Developing and Using Open Electronic Educational Resources in Educational Activities

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Abstract. The article looks into the effective use of open electronic educational resources. The concept of open electronic educational resources is exposed, their structure and key elements are presented, issues of implementation in educational practice are considered. Requirements for open electronic educational resources are defined, tools for designing and platforms for their support and dissemination are identified. The analysis of the existing open electronic educational resources and the experience of their use is conducted. The principles of open electronic resources design based on crowdsourcing are revealed. The stages of creating e-learning resources that meet open Creative Commons licenses on the examples of preservice teachers' training are explored. The essence of Creative Commons licenses is reflected. The theoretical and methodological principles of the use of open electronic educational resources in the educational activity of pre-service teachers are considered. There is a direct link between open educational resources and university education.

1. Introduction

Open education, despite its close connection with information and communication technologies, is considered not only in the field of information. The modern computer and networking technologies are a powerful means of intensifying the educational process and related organizational processes and activities within the framework of education gaining greater openness and enhancing the unity and coherence of the educational and scientific system. However, informatization and the implementation of new means, materials and tools into the educational process cannot be considered the ultimate goal of open education.

Open education is not also limited to providing free access to a variety of educational materials. Modern educational practice requires tools not only for publication and storage, but also for a sophisticated set of tools for working with different materials according to clearly defined criteria within educational systems, both within and outside the education institutions. In addition to providing free access, users should also be given the opportunity to work collectively with the materials, modify and adapt them to the needs of their own teaching and learning.

2. The Results and Discussion

The penetration of computer technology into the educational space has led to the creation of new forms of learning activities and electronic content. The development of the global computer

network in 1999 enabled the University of Tuebingen in Germany to publish video lectures [18]. The Massachusetts Institute of Technology supported the initiative and launched its MIT OpenCourseWare project in 2002. MIT's reasoning was to "enhance human learning worldwide by the availability of a web of knowledge" [20]. Researchers at MIT were convinced that the availability of open learning materials would be an additional opportunity for students to prepare better for classes and make learning more active. In the same year, 2002, with the support of Hewlet Foundation, the research began on the issue of using information and communication technologies to increase access to quality educational content.

Identifying free access to quality academic content as a strategic international initiative to extend people's material freedom, D. Atkins, J. Brown, and A. Hammond have planned to overcome such problems as: "poverty, limited economic opportunity, inadequate education and access to knowledge, deficient health care, and oppression" [1]. The overriding task is to use information and communication technologies to balance the distribution of high quality knowledge and to increase educational opportunities for people, teachers and institutions around the world. A combination of the following components is required to enable access to high quality educational content:

- *sponsorship of high quality open learning content* (funding and promoting of the best samples of high quality open content; setting quality metrics for different forms of educational content);
- *removal of barriers* (focus on web technology; adherence to open standards; multilingual learning content; availability of technological infrastructure);
- *awareness and stimulation of use* (creating networks of developers and users for sharing and collaboration; supporting scientific research on ways of improving efficiency and enhancing evaluation of results).

L. Havrilova's research [5] raises issues of open access to scientific information in connection with the development of "green" and "golden" ways of science development. In particular, the researcher highlights the important role of social networks for scholars, which also become popular and describe role of Ukrainian and international educational global networks Academia.edu (www.academia.edu), ResearchGate (www.researchgate.net), Ayorn (iEARN), ResearcherID (www.researcherid.com), Ukrainian Scientists Worldwide (www.usw.com.ua/), etc. for Ukrainian scientists.

Today, this initiative is often known as the Open Content Initiative or Open Educational Resources (OER). We will use the term which, in our view, is more successful "Open Educational Resources" or "Open E-Learning Resource". OER are teaching resources, learning materials, or research resources that are in the public domain or released under an intellectual property license that allow them to be freely used or reassigned to others. Open educational resources include full courses, training materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or methods used to support the access to knowledge.

