



Formation of Digital Literacy of University Teachers

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Abstract. The need to master digital literacy by university teachers is dictated by external and internal circumstances of professional activity. In the conditions of rapid development of digital society, the need to find effective methods of digital literacy formation requires further empirical study. The purpose of the study is to analyze the effectiveness of the formation of digital literacy of teachers in accordance with the requirements of the competence and system approach, based on the developed criteria and indicators. The method of testing the teaching staff of the Belgorod State National Research University was applied during the development of the advanced training program «Digital literacy: formation and development of digital competencies in the bachelor's degree». It is revealed that the advanced training program contributes to the improvement of digital literacy of teachers and their independence in acquiring the necessary digital competencies, but the management of these processes seems relevant. The ways to solve the problem are seen in the application of interactive forms of training, wider use of educational platforms in online format, in the activation of in-house training of teachers to master information and communication technologies.

Keywords: digitalization of education · digital competencies · formation of digital literacy · learning models based on digital technologies

1 Introduction

Digital literacy is one of the key skills necessary in the modern world. It is becoming increasingly important in our digital age, where technology permeates all aspects of life. Digital literacy is also crucial for fostering innovation, digital transformation, and increasing productivity in various fields, including education, business, healthcare, and government. Overall, digital literacy is becoming an integral part of our modern lives and is a key factor for success and development in the digital era. As digital technologies spread in all spheres of life, the need for digital competencies of every citizen of the country increases in order to build an effective digital society. The concept of “digital literacy” is becoming popular and requires interpretation as a new problem related to the digitalization of society. The problem of digital literacy is discussed both by modern Russian scientists (N.D. Berman, I. Golovanova, O.V. Yeltsova, A.G. Klepikova, E.A.

Konopko, V.N. Kormakova, M. A. Lapina, P.O. Luksha, O.P. Pankratova, M.V. Slesar, G.U. Soldatova and etc.) [2, 4, 5, 11, 13, 15, 20], and by foreign scientists (P. Glister, C. Iordache, Esteve-Mon, A.Martin, L. Limberg, J. Rugelj, O.Sundin and etc.) [1, 8, 12, 16–19]. After analyzing the concept of «digital literacy», we concluded that there are different approaches to the definition of this concept, but this does not reduce its importance for the modern digital society.

Understanding and using information in a variety of formats and sources with the help of computers forms digital literacy and “contributes to the development of network thinking with high information and communication activity” [1]. To improve digital literacy, it is necessary to develop media literacy (the ability to search, analyze, evaluate and create media messages), information literacy (the ability to search for and work with information using digital tools), communication skills (the ability to communicate with others) and creative competence (the ability to create information in various formats) [1]. G. Soldatova emphasizes that creativity is a key component of digital literacy, as the “ability to create new information objects using digital resources of the Internet (texts, visuals, audio and video) contributes to the formation of students’ information and media competence” [13]. Digital literacy also includes aspects of cybersecurity and information protection in the digital space (local and global networks).

The formation of digital literacy among the subjects of the educational process is an important factor in the success of digitalization of education as a whole. According to research by domestic and foreign scientists, the concept of digital literacy includes several key parameters. First of all, this is information and communication literacy, which allows you to effectively work with digital information and electronic communications. Also important is the ability to create digital content; mastering this skill allows you to show your creativity and share information with others in the digital environment. Another important aspect of digital literacy is digital security, which means being able to protect digital data and personal information from threats and unauthorized access. Digital literacy also includes digital problem-solving skills that enable effective use of digital tools and coping with technical complexity. All of this is achieved by acquiring the necessary digital competencies to successfully address educational and professional challenges. However, the development of digital literacy requires not only theoretical training, but also the practice of the cultural use of technological tools such as mobile devices and computers, as well as the active use of the communication capabilities of the digital environment [7].

Digital literacy is a complex set of skills, the development of which requires the ability to think critically, the ability to process, analyze and «filter» a large amount of information; possession of modern communication tools, technical skills to work with certain programs; the ability to cooperate and work collectively in a digital educational environment.

The readiness of teachers to form and develop their own digital literacy and digital literacy of students is the most important component of successful digitalization of the education sector. Due to these circumstances, the teacher’s competencies in the organizational sphere acquire special importance. This, according to Yashina Yu. V., Koloskova G.A., implies “the ability to effectively manage external learning conditions, create an educational environment saturated with various development opportunities,

develop curricula, implementing them in a variety of dynamic forms of organizing educational activities, as well as create a variety of communication situations, having high educational significance” [14].

