The Use of e-Learning Technologies in the Russian University in the Training of Engineers of the XXI Century

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Abstract. The paper deals with the main problems and prospects of using e-learning technologies in the Russian education in the training of engineers of the XXI century. The factors hindering the development of a clear and consistent conceptual framework for the research are revealed as well as contradictions in the results of studies on the use of e-learning, the lack of justification for the effectiveness of the new e-learning technologies. The revealed contradictions allowed to formulate the purpose of the study, associated with the need to create a technology in order to overcome the observed problems for students of technical specialties. A technology to overcome motivational, didactic and activity barriers in the blended training of engineers is offered. The research methodology is based on the competence approach to the implementation of the educational process. Scientific methods include the analysis and content generalization of pedagogical and methodical literature. The results of the experiment proved the fact that e-learning is an effective instrument to level motivational, didactic and activity barriers. The results of the study and materials can be used in the preparation of educational programs aimed at the development of e-learning technologies, as well as for the adjustment of their content.

1. Introduction

Currently, the institutions of higher education in the Russian Federation are transforming their educational activities towards more flexible and open education in order to adapt to the needs of new generations. In universities, this process is strongly associated with the introduction of e-learning technologies that contribute to both improving the level of teaching and the quality of education [1-9]. The use of e-learning in the Russian educational process is provided by the Federal state educational standards (FSES) for all training programs for bachelors, specialists, masters and post-graduate students, which regulate the educational activities of the University, help to preserve the order, consistency and integrity of educational services, as well as guarantee the required level of quality of graduate training. The modern approach to education in the conditions of its modernization is the competence one. The competence approach is understood as the priority orientation of education on its results: the formation of the necessary universal, general professional, professional competencies, self-
realization, socialization for productive activities in the conditions of modernization of the Russian education system, the creation of the labor market for the digital economy.

The main task of the higher educational institution is to prepare a qualified graduate: competent, proactive, flexible, mobile, constructive, able to make free choice in standard and non-standard situations, with a desire for self-education throughout his life, owning new technologies, aware of the possibility of their use, able to adapt to the professional field, resolve professional issues and work in a team.

The XXI century is a time of new information and communication technologies, the century of new thinking and new attitude to the changes taking place. The modern trends in the field of professional education are the tendencies of its change. Firstly, it is the creation of new conditions and active teaching methods, which are the basis of the educational paradigm. Secondly, the growing demands of society to prepare a critically thinking and functionally literate person capable of continuous updating of his knowledge, immediate retraining and changing the scope of his abilities for a successful life in a rapidly changing world. Many educational institutions are aware of this fact and are trying to restructure their activities in accordance with the opportunities offered by new information and communication technologies that can become a catalyst for improving the educational process.

The idea of using e-learning technologies in educational activities in the educational process has recently attracted the attention of many Russian and foreign researchers. The need for the use of e-learning technologies is justified in the works of F. R. Tarragó [10], A. Takemura [11], Yu. M. Cheng [12], E. V. Bataeva [13], V. Khabarov, I. Volegzhanina [14], L. A. Mosunov [15] and others. It was assumed that the introduction of e-learning technologies would entail the transformation of educational processes: from the leading role of the teacher in the educational process to the nomination of the student, and that this transformation would consequently allow students to self-regulate their educational activities. It turned out that this process is more complex than expected, e-learning is not always obvious and there are limits to the use of e-learning technologies. It is evidently that the radical introduction of e-learning technologies in the education system and professional training requires deep, comprehensive understanding and study, including the development of software and methodological support contributing to the updating of the configuration and space of interactive interaction in a technical university through its competent pedagogical implementation. Apparently we are dealing with a relatively new phenomenon for which clear boundaries have not yet been established.

In the scientific and pedagogical literature, in our opinion, the attention paid to the development of the clear and consistent conceptual framework for the study of e-learning technologies is insufficient. In this study, we will try to pay attention to the main problems in the implementation of e-learning technologies. First of all, there is the uncertainty of terminology. Let us explore this problem in details. On the one hand, there are many different interpretations of similar sounding concepts, on the other hand, different sounding concepts are given the same meaning in the description of digital technologies. Researchers do not have a common understanding of the term e-learning. So, e-learning can be referred to as ‘education through electronic media’ [16], electronic learning (e-learning) that is learning through ICT [17], mobile learning – e-learning using mobile devices that are not limited by location or changes in the location of the student [18], autonomous training (offline learning) - training using the computer without connecting to the information and telecommunications environments [19], blended learning - the combination of online learning with in-class or autonomous learning [20]. By e-learning we mean the designation used to describe the wide range of electronic technologies used (television, radio, CD, cell phone, Internet, etc.) in education, with particular emphasis on learning through the global Internet.

