. 362 students took part in this study, of which 235 students (about 65%) liked to create digital content of this type. The students included such categories as “beautiful”, “visual”, and “useful”. Students who were dissatisfied with this work used terms such as “not clear”, “difficult”, “I have no artistic flair”. The answers of dissatisfied students have no meaningful basis. It should be noted this fact. Such answers are a weak justification for their unwillingness to use the proposed cloud services. We did not study the reasons for such reluctance on the part of students.

We also asked the students: “What is the main thing in the cloud service to create data visualization in your opinion?”. The obtained answers for clarity are presented in figure 1 in the form of a diagram. The largest number of students (32.6%) spoke about “understandable language” used in the cloud service interface. Despite the availability of cloud online translation services, the English-language interface caused difficulties when using the application. In second place (28.2%) is the option that corresponds to the ability to conveniently work with the service on mobile devices, or even as a separate application. Today,

the number of users via mobile systems exceeds the number of users via a desktop computer system, so this figure is extremely important. In third position was the design criterion (23.5%). Moreover, although the systems that were proposed were directly relate to graphic design, the ergonomics of these systems still need to be improved. In last place was the criterion of “available examples of work” (15.7%). In our understanding, this criterion indicates a lack of creative thinking and corresponds to the task according to the template. The fact that the smallest number of students are ready to do tasks on the model gives hope, because the capabilities of the systems are sufficient for creativity and creative presentation of information.

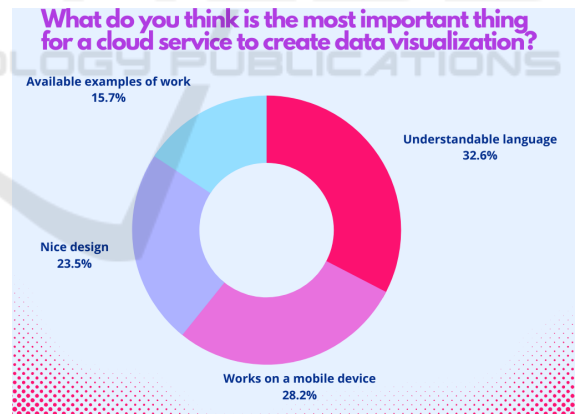


Figure 1: Results of a student survey on the use of cloud services.

The task of creating shared electronic resources was to analyze existing cloud services to create presentations and text documents. For this purpose, it was proposing to use office applications of cloud services, which are presented in table 3. Unlike the previous comparison tables, we analyzed the advantages and disadvantages that were collected according to the subjective judgments of the trainees. It was in these applications that they tried to create electronic educational resources, which then had to be

Table 2: Whiteboard cloud services.

Name	Free usage	Localization	Download object	Embedding in systems
Easel.ly	Free	No	Yes (wiles)	Yes
Infogram.com	Freemium	No	Yes (wiles)	Yes
Canva.com	Freemium	Yes	Yes	Yes
Crello.com	Free	Yes	Yes	Yes
Genial.ly	Freemium	No	Yes (wiles)	Yes
Chartblocks.com	Free	No	Yes	Yes
Piktochart.com	Freemium	No	Yes (wiles)	Yes
Vennage.com	Freemium	Yes	Yes	Yes
Vizzlo.com	Freemium	No	Yes (wiles)	Yes
Adioma.com	Freemium	No	Yes	Yes

come open educational resources. It should be note that the trainees were already familiar with Google Docs and Office Online. Nevertheless, Zoho Office Suite and ONLYOFFICE turned out to be extremely interesting and useful for students. Interns are interested in both the new built-in design styles and the new functionality provided by cloud services. It was in these office applications that interns tried to create electronic educational resources. Tasks for creating open educational resources were propose for groups of three students and the selected topics were similar in content.

After the end of pedagogical practice, a survey of interns was conduct on the joint creation of open educational resources. They were ask the following questions:

- A. Your attitude to open digital content (Positive / Negative)?
- B. Do you have previously had experience of using open educational resources during pedagogical practice (Yes / No)?
- C. Have you used digital resources before despite not having this action with a license agreement (Yes / No)?
- D. Are you ready to create open educational resources (Yes / No)?
- E. How do you feel about the joint development of e-learning resources (Positive / Negative)?
- F. Is it appropriate to use unlicensed software to develop open educational resources (Yes / No)?

