

# The Application of Open Education Resources as a Tool and Object of Study in the Professional Training of a Mathematics Teacher\*

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**Abstract.** The article analyzes and describes the basic concepts associated with the organization of open education: open education (OE), open educational resources (OER), Massive open online courses (MOOC). The experience of organizing the study of history and methods of using open educational resources in the professional and pedagogical training of future Mathematics teachers is described. It also analyzes some of the open education platforms offered by Russian universities. The methodological possibilities of using the resources of open education as an object of study for obtaining professionally significant information in the professional and pedagogical training of future Mathematics teachers are illustrated.

**Keywords:** Distant Learning System, Open Teacher Education, Professional Training of a Mathematics Teacher.

## 1 Introduction

In a concept note by UN Secretary-General António Guterres, together with the #SaveOurFuture campaign “Education in the era of the COVID-19 pandemic and beyond” [1-3], very large disruptions in the global education system have been noticed. It has been caused by a pandemic. This situation can cause a loss of skills and knowledge for many generations of students. In his opinion, it is necessary to combine the efforts of international and national actors to restore education.

According to UNESCO, about 1.6 billion students (94%) in the world are now affected by the closure of educational institutions. It is predicted that 24 million students (from preschoolers to university students) may not return to school in 2020 after the

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closure of institutions due to the COVID-19 pandemic. UNESCO assumes a high dropout rate and predicts a 3.5% reduction in the number of university students (approximately 7,900,000 people).

According to “The Concept of Development of Mathematical Education in the Russian Federation” “Educational institutions of higher education and research centers should ensure the advanced level of fundamental and applied research in the field of mathematics and their use in mathematics education. It is necessary to strengthen the integration of Russian mathematical research into world science, to ensure that the mathematical faculties of leading Russian universities achieve high positions in world rankings, as well as an increase in the quality, quantity, and citation of works of Russian mathematicians, the attractiveness of Russian mathematical education for the best foreign students and professors. The mobility of students, graduate students, and young candidates of sciences should increase, cooperation between educational institutions of higher education and research institutes should develop” [4].

The above-mentioned factors made the pedagogical community look for new as well as modernize old forms of education in all educational institutions. This also affected higher education. In this situation, the phenomenon of open education acquires particular relevance.

In this article, we plan to share the experience of studying the topic “Possibilities of using open education resources in the work of a Mathematics teacher” and the actual use of open education resources in the professional and pedagogical training of future Mathematics teachers.

## 2 Task Setting

Following the recommendations of the UN and UNESCO for mitigating the consequences of the pandemic in education, the fourth item is highlighted; “Reimagine education and accelerate positive change in teaching and learning: The scale of innovations made in a short time to ensure learning continuity proves that change can happen quickly. They have set the ground to reimagine education and build systems that are more forward-looking, inclusive, flexible, and resilient. Solutions must address learning losses, preventing dropouts, particularly of the most marginalized, and ensuring the social and emotional welfare of students, teachers, and staff. Other priorities include better support to the teaching profession, removing barriers to connectivity, investing in digital technologies, and flexible learning pathways”[5].

In our opinion, one of the ways to achieve this task is to use the open education system at all levels of education.

Open education in these conditions is becoming a powerful tool for the implementation of the task. The use of open education resources makes it possible to obtain high-quality education for various groups of students.

Under the new conditions, the faculty of the Department of Mathematics, Theory, and Methods of Teaching Mathematics required an urgent correction of the forms of organization of education. Work in the social network “Vkontakte”, which they

switched to at the CrimeanFederalUniversity, made it possible to implement basic educational programs, but at the same time implied greater independence of students. Not all students were ready for this. Therefore, there was a need for non-standard selection and structuring of the content of the subjects taught.