The competent use of technical innovations by a teacher in his work is an indicator of him as a specialist who is able to form the competencies of the XXI century in students, develop their ability to independently study. It is important to note that digital competencies are associated with the fact that the teacher is forced to work in a fundamentally new digital environment and “interact with other participants in the educational process who are somehow involved in it” [9]. Here it is important for the teacher to understand the possibilities of digital technologies for introducing innovations in order to teach students to solve educational and professional tasks, «critically investigate» and model new knowledge. The use of pedagogical models based on digital technologies enables the teacher to design an educational process that meets the requirements of effective learning. This allows students to form competencies necessary for life and activity in the modern information society. These models include:

1. The model of network collaboration is an educational technology in which students systematically carry out educational and cognitive activities in accordance with educational goals and achieve results in an open controlled information space.
2. Cooperative learning, as a collaborative learning model, involves students working in groups and achieving success through mutual interaction. It is a form of shared learning where students collectively construct and create new knowledge, rather than simply consuming it in its final form.
3. The interactive learning model assumes that each learner actively participates not only in the educational process but also in the research process.
4. Gamification and storytelling are new approaches in teaching aimed at increasing the level of stable cognitive motivation, involvement in the learning process, creating conditions for the realization of individual needs of students.
5. BYOD technology makes it possible to perceive students’ own mobile devices as assistants in organizing work in the classroom; it can represent a combination of various models and learning technologies listed above [9, 10].

2 Materials and Methods

2.1 Statement of the Problem

The objective of this research is to assess the effectiveness of developing teachers’ digital literacy in alignment with competence-based and systematic approaches, using established criteria and indicators. Additionally, the study aims to identify strategies for optimizing the development of digital literacy among university staff. The authors assume that the level of digital literacy is ensured by the acquisition of key digital competencies by teachers: search and critical perception of information in digital sources; Information and data management; multimedia content creation; communication and cooperation in the digital environment; use of services to organize information storage, feedback, surveys, etc. To achieve this goal, it is necessary to prepare teachers capable of working effectively with the main types of information activities, including, among other things, the use of modern pedagogical models of collaborative learning based on digital

technologies. Professional development and self-development of skills to effectively use digital technologies is an integral part of the process of developing teachers' digital literacy.

2.2 Methodology

The research is based on systematic and competence-based approaches in teaching. The systemic approach to the formation of digital literacy serves as a basis for the development of an organizational and technological model of training teachers to effectively use modern pedagogical methods. This training model includes the implementation of a set of training goals and objectives, methodological and technological solutions, as well as training content, which allows to optimize the learning process. The use of a competency-based approach in teaching allows us to assess the level of digital literacy and includes the following digital competencies: information literacy; communication literacy; media literacy (skills in creating multimedia materials for learning purposes); information security (protection of personal data, ensuring confidentiality of digital information); professional and personal attitude to technology.

The empirical research method is based on testing of the teaching staff of the Belgorod State National Research University (NRU "BelSU") at the beginning and at the end of training. The test consisted of tasks aimed at assessing the knowledge, skills and application of information and communication technologies in the professional activities of teachers. The results of integrated activity were analyzed using a level approach, which classified them as high, medium or low.

3 Results

The effectiveness of the proposed model was tested at the NRU "BelSU" among the teaching staff, starting from 05.05.2023. The training was attended by teachers of a higher educational institution, college teachers (secondary vocational education level) who have basic knowledge of a personal computer user (PC). The volume of the program was 72 h. The duration of training is 4 weeks. The form of study is full-time with the use of distance learning technologies (DOT). To assess the level of assimilation of the program, a point-rating system (BRS) was used. Students received credit if they scored more than 60 points during the training (according to the 100-point system).

