MOOC As an Enabler for Achieving Professional Competence: Problem-Solving Aspect

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Abstract—The prerequisites for this research included the rapid development and constant modernization of massive open online courses (MOOCs) and their dissemination in higher education, in particular, in the preparation of medical practitioners of various specialties. The present investigation was conducted among two groups of students of I.M. Sechenov First Moscow State Medical University (experimental and control, 48 and 46 people respectively). For the control group, a standard MOOC with a training design characteristic of the vast majority of similar courses was proposed. The experimental group took the MOOC with additional learning strategies. Results showed the introduction of collaborative learning and decision-making assignments in e-education could overcome the challenges of MOOCs or at least significantly reduce their negative impact on the learning process. The share of experimental group participants who completed the training course and passed all the tests was 78.26%, while in the control group, their part was only 39.58%. The study findings can be widely applied when designing new MOOC curricula or improving the existing courses.

Keywords—Collaborative learning; e-learning; MOOC; professional competence; decision-making

1 Introduction

These days, MOOCs are among the latest trends in education. They provide free access to higher education and help learners acquire knowledge and skills in the most accessible way. MOOCs assist in overcoming geographical, social, ethnic, religious, and other factors, limiting access to knowledge and training [1]. The first reference of the MOOCs appeared in 2008 [2]. Already in 2014, more than 400 colleges and universities offered a total of more than 2,400 online courses. In 2016, MOOCs were
offered by more than 700 higher education institutions, which enrolled about 58 million students. Since 2012, both free and commercial independent MOOC platforms have been actively developed (Udemy, edX, Coursera, Canvas Networks, and FutureLearn) [3]. Now, their number is growing at such a rate that it is difficult to give a global assessment.

The use of MOOCs was of great interest due to the possibility of reducing indirect training costs associated with transportation, accommodation, meals, and other related issues [4,5]. Even though the beginning of MOOCs development occurred in the developed countries of Western Europe and the USA, MOOCs are most prevalent in developing nations in which the problem of education fees is particularly acute at personal and national levels [6].

Modern MOOCs are evolving increasingly fast and becoming more diverse. Most researchers divide them into two most significant types: MOOCs conducted by colleges and universities, that use a specified syllabus practiced in higher educational institutions, and MOOCs placed by any author [7]. University-based MOOCs are taught by the teachers of the educational institution. The value of such MOOCs, to a large extent, lies in certification and confidence in the teachers’ knowledge [8,9]. MOOCs of the second type are often paid and relate to rather narrow areas of study. Their cost is low enough to attract as many participants as possible [10]. Frequently, students are interested in such MOOCs due to the involvement of eminent educators or famous people, demonstrating high competence in one or another professional field. Although the advent of open online learning and easy access to knowledge at no extra cost causes worldwide enthusiasm, the learning outcomes and the quality of acquired skills raise concerns among researchers and dissatisfaction among users [11,12]. All types of MOOCs face with similar challenges: high dropout rate, insufficient knowledge quality, difficulties with the practical implementation of acquired skills, weak motivation and personal satisfaction of users after training [2,13,14]. Many researchers mention that the world dropout rate of MOOC learners stably stays around 90%. As a rule, passing the MOOC does not guarantee that the acquired knowledge and skills will be used in further professional activities, even if the course is fully completed [12,15].

