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DEVELOPING DIGITAL COMPETENCE IN FUTURE TEACHERS THROUGH BLENDED LEARNING APPROACHES

Abstract

This article examines key aspects of training future teachers, focusing on the challenges of digitalizing education, the integration of digital competence, and pedagogical teaching methods. The study's article selection aimed to provide comprehensive coverage, utilizing the Web of Science database through a university library system. Keywords like «education,» «innovation,» and «digital competence» were used to find relevant research across various fields. The article's relevance stems from modern society's demand for well-qualified specialists in general education institutions. Future teachers must not only acquire vast knowledge but also apply it effectively in real-world scenarios. The curriculum for the 6B01505 «Biology Teacher Training» program, including the «Methods of Teaching Biology» course, is designed to incorporate new technologies and teaching methods that engage students and enhance their competencies. To support digital education, the MOODLE platform is used for developing materials such as presentations and video lectures, which align with the course objectives. Additionally, the article explores the role of educational platforms in facilitating effective lesson management and evaluates their services and impact on student learning.

Keywords: blended learning, digital competence, digital education, digital transformation, educational environment, interactive technologies.

Introduction. In the new century, in a time of huge technological advantages, computer services and the development of communication technologies have a positive impact on education in many different dimensions. The structuring of the information age has led to the development of new educational programs new professions and various interdisciplinary fields of knowledge. In today's digital age, the possibilities of digital tools in the speed of teaching and learning in education are increasing day by day (Peretti et al., 2024). Based on diagnostics of the level

of IT skills of teachers, a program for training teachers in digital skills will be developed and updated (The Government of the Republic of Qazaqstan, 2022).

The generation of the digital age is developing in parallel with the spread of Information Technology in all spheres of human life, which introduces a new aspect to the teaching of communication (Lu & Wang 2023). The transfer and storage of information is the activity of any person, which ultimately affects the digital competence of a person, whose communication activity is reflected in the educational environment.

In today's society, in an era of radical changes in the former traditional teaching content, the rapid development of Science and technology, and the intensification of the flow of information data, the main task of educational institutions is to develop the demand for digital competent teachers using new technologies, which has led to the need for new approaches to the integration of technologies in education (Galvis & Carvajal 2022; Lomos et al., 2023).

The law of the Republic of Kazakhstan «On Education» states that «the main task of the education system is to create the necessary conditions for education aimed at the formation and professional training of the individual based on national and universal values, achievements of Science and practice, the introduction of new teaching technologies, informatization of education, access to international global communication networks» (Educational Affairs, 2007). Currently, no sector of the economy can develop without the Internet. Therefore, the state program «Digital Kazakhstan» adopted in the country was considered as a means of actively developing human capital through efforts to digitalize, creating an innovative economy, and improving modern education for students (Government of the Republic of Kazakhstan, 2017).

President of the Republic of Kazakhstan Kassym-Jomart Tokayev, in his address to the people dated September 1, 2021 «People's unity and systemic reforms – a solid foundation for the country's prosperity», emphasized the importance of digitalization of Education, directly linking it with quality education and instructed to implement the educational project «Digital teacher» (Tokaev, 2021).

In the age of increasing the activity of digital technologies in the formation of digital competence of future biology teachers, which we are aiming for, its advanced capabilities are systematically studied by foreign and domestic scientists. In the age of full access to the world's media, the widespread use of digital technologies in the educational potential, communication with them should be adapted to the activity and get used to it.

Therefore, to form the digital competence of future biology teachers, within the framework of the University, the distance learning portal, MOODLE vertical system, was selected.

Theoretically substantiate and develop a methodology for the formation of digital competence of a future biology teacher in the conditions of mixed learning and experimentally prove its effectiveness. \The object of this research is the education system focused on developing digital competence in future biology teachers. The subject of the research is the methodology for cultivating digital competence in future biology teachers within the framework of blended learning. Objectives of the study are:

- to determine the scientific and theoretical foundations of forming the digital competence of the future biology teacher;
- development of a structural and content model for forming the digital competence of a future biology teacher;
- experimental testing of the effectiveness of the methodology for forming digital competence of the future biology teacher, implementation in the educational process.

