

Digitalization of education: trends in teacher training

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Abstract. Taking into account interstate and national requirements, an analysis of the significance was carried out and trends in the preparation of teachers for professional activity in the context of the digitalization of education were identified. It is noted that the ongoing scientific research affects various areas of training future teachers, however, they mainly consider certain aspects of professional training of teachers. Among the promising directions for the development of the process of training teachers are identified: the development of methodological concepts, strategic national projects and programs for the training of teachers, taking into account the prospects for economic development, digitalization of society and the education system; the transition to understanding the digitalization of professional pedagogical education as a process that includes the formation of future teachers' personal readiness for professional activity in the context of the digitalization of society and education; provision of the process of training pedagogical personnel with hardware, network and software resources adequate to the needs; reducing the level of academic load on teachers who train teachers; improving the quality of professional pedagogical education based on personalization and targeting; ensuring the parity of interests of commercial organizations, state and public institutions, personal interests of future teachers; purposeful formation of future teachers' competence in the design and modernization of educational space based on IR technologies; formation of professional competence among future teachers in the field of ensuring the protection of children and youth in the information space.

1 Introduction

Modern education is initially aimed to achieving by each student the unity of the ability to live in society, the skills of knowing the world around and readiness for self-realization. The education system is designed to solve a number of tasks, including: "instilling basic values and transferring cultural heritage, supporting the personal development of young people and adults, promoting democracy and the inclusion of the younger generation in society, developing intercultural understanding, improving health and well-being, supporting economic development, reducing poverty and increasing general welfare" [1].

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The focus on achieving these goals allows for the realization of the idea of lifelong learning.

Education cannot stand aside from the general trends of our time, among which digitalization takes a key place. As a result, the problem of preparing a teacher for work in the context of digitalization arises. This article is created to identify promising directions of the digitalization process of professional pedagogical education based on the analysis of the requirements for the teacher's ICT competence and ongoing research.

2 Material and Methods

Conceptual ideas about the quality of informatization of education, as well as the provisions of the competence-based approach in education, served as the methodological basis of our research.

The empirical source of the study was the normative documents on the organization of education in Russia (Federal State Educational Standard) and the works of modern researchers on this topic. Thus, the material for the analysis in this article is the factology of the state of the teacher training system in Russia and Europe in the context of the digitalization of modern society.

Research methods are analysis, synthesis, content analysis, interpretation, generalization, comparison method [2, 3]. The method of content analysis was used to study the content of the Federal State Educational Standard for the Bachelors level 44.03.01 Pedagogical education (2018). The semantic category of content analysis was the concept of "Digitalization", the unit of account is the terminology that reflects various aspects of this phenomenon.

3 Results

The digitalization of education is understood ambiguously. And very narrowly, as saturation of the educational services market with smart-technology: "the use of desktop computers, mobile devices, the Internet, software applications and other types of digital technologies for teaching students of all ages" [4]; and quite broadly - the digitalization of education is understood as various models of the transition of traditional forms of education into a virtual environment (online courses, online exams, web-seminars, etc.), the digitization of teaching aids (digital textbooks), as well as the attraction of new funds in the learning process (for example, animation) and changing management models in education, interaction of subjects of the educational process using the capabilities of electronic platforms.

The process of digitalization of education today is given a lot of attention by international, state and public organizations of developed countries, leading developers of software and hardware (Cisco, Intel, ISTE, Microsoft, Siemens, etc.)[4]

National education systems are actively involved in the transition of education to digitalization rails. In all developed countries, there are trends in providing the education system with platforms and cloud solutions, SaaS technologies are widely used, electronic educational resources are being developed and modernized, open online-courses are being introduced (EPALE – Electronic Platform for Adult Education in Europe, RES – Russian Electronic School, etc.).

A great deal of work on the creation of new and adaptation of traditional pedagogical tools, models and technologies for the effective operation of the education system in the context of digitalization is being carried out by the scientific community of both Russia and all countries of the world [5].

The Federal State Educational Standard regulating the acquisition of pedagogical education at the bachelor's level reflects the trend towards digitalization. Based on the content analysis of the content of this standard, we obtained the following result (Figure 1).

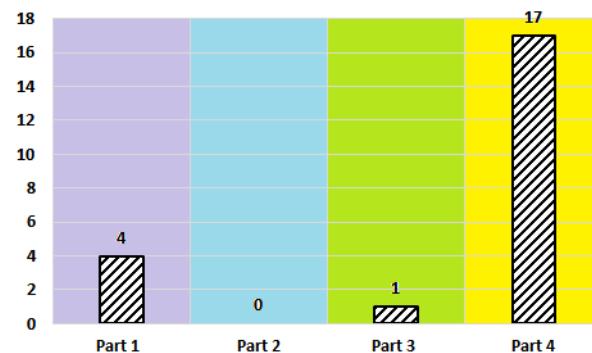


Fig. 1. Distribution of terminology characterizing digitalization problems in the Federal State Educational Standard, 44.03.01 Pedagogical Education (2018).