Electronic libraries of books, electronic archives and other scientific and educational resources have become very popular in Ukraine in recent years, and information and communication technologies are widely used in the promotion of scientific knowledge. Electronic research and educational resources open to widespread network access are usually funded by donations. National funding programs are also working in several countries. In particular, such programs are available in the USA, Japan and some European countries. We should note that the budget of each program can be up to several million dollars. Online libraries of books and information resources are very much in demand, but not with a great amount of sponsorship money, such as contextual advertising for the sites of publishing houses or best-seller books. These resources live in accordance with the completely different laws. Their goal is not to make money for their owner, but to accumulate and disseminate information electronically to the interested audience.

Electronic book libraries greatly contribute to the preservation of scientific and cultural heritage, the development of literacy and knowledge; they increase the efficiency of work and study, regardless of the social status of those who want to study.

In the current legislation of Ukraine, electronic educational resources are divided into the following types: electronic documents, electronic publications, electronic didactic demonstration materials, information and analytical systems, depository of electronic resources, computer tests, electronic dictionaries, electronic directories, electronic libraries of digital objects, e-tutorials, e-textbooks, e-teaching materials, distance learning courses, and e-labs, including virtual labs [16]. However, the issue of openness of electronic educational resources has received little attention.

The quality of e-learning resources is the equally important factor. The International Standard ISO / IEC 40180: 2017 "Information Technology – Quality for Learning, Education and Training – Fundamentals and Reference Framework" [8] is the basis for describing, comparing, analysing, managing quality and approaches to quality assurance in the sphere of e-learning resources. The standard is a tool for comparing already known approaches and agreeing them on the basis of a common quality model. A key element of the standard is The Quality Reference Framework (QRF) for E-Learning. The QRF combines an elaborated and extensive process model with a descriptive model for the processes. ISO/IEC 40180 harmonizes existing approaches, concepts, specifications, terms, and definitions related to quality for E-Learning, education and training. But, unfortunately, most of the requirements of ISO / IEC 40180 apply only to the quality of development of IT systems for teaching, learning and vocational training. Therefore, we con assert that international standards also do not disclose the concept of quality of OER and do not contain requirements for its provision.

In Ukraine, the quality of electronic educational resources is determined by the following state standards: DSTU 7157: 2010 Information and Documentation. Electronic Publications. The main types and background information; DSTU 4861: 2007 Information and Documentation. Publications. Background Information; DSTU 3017-95 Publications. The main types. Terms. It should be noted that these regulatory documents contain only general classification information. The most extensive information on the classification of e-learning publications is given in the Order of the Ministry of Education and Science of Ukraine [16], which defines the concept of electronic educational resources (EER), their types, and the order of development and implementation. But, unfortunately, these documents do not contain any requirements for the completion and formation of EER.

According to the functional feature, which determines the value and place of electronic educational resources in the educational process, they can be classified as:

- educational and methodological electronic educational resources (curricula, syllabi of disciplines, developed regarding to the curricula);
- methodological electronic educational resources (guidelines, methodological man-uals, guidelines for the study of a specific course and guidance on project work, thematic plans);
- teaching electronic educational resources (electronic textbooks and manuals);
- supervising electronic educational resources (testing programs, banks for supervisory questions and course assignments, and other EER to ensure quality control of knowledge);
- auxiliary electronic educational resources (collections of documents and materials, indexes of scientific and educational literature, scientific publications of teachers, proceeding papers, electronic directories, dictionaries, encyclopedias).

A significant number of different types of e-learning resources also cause a significant number of structural components, which they consist of. The simplest version of electronic educational resources is an electronic version of a printed document. And even in this case, it can only be about the availability of electronic document navigation, the ability to search in the content

and formats of electronic document presentation. A more sophisticated version of an e-learning resource, such as an e-learning course, consists of several simpler e-learning resources, including: background information, training tools, testing and monitoring quality of learning material, background information on available tools and resources of the e-learning course etc.