If, through the theoretical principles of forming the digital competence of the future biology teacher, its structural and content model, and methodology are developed and integrated into the teaching process, then the digital competence of the future biology teacher is formed at a high level since in this case the information and communicative knowledge of the future biology teacher will expand and become the basis for implementation in educational activities.

Materials and methods. The formation of digital competencies in future biology teachers within a blended learning context has been the subject of study by philosophers, psychologists, and educators, contributing significantly to the current knowledge base. Among international researchers, several have made notable contributions to the understanding of blended learning and digital competence. Bonk and Graham (2012) explored the content of blended learning, while Demyanenko and Ermakova (2014) examined the combination of traditional and e-learning. Instefjord and Munthe (2017) focused on professional digital competence, and Howard et al. (2021) discussed digital competence as the expression of skills and knowledge. Additionally, Ilomäki et al. (2016) highlighted the importance of critically reading web pages as part of digital literacy.

The challenges of enhancing cognitive activity in the development of digital competence within blended learning have been addressed by various domestic researchers. Kasymova (2021) explores the foundational aspects of cognitive processes in blended learning, while Khalikova (2020) focuses on the current issues related to digital competence. Elibai et al. (2020) discuss the role of online courses as a tool for developing digital competence, and Alimov (2009) highlights the effectiveness of interactive methods in fostering digital skills. These studies contribute to a deeper understanding of how blended learning can support the formation of digital competence. As society evolves and digitalization intensifies, the demand for digitally competent teachers has evolved, creating the need for new approaches to integrating technology into education. Bonk and Graham (2012) distinguish three components of blended learning:

- traditional training-direct training in the form of offline classes in the presence of personal contact between students and the teacher;
- independent work of students- various independent activities (online search for tasks, web quest, etc.) without teacher's help;
- e-Learning-Collaborative Learning, which consists of completing various tasks on the network, and participating in webinars, online conferences, courses, etc. (Kasymova, 2021).

Blended learning is when students learn in a traditional classroom with a teacher using information technology tools; they can then meet with their teachers to discuss their assignments and get answers to their complex questions (Instefjord & Munthe, 2017).

«Mixed learning» - in the opinion of Demyanenko and Ermakovais (2014) a combination of traditional face-to-face learning and e-learning, in other words, the combination of traditional classroom lessons with it. They believe that the use of ICT tools in blended learning complements traditional learning and reduces the time students spend in Class (Howard et al., 2021). Instefjord & Munthe (2017) point out, that professional digital competence is the ability to integrate and use technology for educational purposes, which includes a general set of skills suitable for all situations, both personal and professional, as well as specific pedagogical - professional skills (Bonk & Graham 2012).

According to Howard et al., (2021), digital competence is the expression of digital skills and knowledge that is politically understood to fully participate in our increasingly evolving technological society (Kasymova, 2021). According to L.Ilomäki et al., (2016), digital literacy has been interpreted as the main synonym for digital competence with phrases such as computer use, critical reading of web pages, and understanding how to view digital images (Demyanenko and Ermakova 2014).

The formation of digital competence in the conditions of a digital educational environment is relevant in the educational process since the level of formation of this competence affects not only the effectiveness of obtaining knowledge by students of higher education but also their socialization and the development of the personality as a whole. Digital education is a modern technology that allows learners to make teaching high-quality and accessible, the education of the new millennium, is closely related to the use of the computer as a teaching tool, the Internet, and the educational environment.

