The Role of MOOC Courses in the Development of Polytechnic Education

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Abstract. The research objective is to analyze the contemporary Russian platforms for massive online education, which provide the opportunity to master skills and obtain knowledge in compliance with the conception of polytechnic education: Open Education, Universarium, Lektorium, and Intuit. The research method is comparative analysis by criteria – number of visitors, area of training, target group, content specificity, including interaction means, systems of certification of the acquired knowledge. The authors come to the conclusion that most of the courses offered by the Universarium platform are aimed at schoolchildren, university entrants, and teachers. Open Education specializes in elaborating courses in compliance with federal state educational standards. Intuit specializes in IT sphere and provides additional education issuing documents of established form. Lektorium has significantly increased traffic since 2017, offering high quality content from the leading educational, commercial, and public organizations. An important characteristic common for all the studied platforms is a large variety of courses and educational programs, including those aimed at developing supra-disciplinary universal soft skills, and elaboration and publication of MOOCs for various target groups.

1. Introduction

All-round diffusion of the internet has created technical feasibility for developing globalization processes in various social spheres, including education. Having appeared in 2001, when Massachusetts Institute of Technology first provided open access to a lot of its teaching materials, having passed the process of institutionalization since 2008, today the systems of massive online education give everyone an opportunity to fill in the gaps in their knowledge, to acquire topical skills, to master a profession; in other words, to learn what one likes in the most convenient way. One of the main features of the early online courses was open access: open licensed content, open structure of learning and goals. Gradually, commercialization of such courses began. The system of assessment and the opportunity to acquire certificates of achieving the educational standards resulted in MOOC platforms starting to compete with traditional universities or sharpened competition between them. In

2018 Coursera collaborated with 149 world famous universities. By the end of 2018, over 900 universities around the world had announced or launched 11.4k MOOCs.

For some time, distant learning has become the issue of intent research, both from the viewpoint of education management (a detailed review of 102 academic research of MOOC in 2014-2016 by criteria: students, content and results of learning, students' involvement [1]; behavioral analysis of 320 students with various tools of automatic feedback through information panels, reports, and announcements [2]), and from the viewpoint of methodology [3].

Of interest are the early works, which attempt to reveal the specificity of distant learning of people from different countries [4], of both genders [5], with various motivations [6]. For example, Pintrich and De Groot [7] focused on studying the reasons for choosing e-learning. K. Swan [8] presented the results of analyzing the correlation between the principles of teacher-student interaction preset in various e-courses and the presence of a solid community of students, on the one hand, and the efficiency of program mastering and overall satisfaction with the distant learning process, on the other.

The works written after 2010 allow comparing how the above factors (intercultural features, demography, motivation) changed with the development of massive open courses and the increase of the number of distant programs [9].

Thus, the open platforms of online learning have become part of our everyday life, passing a significant way since 2008 and continuing to develop. It is essential to research the Russian experience of mastering this form of arranging the educational space in order to select the best practices of MOOC for Russia.

2. Research methods

We comparatively analyzed such Russian educational platforms as Open Education, Universarium, Lektorium, and Intuit. Comparison was carried out according to the following criteria: traffic, orientation of the courses, target group, content specifics, including interactive means, systems of certification of the acquired knowledge.

Besides, we used integrated analytical data about foreign platforms for orientation, such as Coursera, edX, Udacity, Futurelearn, Khan Academy, Miríadax. Analysis of these platforms allowed distinguishing the main types of courses from the viewpoint of their orientation and topics in order to systematize them.

3. Results

By the official data, the total number of visits in all platforms from September 2014 till August 2017 was 60.7 million. More than a half of the traffic accounts for Coursera (32.3 mln people). The Russian Open Education platform lags behind the leader by three times (10.7 mln users). However, given it was launched later than others (in 2015), the second position may show a rather effective dynamics of development. In the said period, Universarium registered 7.2 mln, and Lektorium – 4.7 mln people.

