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E-Learning Technologies for Future Teachers: Introduction of Educational Innovations in Higher School Practice

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Abstract: *Mass introduction of e-learning in the higher education system due to spread of the pandemic has led to a search for effective information technologies and their adaptation, taking into account peculiarities of professional training of specialists in a particular field of knowledge. Based on the theoretical analysis, the conditions for ensuring professional growth of higher education teachers in accordance with the requirements of innovative development of society (improvement of professional education, continuing professional development, introduction of innovative pedagogical technologies, etc.) are established. Peculiarities of e-learning of specialists of pedagogical specialties and its functions in the process of their professional training are determined. The content of the concept of "e-learning" and ways to ensure its effectiveness (scientifically sound selection of the content of training courses, creation of discussion groups, feedback and online counselling).Innovative technologies of e-learning in the practice of higher education (gamification of the training process, use of cloud-based systems, information systems of intellectual teaching, mobile learning technologies, as well as virtual and augmented reality) are characterized. Their advantages, disadvantages and possibilities of introduction into the system of professional training of future teachers are determined. Creation of a model of continuous distance learning for high school teachers and experimental verification of its effectiveness seem promising.*

Keywords: *Specialists in pedagogical specialties, improvement of the educational process, information technologies, gamification of the educational process, mobile learning, virtual reality, cloud-oriented systems.*

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Introduction

Integration of domestic higher education into the European and world educational space involves updating national standards in accordance with the requirements of the Bologna Process, credit transfer system and revision of theoretical and methodological approaches to training of future professionals (Gerasymova et al., 2019). Current educational policy is focused on introduction of innovative pedagogical technologies, which creates the need for continuous training of scientific and pedagogical staff of higher education institutions (Bakhmat et al., 2019; Kosholap et al., 2021; Ovcharuk et al., 2021; Sheremet et al., 2019; Onishchuk et al., 2020).

Peculiarities of today's professional training are constant updating of information and availability of access to it. This led to an understanding of the need to reassess the content of knowledge as the main characteristic of professionalism of future specialists, as well as awareness of the need to update educational technologies to ensure high quality of educational services.

Furthermore, spread of the pandemic and the use of hitherto unprecedented quarantine measures, contributed to active introduction of information technology in the training of future professionals. As a result, the scientific community has initiated a discussion on various aspects of e-learning, its advantages and disadvantages, as well as effective methods of optimizing the educational process.

The problem of finding effective e-learning technologies for future teachers is in the centre of attention of scientists, as pedagogical activity requires a specialist to constantly adapt to new rapidly changing conditions, processing the flow of new information, introduction of pedagogical innovations, etc. The process of professional training of educators should include not only acquisition of psychological and pedagogical knowledge and skills, but also promote development of those personal qualities that in future will allow them to effectively solve professional problems, design the process of training future professionals, taking into account the innovative development of society.

The need to use information technology in the training of pedagogical specialists is outlined in publications of Guillén-Gámez & Mayorga-Fernández (2020), Koehler & Mishra (2009), Li et al. (2019). Researchers emphasize the importance of forming a digital competence of future teachers of higher education institutions, because currently their

educational programs are focused mainly on acquisition of psychological and pedagogical knowledge.

Therefore, the purpose of the article is to analyse the domestic and international practice of using e-learning technologies for future teachers, as well as to determine conditions for introduction of educational innovations in the practice of higher education institutions.

Ensuring professional development of higher education teachers in accordance with the requirements of innovative development of society

Formation of professional competence of a future teacher is one of the critical factors of further progress of society. It is the scientific and pedagogical staff of the higher school that provides professional training for future employees of all sectors of the economy and is responsible for quality of the educational services.

We agree with Castaño-Muñoz et al. (2018) and Laurillard (2016) that compliance of the scope of professional training of future teachers with current requirements can be ensured through development and implementation of continuing professional development programs. Such programs should reflect not only the issues of innovations in the education system or production, but also ensure development of creative thinking and digital competence of pedagogical specialists.

Desimone & Park (2017), Hassan (2019) highlighted the existing problems that hinder professional education renewal of future higher school teachers. Scientists have reason to believe that the existing training centres that provide continuing professional pedagogical education, not only lack the necessary resources, but are also incapable to offer appropriate training programs focused on the needs of teaching staff. Among the shortcomings of the traditional system of professional training of future teachers Zidane (2018) also included the lack of material resources, outdated curricula, a limited number of distance learning courses, etc.