Review of foreign practices identified in the field of studying the digital competence of a teacher in the work of the scientist Potemkina (2018):

- the direction developed in foreign studies related to the understanding, description, and structuring of the professional digital competence of a teacher testifies to the expansion of the content of his activities, changes in the requirements for training and conditions of professional development;

- due to the rapid development of the digital space, the unification of professional digital competencies of teachers is not universal and requires constant study and approval;

-taking into account innovative teaching tools that are actively developing in the digital educational environment and the existing provision that digital skills are based on the concepts of Information Literacy, a modern teacher must have a sufficiently high level of knowledge of information and communication technologies for mastering digital competencies (Instefjord & Munthe, 2017).

Digital transformation implies a new responsibility, and new role models in teaching because a graduate of educational institutions is in demand in the labor market in the context of the development of a new digital civilization (Howard et al., 2021). In the context of digitalization, the position of the student also changes, there is an opportunity to independently manage their knowledge, designing an individual curriculum, an individual variable educational program, including the resources of a virtual educational environment. The teacher, in the role of a tutor, or mentor, has the opportunity to provide mobile assistance to students using services and digital content, to provide advice, organize individual work, solve the problem of coordinating individual plans for the student, achieving the required educational results (Ilomäki et al., 2016).

The educational environment is the conditions for the formation of a personality according to a given model and a system of influence, as well as opportunities in the social and spatial-material environment necessary for its development. Yasvin (2001) interprets the educational environment as the conditions and system for the formation of a person according to the needs of society and also asserts that opportunities for its development have been created in the social and spatial-subject environment (Potemkina 2018).

Current digital changes in the world of industrial work, i.e. the developments of the «Fourth Industrial Revolution», require future professional teachers to have a multidisciplinary set of digital competencies consisting of specific knowledge, motivational aspects, cognitive abilities, and skills to meet the requirements of digitally interconnected working conditions (Shvab, 2017). In the opinion of Khalykova (2020), the transition of the education system to digital format requires guidance on two main issues:

- Formation of a digital educational environment (preparation of electronic educational resources, online training courses);

- The process of radical modernization of the educational process, which involves the training of specialists for life in a digital society based on a digital economy (Ustyuzhanina & Evsukov 2018).

If we use distance learning technology and open educational resources in the process of virtual learning in the works of Elibai et al., (2020) then such massive open online courses would be a good opportunity for teachers in the development and formation of didactic and digital competencies (Potemkina, 2018).

This part of the study describes the research method, the research study group, the data collection tool, the data collection process, and the data evaluation.

The study has been conducted in various universities of Kazakhstan, that is the educational program «Biology» of the South Kazakhstan State Pedagogical University Bachelor 3-4 courses (42 students), M. Auezov South Kazakhstan University educational program «Biology» 3rd year Bachelor students (20 students), the educational program «Biology» of the Central Asian innovative university students of the 3rd year of Bachelor's degree (10 students). In total, there were 72 students. In the content of the study, lessons taken on the online

MOODLE platform with offline traditional lessons were monitored and discussed. The stages of the formation of digital competence of future biology teachers are presented in Table 1.

Table 1. *Step-by-step methodological instruction on the formation of digital competence of future biology teachers*