As a result of mastering the program, the students learned about key changes in modern education caused by the active development of digital technologies; goals and objectives of digitalization of education and digital pedagogy; digital literacy and basic digital competencies at the Bachelor's level; modern educational technologies that use the digital environment to create new teaching models; and interactive teaching methods using online tools and services. The study identified key skills that teachers need to develop in order to build students' digital competencies. These include: using modern educational technologies to develop students' digital competencies; applying the capabilities of digital technologies to develop innovative pedagogical models using online tools and services; using interactive teaching methods; application of game-based approaches to enhance learning; managing learning in blended and online formats. These skills are

key for teachers in the digital transformation of education. Developing these skills will help them successfully adapt to the new requirements and utilize modern technologies to enhance the quality of the learning process. Adopting digital tools and teaching methods can significantly improve educational effectiveness and increase student motivation.

The formation of digital literacy at the beginning of training was checked on the basis of test tasks that allowed to assess the level of possession of ICT competencies by teachers of the National Research University “BelSU”. The test included tasks on knowledge, skill and application of IR technologies in the professional activity of the teacher. Based on the results of the training, a final cut was carried out, taking into account the immersion of teachers in the information and educational environment with tasks that include the competencies/indicators of digital literacy that we have allocated. The results of testing at the beginning and end of training are shown in Fig. 1.

Picture 1 shows that teachers enrolled in the advanced training program have significantly increased the level of digital literacy: the level of information literacy by 18.7%, communication literacy by almost 20%, media literacy by 21.3%. The attitude to technology has changed in a positive direction by 18.7%; information security has become better understood by 46.8%. The number of teachers with a low level of digital literacy has decreased: information literacy - from 4.9% to 2%, communication literacy - from 9.3% to 2.8%, media literacy – from 27.6% to 8.7%. 7.8% of teachers reduced their negative attitude to digital technologies.

As a result of the training, teachers have become more confident in using digital technologies in their teaching practice, utilizing interactive and collaborative learning models, and developing communication and collaboration skills, including the ability to share experiences through social media (see, Fig. 1).

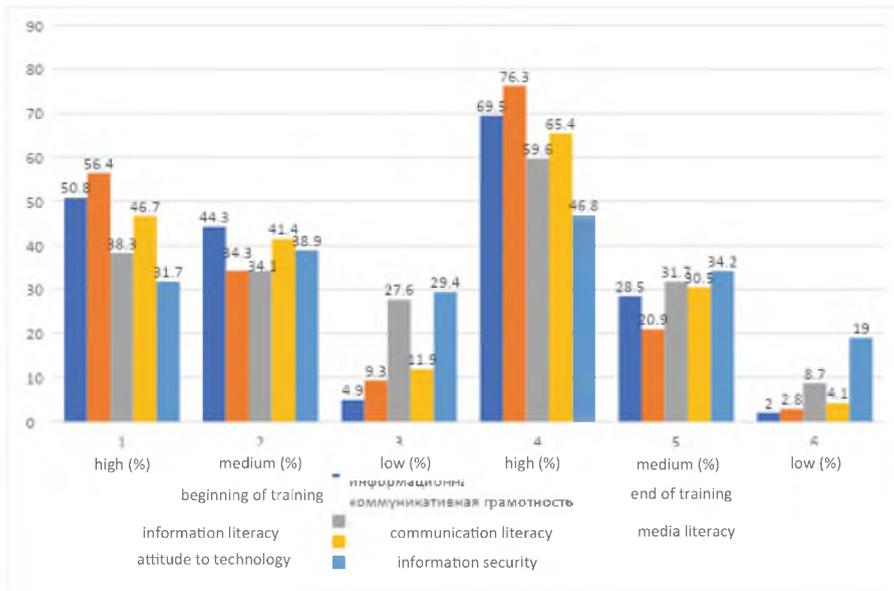


Fig. 1. Dynamics of formation of digital literacy of teachers (at the beginning and end of training)

4 Discussion

The foundation of our research lies in the definition of digital literacy put forth by N.V. Bagautdinova and E.R. Dikikh [3]. According to their definition, digital literacy encompasses the competency of individuals to effectively employ emerging digital technologies and contemporary information and communication networks. This proficiency enables individuals to search for, analyze, create, and manage information in a manner that caters to their personal, educational, and professional requirements. In addition, digital literacy includes active participation in collaborative and collective activities in the digital environment, emphasizing the basics of information security, as well as ethical and legal standards in working with information.