Stracke et al. (2019) emphasize that the existing complications can be solved by using information and communication technologies in the system of professional training of teachers. On the one hand, it will provide every interested person with an access to the training courses at a convenient time and in a convenient format, and on the other –it will provide the opportunity to acquire practical skills in using innovative e-learning tools, to systematically improve skills in the chosen direction.

Interesting developments on this issue are reflected in the publications of Barrera-Pedemonte (2016), Desimone & Park (2018). In particular, Desimone & Park (2018) believe that improving professional training of future teachers should include three mandatory elements:

- content-oriented learning, the scope of which includes mastering innovations of psychological and pedagogical disciplines and acquiring skills in modelling the process of professional training of future professionals, taking into account current development of a particular industry;
- active learning. The need to use active learning methods in the training of higher education teachers is discussed in a number of scientific publications and is not disputed. In particular, the importance of active learning methods for development of critical thinking is substantiated in the studies of Kyoung-oh et al. (2018), Niemi et al. (2016). Scientists claim that such an approach will contribute to effective formation of professional competence and further use of active learning methods in the process of future professional activity of a teacher;
- joint training, the content of which is to form a group of teachers according to professional interests, fulfilment of tasks and support each other in the learning process. The practical experience of such interaction is described in the publication of Barrera-Pedemonte (2016). In addition, Thomas-Brown et al. (2016) argue that the ability to share experiences and ideas for the teaching staff is the foundation of further creative professional activity.

Apparently, in scientific publications, the need for use of innovative e-learning technologies in the process of professional training of future teachers of higher education is positioned. Even before the mass transition to a remote format of work amid the pandemic, scientists considered promising development of e-learning. This approach is due to the fact that the professional growth of specialists in any field should be continuous and, accordingly, the electronic format of professional development in this case is more appropriate (Kurelovic, 2016).

Miyazaki (2015) considers the following features of e-learning of teachers to be positive: the ability to organize training for a large number of people at the same time, accessibility and low cost due to the massive involvement. Cho & Kim (2016) supplement the list of benefits with a choice: self-study or with a consultant. Experimental studies of the effectiveness of e-learning for pedagogical professionals are reflected in the publications of Al-Harthy (2016), Shemya & Al-Habsia (2021).

Thus, e-learning technologies for future high school teachers not only provide access to a variety of educational resources, but also have a

positive impact on development of professional competence, as evidenced by a number of experimental studies. Therefore, there is a need to determine the features of e-learning for specialists of pedagogical specialties and its functions in the process of their training.

Features of e-learning for specialists of pedagogical specialties

Contemporary standards of professional education provide for formation of a digital competence of future professionals, regardless of field of knowledge or qualifications. University students should have the appropriate level of information technology skills and be able to solve professional problems with their help. The fact that a high school teacher should be aware of peculiarities of the future professional activity of specialists the training of which they provide, as well as possible areas of use of information technology in the process of their professional activity is not remarkable. After all, formation of digital competence does not occur during the study of individual disciplines. This phenomenon is interdisciplinary and requires an integrated approach.

To determine the features of introduction of educational innovations in the practice of higher education institutions, we clarify the current content of e-learning and its functions in the process of professional training of future teachers.

Interestingly, there is no unanimity on the meaning of e-learning. Some scientists consider it synonymous with the concept of "distance learning", others - a kind of distance learning, and some even distinguish these concepts.

The initiated research is based on interpretation of the concept of "e-learning", proposed by the European Commission in the following interpretation: "The process of developing knowledge, skills and abilities through the use of computer technology and the Internet" (Communication from the Commission: E-Learning - Designing "Tejas at Niit" tomorrow's education, 2006).According to it, we can consider e-learning as a kind of distance learning, when interaction of all subjects of the educational process takes place through the use of appropriate software and hardware, as well as the Internet.

Given the peculiarities of professional training of future teachers of higher education institutions, we consider it appropriate to distinguish between pedagogical and information technologies of e-learning. The difference between them lies in the peculiarities of their use in the training of

future professionals. In particular, pedagogical e-learning technologies are technologies that provide communication between all participants in the educational process through various means of telecommunications. E-learning information technologies are technologies that allow to create, transmit and store learning materials.