University-based MOOCs rely on existing education programs and are used to attract more students to full-time academic studies. Furthermore, such courses are widely introduced as means of advanced training that improve existing knowledge and develop new competencies in one’s professional field, establish business relations and create global collaborative networks of professional support [16,17]. MOOCs are often implemented into blended learning, being added to classroom activities as an element of online education to create a digital environment for the formation of new generation skills. For example, MOOCs can be used for the search and independent application of advanced knowledge when making decisions in one’s professional sphere [4,17,18]. None of the researchers brings into question the importance of MOOC as a mean of creating a new economic paradigm (knowledge economy), as well as an environment for information dissemination and provision of social interaction [2,19]. However, over the past five years, more and more studies have been devoted to the investigation of how MOOCs improve professional competencies, and whether these courses are effective or not [12]. The prevailing number of sources argues that the central role in
improving MOOCs results is played by the courses’ design, structure, method of educational content presentation, and application of various mechanisms to determine the students’ interests. Undoubtedly, MOOCs contribute to the independent selection of learning rhythm and speed, as well as the determination of the curriculum and study focus. Nevertheless, many scholars have noticed that students are steadily losing learning motivation. It was instrumentally confirmed that the learning quality is declining due to similar reasons and even in the same among many MOOC students [20,21]. A decrease of interest toward education and reduction of time spent on training usually occurs at the end of the first month and during the 10th-11th week of the course [13]. This data are not related neither to the course peculiarities or the target group of users nor to the field of knowledge to which the course dedicated.

Several works indicate that meeting the challenges of MOOCs as a means of building professional competence, especially in the medical field, can be based on the use of modern graphic technologies. Hence, the entire learning process can be transferred to virtual reality, where one can meet with the teacher, follow all the program details, or learn new material. Even regular educational content, such as links to web sources, images, texts, and videos can also be placed in a virtual space, considerably increasing the interest in training and the number of participants who will finish the course [22]. Nevertheless, the implementation of virtual reality affects the level of professional competence less than necessary. The main challenge of modern MOOCs is that they still cannot be considered as the only way to train competent specialists able to perform complex tasks in their vocational area [19]. Without an external control and stressful stimuli, such as the high cost of the training course, constant monitoring by teachers or their assistants, the possibility of getting work based on the training results, and the like, students’ motivation remains low. Poor motivation is manifested in the fact that the majority of learners prefer to view, read and watch training materials, repeatedly returning to different sections of the course, without doing the provided self-study assignments [23-25]. Consequently, the prevailing part of the tasks remains undone (starting mainly from the first quarter of the training course). Often, it is the failed tests and exercises that provoke the one to leave the educational course long before its end [23]. The most obvious reason for this “burnout” is the absence of additional personal skills necessary for effective e-learning. Among such skills are time management, self-organization, psychological stability, ability to overcome obstacles and cope with poor learning results [26].

A wide range of studies focuses on the determination of factors that may significantly enhance the effectiveness of MOOCs and increase motivation to learn and achieve striking academic results [23,25]. Among them, social interaction during training, availability of tasks associated with one’s life experience or environment, and more active cooperation with the instructor are identified [1,8,9]. Currently, there is an accurate understanding of challenges in the functioning of MOOCs and critical factors for increasing their effectiveness. The use of various types of training programs and pedagogical methods implemented in MOOCs has also been examined thoroughly [5,27].

For this reason, the present paper is aimed at finding the possibility to increase the effectiveness of MOOCs, especially in the field of medical education, through the implementation of a specially developed practical course. Nowadays, there is an abundance
of articles that examine the diverse aspects of MOOCs development as well as the unique design of the applied technical solutions for MOOCs improvement [28-30]. However, very few investigations test the effectiveness of other methods for solving specific challenges of MOOC functioning, identified by researchers. This research focuses on the use of two critical factors in increasing the interest in open online courses to overcome such challenges of MOOCs, as high dropout rate, low quality of gained knowledge, and learners’ unwillingness to complete tasks and pass tests.

2 Materials and Methods

The study was based on I.M. Sechenov First Moscow State Medical University (Sechenov University) and carried out among second-year students. Those persons who agreed to participate in the research were anonymously registered via the Internet and assigned random identification numbers. Among the applicants, 94 individuals were randomly selected, making up a sample of the study. For the examination, experimental (46 people) and control (48 people) groups were created with an equal number of male and female respondents. Study participants could communicate via the Internet, remaining completely anonymous, without identifying themselves in collaborative assignments.

Students were asked to take a MOOC in one of the additional disciplines, the study of which did not affect their overall academic performance to ensure conditions consistent with real MOOC. As a result of the course taken, all the involved could gain relevant knowledge and skills useful for future profound study of other disciplines. In such a manner, the initial motivation corresponding to the stimulus that encourages participation in MOOCs was formed.

