

# Effective adaptive training of students in Russian pedagogical universities to use e-learning technologies

## Capacitación adaptativa efectiva para usar tecnologías de e-learning en estudiantes de universidades pedagógicas rusas

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Recibido: 01/02/2018 • Aprobado: 27/02/2018

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#### ABSTRACT:

The study relevance stems from the need to propose effective mechanisms for fast introduction of e-learning (EL) into the work of Russian teachers. The article states that to solve this problem it is necessary: 1) to develop new scientifically grounded educational programs aimed at targeted training of teachers to apply e-learning technologies (ELT); 2) to substantiate the effectiveness of these programs by testing them in various pedagogical universities in Russia, adapting these programs to the regional specifics of education.

**Palabras clave:** e-learning, e-learning technologies, adaptive training, teacher

#### RESUMEN:

La relevancia del estudio surge de la necesidad de proponer mecanismos efectivos para la rápida introducción del e-learning (EL) en el trabajo de los profesores rusos. El artículo establece que para resolver este problema es necesario: 1) desarrollar nuevos programas educativos fundamentados científicamente dirigidos a la capacitación dirigida de los docentes para aplicar tecnologías de e-learning (ELT); 2) para corroborar la efectividad de estos programas probándolos en varias universidades pedagógicas en Rusia, adaptando estos programas a las particularidades regionales de la educación.

**Palabras clave:** e-learning, tecnologías de e-learning, capacitación adaptativa, docente

## 1. Introduction

Currently, Russia is taking part in globalization and international integration. This process manifests itself in education through the development of occupational standards on teachers' qualifications. These standards, in particular, state that every teacher should have ICT

competence. This is due to the fact that new information and communication technologies (ICT) are changing the educational environment, enabling the exchange of knowledge, contributing to the creation of new knowledge, and creating innovative educational tools. They are the basis of e-learning technologies, which change the whole model of school education and the essence of teachers work.

A specific feature of the current situation is that pupils are often more proficient than teachers as far as using modern ICT is concerned. They are better adapted to life and learning in the information society and ready to use the whole range of technologies which can be included in the EL system. However, the introduction of ELT is still very limited, which is largely explained by the insufficient training of teachers to work with them, and, consequently, underdevelopment of ICT competence. To solve this problem, the educators of the HSPU Computer Technology and e-Learning Department have developed and implemented a continuous system of training prospective teachers in a specially created adaptive electronic information and educational environment and developed methodology which will help prospective teachers to solve professional tasks by means of ELT.

The main methods applied to study the problem are: monitoring the dynamics of prospective teachers training, a pedagogical experiment, methods of mathematical statistics. The experiment involved bachelor and master students of various departments of the Herzen State Pedagogical University of Russia (the HSPU) pursuing a degree in Education, as well as master students of M.K. Ammosov North-Eastern Federal University (the NEFU). The authors developed an EL system for the adaptive training of prospective teachers to apply ELT using the updated content of the subject "Information Technologies"; the effectiveness of the system is confirmed by high motivation of students to further study of applying ELT in their work. The research confirms that new learning techniques contribute to the effective professional training of a modern teacher in the conditions of the electronic information educational environment. The study proves the effectiveness of the proposed methodology for training bachelors to use ELT in their future teaching job, while implementing these technologies made the students better equipped for effective work in the electronic information and educational environment. The materials of the article can be useful for the staff of higher educational institutions, institutions of additional education, and teachers.

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## **2. Goals and hypothesis**

The research goal is to develop a continuous and effective system of teacher training within a specially designed adaptive electronic information and educational environment and using a methodology which will allow teachers to solve relevant professional problems (including those of the regional level) using ELT. The research was carried out by a team of authors representing several Russian regions (St. Petersburg and the Republic of Sakha (Yakutia)). This contributed to the cooperative use of the resources, innovative and human resource potential of the universities when solving the problem of ensuring high-quality and effective training of educators in e-learning, risks and specific features of this new type of training in the Russian educational system.

