

ANALYSIS OF THE DEVELOPMENT PROCESS OF DIGITAL COMPETENCE OF PEDAGOGICAL STAFF OF HIGHER EDUCATIONAL INSTITUTIONS

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Abstract. *An approach based on digital technologies occupies an important place in the development of digital competence of teaching staff. In this aspect, an analysis of research shows the need to develop the digital competence of teaching staff. The article highlights the organization of educational processes based on digital technologies and the widespread introduction of modern digital educational technologies into practice, as well as an analysis of the process of developing the digital competence of teaching staff.*

Keywords: *digital educational technologies, digital educational environment, digital literacy, digital competence, assessment criteria, assessment levels, online course.*

Introduction. In the conditions of digitization of the educational process, the development of knowledge and skills based on modern digital technologies in the process of continuous professional development of pedagogues is one of the urgent issues of today.

Digital competence ensures high motivation of learners, orientation towards achieving the goal set before them, communicative ability, constant work on oneself, striving for self-development, ability to choose information [1].

In the concept of the development of the higher education system of the Republic of Uzbekistan until 2030, the educational process includes individualization based on modern digital technologies, the development of distance education services, and the wide implementation of innovative teaching technologies [3].

The approach based on digital technologies plays an important role in the development of digital competence of pedagogical personnel. In this regard, the analysis of research shows that there is a need to develop the digital competence of pedagogical personnel. Digital Learning Environment (DLE) is a set of digital tools and technologies used to organize, manage and support the educational process. Digital competence is a broader concept and is a set of competencies that includes activities for working with educational resources in a digital environment, including creating and collecting data, processing and analyzing them, as well as automating processes using digital technologies.

This article describes the analysis of the process of developing the digital competence of pedagogical staff of higher educational institutions for the teaching staff of higher education institutions.

Literature analysis. Within the framework of the European Commission's Digital Education Action Program, research is being conducted to create a new vision of digital competencies focused on the following three main areas:

- 1) improving the use of digital technologies in the educational process;
- 2) development of skills necessary for digital transformation;
- 3) relying on analysis and forecasting based on educational data.

According to P. Gilster, in the development of digital literacy, it is necessary to emphasize the aspects of social relations in digital professional activity. It defines the following qualifications as criteria for achieving digital competence:

skills of searching for tools for working with necessary information in professional activity, ability to quickly master these tools (information competence);

the ability to communicate with other members of society (communicative competence);

skills to produce information in various forms and forms (creative competence) [3].

P.Krumvisk says that globally, "the term "digital literacy" is better used instead of the term "digital competence", because it has a broader and more holistic meaning", where "the main focus is on the teacher and science, and technical skills are only part of this complex concept of digital competence". is a part of it" [4].

According to G.Soldatova, the four-component structure of digital competence, i.e. knowledge; skills and competencies; motivation; each of the components of responsibility (including security) can be implemented to a different extent with information and Internet resources in different fields of activity (in working with content, in communication, in the field of technology, in consumption) [6].

Pedagogical opportunities for developing the digital competence of pedagogues include:

1. To develop a set of necessary and sufficient measures of the qualification improvement process to create a favorable environment for the development of digital competence in the teaching staff of higher education institutions;

2. Constantly updating the content of the course aimed at developing digital competence in the process of professional development;

3. Application of innovative educational methods and forms of teaching staff to work with various information;

4. Selection of pedagogical tools in the process of qualification improvement and implementation in practice after determination of appropriateness.

In order to implement these conditions, it is necessary to determine the competence that determines the essence of the teaching method in the form of activity.

The open online course "Digital Competencies in Pedagogical Activity" is aimed at developing the digital competencies of pedagogues on the use of digital educational resources, distance learning technologies and the design of the educational process based on digital educational resources in the conditions of digitalization of the educational process.

Methodology.

