Online course (MOOC) "Concepts of Modern Natural Science" on the National Platform of Open Education: experience in teaching students

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Abstract. The article discusses transformation of the education system under the influence of MOOC. It provides information about the features of open online courses offered on the Russian national platform for open education (NPOE), and their place in the educational process of Russian universities. We show the structure of the MOOC "Concepts of Modern Natural Science" at NPOE and consider the features of using the MOOC in teaching natural sciences to humanities students of the Polytechnic University (in blended learning format as well as in completely online learning). The authors investigate the efficiency of the electronic format in teaching students a non-major discipline. We present and discuss the results of the statistical processing of data obtained when testing and surveying the online course students. The article shows the efficiency of applying the MOOC in the implementation of the university’s educational programs.

1. Introduction
The rapid development of information and communication technologies determines the main vector of modern processes in the global educational space. The year 2018 marks the tenth anniversary of the start of a significant and one of the most promising phenomena in education – MOOC. MOOC (Mass Open Online Courses) can be considered as a form of distance education - with interactive large-scale involvement, the use of e-learning technologies and open access via the Internet [1, 2].

Almost immediately after the start, this format of training was recognized by all participants of the educational process who assessed its prospects. The term “MOOC” was introduced as “the most popular term in education - 2012” [3], which reflects a wide interest in the MOOC concept. The MOOC phenomenon is named among the 30 most promising trends in the development of education until 2028 [4]. And today all the leading universities around the world are actively creating their MOOCs, offering them for training not only to their students, but also to anyone who has access to the Internet. The largest MOOC platforms - Coursera, Udacity and edX - mainly use the traditional approach to the learning scheme. Most of the proposed MOOCs are constructed according to a well-known model: teachers (knowledge) are in the centre, and students are replicators, knowledge transponders. But MOOC always includes an active forum, feedback from the teacher, the possibility of individual training. Therefore, as a result of mastering the courses students develop their own creativity, gain experience not only in the acquisition of knowledge, but also in its creation, and apply creative approach to solving problems.
In line with global trends, the educational process in Russia is also being transformed, demonstrating the intensive implementation of information and communication technologies. In 2015, with the active support from the Ministry of Education and Science of the Russian Federation, the Association “National Platform of Open Education” (“NPOE”) was established. Its founders were 8 leading universities in Russia, which offered their online courses on basic subjects studied at Russian universities on the open education platform. All online courses of the platform are developed in accordance with the requirements of the Federal State Educational Standards. Therefore, any user-student can choose and master any interesting online course offered by one of the leading universities of the Russian Federation free of charge. Moreover, students can transfer the results in their own university as part of their educational program, if they successfully complete their studies, having passed the final test with a strict procedure for personal identification. Regular internal and external expert examination of the courses ensures their constant modernization and high quality. Currently, the network interaction of universities in mastering the online courses of the platform is gaining popularity: third-party universities are actively using the courses of the universities-creators in the implementation of their educational programs, entering into special network agreements. According to experts, the project "NPOE" is one of the most effective in the Russian higher education system, the pace of its development is very high.

2. A structure and materials of the course "Concepts of Modern Natural Science"
St. Petersburg Polytechnic University is one of the founders of the NPOO platform. Among the active online courses developed by the university, one can single out the course “Concepts of Modern Natural Science” - CoMNS [5]. The online course model is as close as possible to the traditional e-courses. Graphic, text and media content (audio, video) is organized in a clear and understandable structure including training, controlling and monitoring units (modules). The course participants become familiar with the basis of modern natural science for 16 weeks. This is a duration of the semester. The course materials are divided into 15 topics – modules. Every week the students receive materials of the next topic. Materials of any course module must contain: 1) video lectures; 2) lecture presentations; 3) a brief summary of the lecture material; 4) materials for practical training; 5) materials for independent work; 6) questions for self-test; 7) test tasks (their performance demonstrates to both students and teachers how well the material of the topic is mastered). The last, 16th week of the course is devoted to final testing, which takes place in the mode of students’ personal identification. The schedule of the course is synchronized with the usual educational process of the university: the course on the platform of open education is launched twice in the academic year – at the beginning of each semester.