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## **3. Literature review**

Foreign researchers consider issues related to using e-learning in higher education [Gaebel, 2014] in general and its various aspects. For instance, B.K. Pathak [2016] examines the development of online educational models, which, in his opinion, leads to a change in the traditional learning at university. In this regard, one should study the methods of teaching certain subjects online. Pedagogical problems of teaching research methods and mathematical statistics in the e-learning environment are discussed in the article by A.J. Rock et al. [2016], in which the authors give specific practical examples of online work with students. While admitting the positive aspects of this new flexible type of training, a number of researchers note its shortcomings [Yang et al., 2017]. Other studies discuss various aspects of training teachers for working in the conditions of the flipped and ubiquitous learning [Chen, 2016], changes in teachers' needs in innovative electronic informational and educational environments [Schulz, 2014], along with the increasing economic, and market

factor in motivation to learning [Clark, 2016]; some papers take into account the evolution of interactions between educators and students [Mohammad, 2013]. Researchers give examples of methods for assessing the readiness of the staff at higher educational institutions to solve professional problems using e-learning technologies [Akaslan, 2011]. They also analyze the experience of social cooperation and the possibility of using network tools in e-learning [Imran, Pireva, Dalipi, Kastrati, 2016]. Other authors study the attitude of teachers, their involvement and support of online professional development [Gunter, Reeves, 2017]. Nevertheless, it should be noted that the analyzed papers do not pay sufficient attention to the study of effective methods of adaptive training of students at pedagogical universities regarding the use of e-learning technologies in their further work. However, the issue of education quality in the constantly changing world is studied in great detail in the works of one of the leaders of the Worldwide CDIO Initiative [Kamp 2016].

Theoretical basis of the research is represented by the works of Russian authors devoted to the use of distance and electronic forms of training [Vlasova, Gosudarev, 2015; Lapchik, 2014; Khutorskaya, 2015]. In his article "Adaptive e-learning and assessment of its effectiveness", S.V. Tarkhov [2005] considers an approach to dynamic adaptation in the e-learning system and notes that management of adaptive learning is based on deep decomposition and structuring of training materials that are stored in the database.

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## **4. Materials and methods**

Conducting the research we used systemic and adaptive approaches to the vocational training of teachers to work in the conditions of an electronic information and educational environment using e-learning technologies.

The research was conducted in the period from 2011 to 2017 by a team of authors from several Russian regions (St. Petersburg and Yakutia). This enabled a deeper understanding of the problems and tasks of effective training of education specialists and their adaptation to work in the conditions of the electronic information and educational environment, as well as it made possible to identify and develop relevant general and specific educational technologies adapted to regional specifics and possible risks.

At the first stage of the research we collected, analyzed and systematized a priori information on teachers' readiness to use e-learning technologies to solve professional problems and on how the students of pedagogical universities, prospective teachers, are trained to solve these tasks. Upon the analysis of the curriculum, observations of the learning process in a number of pedagogical universities in Russia, and interviews with colleagues, teachers of pedagogical universities, we could draw a general conclusion that IT course is limited to studying how to work with these technologies, with many tasks not related to education. In addition, teachers of the higher pedagogical education do not use e-learning technologies when conducting classes.

The basic methodological objectives of the study: 1) to develop new content for teaching IT to students of a pedagogical university with a focus on its practical application to solve professional problems of education and e-learning; 2) to transform the nature of the learning process by engaging students in active work when learning and using ELT; 3) teaching students in the electronic information and educational environment adapted to their future professional activities; 4) students should create their personal electronic educational environment with the use of familiar IT. The participants of the research set a goal not only to master the proposed information technologies well, but also to motivate students to use them actively as tools for teaching, self-learning, and for implementing new adaptive educational activities in the conditions of the electronic information and educational environment.

At the second stage, we worked with the first year students (bachelors of the Departments of Natural Science, Mathematics and Humanities of the HSPU majoring in Education), as well as students of the HSPU and NEFU studying Education (master programs "Technologies and Management of e-Learning" and "Corporate e-Learning"). More than 5000 bachelor and 48 master students took part in the experiment.

Upon completing the course of Information Technology, bachelor students answered the question: "Do you consider the course useful regarding its content, modes and methods of teaching?" During all years of the experiment, there was not a single negative answer. Moreover, all respondents emphasized the effectiveness of studying in the e-learning environment that they were offered (<https://inftech.spb.ru>) and that was developed by the staff of the Department of Computer Technologies and e-Learning of the Herzen University and focused on multidimensional use of e-learning technologies for tasks connected with future professional activities of a teacher.

Annually, students doing the course were divided into two groups (the first group included students of the Natural Science and Mathematics Departments, the second group – students of Humanities). Each group answered the question: "Do you consider it viable regarding your professional development to continue studying e-learning technologies with focus on the tasks of your future work?" The hypothesis testing the equality of the attribute fractions was checked at the level of significance  $\alpha = 0.02$  ( $g = 0.98$ ), that is, we determined whether students of the Natural Science and Mathematics Departments and students of the Department of Humanities consider it viable to continue e-learning course covering tasks of their future professional activity.

