Formation of digital competencies of teachers of further vocational education in the era of digitalization of education

Valentina Abraukhova[1*], Anastasiya Zimovetc [1]

[1]Don State Technical University, 1, Gagarin Sq., 344002, Rostov-on-Don, Russia

ABSTRACT
This article is devoted to the study of digital competencies of teachers of further education. The article considers the concept of "digital competencies," "teacher of additional education," "digitalization of education." A special emphasis is placed on the processes taking place at different levels of transformation of teachers regarding their mastery of digital tools and the use of digital technologies both offline and online. In understanding the development of these processes in education, we chose a specific educational institution of the city of Rostov-on-Don -the Center for Further Education of Children of the Oktyabrsky District of the city of Rostov-on-Don and conducted a study of teachers of further education and high school students to study the degree of digital technology and the level of formation of digital competencies among teachers of further education. Improving the information literacy of students becomes a mechanism that accelerates the process of mastering digital. Improving the information literacy of students becomes a mechanism that accelerates the process of mastering digital technologies by teachers of additional education.

Keywords: digital competencies, teacher of further vocational education, digitalization of education, digital technologies, digital tools, distance education.

Introduction

In the past few years, digitalization has become the central direction of educational policy. The new living conditions caused by the digitalization of education have reformatted the educational process. Regulations such as the National Digital Economy Program.

The federal projects "Personnel for the Digital Economy," "Digital Technologies" are aimed at implementing the Decree of the President of the Russian Federation of 9.05.2017 No. 203 "On the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030," set a strategy for the development of all spheres of life, and

first of all - education. Digitalization of education in a broad sense is the introduction of digital technologies into the educational process. To solve the problems posed by the fourth industrial revolution for education, education will have to go through digital transformation. The first industrial revolution eradicated literacy, the second gave rise to a comprehensive school, improving the classroom system, the third led to universal secondary education. The fourth introduces a personalized, result-oriented education model (Cattane , Antonietti, Rauseo, 2022 , Yuvarov , Gable ,Dvoretskaya ,Frumin,2019, Zwierzchowska, Lupa, 2021).

The researchers believe that digital technologies will evolve (and are already evolving) exponentially annually. E-learning received rapid development, which required new competencies in developing online courses, mastery of digital tools, skills in working with open data sources, analytical, critical and flexible thinking, creativity, originality and initiative, leadership and social interaction, validity, ability to solve problems, ability to form ideas.

This is also confirmed by international research in Switzerland, Spain. If in the 1980 s the effective integration of technology into education was focused on the availability and access to technological infrastructure, great attention was paid to the material and technical equipment of educational institutions, then in the 1990s the emphasis shifted to the relevance of the professional development of teachers. Until now, the digital competence of teachers remains a key factor in international educational policy (. Grijalvo,Segura, Núñez,2022, Soldatova, Rasskazova,2016, Teo, Unwina, Scherer, Gardinera, 2021).

The definition of "Digital Competence" appeared in official documents in 2006 as a key competence for lifelong learning. Calvani et al. (2010) emphasized the interaction between three aspects of digital competence: technological, ethical, and cognitive. Similarly, Ilomäki et al. (2016) proposed that digital competence include four components:

1. Technical skills and practice of using digital technologies,
2. Ability to meaningfully use and apply digital technologies,
3. Ability to understand digital phenomena

4. Motivation to Participate and Participate in Digital Culture"

One of the most significant scientific approaches to determining digital competence in Russia is the approach proposed by the team of authors under the leadership of G.V. Soldatova (Soldatova, Rasskazova,2016).