Step	Tasks	Objectives
Before the experiment	Analysis of content on «educational content», «blended learning», «digital competence», «digital educational environment»	This study is aimed at making the problem more clear in the context of the digitalization of education, the methodological directions are presented in detail, the concepts of research are analyzed in philosophical, psychological, and pedagogical research, the main conclusions are guided, and the concept of the formation of the digital competence of the future biology teacher in the conditions of mixed learning is determined.
	Data research in the system of mixed learning education in forming digital competence	Various approaches to learning and philosophical assumptions in the conditions of mixed learning are analyzed. Approaches to learning before educational environments are research analyzed by main approaches to the formation of digital competence.
	Experimental method	The structural and content model for forming cognitive competence of students on the basis of mixed learning education, the principles of mixed learning, and the curriculum «Development of Biology in a digital educational environment» were analyzed and the distance learning part (http://moodle.okmpu.kz) MOODLE vertical system was selected.
During the experiment	Selection of the experiment object	South Kazakhstan State Pedagogical University, M. Auezov South Kazakhstan University, Central Asian Innovative University
	Performingtheexperiment	An experiment in the period from 2022 to 2023 was conducted for the educational program «Biology» of the South Kazakhstan State Pedagogical University 3 - 4th year students (42 St). M. Auezov South Kazakhstan University educational program «Biology» 3rd-year students (20 St). The educational program «Biology» of the Central Asian Innovation University students of the 3rd Year (10) students. In total, there were 72 students in the experimental group.
	Data collection	During each module, at the end of each practical task, information about students' digital competencies was analyzed and summarized for further comparison of learning outcomes in terms of digital development.
After the experiment	Digitaldataanalysis	An analysis of the services of the MOODLE vertical system was carried out to form the digital competencies of students in the context of blended learning. Its purpose is to measure the digital competence of students and provide an opportunity to test the scientific forecast of the study.
	Qualitative analysis of the obtained result	To find out if the students are satisfied with blended learning conditions a survey «Development of Biology in a Digital Educational Environment» has been conducted and analyzed. It was aimed at obtaining new ideas about students' desire for mixed-learning teaching materials to present further research issues and analyze the opinions of future biology teachers on using digital technologies in the education system.

The practice is formed by future biology teachers who voluntarily agreed to participate in the study. The demographic characteristics of biology teachers are presented in Table 2.

Table 2. *Demographic characteristics of future biology teachers*

№	Year	gender		total
		female	male	
1	3rd year	51	5	56
2	4the year	16	-	16
	Total:	67	5	72

Table 2 lists the gender and year division of future biology teachers who participated in the study. 46 future biology teachers are in the 3rd year and 16 are in the 4th year. 67 of the future teachers are women, and 5 are men.

The research data collection tool is a semi-structured interview form developed by researchers. In the process of creating a semi-structured interview form, a literature review was made. The opinion of two experts was heard to assess the compliance of the questions in the form of semi-structured interviews created as a result of the review of the literature with the content of the study. Various amendments were made by the opinions of experts. The final form of the semi-structured interview form is presented in Table 3.

Table 3. *Semi-Structured Interview form*

Demographic information				
Gender:	female		male	
Research group:	3rd. year	4the year	3rd year	4th year
Questions on blended learning and digital competencies				
What is your approach to a blended learning environment? Select one of the options below.				
I find it very useful				
I find it useful				
I find it quite useful				
I don't find it useful				
I don't think it's useful at all				
What is your approach to digital competence?				
I believe that digital competence is very sufficient				
I believe that digital competence is sufficient				
I believe that digital competence is little				
I believe that digital competence is not enough				
I believe that digital competence is completely insufficient				
What are your expectations regarding the digital competencies that will be created in a blended learning environment?				
Send your fe edback:_____				
_____				
_____				

The semi-structured interview form developed for collecting research data is presented in Table 3. In the form of a semi-structured interview, there are two questions to find out the gender and group distribution of future biology teachers. There are two closed questions and one open question on blended learning and digital competencies.

The research data was collected in a face-to-face interview with future biology teachers participating in the study. Interviews with future teachers were conducted at the University. During the interview, students had an opportunity to ask researchers about places they did not understand when filling out semi-structured interview forms. It took students about 25-30 minutes to

complete the semi-structured interview forms. It took about 1 month to complete interviews with all participants of the study.

In the analysis of the research data, the method of descriptive analysis was used. Descriptive analysis is a technique often used to obtain summary information about the various phenomena and events that researchers want to investigate. The main objective of descriptive analysis is to reach concepts and relationships that can explain the collected data. Descriptive analysis consists of four stages: building the basis of descriptive analysis; processing data according to the thematic framework; determining conclusions; and interpreting conclusions (Eysenbach & Köhler, 2002). By following these steps, the answers of future biology teachers participating in the study to questions in the form of semi-structured interviews were analyzed using the descriptive analysis method.