The existence of misconceptions about the reducing role of the teacher in the digital age also makes amendments to the educational process. There is a formed public opinion that the use of e-learning will automatically make students self-organized people able to self-regulate their educational activities. In the implementation of the competence approach, a special place in educational practice is given to the role of the teacher that has a multi-aspect character. The teacher becomes the organizer
and mentor of the classroom and extracurricular independent cognitive activity of students. In the competence model the teacher appears to be one of the many true knowledge holders. The peculiarity of the modern teacher’s activity on the development of the content of the discipline is both the discussion of theoretical issues and practical aspects with the use of information and communication technologies. The teacher's task is to ensure the conformity of teaching methods and evaluation procedure. The support system should be provided on an ongoing basis throughout the learning process, which requires time and the appropriate teaching experience. The scientific and educational environment of the university is becoming one of the key factors in improving the quality of the Russian education. In general, the activity of the modern teacher is multitasking as it supports the parallel implementation of scientific and pedagogical work. The mechanisms of parallel execution of these works are complex and require special work on their transformation. The modern teacher is a luminary of science, he is totally engaged in scientific research and involves students into it. He needs to be aware of the latest achievements in his professional field, to maintain scientific contacts with the professional international community, and in the case of applied developments he has to interact with consumers of scientific developments. At the moment in the competence model there is a tendency to reduce the pedagogical influence of the teacher on the education of a particular student. The main subject of the educational process is the technical staff. In the gnostic paradigm the leadership positions belonged to the teacher as a true knowledge holder, while now they pass into the hands of the student who evaluates the teacher in terms of the quality of the education process, but not as the result of learning. In the modern education system the emphasis is changing from the role of the teacher providing knowledge to the teacher providing educational services. Communicating knowledge to students the teacher gives them the necessary direction forming the most important ideological, social, moral and many other settings.

In the process of using e-learning technologies three types of barriers the teacher faces can be distinguished. Namely, those are motivational barriers, which are characterized by the lack of educational motivation, value orientations to knowledge and future profession. The second type is didactic barriers characterized by the low level of training manifested in the inability to implement certain logical operations properly, to use the proposed cognitive strategies. The third type is the activity barriers, which are characterized by the lack of skills to allocate time budget for the performance of educational tasks. These barriers derive mainly from the difficulties to understand educational information and the lack of finding some productive independent action on the part of the student. The first and third types of cognitive barriers definitely lead not only to the reduction of students’ activity, but also to psychological discomfort expressed in the dissatisfaction of the educational process, as well as distrust, sense of imposition of educational material by the teacher, low interest, partially expressed with some demonstrative acts in the classroom, dismissive attitude expressed by the occupation with other subjects during the lecture. low diligence, attendance, active psychological prejudice, rejection and, at times, opposition to the subject. Students may allow themselves to give frivolous comments or ask sarcastic questions and they may oppose themselves to the personality of the teacher as a person. All those barriers interfere the productive process of communication between the teacher and students which is the exchange of educational information that can help the student in solving specific issues. They may prevent students from getting the skill of competent communication with people that will be efficient in solving production problems at their future workplaces or the ability to analyze the situation and make the right decisions on their own.

Another aspect on the use of e-learning technologies is the uncertainty in research. There is no vivid distinctness in the published results of e-learning studies. The effectiveness of the new educational technology implemented in the educational process in contrast with the traditional one when the same educational goals are achieved is not stated. The existing studies are mainly related to individual manifestations on e-learning, the conclusions are often contradictory and can’t always be regarded as reliable. Efforts should be made to improve the quality of ongoing research on the use of e-learning technologies in different settings as well as to consolidate the findings of many studies into comprehensive results that can be used by researchers. In the description the used e-learning
technology it is necessary to explain its role, whether it is implemented in full-time, distance or blended learning, and to what extent the technology complements or replaces traditional occupations. Such clarifications can help to consolidate the various results of scientific research and to form a clear terminology. Research is limited in its capacity to reflect the full range of issues related to the introduction, use, maintenance of e-learning technologies, the consequences of their application, further difficulties and, finally, their elimination.

In recent years many researchers have noted the trend of attending elective courses in a distance form, and the number of students who require e-learning courses [21] has also increased. To meet this demand we have begun to develop an e-learning program providing students with the remote access to the variety of interactive technologies through the university platform and learning the results of such efforts.

Studies show that in the modern Russian and foreign practice the Internet services Web 2.0 are used with some degree of frequency in the learning process [22, 23, etc.]. Services Web 2.0 are programs (software environments, engines, shells), which are used to organize joint comfortable network activities. A brief didactic description of the most common Internet Web 2.0 services is given below. Instagram is a program that is freely available and designed to enable users to share their photos with the world audience. Blog is a service for the publication of materials on the network with the ability to access their reading and comments by registered users. Wiki is a service for the publication of materials on the network with the ability to access their reading and editing by registered users. Delicious is a service for storing bookmarks on web pages (with descriptions and the ability to search for specific details). YouTube is a service for storing, viewing and discussing videos. Flicr is a service for storing, viewing and discussing photos. Twitter is service with online news and social networking with the possibility for people to communicate in short messengers.