It should be noted that the mass introduction of e-learning in the system of professional education during quarantine restrictions has led to combination and complementation of both types, which allowed to ensure effectiveness of distance interaction. In particular, Martíneza et al. (2021) experimentally tested the impact of e-learning tools on students' academic performance based on distance learning results and offered recommendations for their improvement. According to scientists, improvement of e-learning platforms should take into account the academic, economic and social conditions of the social environment. Similar results were obtained by Lowenthal et al. (2020) and Nagar (2020), which gave scientists reason to highlight achievements and shortcomings of e-learning, to form recommendations for its use in the training of future professionals.

Based on the analysis of scientific publications, including Halimi et al. (2018), Huang (2020), Jotikabukkana and Sornlertlamvanich (2019), et al., we have identified the key elements of e-learning that affect its effectiveness:

- the appropriate objective, aims and circumstances of the educational process of the content of the course or discipline. Given the peculiarities of remote interaction, the content should be divided into modules and contain different content (text, graphics, images, audio, animation, video, etc.). This approach involves maximum consideration of individual characteristics and needs of students. From the offered material they can choose the form of presentation and processing of information convenient for them;

- discussion groups. In the interpretation of higher school pedagogy, learning involves interaction of all participants in the educational process. Therefore, modern e-learning should involve creation of appropriate groups (usually using popular messengers), which discuss urgent and problematic issues;

- online counselling. Consultations in the process of e-learning are carried out by the teacher in accordance with the established schedule. This is usually a scheduled webinar on specific course topics. In addition, consultation with an expert is possible in discussion groups;

- use of video communication services to ensure student cooperation online.

It is worth noting that as a result of long-term mass training in electronic format, there appeared publications that predict a fundamental change in the system of professional training, in particular, shifting most of it in the electronic format. For example, Wang (2019) argues that e-learning tailored to the specifics of training provides motivation and effective interaction among all participants in the educational process, saves time and increases attention to learning outcomes. Therefore, we consider it appropriate to characterize the innovative technologies of e-learning that are used in the practice of higher education institutions and the features of their use in the course of professional training of future teachers.

Innovative e-learning technologies in higher school practice

Nowadays, it is impossible to surprise students by using a computer to show educational videos or bright presentations. For several decades, this has been a mandatory attribute in the study of academic disciplines. A theoretical basis for features of introduction of e-learning and construction of an adapted educational environment were reflected in the publication of Stoyanov & Popchev (2006). However, their use in the training of future professionals was sporadic. Introduction of quarantine measures due to spread of the pandemic has led to the widespread use of e-learning and definition of the basic principles of its implementation in the practice of higher education.

In addition, this initiated a search for innovative educational technologies that would ensure quality of the educational process. We characterize the most promising, in our opinion, which should be used in professional training for future teachers of higher education institutions:

1. Gamification of the process of professional training of future specialists. The basis for creating this area in professional education is game definition in psychology as one of the effective ways to satisfy desires through organization of certain (game) activities, which allows to acquire knowledge, skills and learn certain social experience (Bozhovich, 2008). Gamification of the process of professional training of future professionals is based on concepts that reflect the functions of game in the world of adults. In particular, this is the transactional game theory of Berne "Games People Play" (Berne, 2016), games for training managers in the context of business cases by Schedrovitskiy (1987).

The issue of gamification of the process of professional training of future teachers, its advantages and disadvantages are covered in a number of

publications. In particular, the possibility and expediency of gamification of learning are considered in publications of Eck (2006), Kiili (2005), Werbach & Hunter (2012). Peculiarities of game model development and experience of introducing digital games in higher school practice are reflected in the publication Ger et al., (2008). Song & Zhang (2008) first proposed a model of educational games that thoroughly described the relationship between motivation, learning environment, and learning game.

Also interesting in this context is the study by Blazhko & Luhova (2018), who identified ways to optimize online learning through gamification of the professional training process. In particular, scientists suggest the need for taking the following steps:

1. Rethinking tasks and ways of working in the context of game design principles.

2. Development of a structural model of the discipline, which combines the advantages of traditional, project and e-learning with identification of instances for gamification of learning.

3. Introduction of elements of game design in the process of studying the discipline, in accordance with the features defined in the previous paragraph (Blazhko & Luhova, 2018).