Results. In this section, the answers of participants of the study to questions in the form of a semi-structured interview are presented in tables in the form of frequency and percentage ratios. Table 4 evaluated the opinions of participants about the blended learning environment.

Table 4. *Views of future biology teachers on the blended learning environment*

Category	F	%
I find blended learning very useful	25	34,7
I find blended learning useful	34	47,2
I find blended learning quite useful	8	11,1
I do not find blended learning useful	4	5,6
I don't think it's useful at all	1	1,4
Total	72	100

Table 4 categorizes the opinions of the participants about the blended learning environment. 34.7% of students said «I find blended learning very useful», 47.2% said «I find blended learning useful», 11.1% said «I find blended learning quite useful», and 5.6% said, «I don't find blended learning useful for me». 1.4% replied» I don't think it is useful at all.» In this sense, it can be said that most of the future biology teachers involved in the study find the blended learning environment useful.

Table 5 evaluated the opinions of biology teachers who participated in the study about their digital competencies.

Table 5. *Opinions of biology teachers about their digital competencies*

Category	F	%
I believe that digital competence is very sufficient	15	20,8
I believe that digital competence is sufficient	24	33,4
I believe that digital competence is a little	18	25
I believe that digital competence is not enough	9	12,5
I believe that digital competence is completely insufficient	6	8,3
Total	**72**	**100**

Table 5 categorizes the opinions of biology teachers who participated in the study about their digital competencies. 20.8% of prospective teachers said «I believe that digital competence is very sufficient», 33.4% said «I believe that digital competence is sufficient», 25% said «I believe that digital competence is little», 12.5% said «I believe that digital competence is not enough» and 8.3% said, «I believe that digital competence is completely insufficient». In this sense, it can be said that most of the future biology teachers involved in the study consider their digital competencies to be somewhat adequate.

Discussion. The study shows that most future biology teachers participating in the program can effectively use digital technologies, enhancing their competencies through digital tools and creating applications that help students reinforce their understanding of biology within a digital context. Developing these skills is crucial for keeping up with and adapting to continuous innovations in educational technology.

The research underscores the importance of equipping future teachers with the ability to use innovative pedagogical tools, which play a key role in forming their digital skills. Interestingly, these tools have a positive impact on re-engaging students who might face challenges with traditional teaching methods or require additional time to grasp complex material. This trend highlights the growing need for digital competence in teacher education, as these skills enable future teachers to integrate new technologies effectively, contributing to the creation of blended learning environments.

The results reveal a need to enhance future teachers' digital competencies to meet diverse learning needs, showing that future teachers proficient in digital innovations are better prepared to engage students and meet the evolving demands of modern education.

Conclusion. In the age of new technologies, the future of our state – a young specialist, getting an education by the requirements of the time and promoting creative all-round development-requires deep search and benevolent actions from the teacher.

One of the main conceptual concepts used by the Bologna Process is the orientation of the process of acquiring knowledge to the result, the transformation of the result into the main function of the system of education and acquisition. The result of the educational process is what knowledge, skills, and abilities a graduate student acquires after completing a lesson, subject, program, full course of study, and what he can do.

In conclusion, the tasks of digital pedagogical technology have been implemented. They are as follows:

- ability to purposefully organize various activities of the future biology teacher for Education and development;
- education of a person who possesses knowledge, skills, and abilities;
- formation and development of skills of search work in the planned direction.

The social position, cultural position, political competence, and psychological state of the future specialist are determined by the acquired knowledge system, its level, and organizational activities.

Therefore, what students expect to increase their digital competence: is ease of learning, effective knowledge, use of time, satisfaction with the learning process, interest in learning, and continuous, learning from teachers with skillful experience. The only desire of today's specialists to get a quality education is the introduction of new innovative technologies in the educational process. The main task of the teacher is to integrate, process, and effectively use new pedagogical innovations and interactive methods, not lagging behind the developing scientific and technological progress.

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