In our study, we, agreeing with M.V. Kuzmina's opinion, also consider "digital literacy" as the ability to manage information safely and effectively, to understand, integrate, exchange, evaluate and create information, as well as to access it using digital devices and network technologies for active participation in economic and social life [7]. In developing this literacy, we take into account that the effective application of modern pedagogical models based on the use of digital technologies in the learning process also plays an important role. The rationale for using specific information and communication technologies, digital resources, and internet services is based on novel approaches to facilitate teacher-student interaction and create conditions that cater to individual needs. This is because digital technologies in education enable personalized learning experiences, both during the acquisition of new material and the monitoring of individual progress [7]. In this context, pedagogical models become an effective tool in the formation of teachers' digital competencies.

An intensive path of development of the education system can be carried out only within the framework of a competence-based approach to education. Achieving the goal of our research - the formation of digital skills among university teachers, led us to create a model of the investigated process. The authors note that the construction of an organizational and technological model of teacher training has advantages, as it allows to imitate the internal structured-organized process in an integrated information and educational environment with the use of information and communication technologies. All elements of this model are interrelated, and their integrated implementation contributes to the achievement of digital literacy (see, Fig. 2).

The organizational and technological model consists of 2 blocks: organizational and substantive and technologically effective. The organizational and content block includes the learning objectives that determined its content. The technologically effective block includes the technology of teacher training, which is a set of forms, methods, teaching tools and methods of practical activity, as well as learning outcomes, including indicators for determining the achieved level of digital literacy.

The formation of communicative literacy, the development of skills in using digital technologies to communicate with each other and with an external audience, the development of digital etiquette is facilitated by working together in the Internet information environment, since the digital environment is currently both a source of information and a medium for communication. The inclusion of a network collaboration model in the educational process (based on close group interaction) makes it possible to carry out

various forms of communication in a digital environment: e-mail, chats, blogs, forums, social networks, etc. (see, Fig. 2).