For students studying the program 44.03.01 “Pedagogical education”, the focus “Mathematics” and 44.04.01 “Pedagogical education”, the Master’s program “Mathematics in professional education” there was an urgent need to strengthen the methodological and practical orientation of teaching of all studied disciplines. The peculiarity of teaching all disciplines of the department in the professional training of a Mathematics teacher is that the organization of training (forms, methods, means) is aimed not only at the formation of competencies corresponding to the discipline, but also is a model of the teacher’s methodological activity, which will then (or will not) be used by future teachers. One of the aspects of providing a methodological orientation is the work within the framework of open education.

### 3 Method Development

Let’s analyze the main theoretical aspects related to the concept of open education.

According to Wikipedia’s definition, “Open education is education without academic admission requirements and is usually assumed to be online. “Open” education expands access to learning offered in schools and universities. The term “open” refers to the removal of barriers that can impede both opportunity and acceptance of participation in learning-based learning. One of the aspects of the openness of education is the development and implementation of open educational resources”[6].

In this definition, the concept of open education is narrowed down to online education with open access. It can be obtained by any person who has a desire, and, at the same time, there are no requirements for his educational level, profession, age, and other subjective factors. The absence (availability) of payment is not noted in any way, i.e. the subject can access the resources either free of charge or for a small fee.

In modern pedagogical science, the following definition is used as the main one: “Open education is an integrated and holistic learning system based on the interaction of educational institutions, centers, and virtual offices that provide educational services to various groups of the population” [7]. The integrity of the system under consideration is ensured by its goal –“the creation of optimal conditions for the development of the personality of each person through continuous education and increasing his professional growth in the information society” [7].

The difference between the previous definition and the last one is that the second is based on a systematic approach, relies on the need to ensure the development of the individual, its professional qualities through the continuity of education, and the first may have other motives. Unfortunately, this definition uses the term “educational service”, and also does not indicate whether the services are paid or free.

Open education is directly implemented through Open Educational Resources (OER). According to Cable Green, Director of Open Education at Creative Commons,

this term means “freely available materials that can be legally downloaded, edited, and shared to better serve all students” [8].

The next concept related to open educational space is a Massive open online course (MOOC). “This is a training course with massive interactive participation using e-learning technologies. This is a form of distance education available to anyone with an Internet connection. In addition to traditional actions with the materials of the training course (reading, watching videos, completing assignments), the MEP has the opportunity to use interactive forums that are created and supported by students and teachers”[9].

One of the first works devoted to the introduction of the MEP into the practice of teaching in the transition to the digital economy, which became the benchmark for further research [10].

The ideological inspirers of the creation of an open educational space do not equate to free and free access to educational sources. At the same time, it is noted that for MOOCs to become OER, free licensing is necessary (for example, in Creative Commons). So, the following meaning is put into the concept of OER: the resource exists in digital form (created with the help of electronic technologies, maybe in digital or paper form), it is freely stored, copied, and distributed; using the Internet, its general availability is ensured; open licenses keep copyrights [8].

In our research, we also relied on the results of such works on the professional training of future mathematics teachers [11-15].

## 4 Results

We found out the state of the use of open education sources in the methodological activity of a mathematics teacher using various means (observation, analysis of lessons, electronic journals, conversations, questionnaires). To clarify the attitude of mathematics teachers to the use of open education tools, we conducted an online survey using <https://docs.google.com/forms>(Table 1). Respectfully yours, the staff of the Department of Mathematics, Theory, and Methods of Teaching Mathematics.

It was attended by 198 respondents (teachers of Mathematics and teachers of mathematical disciplines of colleges and universities in Yalta and Alushta, students - future teachers of Mathematics). Here are the main results that made it possible to roughly assess the state of use of open education sources by teachers and teachers of mathematics on the southern coast of Crimea.

takes a lot of time (you cannot offer students unverified information). 22 respondents (11.11%) noted that they do not have enough knowledge of digital technologies. 112 respondents (56.57%) complained about the lack of appropriate methodological support.