88 students of the Faculty of Physics and Mathematics of Donbas State Pedagogical University took part in the survey. The term of the experiment is two years. The results of the survey are presents in figure 2. Questions A-C were relating to the use of open educational resources, and questions D-F were relating to their development. The question of the research was to find out: are students who use open educational resources ready to develop them? Comparisons

of responses between the two groups (A-C) and (D-F) were performed using the Mann-Whitney U test. The results of calculations $U_{emp} = 18$, $U_{0,1} = 3.0$, $U_{0,05} = 7.0$ indicate the absence of significant differences between groups. Therefore, students who are ready to use open educational resources are ready to develop them.

The analysis of the answers shows that there is a not very pleasant aspect, which is highlighted in questions C and F. Students do not pay much attention to the issue of licensing a digital product, and it does not matter whether it is an electronic educational resource or software. It should be note, that the surveys conducted in 2019 on free access to software showed an even worse attitude to the licensing of software.

The following resources were proposed to address the identified issues regarding the licensing purity of digital content, including electronic educational resources, open educational resources, joint development of electronic educational resources, licensing of electronic content, etc:

- open mass online courses “Prometheus: AI101” (<https://prometheus.org.ua>);
- course of review lectures “Open licenses. Creative Commons Initiative”;
- elective subjects of wide choice for students “Data Visualization” and “Infographics in Education”;
- advanced training courses for research and teaching staff of Donbas State Pedagogical University “Information and communication technologies in education”;
- certificate training courses for teachers “Information and communication technologies in education”;
- modernization of the content of academic disciplines.

The final results of the proposed resources are open and need further study. This is because each of the proposed resources for students of different

Table 3: Cloud office applications.

Name	Advantages	Disadvantages
Google Docs (docs.google.com)	Free and no significant restrictions; Convenient, non-distracting design; Well-thought-out collaboration in the cloud; Integration with Google services regular innovations; Templates gallery	Occasionally there are failures; There is no possibility to personalize the workspace (branding).
Zoho Office Suite (zoho.com)	Extensive list of additional applications; Interesting features in the paid version; Free version available; Convenient work with projects thanks to Workspaces.	Lack of localized documentation and incomplete localization of applications; The mobile version only works in read mode Numerous disadvantages of Zoho Sheet.
Office Online (office.microsoft.com/online/)	Excellent compatibility with MS Office formats; Responsive, stable touch interface and convenient Ribbon tape; Close integration with Office 365 and Microsoft services.	Working with documents needs to be reviewed; A small selection of import and export formats, limited by proprietary licenses; No automatic saving, inconvenient version control; Functional “gaps” in Excel; Fuzzy commenting system.
ONLYOFFICE (onlyoffice.com)	User-friendly interface; Import documents from other services.	No spell check; Quite high rates for individual use of the service; There are no full screen and compact modes; Documentation in English; Weak functionality of Spreadsheet Editor and Presentation Editor.

	Yes / Positive	No / Negative
A	66	22
B	65	23
C	53	35
D	45	43
E	75	13

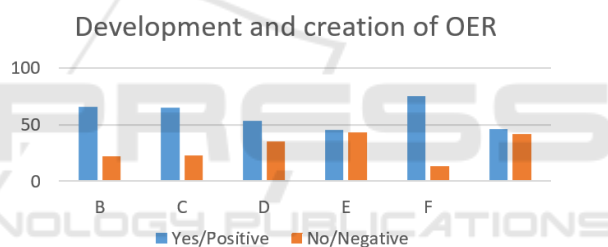


Figure 2: The results of the survey on the joint creation of open educational resources.

courses is designed. By the way, practicing teachers and educators are ready to continue working in this direction in order to create an environment to promote e-learning and create resources for e-learning. The ideas of open education, which are embodied in the process of development and implementation of open educational resources, only when the content of education and information of society will have a common basis, will be spread. Such a process is necessary to create a useful public good.