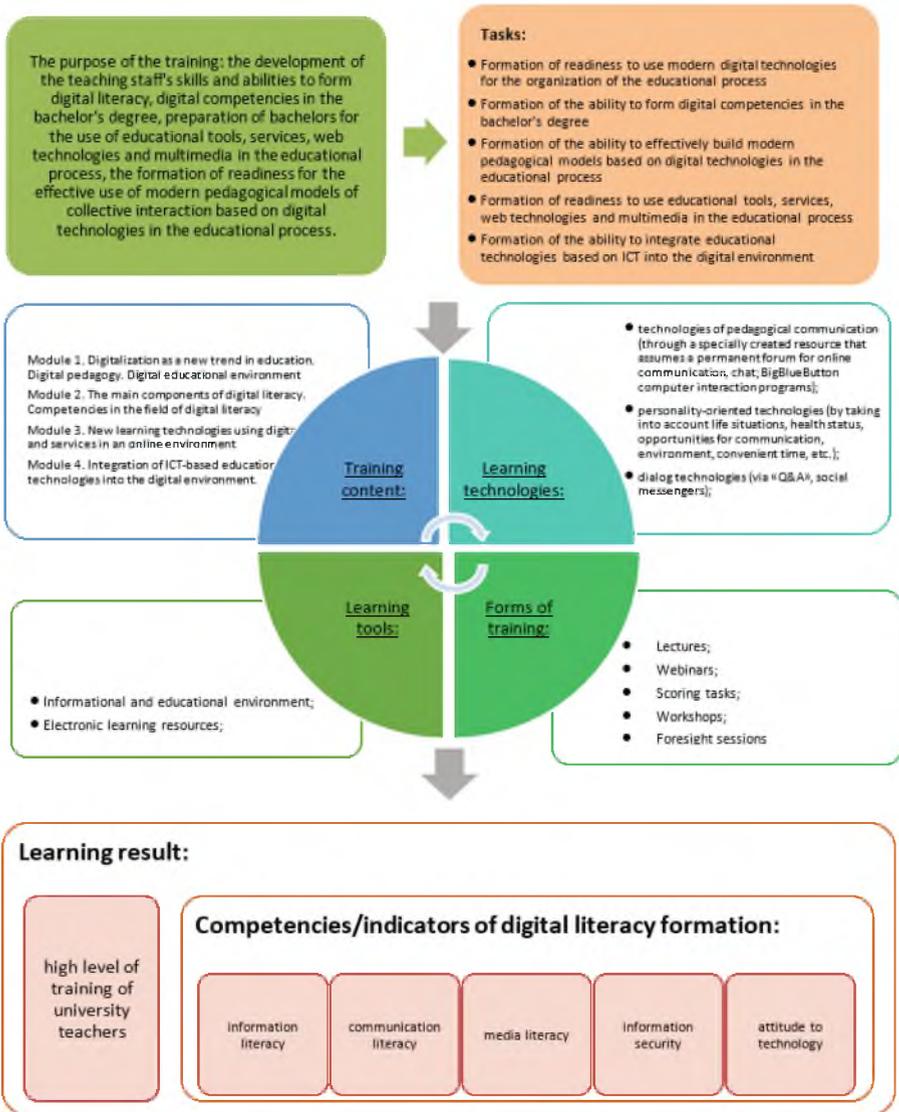


Fig. 2. Organizational and technological model of teacher training

Information literacy is also formed in the learning process, as Internet technologies provide an opportunity to create a multi-level system of access to certain web pages. This provides teachers and students with a critical perception of information from digital sources, full control over collaborative activities, and the ability to regulate and adjust

information depending on the results obtained. The use of the network collaboration model allows organizing interaction between users of the Internet service in the form of an open exchange of information resources and achieving results in a controlled information space in accordance with educational goals. This helps to increase motivation in the study of the discipline, the use of different types of information for perception (text, graphic, video and audio), visual presentation of situational tasks, etc. [10].

Media literacy is also fostered by assignments to create digital content and multimedia materials for learning purposes. The interactive learning model provides opportunities to develop skills in using tools for designing individual, group and collaborative learning activities, visualizing roles and events in the learning process, and creating interactive content and digital stories. The creation of multimedia content has become an urgent educational need due to the transition to e-learning and distance technologies. The application of a learning model based on gamification technology involves turning the learning process into an exciting and effective one. "Gamification is not just developing game tasks for entertainment, but selecting and integrating attractive game elements into e-learning to increase engagement and effectiveness" [6]. It is first important for the teacher to understand what educational result he wants and should receive as a result of achieving his goal, then select technologies (tools).

Formation of a positive attitude of students to digital technologies (for example, Incorporating examples of creative digital learning problem solving, students working in teams and using the Internet, including online services for collaborative project work) promotes the use of BYOD technology in training. The advantage of BYOD technology is that it can include various learning models, which we discussed above: 1) the model of collective work on the Internet; 2) the model of learning in cooperation, when students work together, collectively constructing new knowledge; 3) the model of interactive learning; 4) conducting surveys, quizzes, current control allows, among other things, the construction of an individual learning trajectory.

5 Conclusion

As a result of the study, it was recorded that teachers have significantly increased the level of digital literacy: information literacy by 18.7%, communication literacy by 20%, media literacy by 21.3%; negative attitude to technology has changed in a positive direction by 18.7%; information security has become better understood by 46.8%. The number of teachers with a low level of digital literacy has decreased: information literacy from 4.9% to 2%, communication literacy from 9.3% to 2.8%, media literacy from 27.6% to 8.7%; 7.8% of teachers reduced their negative attitude to digital technologies. Thus, the organizational and technological model of teaching teachers the effective use of modern pedagogical technologies constructed by the authors contains a set of learning goals and objectives, methodological and technological solutions, learning content, which allows to technologize the learning process and create favorable conditions for the formation of digital literacy. The results of an empirical study based on the dynamics of digital literacy levels of teachers at the National Research University "BelSU" indicate the high effectiveness of the proposed teaching model. Assessing the level of digital literacy of higher education teachers is of practical importance. Digital literacy of a teacher

is a fundamental aspect for effective implementation of innovative approaches in the educational process and active involvement of students in the use of digital technologies to solve educational tasks, including critical thinking and creation of new knowledge.