Similar components are distinguished in an electronic textbook – an educational tool that contains a systematic presentation of course materials and meets the requirements of interactivity, integrativity, adaptability, modularity, etc. Nowadays, there is a finite number of such publications for higher education institutions in Ukraine, therefore, according to I. Khyzhniak [10], educators should regularly explore the market of electronic textbooks on the sites of Ukrainian publishing houses ("Nova Shkola", "Atlantic", "Osnova", "Ranok" and others), on general and special educational sites (http://www.mon.gov.ua/; http://osvita.ua/, etc.), as well as they should critically assess their quality and master methods of their use.

The issue of determining the form of an e-learning resource presentation that is the most appropriate for the certain category is more complex. The correspondence between the style of activity in solving the practical range of problems encountered during life, and the style of learning, and vice versa is proved by D. Kolb [12]. N. Morze and O. Glazunova discuss the relationship between learning styles and online course performance in detail [14]. This study identifies the optimal structure of the e-learning course and the presentation of learning resources for the students of IT profession according to their learning style. The formats for the presentation of study materials should be selected taking into account the students' dominant learning style.

In his research, V. Velychko defines standards for the development and transfer of digital e-learning from one e-learning course to another [19], analyses available tools based on free software for the design of digital e-learning objects. A study of free software tools used to create e-learning courses makes it possible to conclude that the software products not only allow them to be used in the specified way, but also have every reason and are a powerful and practical arsenal that should be purposefully aimed at the process of system use in the creation of automated systems for the de-velopment of e-learning courses. These findings are further supported by existing standards for the exchange of educational facilities and their support for e-learning systems, which testifies to the long-term prospects for the use of EER in education and the modernization of teaching methods.

O. Glazunova describes the similar method for designing sophisticated electronic educational resources by the use of digital learning objects [3]. The result of the process of creating e-learning resources should ensure that each discipline has a certified e-learning course, the resources of which correspond to: substantively – the standards of education on the profile; the form of presentation – the order on electronic training courses, and educational style; methods of use – provide an individual trajectory of learning, using both local and network resources. The process of creating electronic educational resources is based on a systematic, synergistic, personally centred and reflective methodological approaches. To create high-quality electronic educational resources, it is necessary to consider the principles of adaptability, flexibility, modularity, accessibility, and individuality.

The use of electronic educational resources in teaching activities is a complex issue. Firstly, it is necessary to determine the very fact of the need for such application. Determining the effectiveness of the use of e-learning resources in educational activities is possible if at least one of the following indicators is improved:

- enhancing the motivational and emotional side of learning;
- improving the quality of training;
- releasing study time;
- reducing financial costs for training.

In this regard, the readiness of pre-service teachers to use e-learning resources is an important issue. To measure this teacher personal phenomenon, I. Khyzhniak [9] has developed a detailed criterion-level structure that illustrates the relationship between components (motivational-value, cognitive, operational-active, and projective) and levels of readiness to use electronic educational resources in professional activities: intuitive-receptive, reproductive, productive, and research-creative. Exploring the practical aspects of creating electronic educational resources by both students and teachers, I. Khyzhnyak [11] notes that the degree of teachers' motivation is generally sufficient, but the level of their technical skills in creating high-quality electronic learning tools, especially using open source software, is a problematic issue for modern secondary and higher education. However, the linear multimedia Power Point presentation is the most commonly used in educational practice, and sometimes it is the only variation.