In the structure of digital competence G.V. Soldatova, four components are distinguished: knowledge; skills and skills; motivation; liability (including, but not limited to, safety). Accordingly, four types of digital competence were identified:

1) information and media competence - knowledge, skills, motivation and responsibility related to the search, pony mania, organization, archiving of digital information and its critical comprehension, as well as with the creation of information objects using digital resources (text, graphic, audio and video);

2) communicative competence - knowledge, skills, motivation and responsibility necessary for various forms of communication (e-mail, chats, blogs, forums, social networks, etc.) and with various objectives;

3) technical competence - knowledge, skills, motivation and responsibility that allow efficient and safe use of technical and software tools for solving various problems, including the use of computer networks, cloud services, etc.;

4) consumer competence - knowledge, skills, motivation and responsibility that allow you to solve various everyday tasks related to specific life situations involving the satisfaction of various needs (Fernández-Molina, Trella, Barros,2015, Hollenstein, Vogt,2024, Haake,Axelsson, Clausen-Bruun, Gulza,2015, Teo , Unwina, Scherer, Gardinera ,2021).

The authors of the articles have already considered the issues of digitalization of education on the example of the preschool level of education, the training of specialists for the agricultural sector of the economy, the content of multimedia orientation of students, where the topic of the formation of digital competencies of the teacher was touched upon only indirectly (Abraukhova, Tavukku, Kalimullin, Litvinov, Shindryaeva, Abdikeev,2020 , Abraukhova, Schadneva, Zimovets ,2020 Vlasova,2020, Estaji, Banitalebi., Brown ,2024, Lin , Chien , Hsiao, Hsia, Chao,2020, Spitzer,2014).

Materials and Methods

The purpose of this study was to develop a model for the formation of digital competencies of an additional education teacher. The unity of the goals of additional education is combined with the variability of education, a variety of types of educational institutions, forms and technologies of education. For the study, an educational institution of the city of Rostov-on-Don was chosen - the Center for Additional Education for Children of the Oktyabrsky District of the City of Rostov-on-Don, with which the Department of Theory and Methodology of Vocational Education of DSTU has been cooperating since 2018 on the basis of a concluded agreement on an educational consortium. The data were collected between January and March 2022 in an online survey conducted by teachers of the department and psychologists of the Center. The online survey was attended by 57 teachers of further education and methodologists, 128 students of high school. The influence of personal and contextual factors on the digital competence of educators was considered, simple and multiple linear regressions were applied for assessment according to the indications of questionnaires. The level of media literacy and media education begins to form in school. School-age students begin to actively use the Internet and the media, which can affect the child in different ways, and that is why it is important for children to form the foundations of media competence. When interviewing students, it turned out that they use the Internet as sources of information - 83%, books - 14%, media - 2%, other sources - 1% (diagram 1).

Chart 1. Information about sources of information
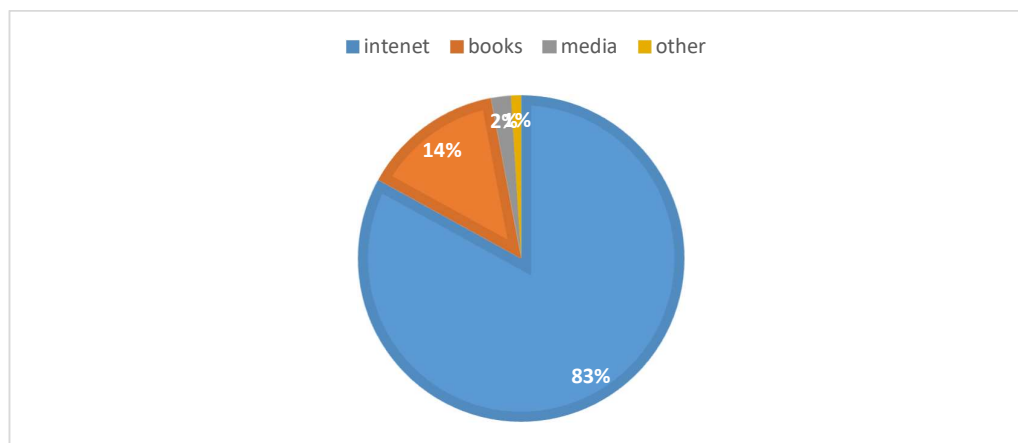
What equipment is used by students for independent work in preparation for classes: in the first place - a computer and a laptop - 52%, then a smartphone, a phone - 13%, a tablet - 12%, a telephone and a video camera - 19% (diagram 2).

