Innovative methods, forms and technologies in the field of education

Métodos, formas y tecnologías innovadoras en el campo de la educación.

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Abstract. The article is concerned with a search of new methods, forms and technologies in a sphere of education to improve the efficiency of teachers' work at the present time. The authors mark the priority directions of the education system development: (1) creation of a high quality, technological infrastructure of the education system; (2) the use of innovative methods and educational technologies; (3) development of new technologies for educational purposes. The article deals with ICT, e-learning, blockchain, VR-technologies, augmented reality technologies, etc.
Key words: education, innovation, innovative educational technologies.

Resumen
El artículo se ocupa de la búsqueda de nuevos métodos, formas y tecnologías en el ámbito de la educación para mejorar la eficiencia del trabajo de los docentes en la actualidad. Los autores señalan las direcciones prioritarias del desarrollo del sistema educativo: (1) creación de una infraestructura tecnológica de alta calidad del sistema educativo; (2) el uso de métodos innovadores y tecnologías educativas; (3) desarrollo de nuevas tecnologías con fines educativos. El artículo trata sobre TIC, e-learning, blockchain, tecnologías de realidad virtual, tecnologías de realidad aumentada, etc.
Palabras clave: educación, innovación, tecnologías educativas innovadoras.

1. Introduction

Change of landmarks of the Russian educational system is taking place at the present stage. The attention is focused on innovative educational technologies which can improve the quality of education. To achieve the set objectives, it is required to "restructure" training sessions, to introduce adjustments to the existing traditional teaching methods.

Scientific literature study allows us to talk about the opportunities that arise as a result of the use of innovative educational technologies. Naturally, the competent use of these technologies contributes to the achievement of the main educational and organizational goals. First, it increases students' interest and learning motivation. Second, it ensures to involve all students into active class work. Third, it is the ability of continuous monitoring of students' knowledge with minimal time costs.

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Strategy of socio-economic development of Russia until 2025 that determines the need for transition to an innovative model of country development indicates the need for changes in the system of higher professional education (Demtsura et al., 2019).

It should be noted that the priority directions for the development of the education system were announced in the message to the Federal Assembly of the Russian Federation for 2020. The President of the Russian Federation stressed the need to use effectively the entire educational and other infrastructure, as well as the possibilities of modern technologies in accord with the interests of learning. The President made a demand to shift the educational process to digital transformation. That is, the main priorities for the development of the educational system are: (1) creation of a high quality and technological infrastructure of the education system; (2) the use of innovative methods and educational technologies; (3) design of new technologies, software products, information systems for educational purposes.

The research of psychological and pedagogical literature shows that many specialists pay attention to the problem of innovative teaching methods. The system of innovative educational technologies at the university was studied by Aksenova at al., (2018), and Vorotnikova, (2018). A similar subject matter is in the works of Grishchenko, (2017) (works are devoted to the use of ICT). The emphasis on the use of e-learning in the educational process is made by I.V. Gubar in her research works (Gubar, 2018). We note a great value of E.N. Efremova et al., (2018), for our research. The practice of innovative technologies in the educational process is considered within these works. The experience of V.A. Kolesov, who implemented blockchain technology in the educational process (Kolesov, 2018) is an interesting issue as well. Herewith, in the last two years a number of works described peculiar properties of practicing of innovative educational technologies in various educational organizations in the higher education system have been published (Mertsalova et al, 2018) Nemchenko, 2018) (Toporkova et al., 2018), - Chelak et al., 2018), etc.), in comprehensive school (works by(Mironova, (2018), etc..

Prospects and possibilities of augmented reality technology in relation to innovative educational technologies in the course of teaching students are described in the works of A.V. Molochko (2018) and T.N. Filimonenkova (2018). Based on the research of A.V. Molochko and T.N. Filimonenkova, we can conclude that the problem of augmented reality as an innovative technology of the educational process is relevant today and attracts the attention of many scientists. S.V. Pogorelaya and V.V. Solovyov (2018) devoted their works to applying innovative technologies in the educational process, the features of multimedia presentations, in particular.