Peculiarities of game design lie in the fact that when developing educational and methodological support of the discipline a teacher should focus not only on the requirements of the standard of higher education, the amount of available information or established practice of its teaching, but primarily on the interests of future professionals. In this context, we agree with the opinion of Luhova (2021) that in the process of gamification of an educational discipline, when making choice of the content and emphasis on educational issues the needs of the end users should be taken into account: students and employers who shape demand on the labor market. Therefore, in the process of training future high school teachers, it is necessary to take into account the need to overcome the established views on understanding the role of the game and computer video games in education.

2. The use of cloud-oriented systems. The relevance of the use of cloud technologies in professional education is associated with the constant growth the scope of information operated by students and teachers. The study by Bykov et al., (2020) considered the model of a cloud-based open educational and scientific environment that provides support for joint activities. Moreover, it is significant for our study that this paper identifies

promising ways to ensure access to cloud learning and research platforms and tools for cooperation of research and teaching staff.

Cloud-oriented systems have significant prospects in implementation of the concept of lifelong learning. In particular, this opinion is substantiated in the publication of Kim & Lim (2019), which proposes the architecture of a cloud information system for online lifelong learning.

Ortega-Sánchez & Gómez-Trigueros (2019) confirmed the need to define the principles of using cloud-based open science systems in the process of teaching and professional development of future teachers. The purpose of further experiment, according to the scientists, is to determine feasibility and identification of optimal forms for the introduction of innovative information tools, scientific, methodological and educational materials on the use of cloud technologies in the educational and scientific environment of pedagogical educational institutions. The experience of using a cloud-oriented methodological system of training teachers of natural and mathematical sciences and results of pedagogical experiments are given in the publication of Vakalyuk & Maryenko (2021).

3. Information systems of intellectual learning. The use of information systems of intellectual learning in education involves a combination of appropriate software and hardware to create intelligent learning environments. In recent years, a number of innovative solutions have been proposed in this field abroad. In particular, Koper (2014) identified conditions for an effective intellectual learning environment based on innovations such as cloud architectures, artificial intelligence and cognitive computing.

Siddiqui et al. (2020) proposed the technology of integrating information systems of intellectual learning in higher education. Researchers based their research on the fact that students are currently considered by higher education institutions as clients and consumers of educational services. Therefore, it is necessary to ensure the demand for the proposed educational courses by improving the educational process.

In this direction, there also appeared developments to improve the system of professional training for students with special educational needs. For example, Olufemi (2017) proposed principles for the use of intelligent learning information systems for students with hearing impairments.

Zhelnin et al. (2012) substantiated the possibility of makingan intellectual learning system function effectively, which takes into account the following factors:

- creating opportunities for accumulation and further use of information about learning outcomes in order to choose an individual educational trajectory and methods of managing the learning process;

- development of criteria for assessing formation of competence, level of professional training, etc.;

- ensuring adaptation of the system to the individual mode of study of students.

4. Mobile learning technologies, which are a kind of e-learning and are based on the use of mobile IT devices, including mobile phones, laptops and tablets in the educational process.

Theoretical aspects of mobile learning have been reflected in the scientific publications of a number of researchers. The problems of mobile learning in general were considered in the publications of Afreen (2014), Hawkes & Hategekimana (2009), Semerci & Kemal (2018). The work of Song et al. (2012) the possibility of using mobile learning to improve the professional skills of specialists was substantiated.

Gómez-Triguero et al. (2019) emphasize that the use of mobile technologies provides a number of opportunities: creating presentations during practical classes, reflecting the dynamics of performing a certain task, access to additional sources of information, including the Internet via QR-code scanning (quick response), organization of real-time communication, access to electronic maps, use of multifunctional training programs, etc.

At the same time, the advantages of using mobile learning technologies in the process of training and retraining of higher school teachers include:

- possibility of continuous exchange of information and messages;
- opportunity to study anytime and anywhere;
- motivation to acquire knowledge.

Designing training courses using mobile learning technologies allows to take into account requirements of the following general didactic principles:

- individualization of learning. Mobile learning is the most individualized. Students have the opportunity to choose the content of training courses according to their own preferences. We agree with Yarandi et al. (2013) that development of adaptive learning content for mobile learning should take into account the existing needs of the student.

- activity and independence, because learning is carried out at a convenient time and creates optimal conditions for increasing activity, in

particular in the process of interaction with other subjects of the educational process;

- purposefulness and systematization. Mobile learning involves a gradual implementation of rational actions, which in turn ensures development of the activity-practical sphere of an individual through activation of the self-governing mechanisms.