**Table 1.** Application form.

№	Dear Colleagues! Please answer the questions posed.
Question 1.	Do you know what open education is? - Yes - I heard, but I'm not sure I understand the meaning - no, but I would like to know - no
Question 2.	Is there a need to study the theory and methods of using the sources of open education in the professional training of a future mathematics teacher? - Yes - no
Question 3.	Do you use sources of open education in your professional activities? - yes, if necessary - sometimes - not using If your answer is "Yes, if necessary" or "Sometimes", please go to question 5 If your answer is "I don't use", please go to question 4 and send us a questionnaire
Question 4.	If you do not use sources of open education in your professional activities or do it infrequently, please indicate the reason (you can choose several answers or suggest your version) - I think that this is not necessary at all (distracting, interfering with learning, I can cope myself, etc.) - preparing for classes using open education sources takes a lot of time for the teacher - I do not know enough IT technologies - there is no appropriate methodological support for organizing the use of open education in teaching mathematics - harmful content - other
Question 5.	Is the need for methodological support for the use of open education sources in the process of teaching mathematical disciplines urgent for you (in the form of guidelines, an electronic training course, manuals, etc.)? - Yes - no - I find it difficult to answer
Question 6.	For what purpose do you use the sources of open education in the process of teaching mathematics?
Question 7.	What sources of open education do you most often use in the process of teaching mathematics?
Question 8.	What difficulties do you face in the process of using the sources of open education (you can choose several answers or offer your version)? - insufficiently familiar with the list of open education sources recommended by the ministry - not all students have a sufficient level of digital competence formation - there is no corresponding software or hardware in classrooms - use in class distracts from the main purpose of the lesson - other

Of all the respondents, only 30 people (7.7%) do not know what open education is and do not use its sources. Out of the remaining 168 respondents (92.3%), they have an idea of this phenomenon or know what it is. They would like to study the historical, theoretical, and methodological foundations of using open education in their activities. Only 7 respondents (4.04%) believe that the use of open education sources harms the educational process. More than 90% of respondents want to know the scientific and practical foundations of using open education. And the desire to improve the quality of their teaching is indicated as the main reason. However, 40 respondents (20.20%) note that in preparation for lessons, you need to carefully review the proposed content, which

Thank you for your help and invite you to scientific cooperation!

Poor equipment of the school with technical means was noted by 63 respondents (31.81%). 134 respondents (67.68%) confirmed the urgency of the need for methodological support of open education sources.

Of the resources that teachers and teachers of mathematics use, in the survey, they indicated Foxford, Info-lesson. And the technical component complicates the work.

The analysis of the results of the questionnaire showed that open education and its resources are of interest to the majority of Mathematics teachers, and they are ready to use them in their professional activities to improve the quality of teaching.

## 5 Discussion

Founded in 2002, ISKME (a global nonprofit organization that inspires educators and brings them together in a collaborative and sharing learning ecosystem, is at the forefront of open education. It is characterized by the research in the social sciences, the development and the scientific justification of innovation for knowledge exchange in education) (<https://www.iskme.org/>).

In our activities, we try to use open educational resources that provide free access to our courses. At the same time, we use some platforms as samples (fictitious), and Russian resources also as training ones.

One of the platforms that we introduce to our students - future Math teachers - is the open education platform OER Commons (<https://www.oercommons.org/>), which is developed and maintained with the participation of ISKME. This platform is considered to be the oldest of its kind. From a methodological point of view, the interface and the possibilities of working with this platform are of high interest. The platform allows you to navigate to 38 hubs (a customizable resource center in the OER Commons where teams can create and share collections related to a project or organization). Projects, institutions, states, and initiatives use the hubs to bring groups of educators together to create, organize, and share collections that align with their common goals (<https://www.oercommons.org/hubs/>). For example, one of the hubs - Open Educational Practice and Professional Training (<https://www.oercommons.org/hubs/open-educational-practice/>) offers a series of interesting webinars on creating your open educational resources. Using the Google Chrome browser allows you to overcome the language barrier. Russian translation for non-English speaking students is of very good quality.