Analysis with https://a.pr-cy.ru/ service allows tracing the traffic dynamics at the sites; thus, in 2018-2019 Open Education platform was visited by 34 100 people a day, 1 060 000 people a month, and 127 200 000 people a year. Lektorium was visited by 12 200 people a day, 378 000 people a month, and 4 536 000 people a year; Universarium was used by 4 910 people a day, 152 000 people a month, and 1 824 000 people a year. This testifies to the most intense development of the educational formal of video lectures. Intuit National Open University counts 16 700 people a day, 516 000 people a month, and 6 192 000 people a year.

Taking into account the history of creation and development of the distant learning system and open access courses, one should consider the features of foreign platforms, as the Russian educational systems are mainly built on the basis of foreign experience. For example, Coursera Online Degrees provides learning in such topical areas as: Arts and Humanities, Business, Computer Science, Data Science, Information Technology, Health, Math and Logic, Personal Development, Physical Science and Engineering, Social Sciences, Language Learning. Thus, having analyzed the western experience

and taking into account the Russian specificity, as well as an insufficient quantitative repletion of the Russian platforms, it was decided to enlarge the groups of specialities.

The results are shown in the Table 1.

Table 1. Quantitative and percentage distribution of disciplines by the areas of training at the main Russian platforms of MOOC.

Area of training	Open Education		Universarium		Intuit		Lektorium	
	Number of courses	% of the total number of courses	Number of courses	% of the total number of courses	Number of courses	% of the total number of courses	Number of courses	% of the total number of courses
humanities	99	25.2	53	28.9	45	4.8	9	11.8
language courses, including Russian	25	6.3	14	7.6	5	0.6	1	1.3
management and economics	50	12.8	38	20.6	118	12.6	5	6.6
medical disciplines	10	2.6	14	7.6	0	0.0	1	1.3
engineering and technology	101	25.7	24	13	637	68.2	16	21.1
natural sciences	39	9.9	6	3.4	4	0.4	10	13.2
physics and mathematics	52	13.2	11	5.9	80	8.6	16	21.1
soft-skills development	17	4.3	24	13	44	4.7	18	23.7
total number of courses, including:	393	100	184	100	933	100	76	100
disciplines with broader topics	340	86.5	133	72. 3	722	77	47	62
disciplines with narrower topics	53	13.5	51	27.7	211	23	29	38

As of August 2019, Open Education platform offered 393 courses, Universarium – 184 courses, Intuit – 933 courses, Lektorium – 76 courses. All disciplines are classified by the areas of training; the majority of disciplines refers to the basic block and can be demanded by students of several areas of training.

4. Discussion

E-education, or online education, is changing the way we approach teaching and learning. The current form of online education started in the 1990s with the advent of the Internet and World Wide Web and continued to develop as information and communication technologies advanced and became more sophisticated [10].

Massive Open Online Courses (MOOCs) are open, large-scale web-based courses designed and delivered by accredited higher education institutions and organizations in which anyone with a smart device and internet connection can participate, regardless of age, gender, geographic location, or education background [11]. Unlike university-sponsored online courses, MOOCs do not limit the number of participants, charge no participation fees, require no pre-requisite units or qualifications, and do not require participants to study a program beyond an individual course [12].

Compared to the courses of other online educational platforms, the courses of Open Education have specific features. It should be noted that Open Education rather thoroughly describes each course, specifies the requirements to students, what a participant would get and where the acquired knowledge can be used. Also, one may learn in which Bachelor, Master and post-graduate majors the specific course is taught.

The students are provided an opportunity to register a course as passed at any university. For that, it is necessary to fulfill the control test in the personal identification regime and to get a certificate.

The courses structure is universal, implying lecture material in video format and in the form of presentations, self-check tests, practical tasks, including creative works, cross-testing of the works by "group mates", and some form of the final attestation. An important tool, influencing the quality of education, is interaction between students and teachers in the form of a forum on every section of the discipline.

In general, the percentage of courses aimed at engineering-technological sphere is high (101 course out of 393, such as "Programming Algorithms and Data Structures", "Mechanism and Machine Theory", "Additive Technology and 3D Printing"), which testifies to the platform's orientation towards maintenance and development of polytechnic education. In the second position are the humanitarian courses (99 out of 393), but most of them imply teaching the basic disciplines stipulated by the federal state educational standards for Bachelor courses in all areas (philosophy, history) and mastering general cultural and universal competences. Many disciplines of economic sphere are oriented towards developing the economic literacy of technical students: "Intellectual Property Management", "Technology Commercialization" (NRNU MEPhI), "Innovative Economy and Technological Entrepreneurship" (ITMO University).