The important feature of modern education is the shift of the vector of educational activity towards the independent work, which with the support of the teacher should smoothly move into a self-controlled and self-regulating learning process by the student [24].

2. Materials and methods

During the survey the following research objectives were determined:
- to analyze the problem of the current state and prospects of using e-Learning in higher education and in the training of engineers, in particular;
- to determine the role of the modern teacher in blended learning;
- to highlight the main barriers that a modern teacher faces;
- to develop technology to overcome the identified barriers using e-Learning;
- to introduce e-Learning technologies into the process of training students of technical specialties at the St. Petersburg Polytechnic University of Peter the Great and carry out the experiment;
- to use the following tools: diagnostic tasks in the form of pre-experimental and final tests, observation, conversation, data collection and analysis.

To solve the above problems, the following research methods, based on a competency-based approach to the implementation of the educational process, are used:
- general scientific methods of theoretical research: analysis of domestic and foreign pedagogical, psychological and methodological literature on the research problem, analysis of educational-programmatic and normative documentation of higher education;
- methods of empirical research: observation, testing, questioning, studying the products of students' activities, pedagogical experiment, qualitative and quantitative analysis of its results.

We surveyed the teachers' point of view and their attitude to the use of e-learning technologies. The use of the questionnaire could help us to identify the main problems teachers may face while implementing e-learning technologies, as well as the benefits of their usage. 17 teachers, representing the majority of Graduate School of Foreign Languages, responded to the questionnaire. This school has been chosen as it is the most intensive e-learning user in recent years that faces the greatest changes and experiences the greatest impact. In our study we analyze the opinions collected from
teachers of Graduate School of Foreign Languages in order to be better prepared for the ongoing changes in the field of education in other universities.

In Graduate School of Foreign Languages the absolute majority of respondents (100%) use e-learning technologies, in particular, the educational resource LMS Moodle, various interactive technologies and plan to use them in their future professional activities. 89% of respondents noted that e-courses contain all learning materials in one place, as well as the ability to track how many students use the learning materials presented in electronic form. Only one third of respondents (28%) had the experience of using such tools. 12% of respondents are planning to use e-courses on their own, more than half of respondents (53%) are taking some e-courses as they are organized by the university administration.

In order to test the effectiveness of e-Learning technologies in solving the problem of overcoming motivational, didactic and activity barriers among students of technical specialties studying at Peter the Great St.Petersburg Polytechnic University, experimental learning was conducted. In several institutes of Peter the Great St.Petersburg Polytechnic University e-learning technologies were introduced in the learning process of the following master's programs: mathematics and mechanics, computer and information technology, construction.

In the course of the work the following tools were used: diagnostic tasks in the form of pre-experimental and final tests, observation, conversation, data collection and analysis.

The experiment included several stages. Firstly, the determination of the initial level of students' ability to overcome motivational, didactic and activity barriers during their studies was estimated. Secondly, e-learning technology in the learning process of experimental groups was implemented. Thirdly, the learning effectiveness in experimental and control groups was determined. Finally, the analysis of the results was made.

Initially, the context of the application of e-learning technologies in higher education in general and in the training of engineers in particular was studied. Then the emphasis was placed on the formulation of the general objectives of the course. The specific learning objectives to each master's program and the level of language proficiency were defined and taken into account as well. Next, methodologists choose specific methods and techniques of training, developing the best course using e-learning technologies. After that, the effectiveness of the implemented technologies and the comparison of control and experimental groups on the selected indicators are checked.

The experiment lasted for one semester. During the experiment undergraduates of each learning program were divided into control and experimental groups. In the course of learning control and experimental groups had access to the same didactic resources: Instagram, Wiki, Delicious, YouTube, Flickr, Twitter, a Moodle course. But the students of the control groups were not obliged to use any of them, except the classical printed manual. The students of the experimental groups were trained alternatively using all the proposed resources of e-learning. The work with these resources did not require the installation of any additional software and could be carried out using any modern computer or mobile device, as well as a tablet.

To determine the initial level of students' ability to overcome motivational, didactic and activity barriers, a questionnaire consisting of 20 questions was prepared. The main questions reflected in the questionnaire were the following: what is the main motivation of students in learning; how useful is the knowledge gained in the learning process; do students have a genuine interest in classes or attend them only formally; what e-learning technologies do students prefer to use in learning; how difficult is it for them to master the subject; how do they evaluate the interaction with the teacher, do they believe that e-learning is efficient, etc.