During the examination, participants were offered the same MOOC containing identical educational resources: videos, printed and illustrative electronic materials, presentations, lecture notes, links to downloadable sources, self-study exercises, as well as forums and social networks to support community interactions between students and teaching assistants. In the experimental group, two additional types of work were also practiced - collaborative assignments that involve other students and decision-making tasks based on real-life situations. These assignments were to be completed in a limited time, counted down by a timer, during which students had to find an adequate solution to the situation, in accordance with the knowledge obtained from the course or their own life experience. Both types of tasks could be discussed on the forum or social networks with other course participants. Thus, there were created such conditions in which the control group received a standard set of training tools of the modern MOOC, and the experimental group had several additional means of e-learning that the authors considered necessary to improve the quality of MOOCs.

For both groups, the course was offered over a period of 61 days. On its completion, each of the participants filled out a questionnaire to subjectively evaluate the level of motivation during the training, satisfaction with the learning process, and the effectiveness of the course in terms of the quality of acquired knowledge. The assessment was carried out on a ten-point scale, where 10 points corresponded to the highest
estimations. Additionally, all respondents passed the special test to objectively assess the knowledge obtained during the MOOC. It consisted of 20 multiple choice questions on the studied material with the only correct answer. The maximum possible number of points, according to the test results, was 20. In order to ensure a fair assessment, this examination was conducted after access to the MOOC was closed for all the participants, and they could not use its materials while performing the test. All the obtained scores were tabulated and statistically processed.

The assumption that the introduction of collaborative learning and decision-making tasks into a standard set of MOOC practices will increase the success and effectiveness of the course forms the hypothesis of this study. Positive changes should be reflected in the following four indicators:

1. Increase in the number of students who finished the course
2. Increase in the amount of time spent in the MOOC
3. Subjective assessment of MOOC in the experimental group is higher than in the control group
4. Improvement in knowledge acquisition.

3 Results

During the 61 days allotted for the training course, participants of the experimental group spent 28,376 teaching hours studying the material and completing tasks, while the students of the control group spent only 14,761 hours (52.02% of the time of the experimental group). Consequently, the period for the comprehensive acquisition of the training material by the experimental group almost doubled. Only 36 of 46 students (78.26%) in the experimental group and 19 out of 48 students (39.58%) in the control group finished the course, having passed all the exercises and tests. Thus, the first condition for accepting the research hypothesis was confirmed.

As follows from Fig. 1, in the control group, the wane of interest in learning and a decrease in the time spent on training were observed. The possibility of such a scenario is quite common and was already noted in a number of studies [13]. Fig. 1 depicts a rapid increase in interest in the MOOC during the first week of training, a two-stage decline after the 7th and 11th day of the course, and a gradual decrease in students' engagement by the end of the course. Generally, this diagram is topologically similar to the normal distribution of attention to a new subject, characteristic to any learning process (if attention was not supported by new behavioral stimulus) [27].

During the course, slower growth of interest, longer preservation of the highest activity level, and a more gradual decline in participants' engagement until the completion of the MOOC was observed in the experimental group. Besides, it was noted that the amount of time spent on training on the last day of MOOC in the experimental group was more than four times higher than in the control group (275 hours and 61 hours, respectively). On the graph, one can notice a more frequent appearance of training activity peaks, associated with the implementation of collaborative tasks and decision-making activities. So, taking into account all the data provided above, the second condition for accepting the research hypothesis could be deemed proved.
Table 1 explicates that most of the time spent by the control group for studying in the MOOC was dedicated to learning the course materials (primarily educational video). A smaller portion of time was devoted to discussions with instructors, while only 7.64% of the whole study period was spent on practical assignments. Trying to achieve the optimal result, most of the control group participants just read or glanced through the study materials and did not complete the exercises or paid minimum attention to them. This information is entirely consistent with the experimental data for various MOOCs, obtained other researchers [13,24].