As Figure 1 shows, in different parts of the Standard, there is a different intensity of representation of thematic terminology. Part 1 "General provisions", Part 2 "Requirements for the structure of the bachelor's program", Part 3 "Requirements for the results of mastering the bachelor's program" demonstrate the minimum indicators. Part 4 "Requirements for the implementation of a bachelor's program" characterizes in sufficient detail the electronic educational environment, features of e-learning, electronic portfolio, the level of qualifications of higher school teachers, which must be used by higher school teachers. This fact testifies to the importance of the theoretical development of this problem.

Despite the great attention to the problem of digitalization of education on the part of the scientific community, states and interested institutions, it must be stated that high-quality electronic educational resources, adapted to modern challenges and meeting the needs of the education system and pedagogical requirements, are not enough either in Russia or in the world. Also, universal effective methods of organizing schoolchildren's education in a digital environment have not been developed, based on the development of their independence and motivation of cognitive activity. The existing and widely used pedagogical means of education, traditional and "innovative" resources and software in many respects do not meet the modern requirements and conditions of digitalization of education. These conclusions confirm the caused in 2019-2021 pandemic of the COVID-19 virus, problems of using hardware and software, as well as problems of ensuring comfortable interaction of educational subjects, socialization processes of students [6].

One of the key factors in the low efficiency of the introduction of information and communication technologies (hereinafter in this article – IC-technologies) in the education system is the insufficient training of teachers in the field of IC-technologies. It is on the shoulders of the teacher, in many respects, that the solution of the problem of ensuring the quality of education, achieving the targeting of the educational process, its compliance with the state and prospects of development of the information society lies.

The requirements for teacher training in the field of knowledge of IC-technologies are well known. They are defined by UNESCO recommendations (the latest version was published in 2019 [7]). They are about standards for the competence of teachers in the field of IC-technology. In particular, the competencies of a teacher in the field of possession of IR technologies include:

- the acquisition of knowledge, which determines the readiness and ability of teachers to effectively participate in the life of the school community: awareness of the importance

of implementing national and institutional policies in the field of informatization of education; skills in analyzing the possibilities of implementing IC-technologies in ensuring the fulfillment of the requirements of state educational standards; skills of adequate selection of IC-tools for the implementation of the used learning models; skills of using general-purpose hardware and software in the educational process; skills of organizing the space of inclusive education based on IC-technologies; skills of using IC-technologies for professional self-improvement;

– the mastering of knowledge, which determines the use of IC-technologies by a teacher to increase the efficiency of his professional activity: skills in the development and implementation of pedagogical practices that meet international, national and institutional policies, as well as social priorities; skills of integration into the taught subject of IC-technologies; skills in organizing project training based on IC-technologies; skills for the development of high-level thinking in trainees based on the creation of an integrated digital learning environment; skills of pedagogical communication using digital resources; skills of interaction with the professional pedagogical community with the aim of their professional development;

– the creation of knowledge, which determines the readiness and skills of the teacher's methodical work: skills of critical assessment and development of national and institutional policy in the field of informatization of education; the skills of organizing the assimilation of the educational program by students based on the ideas of a personality-oriented approach to learning and cooperation; skills of organizing self-directed learning of students; skills in using digital tools to build communities of knowledge and to support pervasive learning; skills to form research groups and subject communities of schoolchildren to support pervasive learning through the use of digital tools; readiness to develop the school's ICT-strategy; skills of professional self-improvement and readiness for methodical work.

Even a superficial analysis of the above requirements for a teacher allows us to conclude that teachers need to be purposefully prepared for professional activities in the digital world; teachers need to be taught the organization of the educational process using digitalization and IC-technologies. Research results confirm that it is the teacher who plays a key role in the digital transition not only to education, but also to society as a whole; the effectiveness of digitalization of education depends on the teacher's ability to develop innovative ways of using IC-technologies to improve the learning environment and develop information literacy, deepen and generate knowledge by students. Digitization and digitalization of education will come to the classroom only with the teacher.