3. Feedback from online course participants
The course provides feedback from students. This is a forum (Discussion tab) where students can ask questions about the content or the course, share their own thoughts, associations, experiences and get an answer and support. The teacher daily (perhaps more than once) looks at the messages on the forum and promptly responds to students’ requests. At the forum students can interact not only with the teacher, but also with each other in the student-student dialogues. The most interesting and fruitful situation here is when many students are participating in the discussion of some topic together. This creates an illusion of communication in the usual social networks for students. The course has a system of not only open, but also personal messages. Such interaction may be used to transfer confidential, private information from one student to another as part of the communication on the course.

4. Testing and evaluation of its results
There are three types of testing in MOOC CoMNS: 1) interim assessment for each topic; 2) testing for each practical lesson; 3) final exam. The performance of test tasks should demonstrate to both teacher and students how well the material of the topic has been acquired. Each type of control tasks 1) and 2)
has its own deadline. Each student can count on independence in choosing the pace (as well as time and place) of studying the course materials within the deadlines. The system of control measures’ deadlines makes the study of course materials a part of the university educational process, encouraging students to discipline in organizing their own time.

Both students and teachers are given access to the special tab “Progress” with the results of regular intermediate testing, where students can track their own success, and teachers can easily monitor students' progress in mastering course materials. The course material is considered to be learned, and the tests passed, if each of them is completed by 60% or more. The certificate is given only to students who have successfully completed the course and passed the final test with the identification procedure.

5. Network partnership
St. Petersburg Polytechnic University offers the online course "Concepts of Modern Natural Science" at NPOE both to its own students and to students from other universities. In the latter case network agreements are concluded between the Polytechnic University and partner universities. Partner universities send their students to master the discipline and then accept the results of training in their own program. Polytechnic University provides partner universities with not only complete information on students’ performance, but also the opportunity to participate in the final control tests. The noticeable and positive experience of such network interaction with partner universities for teaching natural sciences has already been accumulated.

6. Teaching science to students of the Polytechnic University. Blended learning format
The online course CoMNS NPOE is actively used in St. Petersburg Polytechnic University to teach its own students the basics of natural sciences. Typically, these are students of humanitarian and socio-economic field of education, more than 2,000 people annually. The discipline materials acquaint them with the specifics of science, with an array of basic natural science concepts, with the natural science picture of the world, and help to develop a holistic materialistic view on natural phenomena. It is clear that the acquaintance of humanities students with the conceptual basis of natural science, a difficult topic for them, encounters certain difficulties. This includes low levels of competence, lack of motivation for studying natural science and a number of others. Using the online course in training makes it possible to overcome most of them. After all, the MOOC format allows not only to adequately build the course content, but also to present the material in a special way, making it accessible and most interesting for students. All this stimulates creative activity of students and creates conditions for its implementation.

Teaching the basics of natural science to part-time students is almost completely conducted in the remote mode except for the final testing. The final test is held in a specially equipped classroom under the supervision of a teacher (offline proctoring mode). Full-time students master the basics of natural science in the current blended learning format (the symbiosis of distance and traditional face-to-face technologies). The remote part of the discipline is implemented in the form of a MOOC CoMNS at the NPOE, and traditional technologies are represented by classroom (face-to-face) seminars, which take place in the form of discussions of students' reports on natural science topics. The organization of classroom seminars at the same time solves important tasks, among which it is easy to single out the following: 1) discussion and consolidation of the lecture material; 2) detailed acquaintance with individual sections of the theoretical course, which were or were not spoken about at the lectures; 3) the formation of skills of independent work with educational and scientific literature, including the works of outstanding scientists; 4) acquiring the experience of public speaking, opposing reports, discussing the received natural-science information. In addition, face-to-face seminars allow each student to evaluate their own current level in mastering the discipline, and looking at the achievements or failures of their comrades, correct their interaction with the course materials.

The format of blended learning today is extremely popular in the educational space. Research shows the benefits of integrating a MOOC with classroom activities and barriers that may hinder successful implementation [6, 7]. We are all witnessing an accelerated evolution of this pedagogical
mechanism associated with the progress of information and communication technologies. But how can we evaluate the success of training in this format and its prospects? Will the estimation be objective? How do students assess their educational experience?