This platform pays special attention to developing supra-professional skills, which are not associated with the administrative duties of an employee but are the same for all specialities ("Life Navigation" (ITMO University), "Personal efficiency: time management" (NUST MISiS).

Universarium platform differs, first of all, by its audience. A large share of its courses are aimed at university entrants and schoolchildren (for example, "Physics at fingertips" (https://universarium.org/course/621), and teachers ("Problem minimum in physics: how to teach schoolchildren solve problems" (https://universarium.org/course/611). Besides, alongside with free courses it offers paid ones (12 out of 184) on similar topics, providing a deeper study of the same disciplines. The largest number of commercial courses is offered in the niche of management and economics, as well as soft skills (41.7% each). The course topics are more humanitarian as a part of polytechnic education ("History of inventions and discoveries – the second history of humanity" (https://universarium.org/course/802).

Among the platform's drawbacks one may mention a lesser amount of interaction with a tutor, prevalence of asynchronous methods of teaching. Polytechnic education implies forming a multisided personality, not just a professional but also an active and decent member of the society with well-developed communicative skills. This aspect of a modern engineer is developed with the Universarium courses "Scientific method of Sherlock Holmes: observe, argue, assess" (https://universarium.org/course/1029), "Training of making presentations" (https://universarium.org/course/753). Universarium has elaborated a system of assessing each course in scores, but, just as in other Russian projects, it does not provide an opportunity to assemble a complete educational program in a certain area of education.

Another resource related to MOOC is the Lektorium educational project. Today, its website contains 76 courses. The MOOC developers are both the Lektorium and various educational establishments – the total of over 25 participants.

The platform offers convenient search for courses by several parameters – learning format (permanent access or scheduled lessons), availability of the course at the moment, possibility of paid/free learning and paid/free certification, an addressee. However, the filters have no such rubrics as "subject", "area of training", or "Course topic", which impedes the search of specific courses.

The target groups of the MOOC offered on this platform are schoolchildren, students, specialists of various profiles, and parents of schoolchildren. Many courses are adapted to the learners' age, for example, the courses "Self-management" and "Decision making" are offered for 6-8 and 9-11 grades, as well as for parents. Specialists may be interested in programs in the sphere of education ("Methodology of dissertation research", "Physics without formulas"), IT ("Basic course of robotics in Robolab language", "2D+3D design in AutoCAD") and others, as well as for developing universal skills ("Universal competences for providing personal efficiency", a series of courses "Using end-to-end technologies for Technet (Aeronet, Energynet, etc.) market"). Of special interest is the course "Universal competences for managing technological startups" (http://skvot.2035.university/startupmanaging), presenting the material as micromodules – longreads, each of them being self-containing and can be used separately to build individual learning trajectories.

The platform offers a rather convenient management of the courses. Pages are uniformly designed; all the key information is available – the course description, the target audience, the sessions format, the duration and plan of studies, the cost if the course is paid, the possibility and form of certification, the feedback, the authors and developers of the course. All programs are presented as video lectures; some MOOCs offer additional assignments and final assessment of mastering the materials. In their comments, the users often mark high practicability and level of elaboration of the study materials.

Most of the programs offered (almost 24%) are aimed at developing soft skills in students. This is a peculiar feature of this platform compare to others. The second position is occupied by physics and mathematics and engineering-technical sphere (21% each), the third – natural sciences (13%), then – the humanities (about 12%). Many courses are of interdisciplinary ("Historical geography", "Blockchain and cryptocurrencies") or supradisciplinary character ("An airplane: from a passenger to an engineer", "History and techniques of survival", "Universal competencies in managing technological startups").

Most of the courses on the Lektorium site are free of charge. Only seven out of 76 courses imply payment. These are mainly specialized educational programs, for example, "Bases of plastic makeup", "2D+3D design in AutoCAD", or courses aimed at training schoolchildren and university entrants ("Fun with algebra", "Fun with mathematics", "Frrracture it all!").