References

1. Gilster, P.: *Digital Literacy*, p. 276. Wiley Computer Publishers, New York (1997)
2. Klepikova, A.G., Musaelian, E.N., Kormakova, V.N., Prokopenko, Y.A.: Quality management principles of scientific and methodological support for students' activity within e-learning environment. In: *Proceedings International Multidisciplinary Symposium ICT Research in Russian Federation and Europe "Integrating Research Agendas and Devising Joint Challenges"*, pp. 63–75 (2018)
3. Bagautdinova, N.V., Dikikh, E.R.: Integration of end-to-end digital technologies into the work programs of physical education university disciplines. *Scientific notes of Lesgaft University*, No. 7 (209) (2022)
4. Berman, N.D.: On the issue of digital literacy. *Russ. J. Educ. Psychol.* **8**(6–2), 32–38 (2017)
5. Blinov, V.I., Sergeev, I.S., Yesenina, E.Y.: *The Main Ideas of the Didactic Concept of Digital Vocational Education and Training*. Pero Publishing House (2019), 24 p
6. Clark, D.: *Gaming Design for Elearning*. <http://goo.gl/fb/QZ2hbZ>
7. Formation of digital literacy of students: Methodological recommendations for educators in the framework of the implementation of the Federal project "Digital Educational Environment", Author-ed. M.V. Kuzmina et al: IRO of the Kirov region (2019), 47 p
8. Iordache, C., Mariën, I., Baelden, D.: Developing digital skills and competences: a quick-scan analysis of 13 digital literacy models. *Ital. J. Sociol. Educ.* **9**(1), 6–30 (2017)
9. Kormakova, V., Klepikova, A., Musaelian, E., Baybikova, G., Lapina, M.: Formation of ICT—competencies of postgraduate students of teacher education based on interactive techniques. In: *Proceedings of SLET-2019—International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research*, Stavropol-Dombay, Russia, 20–23 May 2019, 2494, pp. 11–21 (2019). http://ceur-ws.org/Vol-2494/invited_paper_2.pdf
10. Kormakova, V.N., Klepikova, A.G., Godovnikova, L.V., Eroshenkova, E.I., et al.: *The System of Support for Socio-professional Self-determination of a Teacher: Experience, Ways of Implementation*. Belgorod (2018), 163 p
11. Pankratova, O.P., Konopko, E.A.: Remote Training of Teachers for IT Navigation Inclusive Education. Selected Papers of the IV All-Russian Scientific and Practical Conference with International Participation "Distance Learning Technologies" (DLT 2019). Yalta, Crimea, September 16–21, pp. 493–498 (2019). <http://ceur-ws.org/Vol-2834>
12. Rugelj, J., Lapina, M.: Game Design Based Learning of Programming: CEUR Workshop Proceedings SLET-2019—Proceedings of the International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research, pp. 29–42 (2019)
13. Soldatova, G.U., Nestik, T.A., Rasskazova, E.I., Zotova, E.Y.: Digital Competence of Adolescents and Parents. The Results of the All-Russian Research. Internet Development Foundation (2013), 144 p
14. Yashina, Y.V., Koloskova, G.A., Lyamina, I.M., Kapustin, I.V.: The role and functions of a teacher in the context of digital transformation of education. In: *Scientific Research of the SCO Countries: Synergy and Integration—Proceedings of the International Conference*. -Tom Part 2, pp. 57–61. Beijing (2022)

15. Taran, V.N.: Use of elements of augmented reality in the educational process in higher educational institutions. CEUR Workshop Proceedings. In 2019 International Conference on Innovative Approaches to the Application of Digital Technologies in Education and Research SLET-2019 (2019). http://ceur-ws.org/Vol-2494/paper_28.pdf
16. Kormakova, V.N., Klepikova, A.G., Lapina, M.A., Rugelj, J.: ICT competence of a teacher in the context of digital transformation of education. CEUR Workshop Proceedings, 2914, pp. 138–150 (2021). <http://ceur-ws.org/Vol-2914/>
17. Basilotta-Gómez-Pablos, V., Matarranz, M., Casado-Aranda, L.A., et al.: Teachers' digital competencies in higher education: a systematic literature review. *Int. J. Educ. Technol. High. Educ.* **19**, 8 (2022)
18. Morze, N., Buinytska, O.: Digital competencies of university teachers. In: *Universities in the Networked Society: Cultural Diversity and Digital Competences in Learning Communities*, pp. 19–37 (2019)
19. Esteve-Mon, F., et al.: Digital teaching competence of university teachers: levels and teaching typologies. *Int. J. Emerg. Technol. Learn. (iJET)* **17**(13), 200–216 (2022)
20. Golovanova, I., Telegina, N., Donetskaya, O.: A study into the requirements of digital society and educators' digital literacy. *ARPHA Proc.* **5**, 555–568 (2022)