The materials posted on this platform are mainly developed by teachers from the United States. For our students on the site <https://www.oercommons.org/>, the following subjects presented some interest: education and mathematics. Of course, we did not limit our work to other subjects either. For each of the subjects, there is an opportunity to choose an educational level (from preschool to higher). Working with the "Educational Standards" menu item gave our students a unique opportunity to analyze the US state math education standards and the math education standards of various states.

The use of free resources based on the principles of open education in the professional and pedagogical training of future Mathematics teachers has proven itself well during remote work and has good prospects.

One of the most interesting platforms providing access to domestic open educational resources is the National Open Education Platform (<https://openedu.ru/>).

This platform is organized by the leading universities of our country: Moscow, St. Petersburg, Tomsk, and other cities (MoscowStateUniversity, MIPT, NRU HSE, SPbPU, St. PetersburgStateUniversity, NUST MISIS, UrFU and ITMO University, and other universities). All courses hosted on this platform, free of charge, built following the requirements of the Federal State Educational Standard of Higher Education, read by the leading professors of these universities, a total of 616 courses are presented on the platform.

For future Mathematics teachers, many sections of the courses offered on the platform are interesting: mathematical ("Various sections of mathematical analysis" <https://openedu.ru/course/msu/CALCSV/>, <https://openedu.ru/course/msu/MATHAN/>; "Analytic geometry" <https://openedu.ru/course/msu/ANGEOM/>, "Higher algebra" <https://openedu.ru/course/spbu/MATGR/>, etc.), linguistic (mathematical English <https://openedu.ru/course/hse/MATHENG/>), pedagogical ("Modern educational technologies" ([https://openedu.ru/course/spbu/EDU\\_TECH/](https://openedu.ru/course/spbu/EDU_TECH/))), etc.

For students of the master's program, we also offered, in addition to the discipline of the same name, which is taught by our teachers, an open course "Pedagogy and Psychology of Higher Education" (<https://openedu.ru/course/tgu/PEDPSY/>), sections of which are read by the leading teachers of Tomsk. Master students note that communication with our teachers and video lectures of professors and associate professors was very useful not only in terms of professionally significant information but also interesting in terms of communication with new people, authors of current textbooks.

Another platform that opens up opportunities for free access to educational resources National Open University "Intuit" (<https://intuit.ru>). While studying the topic "Control and assessment of knowledge in mathematics", our students became interested in the course "Introduction to practical testing" (by V. Kaziev, Kabardino-BalkarianStateUniversity) (<https://intuit.ru/studies/courses/1023/300/info>).

The author in an accessible format accessible level sets out the basics of creating tasks for tests, their high-quality connection into tests, and the specifics of testing. It also provides practical guidelines for testing in some programs.

However, almost all the courses offered on this resource relate to the application of information technology in various industries (education, business, science, programming, etc.).

Project “Universarium”, which is offered by LLC “Assessment of the quality of education” (<https://universarium.org/>), is a network interuniversity platform. The goal of the project is to develop the electronic part of the Russian educational space by leading Russian universities. On this platform, pre-profile training, targeted profile training are organized for the formation and retention of domestic personnel for the Russian industry and economy.

We would especially like to note such social functions of the “Universarium” as preserving the national identity of the Russian educational space, strengthening the position of the Russian language in the Russian Federation, and promoting the Russian language abroad as one of the leading languages of communication (<https://universarium.org/docs/o-proekte>).

Many courses at “Universarium” that are of interest to future Mathematics teachers are presented by MoscowStatePedagogicalUniversity. This is one of the leading pedagogical universities in the country, which trains Mathematics teachers. We will list just a few of them: “Modern lesson as a space for the formation of meta subject learning outcomes”, “Modern psychological and pedagogical technologies in education”, “Geometric methods for solving algebraic problems”, “Geometry: an analytical method for solving a problem”. All of these courses allow us to provide a methodological focus in teaching methodological and mathematical disciplines.