In the experimental group, a much more uniform distribution of the study time was observed. Participants from this group spent only 21.08% of the training time completing the same tasks that the control group worked with during the whole MOOC. Along with this, the experimental group students had two additional types of tasks (collaborative training and decision-making), on which they spent 16.9% of the entire study period. Participants’ involvement in collaboration and the need to find a solution in a limited time led to the fact that the time spent on the forum and Internet communication increased to 25.95%. This positively affected students’ social skills and group interaction experience [18] (Fig. 2).

| Table 1. Percentual distribution of time by training activities |
|---------------------------------------------------------------|
| **Educational video** | **Forum** | **Assignments** | **Collaborative learning** | **Decision-making** |
| Experimental group   | 36.07     | 25.95         | 21.08                   | 7.75                | 9.15                |
| Control group        | 78.85     | 13.51         | 7.64                    |                     |                     |

Fig. 1. Distribution of time spent in MOOC
The statistical evaluation of the subjective assessment of students' attitudes toward MOOC is presented in Table 2. It shows that all the obtained average estimates in both groups are relevant since they are outside the random scatter. For this reason, these data can be taken into account when testing the research hypothesis. The relatively low dispersion of all estimates can be provoked by similar behavior of the population sample since all participants had almost the same age, social status, and personal experience. The assessment of personal attitude toward training in MOOC in the experimental group was relevantly higher than in control. The average evaluation of learning motivation corresponded to 7.3 for the experimental group, and 5.48 for the control group. The average estimates of satisfaction with the learning process equaled 7.41 and 5.02, respectively. In the meantime, the assessment of knowledge quality varied remarkably among students of both groups, corresponding to average values of 7.59 and 4.84.

### Table 2. Subjective assessment of taken MOOC

|                     | Experimental group | Control group |
|---------------------|--------------------|---------------|
| **Average estimates** | 7.304348           | 5.479167      |
| **Dispersion**       | 1.86087            | 1.91445       |
| **Average deviation**| 1.096408           | 1.204342      |

The objective assessment of the MOOC users’ knowledge demonstrated ambivalent results (Table 3). The average scores in the experimental group were higher than in control (14.93 and 11.41). However, given the average deviation of Pearson's correlation coefficient, the relevance of these results may be called into question. Besides, a significant dispersion was observed in the estimates of both groups, which suggests that this assessment criterion lies on the borderline of statistical probability.
The obtained dispersion values and results’ fuzziness were provoked by two main reasons. First of all, there was a great number of participants in both groups who did not complete the course or did not master all the training material. Despite the meaningful improvement of these indicators in the experimental group, the opportunity to use MOOC materials without any limitations puts in doubt the quality of knowledge gained. The second reason is the practice of relying on the information, constantly available on the Internet, or on the help of one’s colleagues or instructors while applying knowledge. This point should become the subject for further research because medical workers must operate with theoretical and practical skills without external sources of information. Therefore, the use of this principle in healthcare MOOCs requires additional investigation and the design of such training courses - further improvement.

Nevertheless, the fourth condition for proving the research hypothesis could be considered satisfied, as well as the hypothesis itself confirmed.

### 4 Discussion

Studies on the use of various MOOC methods for medical workers preparation in the vast majority of cases indicate that online courses can only be effective in conjunction with practical classroom training or further advanced education. If the need arises to train nursing staff, MOOCs are excellently suitable as the core teaching method, which enables the learner to revise the training material more often, and then consolidate knowledge through the practical application in class [31,32]. It is worth noting that this approach is also useful for technical and engineering specialties and in all professional fields for which practical skills in physical interaction with objects, people, and mechanisms are necessary [33]. Implementation of MOOCs in blended learning allows using collaborative learning mechanisms, STEM elements, and other modern teaching technologies to overcome some of the MOOCs’ challenges.