Chart 2. Information about the equipment used
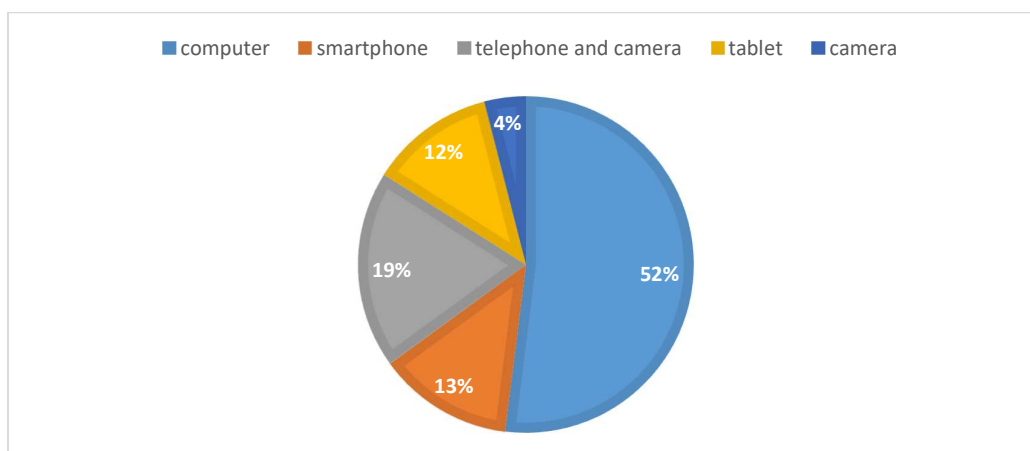
According to the following survey, answering to the question: "How do you use information," received the following answers. More than half of respondents (65%) select information from different sources, then compare and combine it, 14% combine several sources, 21% - usually do not edit it. Moreover, to prepare for classes, less than half of the total time at the computer is used - 41%, most of the time is spent in total on games (17%) and watching video content- 52%. What digital tools are used by the studied: 48% - graphic editors, animation, infographics, 30% - photo editing, 8% - work in text editors, watching video- 7%, and writing music - 3%.

We couldn't put the question about dangers of the Internet. High school students are aware of it. The given answers shows us a rage of risks in different areas such as : 54% - scammers, 34% - negative videos, 7% - viruses, 3% - fakes, 2% - terrorism.

Thus, the survey of students, older children, showed that children have digital literacy, most often use Internet resources in their work, they give preference from media equipment to a computer/laptop/tablet, phone. The Internet is most often used for teaching, watching movies, programs and for computer games. Also, most of the respondents indicated that they are satisfied with the proposed Internet information and for their work the majority combine information taken from different Internet sources. Most

children use media equipment to work in text editors, to draw and watch video clips. Also, most of the respondents are aware of the dangers that can meet on the Internet, about the fight against them. Based on the answers of children, it can be concluded that a sufficient amount of time is given to the formation of the media competence of students. As a result of a general analysis of the questionnaire of students of older children, it was revealed that the formation of media competence takes place in full.

The preparation of such a generation, the desire to develop in the digital environment, pose new tasks for mastering digital competencies before teachers. The system of institutions of further education is unique, without having strict standards, it is initially aimed at the creative development of children and teachers, at co-creation, so the statement that online learning may well replace offline learning was not supported by anyone, 10.5% - do not see the need to introduce online learning (teachers aged 60 plus fell into this category), 54.4% - believe that the introduction of certain elements of online learning will improve the quality of education, and 35,1% - online learning can be used as part of independent work. Almost half of teachers believe that 30% of the total share of classes is permissible for conducting remotely without compromising the quality of material development.

With self-assessment of digital competencies in the first place, teachers are able to work within the digital environment of the institution (42.1%), 22.8% - search for information, 14% ability to use personal computer software.

