Digital pedagogy: analysis, requirements and experience of implementation

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Abstract. The object of research is the process of digitalization of teacher education in Russian universities at the present time. The authors pay special attention to the characteristics of the concept of ‘digital pedagogy’. They analyze the definitions of the concepts of ‘digital pedagogy’, ‘electronic pedagogy’, ‘virtual pedagogy’ and ‘techno-pedagogy’. The authors of the article describe the functional and content components of digital pedagogy characteristics such as content-based, environmental, technological and competence-based components on the result of research by methods of content analysis, discursive analysis, synthesis of ideas of modern digital technologies. The article reveals the significance of digital transformation of education in creating non-standard algorithms for solving traditional pedagogical problems, forming and developing an innovative learning process based on artificial intelligence, big data and distributed computation. The article describes the Master’s program in digital pedagogy implemented at the Mari State University.

1. Introduction
The current stage of our country’s social and economic development is characterized by the move towards digital society by means of developing the digital economy processes that cause transformation of the whole production and service provision system through the use of information and communication technology.

The digital economy defines business activities where the key factor of production is the data in digitized form, mass provision of online services, and the results of the analysis and processing of the huge amounts of data allow improving efficiency of different types of production, technology, etc. Undoubtedly, the formation of a new type of business activity contributed to setting a goal of training the personnel for the digital economy.

The program “Digital economy in the Russian Federation” [1] allots a task to providing the following factors in education and personnel training by 2024: the number of graduates of higher and vocational secondary education who are competent in the sphere of the digital technologies at the global average level – 800,000 people per year; the share of population who have the digital skills – 40 percent.

The creation of the concept of ‘digital economy’ led to developing a corresponding lexical set of terms in the education sector, such as “digital literacy”, “digital pedagogy”, “digital education”, “digital didactics”, “digital educational environment”, “digital footprint” and many others.
2. Digital pedagogy: content and functional aspect

2.1. Definition of digital pedagogy

When studying a set of terms that reflect the essence of digital transformation of education, it is important to analyze the main content characteristics of the categories used. Let's pay special attention to the formation of the term ‘digital pedagogy’.

**Digital pedagogy is**

- a branch of pedagogical science that reveals the essence and regularities of digital education, the role of ‘digitalized’ educational processes in personal growth, develops practical ways and means of improving their effectiveness [2];
- a pedagogical trend related to the task of building digital economy and digital society; science and practice describing the arrangement of an educational process in the new conditions of a bifurcated reality [3];
- embedding computer-based digital technologies in the art of learning, which allow enriching the processes of learning, teaching and assessing throughout the course [4];
- building knowledge by the professor through planning education based on problem solving and higher-order thinking skills [5];
- pedagogy that provides high-quality education using computers and programs, while the use of information and communication technologies is a tool for creating new learning opportunities [6];
- the science of specially organized purposeful and systematic activity on human formation, the content, forms and methods of upbringing, education and teaching using information technologies and the Internet [7].

In the process of observing a set of terms that reflect the essence of digitalization, it becomes important to determine the main content characteristics of the categories used. Synonymous in meaning with the concept of ‘digital pedagogy’ are the terms ‘electronic pedagogy’, ‘virtual pedagogy’ and ‘techno-pedagogy’.

**Electronic pedagogy is**

- a new direction of pedagogical science, the subject of which is a system of open education. It studies methods, forms of training and education in high-tech electronic educational environments [8];
- a scientific study, description and forecasting of the processes in any ICT-rich educational environments [9].

**Virtual pedagogy** is a pedagogy that works with the subjective reality of a person and is able to help the individual in its forming, which becomes a particularly urgent task in an era when many artificial virtual realities are being introduced into the modern world [10].

**Techno-pedagogy** is a pedagogical practice that takes into account both pedagogical (teaching and learning methods, motivation, development of students’ skills) and technological aspects (use of computers, the Internet, interactive whiteboards, etc.) and provides new opportunities to support various learning environments [11].

Based on the above, it can be noted that at the moment there is no unified approach to the definition of ‘digital pedagogy’ in domestic and foreign practice. Different authors interpret this term differently, and the interpretation often depends on the field of author’s activity (teachers, methodologists, programmers, IT specialists, managers, etc.). This circumstance also influences the limitations in the wording and other related definitions, such as ‘electronic pedagogy’, ‘virtual pedagogy’ and ‘techno-pedagogy’. The diverse interpretation indicates the need for further research of this concept in the direction of clarifying the basic content.
2.2. Digital pedagogy: a component approach

In general, we can emphasize that the term ‘digital pedagogy’ is quite voluminous in its functional and informative content, which allows us to distinguish the main components:

- **content-based**: creating a new educational product in a digital form with new opportunities for learning and cognitive communication of subjects of the educational process;
- **environmental**: environmental: transfer of the content and communication component to the digital educational environment and transformation of the teaching and learning process within the framework of the ‘teacher – digital educational environment – student’ model;
- **technological**: forms (synchronous, asynchronous), methods (active, interactive, etc.), tools (computers, laptops, mobile phones, electronic educational resources, etc.) and teaching techniques (multimedia technologies, cloud technologies, etc.);
- **competence-based**: formation and improvement of digital competencies of teachers in order to provide interactive and meaningful learning for students.

Digital pedagogy implies a close relationship between the above-mentioned components creating a unified educational environment. Moreover, it should be noted that most often, the authors highlight the technological support of teaching (81.8 %). Technologies are considered from the perspective of introducing new techniques, processes, forms, methods or means of training. In terms of frequency of use, the second place is given to content-based and environmental provision of teaching and learning (72.7 %). Competence-based provision occupies only the third place (36.4 %), which indicates some underestimation of this factor in relation to improving the digital skills of teachers.