Scientists Julie A. Furst-Bowe and Roy A. Bauer in the research "Application of the Baldrige Model for Innovation in Higher Education" consider innovation as significant changes leading to the improvement of processes and services of an educational organization, to the creation of new corporate values (Furst-Bowe and Bauer 2007). Julie A. Furst-Bowe and Roy A. Bauer emphasize the sustainability of innovation as the main criterion for innovation in education, indicating that many universities consider themselves innovative. However, in most cases, innovations in education are accidental. Only a few educational institutions exercise control over the results of innovations that affect the quality of educational services (Furst-Bowe and Bauer - (2007).

Ludwig J. Issing and Heike Schaumburg in the joint work "Educational Technology as a Key to Educational Innovation: State of the Art Report from Germany" believe that it is not enough to provide educational institutions with technological innovations, to introduce online and offline courses. According to the authors' opinion, deep systemic and structural changes are needed to accompany the implement of innovative technologies in the educational environment (Issing and Schaumburg (2001).

Communications expert, creator of a number of educational innovative technologies Guillermo Orozco-Gomez in his research "Can we be more creative in thinking about how to scale up educational innovation?" suggests treating educational innovations as creativity (creative process), which is seriously influenced by history,

traditions, ideology. Considering the concept of "innovation in education", the expert suggests to distinguish in educational innovations the political, cultural, bureaucratic and social components in addition to the technical one. Guillermo Orozco-Gomez points out that the educator, who is the "mediator" between the participants in the innovation process and "new tools" - innovative technologies, plays the leading role in implementing educational innovations. Guillermo Orozco-Gomez also considers "visible and concrete" positive results to be the main criterion for innovation.

An expert in the field of innovative forms of higher education Kevin Kinser in his article "Innovation in Higher Education: A Case Study of the Western Governors University" reveals the specificity of implementing innovative technologies by the example of Western Governors University (Salt Lake City). Regarding the problems of introducing innovations in education, Kinser points out the main innovation barriers: legitimacy, money and technology, which are overcome an integrated approach (Kinser, 2007).

Based on the listed works, it should be noted that many scientific scholars and individual scientists pay attention to the problems of practicing modern innovative educational technologies. This fact indicates the relevance and significance of our study.

2. Methodology

The aim of the study is complex analysis of modern innovative educational technologies used to improve the quality of education

The basis for this research is a number of approaches that allow to implement a systematic analysis of the object and subject of research. First, it is a systematic approach, as the general scientific basis of research. Second, an activity-based approach that allows to describe the stages of the educational process and educators work (as well as the innovative educational technologies used in this work). Third, an information approach, characterized by certain systemic components (firstly, the use of information technologies; secondly, the formation of information about the world (in general) and the educational process (in particular); thirdly, the analysis of this information; fourth, the construction of information models; fifth, the use of information models to solve educational problems). We used in the research the following methods: theoretical analysis of scientific literature, generalization, systematization, etc.

3. Results

A quest of new methods, forms and technologies to improve the efficiency of teachers' work is currently taking place in the sphere of education. As noted above, the priority areas for the development of the education system are: (1) the creation of a high quality and technological infrastructure of the education system; (2) the use of innovative methods and educational technologies; (3) development of new technologies, software products, information systems for educational purposes.

We consider it important to examine and analyze the possibilities of using modern innovative educational technologies in universities. Wherein, we will dwell on ICT, e-learning, blockchain, interactive learning, VR, augmented reality, multimedia technologies used in the educational process in detail.

Initially, the term "technology" was associated only with the sphere of production. This term was understood as a manufacturing procedure, as well as a set of ways and methods of goods production.

The concept of "educational technology" appeared much later (at the end of the 20th century) and became inextricably linked with the process of training and education. That is, the term "technology" has become applicable to educational activities and the educational process. Primarily, the term "educational technology"

characterized the technologization of the learning process (and meant the use of technical means in teaching). Japanese educator T. Sakamoto noted in his works that the content of educational technology is the introduction of a way of thinking into the learning process, with the help of which learning is systematized. If we turn to the interpretation of UNESCO, we can conclude that educational technology is a systemic method of the entire process of teaching and assimilation of knowledge, taking into account technical and human resources and their interaction.

Based on the analysis of scientific literature, we conclude that there is no uniform interpretation of the term "educational technology" among scientists. This definition is considered from different positions: (1) it is an integral part of the didactic system; (2) it is a complex of psychological and pedagogical requirements to govern the use of special forms, methods, ways and techniques of teaching; (3) it is a summation of means and methods of the teaching and upbringing process, which guarantee the achievement of the set educational objectives; (4) this is the totality of all means that are used to achieve the goal, etc.