The Lektorium offers an opportunity to pass training both with and without a certificate of completion. For some courses, the certificate is issued without additional payment.

The platform's feature is a rather large number of specialized courses (38% of the total number of courses) and original authorship courses. For example, the MOOC "Ecology. Technology. Anime" (https://www.lektorium.tv/anime) presents an anthropological research by Professor Duskin Drum, where the author by the examples from Japanese anime and manga views the problems of relationships between an ecological and technological picture of the world.

Some programs imply interaction with the course author (checking the fulfilled assignments in "Olympiad mathematics") and communication between the participants, including at residential sessions.

Besides publishing online courses, the platform also offers various tools for their production (platform for creating and launching online courses for businesses and universities EDUARDO, video-recording and live broadcasting of lectures, training course developers at Open EdX platform, media-grants for developing courses for budget educational establishments). According to information on the site, it hosts the first Russian MOOC publishing house and the largest open access video-archive of lectures in the Russian language. At the moment of writing the article, the archive contained 5526

video lectures and works of conferences in 59 areas, created or published in collaboration with 149 partners, including the largest Russian universities, state establishments, Russian and foreign commercial and public institutions. The Lektorium per se shot 5027 video lectures, including 1486 within media-grants financing.

Intuit is the largest and one of the oldest Russian MOOC platforms. The first courses were created as early as in 2003, a non-profit organization was registered in 2009, and in 2016 it was licensed for performing educational activity by programs of additional professional education.

A peculiar feature of Intuit platform is significant prevalence of courses in the area of engineering and technology, aimed, first of all, at teaching information technologies, computer hardware and software. Such courses account for over 600 (68.2%). There are much fewer programs in the area of economics and management (12.6%), physics and mathematics (8.6%). Programs in the humanities and soft skills development account for 4.5% each. There are almost no courses in languages and natural sciences (less than 1%).

However, in our opinion, such misbalance is not an essential drawback, as most of the courses in various areas form a comprehensive polytechnic educational environment, aimed at developing the sphere of information technologies and, to a less extent, economics and management. For example, the courses of Physics and mathematics cycle "Mathematics of cryptography and theory of ciphering", "Mathematical theory of formal languages", "Classical and quantum calculations" and others significantly deepen and broaden the students' knowledge, while the students can choose the necessary modules for independent learning. The same is true for the humanities ("Legal and organizational bases of technical information protection", "Intellectual property rights for IT specialists"), language courses ("English for IT specialists", "Business correspondence in English"), economics and management ("Finance for IT managers", "Making advantageous financial decisions: criteria and algorithms"), and soft skills development ("Effective information processing (Mind mapping)", "Game theory and operations research", "Working in the internet", "Bases of personal efficiency in working with information").

The total number of MOOC on the platform is 933. On the one hand, such a large number of courses testifies to the high demand for the resource on the part of developers and students, as well as to the high quality organization of the platform functioning. On the other hand, however, almost a half of the courses (43%) were published before 2010, another 40% were published before 2015. It means that information is poorly updated; many courses are obsolete, which is especially crucial for the IT sphere.

The site has a rather complicated interface, uniting links to various projects of the resource. Searching for courses is rather difficult, as there is actually no full-fledged selection by parameters. A simple text search is also available. This is apparently insufficient for convenient navigation and selection of courses.

At the same time, many courses contain tags and key words, which could help find the necessary materials easily. For example, a course "Techniques of team development of software for information systems" (https://www.intuit.ru/studies/courses/4806/1054/info), devoted to the study of Microsoft methodology and solutions in managing the lifecycle of Visual Studio and Team Foundation Server applications, is marked with the following tags: MSF, Visual Studio, Team Foundation Server, uml, applications development. The course description contains all necessary information for convenient search – the topic, the major, the form of education, the cost, the access regime, the certificate of completion, the duration, the level of difficulty, the number of students and graduates, the ranking of the course, and references to similar or additional courses. We think that solution of this problem may be a vector of development and increasing the quality of the Intuit platform.

The courses are presented both in text (75% of the total number of courses) and video format (25%). Their structure may vary, but in most cases the lecture text is available. If a user is in the learning regime, they must fulfill an intermediary control assignment or a test to pass to the next section.