In view of the fact that social interaction creates various communicative relationships and dependencies that support students’ motivation, many researchers suggest the implementation of collaborative learning as an effective way to solve the problems of MOOC. Long-term usage of the e-learning system often leads to a sense of aimlessness of performed actions. For this reason, the presence of other people in the process of mastering the course becomes essential in the formation of student's motivation [34,35]. This assumption was fully confirmed in the current study; however, its additional investigation is still needed. Even advanced collaboration does not guarantee remarkable changes in the quality of knowledge acquisition since a meaningful part of students refuses to do exercises starting from about the middle of the course. A number of works suggest various ways to tackle this matter. Although, newly created solutions were

| Table 3. Results of an objective knowledge evaluation |
|------------------------------------------------------|
| **Control group** |
| Average score | 11.41304348 |
| Dispersion    | 8.553191489 |
| Average deviation | 2.3125 |
| **Experimental group** |
| Average score | 14.93478261 |
| Dispersion    | 8.728985507 |
| Average deviation | 2.34935728 |
found and proposed only theoretically and have not yet been practically and experimentally verified. One of these solutions is the use of virtual technologies to stimulate a constant interest in the course by creating a unique study environment [22]. Its weakness lies in the technical complexity of its implementation and the lack of universal platforms on which training programs can be easily created. Moreover, there is a suspicion that the more training courses will be based on virtual reality, the less noticeable their positive effect will be due to students' habituation.

Researchers call creativity, which is inherent to this type of training, to be one of the most important factors in improving the effectiveness of MOOCs [36]. Nevertheless, the learning technology's creative potential can be suppressed by the incorrectly used course design or inadequate style of study material presentation [37]. The user should not be confined to the proposed set of materials. The fundamental competencies that each MOOC is to disclose should include decision-making, independent search for information, and verification of data accuracy. However, it is not yet possible to implement this requirement without the participation of a human teacher or instructor in the e-learning process [38]. This form of interaction is also a kind of collaboration, though it occurs not among students themselves but between the student and the teacher.

Vast attention was attracted to the importance of building students' independence with the help of MOOCs. In particular, scholars proposed the methodology for setting learning goals before and during the course to increase students' motivation in e-learning. The role of the teacher in this process is to stimulate and control the goal achievement. It is essential to guarantee that the student sets goals related to his/her direction of further work and the desired personal achievements. In this case, the motivation for learning will increase dramatically [39].

Many researchers have also identified specific behavioral stereotypes that allowed grouping MOOC users with the same behavior. Scholars proved that groups with different behavior-based stereotypes achieve different results when mastering an e-learning course. These findings can contribute to the activation of the cognitive processes among learners and instill more effective stereotypes for those whose learning process was inhibited by old behavior patterns. On the whole, the determination of training stereotypes provides accurate identification of the course's target audience and the creation of specialized MOOC design following particular users' requirements.

5 Conclusion

Even though the modern MOOC market is growing rapidly, its unresolved issues create a barrier to the effective implementation of e-learning in the process of professional training. For over a decade of MOOC development, the main challenges of this technology, as well as many determining factors to overcome them, have been outlined. The current paper presented an attempt to experimentally address several MOOC challenges that reduce its effectiveness in building professional competencies. For this aim, 94 participants among medical students were selected and divided into two groups. The control group had a standard set of MOOC training tools, while in the experimental group, collaborative learning and decision-making tasks based on situations connected

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with students’ personal experience were introduced along with standard MOOC services. The examination of training outcomes revealed that in the experimental group, the results of both subjective and objective evaluation of the preparation quality were better than in the control group. Only 39.58% of students in the control group completed all the exercises within the course, while in the experimental group, their share equaled to 78.26%. According to the objective testing, the control group’s average score reached 11.41 points out of 20 possible, and in the experimental group, it amounted to 14.93 points. Future research should focus on the peculiarities of acquisition knowledge during the MOOC and find methods to eliminate students’ addiction to constantly available online material during learning. It is especially important for the use of MOOCs in the medical field.

6 Acknowledgement

Not applicable.

7 References

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Article submitted 2020-09-22. Resubmitted 2020-10-21. Final acceptance 2020-10-23. Final version published as submitted by the authors.