

# Formation of Digital Competences of Future Teachers by Means of Information Educational Environment

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## Abstract

The problem which is solved by the research is due to the need to transform the system of higher pedagogical education in accordance with challenges of the digital economy and new requirements for the existing system regarding the quality of formation of key competences.

The purpose of the research is to theoretically substantiate the use of information technologies for formation of digital competences of future teachers.

The research methodology consists of the theoretical analysis of foreign and domestic approaches to the definition of digital competences, principles, mechanisms and conditions for their formation; generalization of fundamental scientific works, which are significant in the field of digitalization of education, and using software for the development of competences.

Research results. The necessity of reconsidering higher education standards in terms of supplementing universal and general professional competences with key competences of the digital economy is substantiated. The concepts "digital literacy", "digital competences", "digital skills" are clarified. The concept of formation of digital competences of future teachers in information educational environment using project activities when developing electronic educational materials is presented.

In the conclusion it is confirmed that the use of information educational environment, based on principles of the system-activity approach and innovative educational and information technologies, can improve the quality of formation of digital competences of future teachers.

## Keywords <sup>1</sup>

Digital competences, pedagogical education, information educational environment, informatization of education, Federal State Educational Standards of Higher Education, network teaching materials.

## 1. Introduction

The era of transformation of modern society is directly related to creation of such a digital space, which will be adapted to actively progressing information technologies, which are closely connected with social technologies, and, consequently, with requirements of the economy of the future.

The "Strategy for Developing the Information Technology Sector in the Russian Federation in 2014-2020 and until 2025" [1] defines the main directions for the development of the digital economy, taking into account trends in globalization and automation. It should be noted that creation, development and successful functioning of the digital economy in Russia is impossible without people who have a sufficient level of digital literacy, and, consequently, the potential to develop

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competences which are in demand in modern conditions. Today, preparation of a graduate of any training program takes place in educational environment where there are a lot of digital technologies and new challenges for both the future specialist and the current teacher. All participants of the educational process are required to respond quickly to constantly changing and improving information technologies.

The relevance of the presented research is as follows.

Firstly, training of a creative, responsible specialist who possesses research skills and experience in intellectual activity supported by modern high-tech means is an actual direction for modernizing science and education [2].

Secondly, the essence of digitalization of education in the context of the emergence of Industry 4.0 is the ability to effectively and flexibly use the latest technologies for a timely transition to a continuous, non-linear, student-centered educational process [3].

Thirdly, the digital era requires not only new skills from school and university graduates, but also a different approach to organization of training in terms of formation of new competences in future specialists that are in demand in the digital economy. From these positions in the studies of domestic and foreign authors [4; 5; 6; 7] the role of the didactic process, which in the era of automation and globalization, in their opinion, should focus on solving problems of socio-economic development of the country in the context of formation of Industry 4.0 is noted. The sphere of education is no exception, and digitalization processes penetrate it, becoming the driving force behind the transformation of the entire system.

## **2. Purpose and objectives of the research**

The purpose of the research is to theoretically substantiate the use of information technologies for formation of digital competences of future teachers.

Research objectives:

- to analyze the existing models of digital competences and correlate them with the requirements of the current Federal State Educational Standards of Higher Education (3 ++), hereunder referred to FSES HE [8];
- to substantiate the need to transform the current educational standards in the direction of specifying competences formed in the interests of the digital economy, including digital competences;
- to develop, within the framework of the discipline "Digital technologies in education", the concept of a training module, revealing the functionality of the information educational environment, aimed at formation of digital competences of future teachers.

## **3. Literature review**

To confirm the need for formation of digital competences of future teachers and the need to create information educational environment, both fundamental scientific works devoted to the research of the processes of informatization of education in Russia and abroad and the innovative experience of teachers were analyzed.

Numerous studies are being conducted to clarify such concepts as digital literacy, digital competences, digital skills. Let us highlight the works that summarize various approaches to the interpretation of these concepts.

Figure 1 shows the definitions of these concepts found in the analytical report prepared by the Corporate University of Sberbank with the participation of 700 experts from 13 countries of the world [9].