Another significant advantage of mobile learning is the ability to provide education for low-mobility and low-income groups. This position is justified in the publications Cho & Kim (2016), Sánchez & de Los Ríos (2015).

Also interesting is the method of frontal assessment of students using a mobile phone. A practical implementation of this idea is reflected in the publications of Zlobin et al. (2014), where its use in the study of disciplines "Cryptographic tools and methods of information security" and "Fundamentals of programming and databases" are presented.

Despite significant prospects for the use of mobile technologies in the training process, they are not without certain shortcomings that should be taken into account by future teachers in the process of designing training courses. In particular, these include a small screen size of mobile devices, which imposes restrictions on the number, type and conditions of display of educational information, as well as limited conditions for the use of certain software, such as graphics editors.

5. Virtual and augmented reality technologies have found application in various fields of human activity, such as design, mining, military technologies, construction, marketing and advertising, the entertainment industry, etc. We agree with the opinion of Foreman & Korallo (2014) that the prospects for their use in education are quite significant. Furthermore, the effectiveness of the use of virtual and augmented reality technologies in e-learning has been proven by a number of studies, such as Popchev & Orozova (2019), Petrov & Atanasova (2020).

In particular, Blagoev et al. (2021), describe the following types of virtual reality technologies, which are reflected in higher education:

Window to the world systems in which a monitor is used to display the visual part of the cyber world;

- video overlay, which allows to move images of a real object in the virtual world and establish different types of interaction between them;

- immersion systems, which with the help of certain hardware completely immerse the user into the virtual world, while creating a sense of presence;

- remote presence systems that allow remote sensors located on any object in the real world to remotely connect to the operator;

- mixed reality, which using the capabilities of several types of virtual reality allows to create a sense of remote presence in virtual reality.

The use of virtual and augmented reality technologies in higher education allows to:

- provide a full learning opportunity for users with special educational needs;

- to create the possibility of a life-long educational process in the context of the concept of sustainable development;

- increase effectiveness of training by creating the effect of involvement. For example, one can visit any historical event or go on a trip around the world, etc.;

- to ensure development of the necessary practical skills in a variety of fields. For example, future professionals can immerse themselves in detail in the modelling of complex surgical operations or management of automated production lines, without feeling nervous tension and threats to other people's lives;

- ensure maximum visualisation of the material being studied. For example, using 3D graphics, one can show in detail the chemical processes of any level and complexity.

The task of a higher school teacher is to understand the peculiarities of creating training courses with the help of technologies of virtual and augmented reality. It is clear that this process is quite complex and requires cooperation of specialists in various fields, but the script of such a project should be written by a teacher.

To ensure integration of digital technologies in higher education institutions, it is necessary to teach digital skills to the teaching staff, to form the ability to integrate them into the process of professional training of specialists. Models of professional training and development of higher education teachers should be based on communities that provide ongoing informational support for integration of e-learning in professional education.

Conclusion

Therefore, peculiarities of functioning of the contemporary information society create preconditions for introduction of e-learning technologies in higher education institutions. Integration of innovative information in the process of professional training of future professionals

requires from the teacher knowledge of the content and the scope of their use, orientation in search engines and web pages, use of computer equipment in professional activities, the ability to create e-learning courses.

Simultaneously, it's role is expanded and updated, in addition to teaching new material, it takes over the additional functions of a consultant who coordinates the educational and cognitive process and constantly improves own training courses. In turn, this requires systematic training in accordance with innovations.

In this study, e-learning technologies for future teachers were analysed. In particular, the peculiarities of ensuring professional development of higher school teachers in accordance with the requirements of innovative development of society have been established.

The theoretical analysis confirmed the need to develop innovative teaching methods used in the process of professional education. Features of e-learning of pedagogical specialists, their current state and prospects of development are analyzed. It has been established that e-learning requires an understanding of the relationship between technologies, pedagogy and semantic concepts of training.

Innovative e-learning technologies in higher school practice are characterized, in particular, such as gamification of the educational process, the use of cloud-based systems, mobile learning technologies, virtual and augmented reality, as well as information systems for intellectual learning.

We believe that the prospects of further scientific research are associated with creation of a model of continuous distance learning of higher education teachers and experimental verification of its effectiveness, as well as development of electronic author's refresher courses for pedagogical specialists, taking into account the outlined psychological and pedagogical requirements.

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