The study also included master students of two universities who majored in e-learning. At the same time, their training implied active use of e-learning technologies, which significantly transformed learning process for both students and teachers. The students from the HSPU and the NEFU answered the question: "Which of the listed characteristics of the new educational activity influence the effectiveness of the professional training of a modern teacher? Rank them according to their importance". We tested the hypothesis that the correlation between the two ordered groups of characteristics in the samples of the HSPU and the NEFU was statistically significantly different from zero (that is, the students of these two universities had the same opinion on the subject). To process the results, we used Spearman's rank correlation coefficient.

## 5. Results

Having conducted the theoretical analysis and study of trends in the development of modern Russian education, we identified the need for training teachers capable of active use of modern information and communication technologies in their work, these being technological and instrumental basis of e-learning. To achieve this goal, we developed electronic information and educational environment that would allow solving professional pedagogical tasks. Its effective application in learning is confirmed by reliable results obtained after processing of the experimental data.

The data of the survey results by year are presented in Table 1.

**Table 1**  
Results of the student survey  
Departments of Natural Science, Mathematics and Humanities in the period from 2011 to 2017

Year	Students of the Natural Science and Mathematics Departments		Students of the Department of Humanities		Statistics, t
	Total n1	Answered "yes" m1	Total n2	Answered "yes" m2	
2011	110	67	105	59	1.54
2012	93	63	102	74	1.75
2013	110	71	112	69	1.91
2014	97	59	102	68	1.84

2015	100	62	100	59	0.882
2016	102	81	95	73	0.448
2017	108	71	97	61	0.444

The table presents two samples with sizes  $n_1$  and  $n_2$  and two populations. The data are processed using the hypothesis that tests the algorithm on the equality of attribute fractions. The sample fractions  $w_1$  and  $w_2$  were calculated according to formulas:

$$w_1 = \frac{m_1}{n_1}, \quad w_2 = \frac{m_2}{n_2}, \quad (1)$$

where  $m_1$  and  $m_2$  are the number of elements in the first and second samples with the attribute under study. Statistics  $t$  (for each year) was calculated by the formula

$$t = \frac{w_1 - w_2}{\sqrt{p(1-p)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}, \quad (2)$$

where  $p$  was calculated by the formula

$$p = \frac{m_1 + m_2}{n_1 + n_2}. \quad (3)$$

For the significance level  $\alpha = 0,02$  the values of  $t_{cr} = 2.33$  were found from the tables. Since

$$|t| < t_{cr}, \quad (4)$$

Then the hypothesis that both the students of Natural Science and Mathematics and the students of Humanities consider it equally viable to continue studying e-learning technologies regarding the tasks of their professional activity. As a result, in 2013 the university administration invited all students doing a course in Education to study the university-wide optional course of "E-Learning at School" for 70 students in the 1st semester and 57 students in the 2nd semester. However, the authors of the article do not think that this experience may be called a success. This is due to three reasons: 1) a short duration of training, only 16 hours; 2) the course was offered to second year students (they have not yet studied the methodology of teaching the subject); 3) the course included lectures only. The obtained result should be analyzed to improve the management of learning. It is the creative content of master programs "Technologies and Management of e-Learning" and "Corporate e-Learning", as well as the effective organization of the learning process with a wide application of e-learning technologies which allowed receiving very positive results in terms of students training in the field of e-learning. This is confirmed by the results of an experiment conducted among master students in two universities. The data obtained were averaged for 24 participants, and the averages were ranked. Table 2 shows the rank indicators of the characteristics of the new learning activity. There are 13 of them. These were used to estimate Spearman rank correlation coefficient  $r_s = 3.87$  which is calculated by the formula:

$$r_s = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)} \quad (5)$$

There is a positive correlation between the opinions of students of two universities on the studied issue at a significance level of  $\alpha = 0.05$  since  $t_{\text{calc.}} > t_{\text{cr.}}$  ( $3.87 > 2.20$ ). To make a conclusion, we used Student's t-test calculated by the formula

$$t = |r_s| \sqrt{\frac{n-2}{1-r_s^2}} \quad (6)$$

The similarity of the views of master students in two universities is statistically significant at a 5% level of significance.