The topic of the open online course "Digital Competencies in Pedagogical Activities" is based on the general qualification requirements of the retraining of pedagogues and their professional development, and is aimed at the development of relevant knowledge, skills and competencies with the active use of mixed educational technologies in practice. The content of the

online course has been improved by specifying the features of Digital Footprint, Digital Skills, and Digital Ethics. The course content includes the following modules and topics:

Digital Footprint:

Module 1. Digital transformation of the educational process:

- 1.1. Digital competence of pedagogues in a digital educational environment;
- 1.2. The concept of "digital footprint": essence and stages of management;

Digital Skills:

Module 2. Digital learning technologies:

- 2.1. Digital didactics. Requirements for digital learning resources;
- 2.2. Creation and implementation of digital educational resources;
- 2.3. Open digital educational resources and web services;
- 2.4. Cloud technologies and their use in the process of digital education;
- 2.5. Use of VR, AR, MR technologies in the digital educational environment;

Module 3. Distance learning technologies:

- 3.1. Massive Open Online Courses (MOOC) and their creation steps;
- 3.2. Use of webinar platforms for online training;
- 3.3. Using social networks to create a digital learning environment;

Digital Ethics:

Module 4. Digital Ethics and Cybersecurity:

- 4.1. Digital ethics: basic concepts and principles. Copyright protection methods;
- 4.2. Cybersecurity in the Digital Learning Environment: Key Concepts and Cybersecurity Policy Management.

Currently, there are various methods of evaluating the digital competence of teaching staff of higher education institutions. There are two approaches to assessing digital competence: self-assessment and testing. Self-assessment techniques can be done by asking respondents to assess their level of knowledge, skills, and experience (i.e., application) through a questionnaire.

In addition to the survey, other methods can be used, for example, "monitoring the activities of using digital technologies, analyzing the results of working with digital tools of learners, as well as evaluating various practical tasks and projects performed with the help of digital tools" [8].

An important aspect in diagnosing the development of the digital competence of pedagogues is not only the assessment of the current level of knowledge and skills, but also the development of an individual development trajectory. Additional activities, trainings and master classes, as well as recommendations on the use of digital tools and technologies in daily activities may be offered [7].

In assessing the level of development of digital competence, test tools can be presented in several ways. For example, it uses alternative single-choice and multiple-choice questions. The results are evaluated according to the number of correct answers [5].

The criteria for evaluating the development of digital competence of teaching staff are based on the following principles: orientation to competence, levels of digital competence and orientation to the needs of the audience.

In our scientific research work, based on the content of these assessment levels, it was proposed to determine the digital competence of pedagogues on the basis of three levels of development assessment: digital reproductive (low), digital productive (medium), digital creativity (high):

Level 1. Digitally literate means having basic digital skills such as the ability to use computers, the Internet, e-mail, etc. This means they can use ready-made digital resources and tools, but not create their own projects.

Level 2. Digitally productive means the ability to effectively use digital technologies to solve problems and achieve goals. This may include working with spreadsheets, creating and editing documents, using email, and more.

Level 3. Digital creativity refers to the ability to design and create digital content using digital technologies. These include creating educational materials, developing online courses, creating multimedia presentations, and more.

Also, motivational, constructive, integrative, reflexive criteria for evaluating the level of development of digital competence of pedagogic personnel were proposed.

The motivational criterion reflects the pedagogue's conscious awareness of the use of digital educational technologies in professional activities, that is, the need to introduce digital technologies into the educational process and the willingness to learn and develop digital competence skills.

The constructive criterion is the ability of a pedagogue to find different solutions in problem situations in the course of professional activity, that is, to be able to use digital technologies that allow the integration of digital educational content into the educational process, to create educational content and evaluation resources based on digital educational technologies.

The integrative criterion means knowing the principles of creating an educational environment based on digital educational technologies during the professional activity of a pedagogue, creating digital educational resources to find solutions to problematic situations, and a systematic approach to their integration into the educational content [9].

The reflexive criterion refers to the pedagogue's ability to assess the level of personal digital competence in the introduction of digital technologies into the educational process in his professional activity and is related to the process of self-development, openness to development and non-standard approaches, readiness for changes and the ability to adapt to new conditions and requirements of modern digital education.

These criteria make it possible to determine how ready the pedagogue is to constantly improve his digital competence, his suitability and flexibility, as well as his readiness to adapt his activities to new requirements and changes in education and digital technologies.