Almost all MOOCs on the Intuit platform are free for the students. An exception is programs of higher education, mini MBAs, professional retraining, and advanced qualification.

Course on the Intuit platform are not classified by target groups. The main MOOCs are supposed to be demanded by students and school/technical school graduates, as well as by specialists in various spheres. Access is also granted to schoolchildren, but at some courses getting an official certificate implies submitting a diploma of a higher or secondary special educational establishment. For example, to obtain a diploma of professional retraining in the program "Comprehensive protection of informatization facilities" (https://www.intuit.ru/studies/professional_retraining /19358/info) one must submit documents on previous higher or secondary special education. The course was developed for head and chief specialists of structural divisions on information protection in federal bodies of executive power, administration of the Russian subjects, local self-government bodies, organizations and institutions. Some courses are intended for schoolchildren ("Classical algorithms and games on C# for schoolchildren", "Mathematics and programming for primary school children", "Olympiad assignments in Information Science", "Introduction to logic"). These courses are free of charge; a certificate is issued on their completion. Just like the courses for grownups, the courses for schoolchildren are mainly in IT sphere.

As for arranging teacher-student and student-student communication, the platform offers only asynchronous mechanisms of interaction. Communication with a course's author is virtually lacking. Instead, there is an option of paying for the services of a tutor, who will check the fulfilled assignments and maintain discussion in case of questions, but will not help in solving the set tasks or give correct answers. Interaction with the tutor is asynchronous too; they are given up to 24 hours to respond. Students may communicate with other participants in "Questions" and "Discussions" sections, and exchange their "Thoughts" in the corresponding pages of the course.

"In this digital era, it is important to make a wise course choice since the building blocks of a career starts from choosing the career-specific course. With the number of online courses available, it is tough to differentiate a relevant career-focused course from a mediocre one. Hence, the authenticity and validity of a particular course influence the career choice of individuals" [13]. That is why "e-learning services, instead of being centralized, must be available as a general feature of other containing services, so that it can generate a learning event in the midst of the student being engaged in other activities. These other activities comprise authentic contexts of learning, as they are the normal situ for the corresponding knowledge to be learned" [14]. An important factor of efficient teaching within the frameworks of open courses is orientation towards students' needs. This is, first of all, due to that students can choose their own educational trajectory; for example, determine the area of education or choose between courses with similar topics designed by different educational establishments, guided by the announced program. For example, the Open Education platform present courses of the same topic "Health and Safety" by National University of Science and Technology MISiS (https://openedu.ru/course/misis/SAFETY/) and by Saint Petersburg State University (https://openedu.ru/course/spbu/BZDH/). The former course lasts for 10 weeks and provides four credits; a larger number of topics is offered. The course by another university lasts for eight weeks and provides two credits; the topics are more applied. Thus, the students may choose a particular program, guided by the schedule and open registration periods, the number of credits per a course at their university, or by the topic most interesting for them, depending on their major.

If a student needs to improve their knowledge in differential calculus, they may choose between specialized programs by the same or different authors on Intuit platform, such as "Differential equations" (https://www.intuit.ru/studies/courses/911/325/info), "Differential equations and boundary-value problems" (https://www.intuit.ru/studies/courses/4819/1071/info), "Differential calculus of a single variable functions" (https://www.intuit.ru/studies/courses/621/477/info), "Linear differential equations and systems" (https://www.intuit.ru/studies/courses/2341/641/info). Mathematical analysis is taught at five courses of Intuit and four of Open Education; besides, there are similar courses on foreign platforms, for example, "Introduction to mathematical analysis" of the Autonomous University of Barcelona (https://www.coursera.org/learn/introduccion-al-calculo?). Also, success of e-learning

systems depends on the system of recommending the content to a particular student depending on their requirements, interests, and earlier taken courses [15]. One has to agree that "the development of deep learning will allow future education to evolve into individual problem solving that is problem-oriented, rather than one-way broadcast or memory examination models of education. Immersion education will be greatly considered and learning will not be limited to the classroom, but to actual scenarios where problems are solved using what was learned" [16].