**Table 2**  
Rank indicators of the characteristics of the new learning activity

Characteristics	Raking in the HSPU sample	Raking in the NEFU sample	d	d2
Focus on an individual	13	11	2	4
Flexibility	3	4	-1	1
Mobility	1	3	-2	4
Distribution	7	10	-3	9
Active work of students	6	9	-3	9
Timely monitoring	10	12	-2	4
Independent cognitive activity of students	8	7	1	1
Availability	4	2	2	4
Centralized storage of educational and methodological materials	2	1	1	1
Cooperation	9	6	3	9
Adaptability	11	5	6	36
Active communication	5	8	-3	9
Focus on an individual	13	11	2	4

Among the most significant results we can name: the development of a fundamentally new adapted to teachers work content of the course "Information Technology" for bachelor

students of "Education" and teaching it with active application of e-learning technologies; bachelor students completing this course are motivated to further study of e-learning technologies in relation to their work tasks; master students in various universities majoring in e-learning confirmed that new types of learning activities contribute to the effective professional training of a modern teacher. The results obtained comply with the results of the researchers presented in other papers [Rock et al., 2016; Pathak, 2016]. At the same time, the authors of the article agree with colleagues [Yang et al., 2017] who pointed out to some problematic issues in the use of e-learning.

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## 6. Discussion

Radical changes that are currently taking place in the system of higher pedagogical education in Russia give birth to new pedagogical ideas and stimulate pedagogical innovations. Pedagogical innovations manifest themselves in the rethinking of goals and objectives, which entails changes in the content, methods and in the overall organization of the learning process.

This article considers effective adaptive training of future teachers through technologies that are used to change students' characteristics regarding their future work. They aim to ensure that the knowledge obtained becomes the means of improving their performance and the basis for self-realization through all three types of technologies a person may resort to: information, activity, and organizational technologies. In the course of the research, we showed that the synthesis of these technologies with ICT allows constructing various e-learning technologies. Feedback is crucial for these so that technologies may be adapted to the conditions of a certain learning process. E-learning technologies, being a kind of adaptive learning technologies, make it possible to organize lessons in a flexible way, as well as promote interaction and cooperation of the parties in the learning process and enable to use a whole variety of didactically justified information and communication technologies and technical means.

These technologies focus on the student, their personal qualities and teach them to solve professional tasks ensuring high quality training in the context of an innovative approach to education, developing their skills of independent work, including those required for their future occupation. During the research, special attention was paid to the development of students' active work and innovative training. For this purpose, it was necessary to apply innovative educational technologies that promote e-learning technologies. Adaptive training through e-learning technologies was carried out within the adaptive electronic information and educational environment of the Department, which also included a specially developed system of e-learning for the subject of Information Technologies (Certificate of State Registration of Computer Programs No. 2014616086 in the Computer Programs Register). Its main principles are: 24/7 availability; all work is done online. It includes: educational electronic content which fully covers the topics of the curriculum of the course "Information Technology" and allows students to master it at their individual pace and an ability to choose technology for working with the material (text, audio, video, infographics); the system of distributed joint development and the use of electronic didactic and educational materials; one e-learning environment for students of all university departments and external users. Teaching students can be carried out both by the staff of a certain department and in the form of blended learning. All teachers have undergone special training to work with students using e-learning technologies.

Developed and successfully implemented master educational programs "Technologies and Management of e-Learning" and "Corporate e-Learning" represent an important part in the created training system which promotes using e-learning in professional activities. These findings were discussed in a number of papers [Barahsanova, Vlasova, 2016; Aksyutin et al., 2015; Aksyutin et al., 2016]. High motivation of prospective teachers and teachers already working in Russian schools to master the didactic potential of e-learning technologies explains our decision to develop a new educational program for masters training. This program is called "Information Technology and e-Learning in Teaching School Subjects". The program was created in Herzen State Pedagogical University and is ready for practical

## 7. Conclusion

In the course of the research, we proved that successful teaching at schools in the context of the modern information and educational environment through e-learning technologies demands targeted training of teachers to use e-learning potential. For this purpose we created a continuous and effective two-stage system for training prospective teachers (bachelor and master students majoring in "Education") within a specially designed adaptive electronic information and educational environment. At the first stage, students mastered e-learning technologies when studying "Information Technologies". The content of the course was substantially updated, with an emphasis made on the practical application of ELT to solving professional problems in the field of education. The students were offered tasks that implied active work with e-learning technologies. This not only allowed increasing students' competence, but also motivated them to use ELT as a tool for learning and self-study. At the second stage, the students focused on e-learning and its technologies and studied them in detail while doing master programs "Technologies and Management of e-Learning" and "Corporate e-Learning". The research findings showed the prospective teachers are interested in specialized training in e-learning and consider it useful. Thus, the authors developed a new master program "E-learning in Teaching School Subjects".

The research findings let us conclude that it is possible to develop high qualifications and creative professional potential of the graduates of pedagogical universities, their ability to adapt the accumulated knowledge and skills to new educational goals and objectives in constantly changing working conditions through the active use and didactically substantiated application of e-learning technologies that are aimed at solving professional pedagogical tasks.

Further research in this direction may include the development of training programs for teachers regarding the methods of e-learning.

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