Results: We use the method of regression analysis of the entrance and exit online tests of 173 participants of the online open course "Digital Competencies in Pedagogical Activities" developed in the course of the research (Table 1).

1-table.

Listeners who participated in the pilot test of the online open course "Digital Competencies in Pedagogical Activity".

№	Fields of knowledge	Number of listeners	Average age	ET	
				average score	ET
1.	Humanitarian field	25	41	58,20	71,29
2.	Production-technical field	46	39	62,32	77,83
4.	Social, economic and legal, service sectors	29	40	54,99	72,13
3.	Agriculture and water resources	34	42	61,10	69,42

№	Fields of knowledge	Number of listeners	Average age	ET	ET
				average score	
5.	Health and social care sector	39	43	52,83	67,78
TOTAL		173	41	58,22	71,21

The results of the entrance test before the experiment x_i , number of suitable listeners n_i , as well as post-experimental exit test results y_i , number of suitable listeners m_i we can determine. As a result, we have the following 2 statistical series for comparative analysis (Table 2).

2-table.

Comparative analysis of experimental results

№	Centres	x_i	y_i	n_i, m_i
1.	Humanitarian field	58,20	71,29	25
2.	Production-technical field	62,32	77,83	46
4.	Social, economic and legal, service sectors	54,99	72,13	29
3.	Agriculture and water resources	61,10	69,42	34
5.	Health and social care sector	52,83	67,78	39

The table below presents confidence intervals ($g=95\%$) for pre-experimental entry test results and post-experimental exit test results by domain (Table 3).

3-table.

Confidence intervals for pre-experiment entry test scores and post-experiment exit test scores by domain

Indicators	Number of listeners	Digital reproduction (low)	Digital productivity (medium)	Digital creativity (high)	Average score	Confident deviations	Confident interval
Humanitarian field							
Entrance test	25	56,50	62,25	55,85	58,20	$\Delta x = 2,780$	[55,41; 60,98]
Exit test		68,80	73,53	71,55	71,29	$\Delta y = 2,894$	[68,39; 74,18]
Production-technical field							
Entrance test	46	58,70	61,58	66,68	62,32	$\Delta x = 2,388$	[76,69; 78,38]
Exit test		70,80	76,63	86,08	77,83	$\Delta y = 2,418$	[75,41; 80,24]
Social, economic and legal, service sectors							
Entrance test	29	48,65	53,03	63,30	54,99	$\Delta x = 1,965$	[53,02; 56,95]
Exit test		65,45	72,18	78,78	72,13	$\Delta y = 2,972$	[70,16; 74,10]
Agriculture and water resources							
Entrance test	34	57,18	56,05	70,08	61,10	$\Delta x = 2,617$	[58,48; 63,71]
Exit test		65,95	68,58	73,73	69,42	$\Delta y = 2,306$	[67,11; 71,72]

Health and social care sector							
Entrance test	39	50,63	48,98	58,90	52,83	$\Delta x = 2,092$	[50,73; 54,92]
Exit test		66,45	66,45	70,43	67,78	$\Delta y = 1,494$	[66,28; 69,27]
Total indicators							
Entrance test	1372	57,05	56,52	63,09	58,22	$\Delta x = 2,610$	[55,61; 60,83]
Exit test		67,05	70,75	75,82	71,21	$\Delta y = 2,367$	[68,85; 73,58]

From the table above, it can be seen that the average mastery rates of entrance and exit tests for each field are in non-intersecting ranges, and the highest rate is in the production-technical sector, and the lowest rate is in the health and social welfare sector.

Based on the numerical values presented in Table 3, we create the dynamics of acquisition by the motivational, constructive, integrative, reflexive evaluation criteria of the participants of the online open course aimed at developing digital competence, as well as the digital reproductive (low), digital productive (medium), digital creativity (high) levels.