C.H. Lin, W.C. Wang, C.Y. Liu, P.N. Pan, and H.R. Pan assert: "This learning model [e-learning] is mostly successful in teaching and explaining set theory, or fortifies memory training to allow trainees to familiarize themselves with the lesson content. With regard to the enhancement of the user's thinking ability, logical reasoning or man and machine interaction, etc., the effects of e-learning are quite slim" [17]. In our opinion, the system of online learning is capable of solving the above-listed tasks, provided it uses specially selected assignments, assessment system, and practice-oriented approach in general. For example, a number of the Open Education courses are aimed exactly at developing logic, nonstandard techniques of creating something new, and creative thinking. For instance, a course "Psychology of giftedness, creativity, and genius" (https://openedu.ru/course/tgu/PHGIFT/#) offers, alongside with thematic video-lectures and additional materials, multi-variant test assignments with scores (11–19 questions to each section of the course) and creative tasks (for mutual assessment). For successful completion of the program on the theory of inventive problem solving, offered by Ural Federal University named after the first Russian President B. N. Yeltsin (https://openedu.ru/course/urfu/TRIZ/#), one must fulfill creative educational tasks and project assignments based of relevant graphic examples. In general, most of the MOOC contain certain combinations of the most popular functions (video-lectures, mutual reviewing, multiple choice tests, essays, discussion forums, online webinars), although there are large differences in the quantity and features of the offered means of learning [18].

Analysis of educational platform showed that modern massive open educational resources provide a lot of opportunities for bilateral interaction between students and professors. For example, all courses offered in the "Open Education" platform imply communication in a forum both on general issues and specific topics; there is a system of announcements about the terms of new modules mastering and tasks fulfillment. The research confirms the results of previous works, which showed that early engagement in MOOCs (e.g., watching lectures, contributing to discussion forums, and submitting assignments) can be used to predict course completion and course grade, which may help instructors and administrators to identify at-risk participants and to target interventions [19].

Thus, one has to agree that E-learning is a particularly important sociotechnical phenomenon, referring not only to learning-management systems of universities and similar institutions, but the pervasive activity of technology-mediated learning [20].

5. Conclusion

MOOC platforms become more and more demanded today. Thus is due to both technologies development, awareness of the value of information, and the specific lifestyle of a modern person. The platforms give millions of people access to educational resources and the possibility to flexibly control both the time of course completion and the content of the educational programs. To identify the best practices of MOOC в in Russia, the authors carried out a comparative analysis of such multifunctional and universal Russian educational platforms as Open Education, Universarium, Lektorium, and Intuit.

The national platform Open Education achieved the highest degree of integration with the existing educational system. This is manifested in elaborating all courses in compliance with federal state educational standards, in specific requirements to the quality of content and design of the online courses, and in the system of assessment of the study results. Moreover, students may register the completed courses as passed at any university. The training efficiency is promoted by the practice of interaction between students and teachers at a forum for any section of a discipline. While the areas of training are diverse, a special place is given to the courses aimed at developing supra-professional universal soft skills.

A peculiar feature of Universarium is orientation of courses to schoolchildren, university entrants, and teachers. Polytechnic education manifests an apparent inclination towards the humanities, taking into account interdisciplinary links. Besides, the resource offers a system of the courses assessment. A drawback, or rather a promising direction of the platform development, is impossibility to form a complete educational program in a particular area.

The platform of Lektorium educational project provides broad opportunities both for students and developers of MOOC. It presents a vast video material; most of the courses are free and even do not require registration; continuity and comprehensiveness of additional polytechnic education is ensured, including in the sphere of universal supra-disciplinary competencies. It also provides an opportunity to obtain a standard form certificate of taking some educational programs. Among its drawbacks are: a small number of courses, no filter by study areas, and the lack of integration of the offered programs into the system of school, specialized, or professional education.

Intuit has a number of peculiarities compared to other objects of our research. First, this is absolute accessibility of all materials for a user; second, a rich choice of high quality courses in the IT sphere and adjacent areas. Also, the resource provides an opportunity to take courses of professional retraining, advanced qualification, pass certification of skills and obtain an official document of established form; thus, it occupies the niche of additional education. On the other hand, the site has inconvenient navigation, no interaction with the author of a course; after completion of most of the courses a student gets only an electronic certificate; there is no integration into the Russian system of secondary and higher education.

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