Consequently, we can summarize that, despite different approaches to the definition of the concept of educational technology, educators consider it as a system of means and methods of teaching in education, foremost, with the help of which the set goals are achieved. Unlike the teaching method, technology is supposed to be only entity, which has precise description and algorithmization.

Many classifications of educational technology exist. According the goal of our work, we will examine the generally accepted classification based on the division into two groups: (1) traditional (reproductive) and (2) innovative.

The essence of reproductive technology is to transfer knowledge, ability and skills by the teacher. Students must master the content of the material. The teacher is responsible for assessing the quality of knowledge at the level of reproduction of the heard information.

Training is carried out according to a certain scheme, which must not be violated. At first, new material is studied and then it is consolidated. The educator controls the level of consolidation and assesses the knowledge. The amount of knowledge that a student must acquire is determined in advance, based on the curriculum. The educator explains and shows, the students listen to, remember, and reproduce the information they got. The mark goes according to the level of error-free reproduction of the studied material.

Two main concepts "technology" and "innovation" are on the basis of the definition "innovative technologies". The term "novelty" or "introduction of novation" has become a synonym for the word "innovation" in Russian. However, not every novation becomes an innovation, only one that will be effective after implementation. In pedagogy, "innovation" is viewed as a new approach to teaching and upbringing. Innovation in education is an interconnected process that includes new methods and approaches of the educator, as well as scientific and cognitive activities on the part of students.

Innovative educational technologies are considered to be tested in the course of experimental activities, new models and methods that increase the effectiveness of learning.

It should be noted that interactive learning technologies are analyzed in the works of many researchers. The study of pedagogical literature shows that there is no single definition of the concept of "interactive technologies". In the pedagogical encyclopedic dictionary edited by B.M. Bim-Bad interactive learning technologies are defined as learning based on the interaction of the student with the learning environment, the learning surroundings that serves as an area of learned experience.

Interactive learning technologies are ways of assimilating knowledge, developing skills in the learning process. The learning process is organized in such a way that students acquire communication skills, learn to think critically, solve complex problems based on the analysis of situational professional tasks. Thus, these technologies represent an ordered summation of actions, operations and procedures that ensure the achievement of a diagnosed and predictable result.

In the last 5-10 years, the technologies of virtual reality (VR), which have great potential in modeling various situations in the work of an educator, have been especially actively developed and used. Virtual reality (VR), created by visualizing three-dimensional objects using computer graphics, animation and programming, is a product of not only information, but also educational technologies.

Speaking on virtual reality, we understand an artificial world that is recreated (similar to the existing one) or created from scratch (has no analogues) based on computer technology. Herewith, it is perceived by a person with the help of the senses and seems real. A similar effect is achieved by using a variety of devices and programs.

There are devices on the market that allow you to immerse yourself in the virtual world using a mobile phone. For example, the NOLO device (Pizhevsky, 2020). This device needs to be "supplemented" with a mobile phone and a card box. NOLO works with almost all android smartphones. Besides this, the device is compatible with some computer helmets and can work in combination. The station reads signals from sensors located on the phone, helmet and controllers. Then it analyzes and processes them with a slight delay. Thus, the virtual world is optimally synchronized with reality. All this expands the arsenal of educators in working with university students, allows them to achieve the required effect as soon as possible.

Researchers note the following features of virtual technologies - immersion, involvement, focus and isolation. The main feature is considered to be immersion in "virtual reality". Wherein, a person does not respond to external stimuli, he is completely absorbed in the ongoing process, is not distracted by anything, and together with the teacher builds the required model of behavior, set by a series of certain events. The student is in direct interaction with the virtual world (full immersion in the conditions of a specific place and time), performing certain actions, reacting to the actions of virtual subjects. The focus is on the details that the teacher negotiates and fulfills. If necessary, the situation can be repeated, "relived" to consolidate the desired result.

One of the modern innovative forms of organizing the educational process is distance educational technologies / e-learning. It makes possible to arrange student training using the Internet. For example, the Moodle distance learning system, which is a free web application that helps to create websites for online learning (Gubar, 2018). This is especially relevant in the situation related to the COVID-19 coronavirus infection pandemic.