The second issue is the quality of e-learning resources. As it has already been shown, the quality of e-learning resources is a complex issue that needs to be taken into account. Thirdly, there is a need to gain sufficient experience of using e-learning resources in educational activities. A. Hurzhii and V. Lapinskyi consider the electronic educational resources to be the basis of the modern educational environment of education institutions [4]. The creation of e-learning resources, which has become widespread in countries with a high level of development of education systems, is a necessary process for education increase. This process is also taking place in Ukraine, but its effectiveness is far from desirable. The target of education informatization in Ukraine, which has been relevant for more than 30 years, remains completely unfulfilled, since the system of creation and introduction into the educational practice of electronic educational resources is far from perfect. Simple calculations show that it is almost impossible to fully commercialize the development and production of electronic educational tools in Ukraine. Hence, it becomes clear that we should return to state-level support for this process and begin the creation of a public e-learning repository.

There are tools for meaningful visualization of educational material. An example of such a visualization is an interactive image or video. An interactive image is understood as a photo, image or video fragment in which there are active areas, the choice of which leads to the corresponding action. For example, following a link, showing a card, an additional text, a photo demonstration, etc. With these images, you can create many interesting projects: interactive biographies, timelines, experimental results, content and history of mathematical and physical formulas, etc.

The benefits of such systems usually lie in a wide range of project types (travel maps, tutorials, posters, interactive diagrams, virtual tours); each project can be created both individually and together with other users of the platform, including teamwork; other users' library, each project can be copied and then edited; editing projects is possible at any time with a wide range of options. The completed project can be saved online, distributed on social networks, or embedded in HTML into your own blog or site.

Interactive image creation tools include Thinglink (thinglink.com), Glogster EDU (edu.glogster.com), H5P (h5p.org), and many others. For example, T. Tabler [17] analyses in more detail both the mentioned systems and systems for creating tests, crossword puzzles, quizzes, educational games, surveys, etc.

V. Velychko's study examines in detail the tools for developing e-learning courses that include Xerte Online Editor, eXe eLearning XHTML editor and Reload Editor [19].

Founded in 2001, the Creative Commons Initiative is a satellite of the Open E-Learning Resource initiative. The main purpose of the organization is to help to revive the public domain among creative achievements, as the level of copyright for the produced electronic content has repeatedly increased due to the pressure from the media industry. Creative Commons as well as the initiatives for free software and open source are promoting collective goals focused on community and based on the principles of crowdsourcing. Creative Commons has developed

Table 1. Table classify the electronic educational resources.

Type of Learning Activity	Electronic Educational Resources
story, explanation, conversation, lecture, illustration, demonstration	demonstrative, referative, multimedia
writing exercises, problem solving, training and consolidating skills, lab work	expert systems, simulation and modelling environments, electronic textbooks, manuals, electronic workshops, simulator programs, electronic laboratories, training programs, laboratory stands
written control, laboratory control, machine control, self-control	e-learning training laboratories, e-assessment systems, tests, e-exams, e-assessment systems

a Web application that helps people provide their creative work with public license or partly retain copyright while licensing them as free for certain uses under certain conditions. Unlike the General Public License, Creative Commons licenses are intended not for software, but for other types of creative work: websites, music, movies and videos, photos, literary works, training courses, and more. The purpose is not only to increase the amount of open content on the Internet, but also to make access to materials free and easy. Regarding to this, metadata has been developed. They can be used by search engines and other online applications for searching photos that are free of charge when the original photographer is mentioned, or songs that can be copied, distributed or downloaded without any restrictions.

Today there is a considerable range of e-learning resources available for information supporting, functioning and developing of the education system. Among them V. Demianenko, G. Lavrentieva and M. Shyshkina distinguish the following resources [2]:

- local and network electronic educational tools, in particular optical digital media;
- educational web-resources: special sites, electronic collections, libraries, collections of learning materials, etc.;
- electronic databases and bases of knowledge of educational purpose;
- e-learning systems and platforms, including distance learning and virtual learning.

Also, there are other types of classification of electronic educational resources in accordance with: areas of use, interaction architecture, form of implementation, spatial limitations, etc. It is a significant issue for our study to classify the electronic educational resources by the type of learning activity (Table 1).