2.3. The role of digital pedagogy in the university practice

Today, the modern educational process and digital pedagogy are inextricably linked and are conditioned by such characteristics as efficiency, quality, intensity, personalization and adaptation. In our opinion, the essence of digital pedagogy is not the traditional use of digital resources and information and communication technologies for teaching and creating the educational digital content. The meaning of the digital transformation of education and, in particular, digital pedagogy is to create non-standard algorithms for solving the traditional pedagogical problems, to form and develop an innovative learning process based on digital intelligence, big data, distributed computing, etc., which will effectively contribute to:

- keeping personalized record of students’ progress in a digital form, tracking activities of students and teachers by means of digital footprints in the framework of various formats and systems;
- developing an individual learning path, enabling students to define a learning goal, choose strategy and the way of learning, the rate and the level of mastering the course content while studying at a preferable pace and at a convenient time;
- implementing the adaptive learning systems and algorithms, which allow adjusting an educational programme to the needs of students automatically, according to a student model depending on the psychological, pedagogical, physiological, and professionally oriented factors [12];
- developing systems of diagnostics and control of students’ progress (detailed elaboration and specialization of different levels) which enables to identify primary and additional criteria and take into account the extent to which a student’s required competence is formed;
- managing the learning process facilitating purposeful influence on students by means of planning, organization, motivation, control and correction of their activity for achieving targeted study results;
integrating the means of mobile learning in order to support the organizational and learning processes of students’ vocational training.

3. Master’s program in digital pedagogy
In order to ensure the formation of human and scientific resources in accordance with the principal directions of social and economic development of the country in the conditions of digital economy, the Mari State University (Yoshkar-Ola, Russia) developed and launched the Master’s program “Digital Pedagogy” for students of the major 44.04.01 “Teacher Education”.

The goal of the program is to provide complex and high-quality training for future teacher-researcher who can effectively apply modern digital technologies in the educational practice, conduct scientific and pedagogical research using digital tools and services, and effectively manage the educational process based on the use of digital tools.

The program consists of the following main modules:

- module “Research Methodology in Education”: students get acquainted with the method of critical analysis of approaches, theories, ideas, methods, and technological techniques that are common in modern educational practice; master the methodology, methods of organizing and conducting replication research in the field of education; study modern problems of science and education, as well as the application of mathematical methods in pedagogical research;
- module “Professional Communication in Digital Environment”: introducing the theory of communication as a structure, process and type of activity, taking into account the system of factors operating in the social space and influencing the nature of communication, in determining the role and place of various types of communication in real life of modern society, identifying the features of information exchange in communication, mastering work in digital environments of professional communication;
- module “Scientific Foundations of Digital Pedagogy”: forming knowledge from the field of modernization of the educational process designed to prepare a person for real life in a digital society and professional activity in a digital economy; forming skills to create a modern digital educational space and use methods and tools of digital pedagogy in the process of organizing and implementing the educational process;
- module “Digital Technologies in Education”: developing the skills of forming a digital educational environment as a set of digital learning tools, online courses, electronic educational resources; designing the models of digital educational interaction, studying ways to fully individualize the educational process based on the use of digital technologies and personalized continuous monitoring of educational success and personal and professional development of students;
- module “Digital Educational Environment”: acquaintance with the possibilities of digital technologies in terms of their functionality for using various group forms of organizing the educational activities and ensuring the complete acquisition of the given educational results; acquaintance with digital technologies focused on the formation of pedagogical design of digital educational environment, as well as on monitoring and examination of its resources; development of competences in the application of teaching technologies in the digital educational environment.

Master’s program includes 120 credits. The implementation of the Master’s program implies the use of e-learning and distance learning technologies.

4. Conclusion
Thus, the transformation of the education system shows a clear need for restructuring the educational process in order to use the potential of digital pedagogy with maximum efficiency. It is designed to
prepare modern students for the implementation of professional activities in the digital economy and for life in a digital society.

References

[1] Digital Economy in the Russian Federation http://www.consultant.ru/cons/cgi/online
[2] Ilaldinova E Yu, Belyaeva T K and Lebedeva I V 2019 Digital pedagogy: features of the term evolution in the framework of categories and concepts of pedagogy Perspectives of Science & Education (Moscow: Education) 4 p 40
[3] Five basic qualities of digital pedagogy http://teachers.nanograd.academy/digital_pedagogy_101
[4] Kivunja C 2013 Embedding Digital Pedagogy in Pre-Service Higher Education To Better Prepare Teachers for the Digital Generation Int. J. of Higher Education 2 (Moscow: MIFI) p 103-12
[5] Digital literacy and digital pedagogies for teaching literacy: Pre-service teachers’ experience on teaching rounds www.literacyandtechnology.org/uploads/1/3/6/8/136889/jlt_v14_1.pdf#page=72
[6] Online school “Foxford” https://foxford.ru/
[7] Digital pedagogy in the teaching and learning process of medicine education https://rosomed.ru/theses/702
[8] 2009 New dictionary of methodical terms and concepts (theory and practice of teaching languages) (Moscow: IKAR)
[9] Andreev A A 2011 Pedagogy in the information society Higher Education in Russia 11 (Moscow) 113-17
[10] Kalmykov A A 2018 Presenting knowledge (visualisation issues) (Moscow, Berlin: Directmedia)
[11] Techno-pedagogy https://ccerbal.uottawa.ca/litrg/techno-pedagogy.
[12] Toktarova V I 2018 Adaptive system of the mathematical training of hei students: structural and content components Innovative Projects and Programs in Education 4 (Moscow: Academy of Social Management) p 73-83