Another vivid example of practicing distance educational technologies is learning on the multifunctional platform "University without Borders". This is a network educational platform for various areas of continuous distance education. Within the framework of this project leading professors of the Moscow State University named after M. Lomonosov conduct lectures.

As part of our research, we conducted a survey among 245 educators working in Russian universities. In one of the questions, the respondents were asked to evaluate what platforms or other means they use as the basis for the implementation of general education disciplines, in the other - for the implementation of subjects of the general professional and professional cycles. One of the possible suggested answers was: "Platforms are not used as such or are used as a teaching aid. The main training tools are Non-platform solutions (Skype, Zoom, social networks, instant messengers, Google tools, e-mail, etc., as well as some MOOCs)".

The poll results are as follows: Moodle dominates among the educational platforms. It is determined by a whole complex of factors (free access, multifunctionality, a fairly convenient user interface, the presence of a large

number of methodological recommendations, educators' relevant experience, chances to share, etc.). Moodle turns out equally good for all types of training courses - both professional and general education; in both cases, 42.85% of respondents use "constantly" this platform, and 25.71% do it "rarely".

A slightly smaller proportion of respondents indicated the constant or occasional use of "their own platform developed at the university". The limited scope of the questionnaire does not yet allow us to understand how these platforms are functional, whether they provide the necessary methodological level (having, for example, corrective assessment tools built into the consolidation stage; means of organizing virtual practical works, etc.) or they are purely technical organizational and management shell – this also requires additional research.

The main part of the tasks to be solved for the organization of full-fledged e- learning teaching was assessed by the respondents as partially solved ("significant" or "slight" progress from the beginning of lockdown), including: the formation of plans for express-improvement of the qualifications of teachers in the field of online education; creation of educational and methodological documentation complex: requirements for the structure of online courses; roadmaps for the development and implementation of online courses; work programs of online courses (however, for this position, about a third of respondents noted only little or no progress); online courses design: 26% of respondents – "the problem is completely solved"; 20% of respondents – "significant progress"; 54% – "little advance". Let us note that 7% of respondents speak of "complete solution of the problem before lockdown begins"; the practical part of training is transferred to distance mode; students are provided with the equipment necessary for e-learning; feedback lines on e-learning issues are being organized; identifies the main difficulties of teachers in the organization of e-learning; work to improve the readiness of teachers to organize online learning is underway: information technology readiness (19% of teachers indicate to unsolved problem).

The use of e-learning technologies has its advantages and disadvantages, which play their role not only in separate work of a student and of a teacher, but also in the collaboration.

The advantages of using distance educational technologies are highlighted through the analysis of not only literary resources and the Internet space, but also through the personal experience of the authors of the article. Thus, the following positive aspects of using distance learning technologies can be identified: first, a student chooses the time and the place for the study; second, access to educational materials via Internet is available from any part of our country; third, student can combine study with additional/optional activities (if any); fourth, flexible terms of study; fifth, the use of distance learning technologies helps to reduce the cost of travel to and from the place of study; sixth, distance learning technologies can be used to train a large number of people.

Blockchain technologies also belong to innovative educational technologies. Note, that an integral part of the educational process is the procedures for final and intermediate control, assessment (in this aspect, the following forms of knowledge control can be distinguished: credits, exams, defense of qualification papers and other activities during which students demonstrate their academic achievements). One of the reliable, proven, safe ways of fixing, storing, using the obtained results is modern innovative blockchain technology. Indeed, in the created digital educational environment there is an opportunity to "get away" from paper documents. Blockchain is a kind of digital register, distributed digital ledger. It is a type of decentralized network storage technology. Blockchain allows any number of participants to create a secure network in which programs and information are almost impossible to fake or destroy. That is, the blockchain is a chain of blocks of data (texts, images, videos, software applications) that are linked to each other and stored as identical copies on many different computers.

Augmented reality also belong to innovative educational technologies. The term "augmented reality" in the works of scientists has been used for a long time. This term refers to an environment where the real physical world is supplemented with digital data in real time. In other words, these are systems with the help of which

the surrounding reality is supplemented with virtual objects (texts, photographs, graphic objects in 3D format, sounds, video frames, links to sites, etc.). Moreover, the listed objects can be not only observable. They can be interactive, that is, they can react to certain actions of a student or a teacher. In short, augmented reality technology is the imposition of digital content into the user's environment. Digital content is processed to make it as indistinguishable as possible from the real environment and is presented in real time (Filimonenkova, 2018).