The rating (top 5) of the main competencies of the additional education teacher includes the following: flexible thinking, knowledge of existing tools, creativity, the ability to find new solutions and critical thinking.

Among the factors that restrain the formation of digital competencies, teachers distinguish the following reasons: lack of "live" communication, insufficient technical equipment, low quality of Internet resources. The last two reasons are related to the need for constant modernization of technical means, but the first reason speaks of the need to train teachers, and self-study is less effective, the organization of course training is required under the guidance of experienced professionals. In terms of the use of technical means, the answers of teachers almost completely coincide with the answers of high school students, the most used technical means are a personal computer, a mobile phone and a printer. The most popular digital tools among teachers are: the Internet search process, text editors and presentation editors. Moreover, the creation of presentations teachers put in the first place and indicated such tools as Canva, Sentimeter, Visme, Mikrosoft PowerPoint, in second place - the creation of interactive content and in third place - the development of services for collaboration: Miro, Padlet, Zoom, Meet.

To develop digital competencies, teachers of additional education themselves call 3 main conditions: the development of digital infrastructure, the purchase of modern equipment and the organization of advanced training courses (Figure 9). Moreover, the online courses are chosen by a smaller number of respondents, this generation needs live communication. Teachers of further education have a high motivation for the learning process.

Results

The result of this study was the development of an effective model for the formation of digital competencies of an additional education teacher. We have identified a list of digital competencies. For a teacher of additional education to be in demand and successful, he must master the following digital competencies:

1. Communication and cooperation in the digital environment. Competence implies the ability of a person in a digital environment to use various digital means that allow him to achieve his goals in cooperation with other people. These are professional communities, groups created on a certain basis, this is the use of digital tools that allow you to conduct collective activities simultaneously and individually at a convenient time. A modern teacher should not distance himself, close himself in his world, he should be included in groups, communities, and be open to communication.

2. Self-development under uncertainty. Competence implies the ability of a person to set himself educational goals for emerging life tasks, to select ways to

solve and means of development (including using digital technologies), to motivate himself for constant development, to constantly master new effective digital tools.

3. Creative thinking. Competence implies the ability of a person to generate new ideas for solving the problems of the digital economy, to abstract from standard models: to rebuild the existing ways of solving problems, to put forward alternative options for action in order to develop new optimal algorithms.

4. Information and data management. Competence implies the ability of a person to search for the necessary sources of information and data, perceive, analyze, store and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the information received to solve problems.

5. Critical thinking in the digital environment. Competence implies the ability of a person to assess information, its reliability, to build logical conclusions on the basis of incoming information and data.

6. Data security and protection. Competence implies the ability of a person to ensure the security of a browser and network, as well as correct behavior on the network, to recognize threats to Internet security: hacking, viruses and malware, identity theft, you need to know the threats to Internet security: phishing, hacking and remote access and others.

7. Digital content creation. Competence assumes a person's ability to use digital media. These are digital versions of traditional physical media such as images and documents; audiovisual content such as music and video in digital format; digital elements such as web pages, software, and social media posts.

Discussion

Pedagogical science at different times put forward a variety of training models, which became the main vector for the formation of teachers' competencies. The modern learning model has been forced to embrace change through technology to better meet the unique needs and learning styles of students. These innovations have changed not only the location of classes and the process of gaining knowledge, but also the learning management system. For more than a decade, many schools, colleges and higher education institutions have successfully integrated distance learning and educational technology into their curricula. The traditional learning model has a number of contradictions. This is a contradiction between the conversion of the content of educational activities into the past. Students are not motivated to apply the knowledge gained. Students receive ready-made knowledge, thereby the individual, culture and knowledge are out of the development process. Hybrid learning is a comprehensive combination of distance and online learning. Hybrid and mixed learning models have become important for the learning process, as they allow not only to continue learning in times of crisis or instability, but also to bring education to a new stage of development. The disadvantages of mixed learning include low computer literacy, if the

child does not understand how to use technology, then the education process will be difficult, especially in lower grades. Shulman's TPACK model (1986) assumes that a digital competent teacher masters seven components of the model - three corresponding to the main areas of knowledge (related to discipline content, pedagogy and teaching methods and processes, use of technology), and four additional competencies combining each component with others (knowledge of pedagogical content, knowledge of technological content, knowledge of technological pedagogical content and knowledge of technological pedagogical content). The model also explicitly considers the role of the context in which teachers act and apply these seven components.