It should be noted that today all over the world, including in Russia, research is being conducted on the problems of preparing teachers for professional activity in the context of informatization and digitalization of society and the education system. These studies cover various areas and aspects of the process of preparing future teachers. In particular:

– problems of the relationship between the ICT-competence of teachers and their professional competence [8], the ICT-competence of teachers and the quality of teaching of schoolchildren [9] are being actively developed;

– studying the problems of interaction between "external" and "internal" digitalization of education (respectively, carried out by the state, being "influenced by international trends" and implemented directly in educational institutions, at the initiative of the teacher) [10];

– the issues of the specificity of the application in education of traditional teaching models and models based on IC-technology [11] are analyzed, and the directions of implementation in education of various models of digital didactics, the mechanisms of the implementation of the systematic influence of digital means in the process of educating the personal qualities of future teachers are revealed;

- the mechanisms of integrating media education into the professional training of teachers are being investigated (within the framework of the European project e-MEL Education Lab [12]), the analysis of models and ways of implementing promising developments in the field of IT-technologies in education [13], 5G technologies, streaming video, mixed reality, models of multilevel professional pedagogical training are being designed in the context of digitalization of education [14, 15];
- the influence of digital technologies on the attitude of students to the educational process and on the flexibility of models for the use of educational resources and tools is analyzed;
- mechanisms are being developed for the formation of future teachers' professional competence in the field of ensuring the protection of children and youth in the information space.

Despite the high level of attention to the problem of training future teachers on the part of scientists, state, public and commercial institutions, the results of scientific research and educational practice show that the level of professional IC-competence of teachers everywhere leaves much to be desired. It is required to develop promising directions for the training of pedagogical personnel related to the formation of future (and working today, existing) teachers of the skills of obtaining, assimilating and generating educational digital content.

4 Discussion

When developing promising directions for increasing the effectiveness of training teachers for work in the digitalization of education, all aspects should be taken into account, if possible. The most important among them are at least three. The requirements for the level of the teacher's IC-competence play a key role in designing the trend of professional pedagogical education. These requirements are defined at the international level and in their implementation are based on national concepts of teacher training. A special place is taken by taking into account the importance of the teacher in the development of the information society, education; taking into account the current and promising levels of digitalization of human life. Considering the factors that hinder the quality training of teachers is important in determining the characteristics of the development of teacher education. These factors are indicated in the scientific studies we have analyzed (given above).

Thus, it is advisable to allocate the following prospects for the development of professional pedagogical education:

- development of methodological concepts, strategic national projects and programs for training teachers, taking into account the promising needs of the economy and industry, the development of digitalization of society and the education system, focused on the systemic modernization of training of teachers. It is required to develop a systemic methodology for solving the problem under consideration (the studies we have analyzed are, for the most part, "point-like" in nature, they consider certain aspects of professional training of teachers). Modern conceptual documents and scientific developments mainly propose the modernization of traditional models and technologies of teaching based on the introduction of existing IR technologies into the field of education. Thus, the adaptation concept of professional training of teachers to the digital essence of society is implemented. At the same time, the effectiveness of modern professional training of future teachers requires the implementation of at least a design ideology aimed at training specialists in the field of education to design and development of a digital educational space and electronic educational resources;
- professional training of teachers in the context of digitalization should be considered in a broad sense. Digitalization of teacher education is a systemic process. It includes not only

the widespread optimal variable implementation of IC-technologies in the pedagogical education system. Digitalization of pedagogical education is, first of all, an orientation towards the targeted formation of future teachers' personal readiness to carry out professional activities, taking into account the prospects for the development of society and education. The digitalization of teacher education includes, as a key component, the formation of the required personal qualities, the corresponding worldview of the subjects of the educational process - the student, teacher, education manager, and ultimately society as a whole. The competence of each teacher, his personal attitude to digitalization and IC-technologies, together with the unity and integration of "external" ("administered") and "internal" ("unadministered") digitalization, constitute the key conditions for the effectiveness of digitalization of education. As a consequence, it is necessary to purposefully work on the formation of the axiological component of the personal information culture in future teachers;

– provision of the educational process of training pedagogical staff with hardware and software adequate to the needs (saturation of the education system with various devices, smart technology and digital resources), access to the resources of the global network. Today, we are preparing "Generation Z" youth and millennials who have grown up with IR technology raised through digital content for the teaching profession. Therefore, the educational process must be built in the conditions familiar to modern youth using modern means (especially since the digital educational environment is the environment for their future professional activities). It is necessary to focus in the training of pedagogical staff on the widespread use of not just modern, but advanced, innovative and promising IC-technologies, reorientation of content, methods and forms of training to the possibilities of modern IC-training tools (multimedia, hypertext, network resources, social networks, virtual, mixed and augmented reality, etc.);

– reducing the level of academic load on teachers who train teaching staff. This can be done by increasing the flexibility and variability of curricula and programs, integrating profiles within the pedagogical direction of personnel training. A significant role in reducing the load on the teacher will be played by a balanced, analyzed introduction of distance and hybrid teaching models into the training system of future teachers, an increase in the share of practices in the curriculum;

– improving the quality of training of pedagogical personnel by orienting the educational process towards personalization and targeting of pedagogical education (diagnostics in the selection of applicants, reducing the number of students in academic groups,, the development of individual trajectories for the professional training of future teachers, etc.), early assignment of the future teacher to the school - the future place of work, the introduction of a practical exam as a form of state certification of graduates of pedagogical universities, the gradual abandonment of secondary vocational pedagogical education;