T. Luo, K. Hostetler, C. Freeman, and J. Stefaniak present an analysis of the current state of using the open electronic educational resources. The researchers came to the following conclusions: "discoverability, sustainability, and remixing are significant barriers that stand in the way of OER disrupting traditional textbook models; there is no significant difference in learning outcomes when instructors incorporate OER; implementation of OER as instructional strategies is challenging but can be effective in supporting positive learning outcomes when properly designed" [13].

S. Panke, R. Morse, and S. Stone [15] investigate the use of open e-learning resources in non-formal learning and methods of implementing open e-learning resources in learning

activities. Researchers discuss the benefits of using and creating open textbooks and, as a result, describe the process of creating the textbook "Local Government in North Carolina" (2019). The theme example provides an overview of the open content and resources for developing a creative community for multimedia content and electronic books that meet specific educational requirements of promoting digital citizenship at the local government level.

The development of high-quality electronic educational resources requires considerable material and human costs. The published materials make it possible to get an approximate cost of developing electronic educational resources. Companies engaged in developing e-learning courses demand minimal expense in 2000 dollars for creating of the script, design, layout, and testing. There is an extra charge for video and audio, animation design etc. The cost of one online course at Coursera, a Stanford University project, is estimated at $15-30,000. Developing the MIT Open-CourseWare course costs $10,000-$ 15,000. As we can see, the development of e-learning courses is very expansive. Understanding that each e-learning course includes e-learning resources, it is possible to propose the development of an open e-learning course through a combination of an open learning management system and open e-learning resources. And if open learning management systems exist and their functionality is sufficient to organize and support eLearning, there are some difficulties with the development of open eLearning resources at this stage.

In order to develop open e-learning resources, we suggest engaging prospective professionals in their training. Learning activity involves not only the study of certain topics and disciplines, but also the practical reproduction of the acquired knowledge in teaching practice lessons. Adding to the practical tasks the condition of creating electronic content rather than paper one, we get a significant number of electronic documents that can serve as a basis for future electronic educational resources. Providing prospective experts with ready-made templates for the results of their research or certain rules for the design of electronic content, we will eliminate the need for formatting. Moreover, such tasks will increase the level of digital competence and introduce practice-based tasks into the learning process. The use of the project method, especially collective ones, is advisable. The project activity of like-minded people not only increases the ability to work in a team, but also improves the content quality of the work performed.

The next step to creating open eLearning resources is to publish them with mandatory licensing. Open licenses for Creative Commons electronic content, which are usually ignored, will educate prospective professionals about the licensed purity of electronic content. While training prospective professionals are using existing electronic content for their own reports. Therefore, the legal use of electronic content on the basis of academic integrity is one of the tasks of modern vocational training.

The final step is developing and building a repository of open e-learning resources. There are two different ways to resolve this issue. The first is that the state deals with it, and such projects of the repositories with the open electronic educational resources exist. Unfortunately, it is not the first year when in Ukraine such a repository is going to be created, but to no avail. Experts alone provide access to the electronic content developed on their own sites, pages and blogs, but finding the necessary information is extremely difficult. The second way is the use of resources from various foundations that support the ideas of open education. This example is OER Commons resource (oercommons.org). In any case, a dedicated system is essential for the dissemination of the open electronic educational resources. It will not only motivate professionals to create high quality open e-learning resources, but also maintain a high level due to the competition and collaboration.

A practical example of the introduction of these principles is the work on creating the open electronic educational resources at the SHEI "Donbas State Pedagogical University". Pre-service teachers at different faculties are developing open e-learning resources that are both a

complement to the university's distance courses and standalone products. The course "Modern Information Technologies in Education", taught at the faculties of the SHEI "Donbas State Pedagogical University" is aimed at providing prospective specialists with theoretically grounded knowledge and clearly developed skills of using modern information technologies in educational activities; preparing for self-educational activity and self-improvement, and therefore the lecture material contains, in addition to operational information about the considered systems, the methodological component of using their work results.