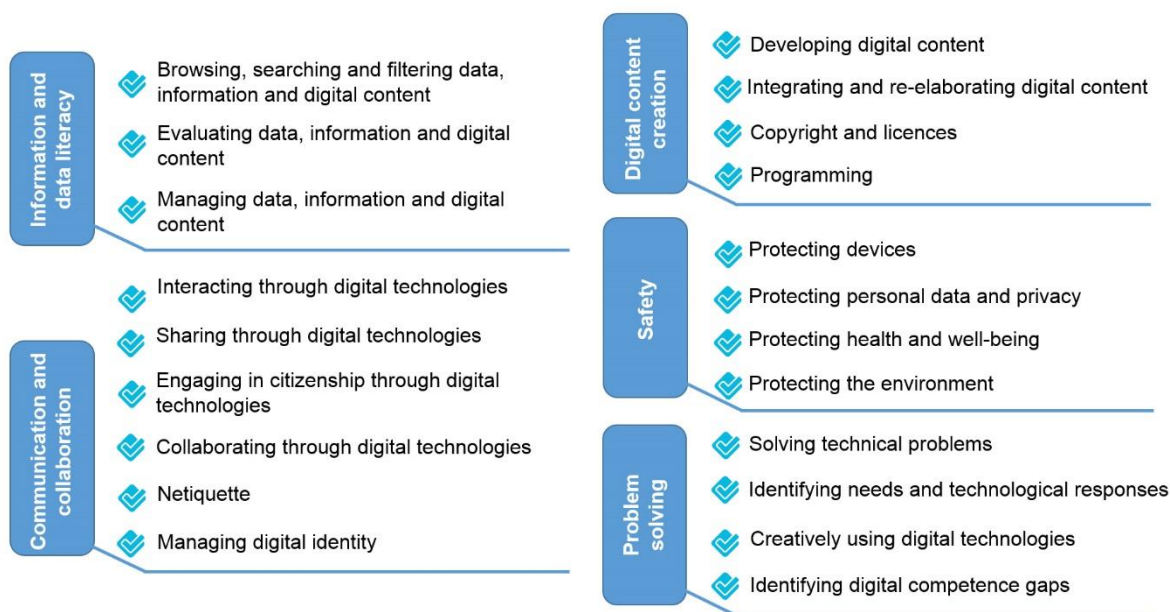


**Figure 1:** Interpretation of the concepts "digital literacy", "digital competences", "digital skills"

The European Commission documents indicate that digital competence should include the ability to digitally collaborate, ensure security and solve problems [10].

In domestic and foreign studies, various approaches to the creation of models of digital competences are revealed.

The European Commission proposes the following approach to the classification of digital competences: 21 competences are distinguished in 5 areas [11] (Fig. 2).



**Figure 2:** The European Commission's Approach to Classification of Digital Competences

In our country, the active phase of implementation of the results of the national program "The Digital Economy of the Russian Federation" is taking place, within the framework of which the federal project "Human resources for the Digital Economy" is being implemented. This project supposes work on expert-analytical and organizational-methodological support of activities; this work is funded from the state budget. In particular, performers of this project formulated a list of key competences of the digital economy, which, most likely, should become a guideline for the transformation of the education system in Russia in the near future [12] (Fig. 3).



**Figure 3:** Key competences of the digital economy in Russia

For some reason, the above list lacks competences related to such an important area of life of the modern person and, moreover, of the specialist of the future, as information security (device protection, data protection, copyright protection, health and environmental protection). Also, the competences related to digital content creation (for example, programming) are not explicitly highlighted. And in general, it should be noted that these 5 key competences are formulated too broadly, which in the future may complicate clear formulation of educational goals.

Russian higher pedagogical education is currently being organized in accordance with requirements of the current FSES HE (3 ++, Pedagogical education) [8]. The analysis of the universal and general professional competences inherent in it allows us to conclude that only two competences can approximately be classified as digital competences: UC-1 (capable of searching, critical analysis and synthesis of information, applying the systematic approach to solving the assigned tasks ) and GPC-2 (capable of participating in development of basic and additional educational programs, develop their individual components (including with the use of information and communication technologies). Obviously, there is a clear discrepancy between these competences and requirements of the digital economy and international researches. Thus, we can conclude that it is necessary to review the Standard in the direction of expanding the range of digital competences presented in it and their concretization in the field of pedagogical education.

#### 4. Methodology

The methodological basis of the research of aspects of digital competences formation of future teachers in the conditions of their acquiring higher education is the main provisions of the competence approach, formulated by A. V. Khutorskoy [13]. They make it possible to take into account the shift in the priorities of the modern educational environment in the direction of training teachers who are capable of critical assessment and system analysis, use of innovations, cooperative project activities, and work in conditions of high uncertainty and rapid changes in professional tasks.

When developing the concept of a training module within the framework of the discipline "Digital technologies in education" for the training program of higher education 44.03.01 Pedagogical education (Bachelor's programme), taught at Vyatka State University (Kirov), the system-activity approach based on the idea of the need to take into account the structure of the activity and explain

the process of active assimilation of knowledge by the subject, formation of methods of the activity through motivated and purposeful solving of the system of tasks.