The ways of using augmented reality technologies in education are reflected in the MARE (Mobile Augmented Reality Education) methodology. The proposed MARE structure consists of three hierarchical layers: foundation, function and results. It is based on the analysis of various ways of teaching, from obtaining theoretical knowledge to developing practical skills. Whatever learning theory is adopted in an educational institution, for example, the associative-reflex theory of learning or the theory of problem-activity learning, for higher education the main criterion for mastering knowledge is their practical application. The functional level depends on the personal approach and actions of the student and his interaction with educational resources.

Let us consider the practical possibilities of using augmented reality technologies in the educational process. Since more than 90% of all students have gadgets – tablets, smartphones or computers with built-in video cameras, the technical issue of using augmented reality is not a problem. Despite the fact that now there is no unified platform in Russia on which the process of introducing AR technologies in education will be built, more and more developments and software solutions for educational programs appear in this direction.

Augmented reality books can be considered one of the optimal educational resources, which significantly expand the functions of a traditional textbook, allowing information to be conveyed in the form of volumetric animation and sound. In this direction, it should be noted the development of the company Lab24 (http://laboratory24.com), which has patented several dozen basic technologies that provide the preparation of textbooks with augmented reality, including such as "living alphabet", the movement of the Earth in the solar system, the manual in chemistry and others (Averyanov and Troitsky, 2016).

One of the largest Russian hi-tech companies that develops augmented and virtual reality products is EligoVision (https://www.eligovision.ru/ru). Its first augmented reality toolkit developed in Russia is EV Toolbox. It has a special edition for educational institutions: EV Toolbox Standard Edu. The software includes a training system, educational courses for teachers, a library of 3D models and ready-made AR projects. This software allows educational organizations to independently create and use augmented reality technologies and implement them in the educational process (Filimonenkova, 2018).

For example, A.V. Molochko in his work "Prospects and possibilities of augmented reality technology in relation to innovative educational technologies in the course of teaching geography students" describes the experience of digital visualization of student projects in the "first person" format. That is, the student project was created in three-dimensional space and has a non-standard presentation. It "includes" additional virtual objects. This allows you to expand the practical and theoretical skills of students, to involve them in the study, testing and implementation of projects in a completely new form for them, as well as to increase motivation and interest in the disciplines studied (Molochko, 2018).

Thus, one can state that modern innovative educational technologies allow the use of special methods, software and hardware for working with information.

Similar results obtained in the process of analyzing the features of the application of innovative educational technologies in universities are presented in the works of different authors. However, these studies were carried out in 2017-2018, and therefore, they do not present a number of analyzes of the latest innovative educational technologies that were actively used by university educators in 2019-2020.

4. Conclusions

From the outcome of our investigation, it is possible to make the following conclusions. The authors analyzed ICY, e-learning, blockchain, interactive learning technologies, VR, AR, multimedia technologies used in the educational process. The listed technologies are ways of assimilating knowledge, forming skills in the learning process. The learning process is organized in such a way that students acquire communication skills, learn critical thinking, solve complex problems based on the analysis of situational professional tasks.

Applying the described innovative technologies in teaching allows you to achieve the following results: 1.To ensure the mastery of knowledge and skills by each student. 2. To develop educational independence of each student. 3. To form a zone of proximal professional development, ensuring further individual work on the educational program. 4. To create conditions for each student to realize the personal meaning of the results of educational activities based on their self-control, self-assessment and self-correction. 5. To reduce the number of mistakes made in solving practical problems in comparison with another discipline of a similar complexity. 6. To reduce significantly the number of retakes and workouts of educational material and set aside time for other activities. 7. To increase motivation to the learning process and future professional activity. 8. To show that the achieved high level of qualification of each university graduate for professional activity is the main indicator of the level of professionalism of the teachers who taught him, the final indicator of the quality of their teaching.

This research has clearly shown that innovative technologies represent an ordered combination of actions, operations and procedures that ensure the achievement of a diagnosed and predictable result. They allow expanding the practical and theoretical skills of students, involving them in learning, testing and implementing projects in a completely new form for students, as well as to increase motivation and interest in the subjects they study.

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