3. Results and discussion
The survey involved 178 students. In the result, it turned out that almost 100% of students actively use information technology in their educational activities. Moreover, almost all surveyed students are ready to use computer technologies in learning foreign languages. We also included questions that revealed students' level of technical English. To determine the ability of students to overcome each
type of barriers test control was developed. Tests included tasks to let the students to get points. The results of the initial stage are presented in the table 1 where one can find the number of received points from the possible 100%.

**Table 1.** The level of students' ability to overcome barriers at the initial stage of the experiment

| Indicator           | Control groups | Experimental groups |
|---------------------|----------------|---------------------|
| Motivational barriers | 43.5 %         | 42.4 %              |
| Didactic barriers   | 61.2%          | 60.7%               |
| Activity barriers   | 53.3%          | 55.1%               |

According to the results the level of students' ability to overcome barriers is almost the same on all three indicators in the control and experimental groups at the initial stage of the study. The weakest indicator was the motivational barrier. More than 60% of students demonstrated the ability to cope with didactic barriers.

The analysis of the practical use of e-Learning technologies allowed to determine the potential of various activities and tools aimed at the formation of the ability to overcome barriers in post-experimental diagnosis. We took into account the number of active students in the group during all classes, entry into the discussion, arguments, comments on the issues considered in the classroom, the results of intermediate tests, attendance, etc. The results are summarized in table 2.

**Table 2.** The level of students' ability to overcome barriers at the final stage of the experiment

| Indicator           | Control groups | Experimental groups |
|---------------------|----------------|---------------------|
| Motivational barriers | 44.6 %         | 88.5%               |
| Didactic barriers   | 59.4%          | 80.2%               |
| Activity barriers   | 54.1%          | 79.4%               |

At the final stage of the experiment the indicators of the experimental groups increased significantly. The indicator of motivational barriers has doubled in experimental groups. More than 20% of participants succeeded in the leveling educational and activity barriers. The control groups did not show significant changes in the selected evaluation criteria, the indicator didactic barriers decreased slightly in comparison with the initial stage of the experiment. The initial states of the experimental and control groups are similar, and the final ones are significantly different. The indicator related to overcoming motivational barriers has increased most of all (Figure 1). This leads to the conclusion that the effect of changes is surely due to the use of e-learning technologies.
Students who took part in the experiment noted that they liked the interactive type of work and cooperation with the teacher. They pointed out that the technology used in the classroom is a familiar tool they use to communicate in everyday life. They attended classes with pleasure, were involved in creative work together with classmates and were proud of their results.

The focus on the use of e-learning technologies can help to expand the range of educational information perception by students. In our opinion, the use of such technologies should lead to a qualitative change in the process of foreign language training of professionals in various fields.

The data presented in the diagram (Figure 1) confirm the effectiveness of our experimental work. The test control allowed to determine the significant increase in the level of the ability to overcome motivational, didactic and activity barriers of the students in the experimental group in teaching foreign languages to students of engineering specialties.

4. Conclusion

During the survey, the following tasks were completed: the problem of the current state and prospects of using e-Learning in higher education and in the training of engineers, in particular, was analyzed; the role of the modern teacher during the blended learning process is defined; the main barriers that a modern teacher faces (motivational, didactic and activity barriers) are highlighted; the technology of overcoming highlighted barriers using e-Learning was developed and successfully tested.

According to the results of the experiment we believe that the use of e-learning technology is necessary to maintain the current trend at the present stage of science development. E-learning is actual together with the traditional personal "tutoring", which, in turn, will allow to avoid the difficulties associated with the lack of thought-out organization of the educational process (excessive involvement of participants in the process of technological aspects), insufficient bandwidth of the Internet. On the other hand, it is completely wrong to return to the "traditional way" of implementing
the educational process as we need to prepare a modern graduate. Due to the fact that e-learning technologies are becoming more common and demanding in the Russian university contributing to the creation of conditions for the productive development of academic disciplines of different cycles, to ensure the quality of the educational process we propose the introduction of regular surveys in educational practice, which are associated with e-learning, the surveys that are to become a mandatory part of the annual self-assessment reports of each university [25, 26, etc.]. The ready-made electronic content, in particular, in the form of electronic records of lectures and presentations, requires updating, and is an auxiliary tool between students and a qualified teacher, not the substitute for its electronic system. E-learning technologies provide an opportunity to work with large amounts of data, each student can maintain a detailed database to adjust the individual training plan and make conclusions about the education system on the whole. It is necessary and important for the teacher to shift the focus of students’ attention from the final marks to progress results, which are much more important for building a learning strategy. Since these data are available to both teachers and students, the latter receive more autonomy and opportunities for self-regulation.

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