For the e-learning courses created by the Master students, in accordance with the curriculum of the discipline, their didactic capabilities were analysed. The results of the analysis showed that the selected free software allowed to create courses that: diversify forms of presentation of educational information and types of learning tasks; provide response to learners' actions; individualize the learning process using basic and auxiliary learning influences; apply game techniques; reproduce fragments of educational activity; activate educational work, increase motivation to study.

The e-learning courses were implemented in two ways. For the courses using blended learning, they were imported into the distance learning system of the Faculty of Physics and Mathematics. The subjects taught in the traditional form used e-learning courses as educational material in independent work.

The reform of New Ukrainian School has given impetus to the development of electronic educational resources at the Faculty of Primary, Technological and Vocational Education of SHEI "Donbas State Pedagogical University" where since 2017 the process of developing electronic educational resources has taken place. For example, the implementation of Interactive Communication Electronic Training Simulator for prospective primary school English teachers [20] has undergone diagnostic, corrective, and analytical stages while being created. The final electronic questionnaire among students using Google Forms shows that the implementation of the simulator has increased the students' motivation to study, strengthened their practical skills in using a foreign language, and developed acmeological aspirations.

Except of distance learning courses designed on the Moodle platform ("Introduction to the Teacher Profession", "Linguistic Country Study", "Electronic Linguomethodics", "Multimedia Technologies in Art Education", "Electronic Content of Studying Art Courses in Universities", "Information and Communication Technologies in Pedagogical Research"), students of the faculty use the following electronic text-books and manuals in the educational process, developed by Professor L. Havrilova: "History of Ukrainian Music" and "Ukrainian Spiritual Music", "Ukrainian Culture of the End of XIX – Beginning of XX Century" and "Information and Communication Technologies in Pedagogical Research". The electronic textbooks on professional methods of teaching primary school subjects and special courses has been developed: "Methods of Teaching the Ukrainian language", "Children Literature and Methods of Teaching Literary Reading", "Methods of Teaching the Subject "I explore the World", etc.

Aiming at more systematic use of open educational resources, the lecturers of the Department of Primary Education Theory and Practice are designing the educational portal "Primary Education: Lifelong Learning" [7]. Its use, according to L. Havrilova and O. Beskora, will help to upgrade the system of professional training of primary school teachers, to create high-quality digital educational content that meets the requirements of New Ukrainian School and global trends of education informatization, based on studying the world and, in particular, the European higher education experience.

The educational portal is planned to be launched in 2020, taking into account the requirements of the platform Next Generation of Digital Learning Environment (NGDLE), which is a new generation of learning resources with modern software and has the following structure [7, p. 55]:

The Digital Learning Resources section provides online learning tools for primary school

Figure 1. The structure of educational portal "Primary Education: Lifelong Learning".

teachers. The Internet Conferences section includes effective scientific communication events by using both free and commercial software: Apache OpenMeetings, AdobeConnectProMeeting, BigBlueButton, Microsoft Teams, Microsoft Lyncand and others.

The Webinars section is used to provide educational online services on a free webinar platform: MyOwnConference, GoogleHangouts, Facebooklive, Skype Group Callsare, and others. The Scientific and Methodological Repository contains an electronic library for students, the Methodological Portal includes the most successful lesson plans and extracurricular activities for primary school. The Distance Courses section contains links to Moodle or Google Classroom platforms where teachers have developed a great number of distance courses.

3. Conclusion

Providing comprehensive and equitable quality education and promoting opportunities of lifelong learning for all are priorities of society sustainable development. This form of education is realized through the implementation of the ideas of open education, in which open electronic educational resources play a crucial role. Developed by the prospective professionals, open e-learning resources hosted on the open platforms are expanding the learning content available. Prospective professionals will gain the skills of teamwork, participating in projects and increasing the level of mastering of information and communication technologies both for their personal and professional needs.

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