4 CONCLUSIONS

Open educational resources are a product of the digital world, which has great potential for further achieving UNESCO’s goals in the field of education. They help countries, institutions and teachers to share quality education and materials free of charge. They give teachers a new challenge to integrate digital technol-

ogy into their courses and programs, and enable students to access quality content offline. They are an incentive for teachers, students and institutions to work together to create original learning material. The creation of open educational resources by future teachers during pedagogical practice provides an opportunity not only to get a great practice of creating e-learning tools. They allow implementing in practice the acquired theoretical knowledge of the theory of learning, methods of teaching specialized subjects, a creative vision of solving urgent problems of learning. The conducted experiment revealed the potential of such a practical activity as the creation of open electronic educational resources. Improving interaction between participants of educational activities by means of information and communication technologies. Launching the process of creating digital educational content of a new type.

Strategic policies need to involve OER in education systems at the state level to be developed, encouraging educational institutions to make full use

of these developments to achieve global development goals. Prospective areas of research are the study of the quality of created open electronic educational resources and their classification.

REFERENCES

- (2018). Software management: Security imperative, business opportunity. Bsa global software survey, BSA. https://gss.bsa.org/wp-content/uploads/2018/05/2018_BSA_GSS_Report_en.pdf.
- Day, S. and Erturk, E. (2017). e-Learning objects in the cloud: SCORM compliance, creation and deployment options. *Knowledge Management & E-Learning*, 9(4):449–467. <https://doi.org/10.34105/j.kmel.2017.09.028>.
- Gruszczynska, A., Merchant, G., and Pountney, R. (2013). “Digital futures in teacher education”: Exploring open approaches towards digital literacy. *Electronic Journal of e-Learning*, 11(3):193–206. <https://files.eric.ed.gov/fulltext/EJ1016248.pdf>.
- Kholoshyn, I. V., Bondarenko, O. V., Hanchuk, O. V., and Varfolomyeyeva, I. M. (2020). Cloud technologies as a tool of creating Earth Remote Sensing educational resources. *CTE Workshop Proceedings*, 7:474–486. <https://doi.org/10.55056/cte.388>.
- Kim, D. (2018). A Framework for Implementing OER-Based Lesson Design Activities for Pre-Service Teachers. *The International Review of Research in Open and Distributed Learning*, 19(4). <https://doi.org/10.19173/irrodl.v19i4.3394>.
- Kimmons, R. M. (2014). Developing open education literacies with practicing K-12 teachers. *The International Review of Research in Open and Distributed Learning*, 15(6). <https://doi.org/10.19173/irrodl.v15i6.1964>.
- Lytvynova, S. H. (2018). Cloud-oriented learning environment of secondary school. *CTE Workshop Proceedings*, 5:7–12. <https://doi.org/10.55056/cte.129>.
- Markova, O. M., Semerikov, S. O., Striuk, A. M., Shalatska, H. M., Nechypurenko, P. P., and Tron, V. V. (2019). Implementation of cloud service models in training of future information technology specialists. *CTE Workshop Proceedings*, 6:499–515. <https://doi.org/10.55056/cte.409>.
- Nechypurenko, P. P., Stoliarenko, V. G., Starova, T. V., Selivanova, T. V., Markova, O. M., Modlo, Y. O., and Shmeltser, E. O. (2019). Development and implementation of educational resources in chemistry with elements of augmented reality. In Kiv, A. E. and Shyshkina, M. P., editors, *Proceedings of the 2nd International Workshop on Augmented Reality in Education, Kryvyi Rih, Ukraine, March 22, 2019*, volume 2547 of *CEUR Workshop Proceedings*, pages 156–167. CEUR-WS.org. <https://ceur-ws.org/Vol-2547/paper12.pdf>.
- Nosenko, Y. H., Popel, M. V., and Shyshkina, M. P. (2019). The state of the art and perspectives of using adaptive cloud-based learning systems in higher education pedagogical institutions (the scope of Ukraine). *CTE Workshop Proceedings*, 6:173–183. <https://doi.org/10.55056/cte.377>.
- Popel, M. V. and Shyshkina, M. P. (2019). The areas of educational studies of the cloud-based learning systems. *CTE Workshop Proceedings*, 6:159–172. <https://doi.org/10.55056/cte.375>.
- Semerikov, S. O., Vakaliuk, T. A., Mintii, I. S., Hama-niuk, V. A., Soloviev, V. N., Bondarenko, O. V., Nechypurenko, P. P., Shokaliuk, S. V., Moiseienko, N. V., and Shepiliev, D. S. (2022). Design methodology for immersive educational resources. *Educational Dimension*, 6:176–199. <https://doi.org/10.31812/educdim.4716>.
- Shyshkina, M. P. and Marienko, M. V. (2020). The use of the cloud services to support the math teachers training. *CTE Workshop Proceedings*, 7:690–704. <https://doi.org/10.55056/cte.419>.
- Tur, G., Urbina, S., and Moreno, J. (2016). From OER to Open Education: Perceptions of Student Teachers after Creating Digital Stories with Creative Common Resources. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 7(2):pp. 34–40. <https://lumenpublishing.com/journals/index.php/brain/article/view/2077>.
- UNESCO (2019). Recommendation on Open Educational Resources (OER). http://portal.unesco.org/en/ev.php-URL_ID=49556&URL_DO=DO_TOPIC&URL_SECTION=201.html.
- Vakaliuk, T., Antoniuk, D., Morozov, A., Medvedieva, M., and Medvediev, M. (2020). Green IT as a tool for design cloud-oriented sustainable learning environment of a higher education institution. *E3S Web of Conferences*, 166:10013. <https://doi.org/10.1051/e3sconf/202016610013>.
- Valko, N. V., Kushnir, N. O., and Osadchyi, V. V. (2020). Cloud technologies for STEM education. *CTE Workshop Proceedings*, 7:435–447. <https://doi.org/10.55056/cte.384>.
- Velychko, V., Omelchenko, S., and Fedorenko, O. (2021a). Open Access to ICT and Electronic Educational Resources as a Guarantee of Sustainable Development of Society. In *Proceedings of the 2020 3rd International Seminar on Education Research and Social Science (ISERSS 2020)*, pages 79–85. Atlantis Press. <https://doi.org/10.2991/assehr.k.210120.017>.
- Velychko, V. Y., Fedorenko, E. H., and Kassim, D. A. (2018). Conceptual bases of use of free software in the professional training of pre-service teacher of mathematics, physics and computer science. In Kiv, A. E. and Soloviev, V. N., editors, *Proceedings of the 1st International Workshop on Augmented Reality in Education, Kryvyi Rih, Ukraine, October 2, 2018*, volume 2257 of *CEUR Workshop Proceedings*, pages 93–102. CEUR-WS.org. <https://ceur-ws.org/Vol-2257/paper11.pdf>.
- Velychko, V. Y., Fedorenko, E. H., and Serdiuk, O. Y. (2022a). Theoretical Bases of Application of Free Software in Preparation of Pre-service Teachers of Mathematics, Physics and Computer Science. In Semerikov, S., Osadchyi, V., and Kuzminska, O., edi-