From a methodological and cognitive point of view, our students were attracted by the course “Course on the Unified State Exam or Unified State Exam for Teachers”, the purpose of which is to improve the level of training of Mathematics teachers.

Of the Russian-language platforms of open education, I would like to note the “Lectorium” project (<https://www.lektorium.tv/>). This resource also offers both paid and free courses.

From a methodological point of view, our students are interested in a selection of courses “Mathematics with Georgy Wolfson” by one of the best young teachers in St. Petersburg and Russia. These are courses “Not boring Algebra”, “Not boring Geometry”, “Gambling theory of probability”, and others. The audience includes pupils, parents, students, and teachers.

When studying the topic “Methods for studying ordinary fractions”, by the way, I got a free course for schoolchildren of grades 4-6 “Crrrrush everything” (Crush everything). It presents a practice-oriented approach to learning fractions. Some of the classes take place in a pizzeria, where the whole is visually divided into equal parts (usually 8), but less or more is possible). The concept of a fraction is formed in action, which is very important for this age group of students. The course consists of 15 full lessons (colorfully illustrated), 7 interesting homework assignments, and tests.

Also “Lectorium” together with the Autonomous non-profit organization “Center for Continuing Professional Education” ALFA-DIALOG (<http://www.alfa-dialog.ru/>) within the framework of the program “Personal digital certificates” from the state of the project “Personnel for the digital economy” offers free advanced training courses “Modern course building”, “Artificial intelligence in creative industries”, “Design of Crypto economic Mechanisms”.

Our undergraduates who already have higher education (bachelor's level) chose the first one. The course program analyzes existing online educational products and teaches

you to design and produce your online courses. The authors emphasize that blended learning forms the future of education (a combination of full-time and digital (online) forms). Therefore, the future teacher needs knowledge of the principles of creating and using digital content.

Students receive knowledge in computer graphics, which is necessary for the work of a modern teacher, media manager, producer, or leader in online education, modernization of educational programs. The stages of creating a MOOC are considered, the features of the production processes of online courses are revealed. In the practical module, users develop and submit their projects of online courses for examination (goals, visual solution, work plan following global educational trends, application of the acquired skills in graphic editors and website builders). To complete the project assignment, users are encouraged to master Tilda site builder tools for project presentations.

Our students also use free materials, which are kindly offered during the pandemic by famous platforms: Urait (<https://urait.ru/>), Netology-group (Foxford project (<https://foxford.ru/>) and Edmarket (<https://edmarket.ru/>)), GK “Prosveshcheniye” (<https://prosv.ru/>), Russian teachers (<http://school-detsad.ru/>) and many others.

Edmarket (<https://edmarket.ru/>) offers free webinars. For example:

“How do different types of online activities affect the motivation of children?” (what is important to consider when teaching children online, the peculiarities of motivating children of different ages, how to involve parents in online learning).

“How does game design work?” and others.

Other forms of work are also offered. For example, an online camp for creating courses, (5 days, live broadcasts) (topic and niche for an online school, drafting a course strategy, project launch budget, creating a popular online course).

In working with such materials, the opportunity to organize “observation lessons” that are included in the program of introductory training practices is especially valuable for us. During the quarantine period, working online in real-time at Foxford, MIPT free courses have become an indispensable help.

## 6 Conclusion

The use of resources of open education in the professional and pedagogical training of future Mathematics teachers during the period of distance learning made it possible not only to increase the level of professional competencies but also contributes to the methodological orientation of the training in question and an increase in interest in the profession.