## 5. Results

The important result of the work is the justification of the need to review the Federal State Educational Standard of Higher Education (3 ++, Pedagogical Education) in terms of improving competences and more clearly identifying those that will be in demand in the digital economy and will form the basis of the pedagogical activity of the bachelor- graduate in the digital school of the future.

In the presence of a certain disagreement in the disclosure of the essence of the phenomenon of "digital competences", most researchers recognize the didactic potential of the information educational environment for their development. It should be stated that the key component of this environment is electronic educational resources [14; 15] in general and, in particular, e-learning materials that initiate learning activities aimed at achieving new educational results. In the information and communication educational environment, requirements for the teacher's professional activity are changing and becoming more complicated. First of all, the teacher must possess the appropriate level of digital competences and teach students, as future teachers, to navigate possibilities of information technologies for successful construction of the educational process.

In accordance with the principles of the system-activity approach, formation of digital competences is possible in the course of active and purposeful work, involving implementation of project activities in information educational environment. This fact was taken into account when developing the training module within the framework of the discipline "Digital technologies in education", which is devoted to the design of electronic teaching materials for the organization of network project activities.

Cloud technologies have a wide range of possibilities, including those for creating various learning tools. In this regard, for designing electronic teaching materials students are offered network tool environment [16]. Figure 4 shows the author's diagram showing the types of e-learning materials implemented with the help of using various online services. In the article we define this format of didactic materials as network educational material (NEM).

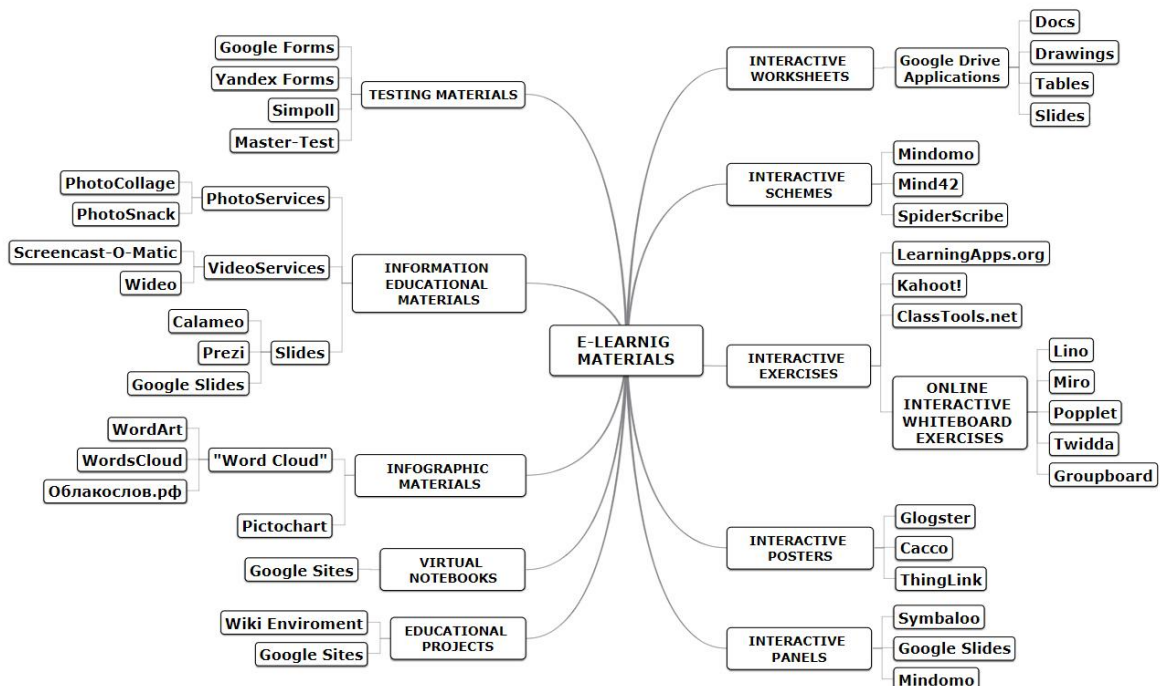


Figure 4: Types of Online e-Learning Materials

In a general sense, NEM is a teaching tool that is implemented in the cloud services environment with the aim of organizing various types of educational activities that contribute to the achievement of specific educational results for students [17].

So, in the process of implementing any project, three stages are traditionally defined: preparatory, main and final. We tried to identify digital competences (Table 1), which can be formed in students at different stages of the design of online educational material.