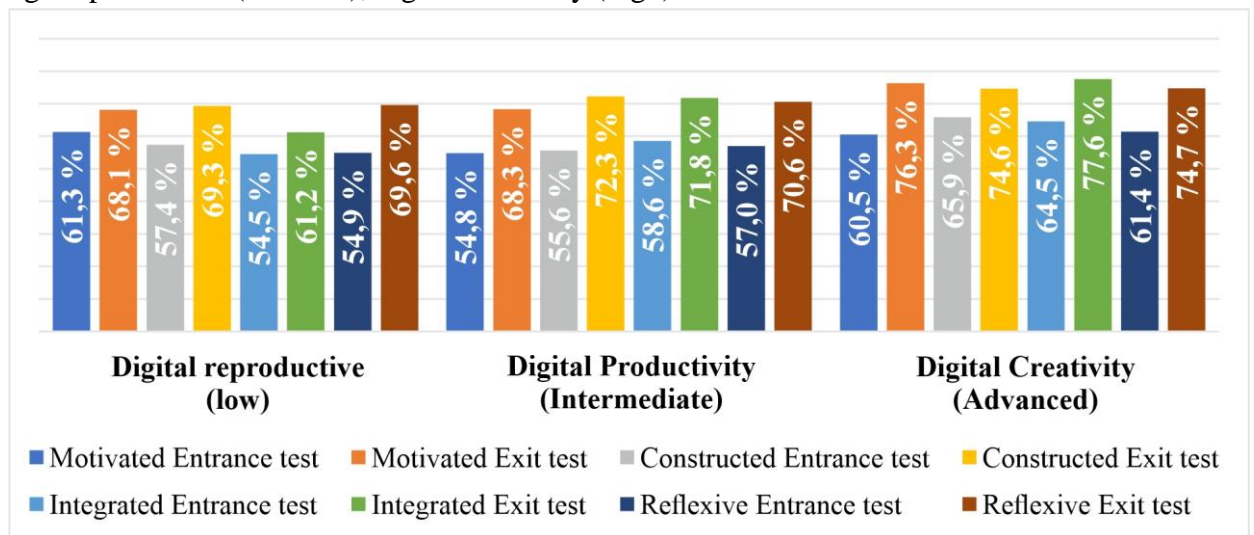


Figure 1. Acquisition Dynamics of Online Open Course Attendees

From the above calculations, it was found that the results of the students after the experiment increased by 12.0% according to the motivational criterion, 12.4% according to the constructive criterion, 11.0% according to the integrative criterion, and 13.9% according to the reflective criterion.

Now let's test the hypothesis that the results of the pre-experimental entrance test and the results of the post-experimental exit test differ by field using the Kramer-Welch test (Table 4):

4-table.

Difference between pre-experimental entrance test results and post-experimental exit test results

№	Field	The value of the Cramer-Welch criterion T_{kuz}	$T_{kuz} > T_{0.05}$, ($T_{0.05} = 1,96$)
1	Humanitarian field	14,38	$T_{kuz} > 1,96$
2	Production-technical field	13,65	$T_{kuz} > 1,96$

3	Social, economic and legal, service sectors	19,45	$T_{kuz} > 1,96$
4	Agriculture and water resources	7,80	$T_{kuz} > 1,96$
5	Health and social care sector	19,04	$T_{kuz} > 1,96$

It can be seen from the table that the value of the Kramer-Welch criterion for all areas is greater than the value of the critical point, that is, the hypotheses that the results of the pre-experimental entrance test and the results of the post-experimental exit test differ in all areas are accepted.

The conducted studies have shown that it is possible to monitor the growth of the digital competence of pedagogues in the system of continuous professional development.

Conclusion. The level of development of the digital competence of the teaching staff was evaluated according to the open online course "Digital Competencies in Pedagogical Activities". Their indicators were analyzed mathematically and statistically using the Kramer-Welch criterion. According to the results of the analysis, it was found that all criteria (motivational, constructive, integrative and reflexive) were higher compared to the results of the entrance test before the experiment and the results of the exit test after the experiment. This means that the proposed research is effective.

The effectiveness of teaching technologies developed on the basis of the content of the open online course created for the development of digital competence of pedagogic personnel, the educational methodological complex, the digital educational resources placed on the distance training platform, and the model lesson developments was determined.

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