- tors, *Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 1: AET*, pages 261–271. INSTICC, SciTePress. <https://doi.org/10.5220/0010923600003364>.
- Velychko, V. Y., Omelchenko, S. O., Fedorenko, E. G., and Kravtsov, H. M. (2022b). Familiarity with Free Software through Online Services. In Semerikov, S., Osadchyi, V., and Kuzminska, O., editors, *Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 1: AET*, pages 605–615. INSTICC, SciTePress. <https://doi.org/10.5220/0010926500003364>.
- Velychko, V. Y., Omelchenko, S. O., Khyzhniak, I. A., and Fedorenko, E. G. (2021b). Developing and using open electronic educational resources in educational activities. *Journal of Physics: Conference Series*, 1840(1):012063. <https://doi.org/10.1088/1742-6596/1840/1/012063>.
- Werth, E. and Williams, K. (2021). What Motivates Students About Open Pedagogy? Motivational Regulation Through the Lens of Self-Determination Theory. *The International Review of Research in Open and Distributed Learning*, 22(3):34–54. <https://doi.org/10.19173/irrodl.v22i3.5373>.
- Wiley, D. and Hilton III, J. L. (2018). Defining OER-Enabled Pedagogy. *The International Review of Research in Open and Distributed Learning*, 19(4). <https://doi.org/10.19173/irrodl.v19i4.3601>.
- Wiley, D., Webb, A., Weston, S., and Tonks, D. (2017). A Preliminary Exploration of the Relationships Between Student-Created OER, Sustainability, and Students' Success. *The International Review of Research in Open and Distributed Learning*, 18(4). <https://doi.org/10.19173/irrodl.v18i4.3022>.