## References

1. Concept Note by the Secretary-General on Education and COVID-19, available upon request from the UNESCO Press Office, Roni Amelan, [r.amelan@unesco.org](mailto:r.amelan@unesco.org) (link sends e-mail)

2. UNESCO COVID-19 Briefing Paper: How many students are in danger of not returning to school? <https://en.unesco.org/news/new-academic-year-begins-unesco-warns-only-one-third-students-will-return-school>
3. Campaign#SaveOurFuture:– Access mode : [www.saveourfuture.world](http://www.saveourfuture.world)
4. The Concept of Development of Mathematical Education in the Russian Federation (approved by the order of the Government of the Russian Federation of December 24, 2013, No. 2506-p). Moscow (2013).
5. UN Secretary-General warns of education catastrophe, pointing to UNESCO estimate of 24 million learners at risk of dropping out Press release – Access mode: <https://en.unesco.org/news/secretary-general-warns-education-catastrophe-pointing-unesco-estimate-24-million-learners-0>
6. Open education – Access mode : [https://ru.wikipedia.org/wiki/Открытое\\_образование](https://ru.wikipedia.org/wiki/Открытое_образование)
7. Lupanov V.N. Open education – Access mode : [https://w.histrf.ru/articles/article/show/otkrytoe\\_obrazovaniie](https://w.histrf.ru/articles/article/show/otkrytoe_obrazovaniie)
8. Cable Green Sharing legally and freely for better learning – Access mode: <https://en.unesco.org/courier/julio-septiembre-2017/sharing-legally-and-freely-better-learning>
9. What is MOOC? – Access mode: <https://www.facebook.com/URAITpublishing/photos/a.1111396068882898/3537079386314542>
10. McAuley A., Stewart B., Siemens G. and Cormier D. The MOOC Model for Digital Practice: – Access mode: <http://amp.gs/Lowj>.
11. Zenkina, S., Suvorova, T., Pankratova, O., Filimanyuk, L.: The Method of Design of Electronic Advanced Training Courses for the Development of Information Competence of the Teacher. Proceedings of SLET-2019 - International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research, Stavropol - Dombay, Russia, 20-23 May 2019. pp. 366 - 375. [http://ceur-ws.org/Vol-2494/paper\\_35.pdf](http://ceur-ws.org/Vol-2494/paper_35.pdf)
12. Konopko, E., Pankratova, O., Nersesyan, E., Abdullaev, J.: Training of Teachers for Professional Activity in the Digital Environment of the Educational Space. Proceedings of SLET-2019 International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research, Stavropol - Dombay, Russia, 20-23 May 2019, pp. 205-212. [http://ceur-ws.org/Vol-2494/paper\\_18.pdf](http://ceur-ws.org/Vol-2494/paper_18.pdf).
13. Taran, V. Use of Elements of Augmented Reality in the Educational Process in Higher Educational Institutions. CEUR Workshop Proceedings. In 2019 International Conference on Innovative approaches to the application of digital technologies in education and research SLET-2019 [http://ceur-ws.org/Vol-2494/paper\\_28.pdf](http://ceur-ws.org/Vol-2494/paper_28.pdf)
14. Astafieva, M., Bodnenko, D., Proshkin, V. Cloud-oriented training technologies as a means of forming the XXI century skills of future mathematics teachers. ICT in Education, Research, and Industrial Applications. Integration, Harmonization and Knowledge Transfer Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization, and Knowledge Transfer. Volume I: Main Conference Kherson, Ukraine, June 12-15, 2019. <http://ceur-ws.org/Vol-2387/20190507.pdf>
15. Ovchinnikova M., Shilova L., Linnik E. Using Means of Cloud Technologies of Training in the Study of Discipline "Discrete Mathematics" in the Professional-Pedagogical Training of Math Teachers. Information Systems and Technologies in Modeling and Control 2019: Selected Papers of the IV All-Russian scientific and practical conference with international participation "Information Systems and Technologies in Modeling and Control" (ISTMC'2019) Yalta, Crimea, May 21-23, 2019. <http://ceur-ws.org/Vol-2522/paper15.pdf>