7. Evaluation of the MOOC effectiveness in training
Let us try to assess the effectiveness of the MOOC, which is used in the blended learning format. It is clear that such indicators as attendance of e-lectures, current test results, final grades - look more objective than, say, testimonies of students about their learning experience, assessing their own success or efficiency of communication during the course, opinions about the effectiveness and convenience of the learning environment. In addition, it should also be noted that all these indicators will vary depending on a number of factors. For example, on whether MOOC is used only in distance learning or in the blended learning format.

We carried out a statistical processing of final results of mastering the course "Concepts of modern natural science" by students, as well as other indicators (surveys, questionnaires, activity data on the forum, the nature of the questions asked, attendance analysis, viewing electronic materials of the course, intermediate testing data, etc.). Among the results obtained, one can note a clear correlation between attending e-classes and grades for solving test tasks, between participating in forum discussions and the level of the final grade. We present the data of the final testing on the electronic course, which took place in a special computer class on the 16th week of course work. Humanities students of one of the institutes in Peter the Great St. Petersburg Polytechnic University wrote a test of 40 questions for 40 minutes in the presence of the teacher.

8. The results of the final testing
The results of the final testing (Table 1, Fig. 1) demonstrate, on the whole, a satisfactory level of mastery of natural science materials by the humanities students, as well as a noticeable resistance of students to exam stress.

Table 1. Results of final testing of e-course students.
Total tasks in the test - 40. Total students who solved the test – 797.

| Solved tasks of the final test (%) | Number of students who solved the tasks (%) |
|-----------------------------------|-------------------------------------------|
| 0 – 50                            | 12.42                                      |
| 50 – 60                           | 13.8                                       |
| 60 – 70                           | 23.59                                      |
| 70 – 80                           | 31.12                                      |
| 80 – 90                           | 16.69                                      |
| 90 – 100                          | 2.38                                       |

Note that the discipline of natural science is not a profile for humanities students, and the format of the MOOC was unknown to them earlier. It is interesting that the results of the final testing of students involved in the e-course, in general, coincide with the final results of students engaged exclusively in the traditional "face to face" format. A high percentage (12.42%) of students who did not pass the final exam on the first attempt is undoubtedly associated with both the stress factor at the offline exam and their unfair work on the electronic course during the semester. This is proved by the analysis of the correlation between the exam results, the results of intermediate tests as well as the viewing of
electronic lectures in the semester. The result at the end of the semester totally depends on the students’ effort during the whole course of studies.

![Figure 1](image.png)  
**Figure 1.** Results of final testing of e-course students.

9. The results of data processing of student surveys
The results of student surveys data processing indicate, mainly, the positive assessments by students of their participation in the MOOC. The MOOC format itself is of great interest to the audience. Most students call the following MOOC advantages in their own learning: the possibility to access content at any time (which means having a choice of hours that are convenient for classes), the ability to plan a personal learning process, the opportunity to repeatedly refer to the text materials of the course, to video and audio content. Students noted the value of forums, communication with the teacher, discussion of the discipline materials within student groups. Even the effectiveness of frequent, weekly test control of the discipline materials mastering was noted. Regular testing reduces stress and allows increasing the array of mastered and retained knowledge.

10. Conclusion
We studied the effectiveness of the electronic format in teaching students a non-major discipline. The use of MOOC in both blended learning and fully distance format was taken into account. The results of teaching the humanities students of the technical university to the fundamentals of natural science, as well as data on the interaction of students with e-course materials were obtained. Analysis of the results showed a rather high efficiency of MOOC in teaching students. The surveys of students involved in the e-course show their positive assessment of the learning environment and their own experience.

The obtained materials allow us to conclude that MOOCs, placed on the national platform of open education, can be effectively used by universities in the implementation of educational programs both completely remotely and in blended learning, bringing this learning mechanism (the format of higher
education) to a completely new pedagogical and technological level. All this allows us to link the current stage of development of higher education and its prospects with the MOOC phenomenon.

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