– ensuring the parity of interests in the digitalization of the process of training pedagogical personnel of interested commercial organizations, state and public institutions, personal interests of future teachers. Digitalization of education in general and teacher training in particular requires the development of public-private partnerships. The global, poorly conceived commercialization of the processes of informatization and digitalization of education negatively affects the quality of education in general. Short-term commercial benefits in the field of education negatively affect the prospects for the economic development of society;

– purposeful formation of future teachers' competence in the design and modernization of educational space based on IC-technologies. This competence presupposes, on the one hand, the teacher's possession of the skills of expediently equipping the space of an educational organization with electronic boards, virtual and augmented reality devices and other smart technology, and on the other hand, confident mastering by the teacher of

modern models of educational work in an electronic campus; skills in using the resource base of electronic educational systems; skills in the implementation of distance and hybrid training models, experience in involving trainees in the implementation of telecommunication projects, social and educational projects, etc.;

– the formation of future teachers' professional competence in the field of ensuring the protection of the young generation in the information space. This competence presupposes the teacher's possession of both knowledge and skills of implementation (including at the level of prevention) of protecting children and young people from information content that negatively affects their psyche.

5 Conclusions

Summarizing what has been said, we note that the preparation of future teachers for professional activity in the context of the digitalization of society and the education system is a multifaceted, complex problem. The complexity of its solution is due, first of all, to the swiftness in the development of information and communication technologies and, accordingly, some uncertainty in the tasks and directions of training of pedagogical personnel. The solution to this problem is seen in consistency, the integration of efforts of all interested public, national and interstate institutions.

The results obtained in this article can be used in the development of a methodological framework for the design and implementation of teacher training in the context of digitalization.

References

1. ICT competency standards for teachers: policy framework. PARIS. UNESCO, 2008. 15 p. <https://unesdoc.unesco.org/ark:/48223/pf0000156210>.
2. L. Cohen, L. Manion, K. Morrison, Research methods in education. 6th edition (Routledge, London and New York, 2008).
3. J. Freeman, S. Walters, M. Campbell, How to display data (Blackwell Publishing, London, 2008).
4. <https://www.plm.automation.siemens.com/global/ru/our-story/glossary/digitalization-in-education/25307>.
5. O. Fedotova, V. Latun, Mediterranean Journal of Social Sciences **6 (4)**, 356–361 (2015) DOI:10.5901/mjss.2015.v6n4p356.
6. O. Fedotova, E. Platonova, V. Latun, I. Filkevich, O. Igumnov, E3S Web of Conferences **210**, (2020). DOI:10.1051/e3sconf/202021022019.
7. UNESCO ICT Competency Framework for Teachers (2019). <https://iite.unesco.org/wp-content/uploads/2019/05/ICT-CFT-Version-3-Russian-1.pdf>.
8. E.J. Instefjord, E. Munthe, Teaching and Teacher Education **67**, 37-45, (2017) DOI: 10.1016/j.tate.2017.05.016.
9. F.M. Røkenes, *Preparing Future Teachers to Teach with ICT: An investigation of digital competence development in ESL student teachers in a Norwegian teacher education program*.
10. https://www.researchgate.net/publication/304658758_Preparing_Future_Teachers_to_Teach_with_ICT_An_investigation_of_digital_competence_development_in_ESL_student_teachers_in_a_Norwegian_teacher_education_program (2016).

11. C. Edelhard, T. Fossland, Pathways, Practices and Performances (2019). DOI: 10.1080/13538322.2019.1603611.
12. O. Erstad, B. Eickelmann, K. Eichhorn, Educ Inf Technol **20**, 641–654 (2015). DOI: 10.1007/s10639-015-9431-3.
13. M. Ranieri, I. Bruni, Digital and Media Literacy in Teacher Education: Findings and Recommendations from the European Project e-MEL <https://core.ac.uk/download/pdf/301576124.pdf>.
14. J.T. Schmidt, M. Tang, Digitalization in Education: Challenges, Trends and Transformative Potential. In: Harwardt M., Niermann P.J., Schmutte A., Steuernagel A. Führen und Managen in der digitalen Transformation. Springer Gabler, Wiesbaden. (2020). DOI: 10.1007/978-3-658-28670-5_16.
15. A. Baratè, G. Haus, L. Ludovico, E. Pagani, N. Scarabottolo, *5G technology and its application to e -learning*, Proceeding 11th Annual International Conference EDULEARN2019.pdf. (2019). DOI:10.21125/edulearn.2019.0918.
16. I. Saiful, J. Nusrat, Digitalization and Education System: A Survey, (2018). https://www.researchgate.net/publication/328511962_Digitalization_and_Education_System_A_Survey.