**Table 1**

The concept of the formation of digital competences in the framework of the design of network educational materials

Designing web-based learning materials	Formed digital competences
<b>1. Preparatory stage</b>	
Lesson type, its goals, objectives, stages, planned educational results	<ul style="list-style-type: none"> <li>• Analysis of official documentation, sources in the digital environment</li> </ul>
Lesson content (information)	<ul style="list-style-type: none"> <li>• Search, information assessment (critical analysis and synthesis), data filtering in digital space</li> </ul>
<b>2. Main stage: creation of online training materials</b>	
The choice of the type of network educational material in accordance with the purpose of the implementation of the system-activity approach (author's classification)	<ul style="list-style-type: none"> <li>• Creative application of digital technologies: using web-based tools to create educational content</li> </ul>
Training material script	<ul style="list-style-type: none"> <li>• Integration and processing of digital content</li> </ul>
Implementation of training materials in online service environment	<ul style="list-style-type: none"> <li>• Creation of educational content in the digital environment</li> <li>• Data, information and digital learning resource management</li> </ul>
<b>3. Final stage</b>	
System of implementation NEM in the educational process	<ul style="list-style-type: none"> <li>• Development of online educational content</li> <li>• Organization of interaction of participants of the educational process by means of digital technologies</li> <li>• Ensuring safe behavior of participants of the educational process in the digital environment</li> </ul>

So during the preparatory stage, when the content of the lesson is determined, the student must analyze the official documentation, sources in the digital environment, search, critically analyze and synthesize information. At the main stage of NEM development, the future teacher determines the type of educational materials, guided by the author's classification of the types of electronic learning materials based on online services, draws up the NEM scenario (taking into account the age and individual characteristics of students) and implements it in the appropriate instrumental environment. At this stage, the student must be ready for creative application of digital technologies, namely, to be guided by the capabilities of network tools for creating educational content, able to modify and improve its quality, organize, store, process data and information, and manage educational resources. At the final stage, a system of measures is formed to introduce the NEM into the educational process. The future teacher must understand that, firstly, any developed resource may require additional

processing to make the resource more perfect and relevant at the right time; secondly, the NEM is a transmitting element in the interaction "teacher - network educational materials - student", which means that on its basis it is necessary to envisage ways of interaction (communication and cooperation) of participants in the educational process in the digital environment; thirdly, work on the Internet requires understanding of security measures, privacy, protection of personal data, devices and digital content.

When doing this creative task, it is recommended to draw up a clear plan of action, set key tasks, time frames for their implementation, think over the possibilities of the iterative approach to the design of training materials (assessment of intermediate results, corrective actions) [18]. Successful mastering the training module largely depends on the student's internal motivation, on the ability for self-determination (own organization and regulation) and self-development in conditions of uncertainty.

## 6. Discussion

The digital educational environment, in which the participants of the educational process must be immersed, requires the future teacher to possess a set of digital competences. The authors of the article made an attempt to concretize the digital competences of future teachers, which are formed in the course of designing network educational materials. The presented digital competences are consistent with the competences specified in the list of key competences of the digital economy of Russia and the European Union report "The Digital Competence Framework for Citizens".

The research shows that the discipline "Digital technologies in education" according to the author's concept allows formation of the following digital competences:

- communication and cooperation in the digital educational environment;
- self-determination and self-development in the context of digitalization;
- strategic, creative, systemic and critical thinking in the digital environment;
- information and data management;
- digital content creation;
- information security.

As a result of the comparison of the digital competences identified by the authors, formed in the process of designing network learning materials, competences presented in various domestic and foreign sources, and competences, formation of which is indicated as the planned educational result in the existing FSES HE (3 ++), the authors came to the conclusion about the need to review the existing standards in the direction of expanding and concretizing the competences of the teacher of the Russian school of the future.

## 7. Conclusion

The results of this work prove that digitalization of the educational system opens up additional opportunities for formation of key competences of subjects of the digital economy. The analysis of world-class digital competence models allows extrapolating the results to emerging competences in the Russian education system, which should be reviewed and expanded from the point of view of digitalization.

The use of information and educational environment built taking into account the principles of the system-activity approach and on the basis of innovative educational and information technologies, can improve the quality of the formation of digital competences of future teachers.

The proposed approach to training students allows formation of digital competences necessary for their further implementation in the school of the future. At the same time, there is no doubt that the Federal State Educational Standard of Higher Education (3 ++ ) needs to be improved in the direction of expanding the range of digital competences presented in it and their specification for the sphere of pedagogical education



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