The Will Skill Tool model of pedagogy argues that four main factors contribute to the effective integration of technology into education. These are attitudes and beliefs regarding the use of technology for learning purposes (Will), the ability to use technology and self-confidence, self-efficacy and readiness (Skill), the availability and availability of hardware, software and infrastructure (Tool), and finally the accepted teaching style and teaching practice (pedagogy).

This model combines the use of multimedia with traditional classroom work. By analyzing the main learning models, we can generate a new modern classification, which will include the traditional education model, mixed and hybrid. Each of which has its pros and cons. All these training models involve bringing the teacher to a new level of mastery of digital competencies. Teacher technology

issues, whether perceived or actual, can be a major obstacle, so it is critical to take action to ensure high availability and good technical assistance. When moving to a hybrid or blended learning platform, there are a few important things to consider: Can the network handle the surge in traffic outside of educational settings? Do students have a good way to collaborate online? Will technical equipment cope at home? How can educators complete assignments and score? What are the video conferencing options? What integrations are available for ease of use? Is there a system for protecting the data of students and course materials? We are confident that a variety of training models will be applied, but in each training model, the share of digital technologies will increase, which means that each institution should develop its own model for the formation of digital competencies among teachers.

Conclusions

Theoretical and practical training of teachers on digital tools is an integral part of the program for introducing digital technologies into education: this is the development by the teacher of an application for digitalization in education integrated into basic educational disciplines, the holding of training seminars on the formation of digital competencies, the development and testing of elements of the system for improving the qualifications of teachers in the field of digitalization of education, the use of ICT (information and communication technologies) in the activities of a teacher of further education, master classes on

conducting classes using modern digital technologies in education among teachers, the creation of electronic textbooks and manuals, the formation of skills in working with open data sources, the use of flexible approaches to project activities. All these areas will contribute to the formation of digital competencies of teachers of further education.

References

1. Abraukhova V., Tavukku T., Kalimullin A.M., Litvinov A.V., Shindryaeva N.N., Abdikeev N.M. (2020). Analysis of articles on education and educational technologies. International Journal of Emerging Technologies in Learning (iJET). Vol l.,No. 23. P. 108-120. URL: https://online-journals.org/index.php/i-jet/article/view/18803. https://doi.org/10.3991/ijet.v15i23.18803

2. Abraukhova V., Schadneva M., Zimovets A. (2020). Innovations in teacher training through partnership with employers in further education. Innovative Technologies in Science and Education (ITSE-2020).Vol 210.URL: https://www.e3sconferences.org/articles/e3sconf/abs/2020/70/contents/contents. https://doi.org/10.1051/e3sconf/202021018003

3. Abraukhova V., Vlasova T., Zimovets A. (2020). Continuity of natural science education as a condition for training specialists in the agricultural sector of the economy. Vol. 175. URL: DOI: https://doi.org/10.1051/e3sconf/202017515005

4. Cattane Alberto A.P.A., Antonietti C., Rauseo M. (2022). How digitalised are vocational teachers? Assessing digital competence in vocational education and looking at its underlying factors. Computers & Education.Computers & Education.Vol.176. URL:https://www.sciencedirect.com/science/article/pii/S0360131521002359. https://doi.org/10.1016/j.compedu.2021.104358

5. Estaji M. , Banitalebi Z., Brown G.T.L. (2024) The key competencies and components of teacher assessment literacy in digital environments: A scoping review. Teaching and Teacher Education.Vol.141.URL: https://www.sciencedirect.com/science/article/abs/pii/S0742051X24000295. https://doi.org/10.1016/j.tate.2024.104497.

6. Fernández-Molina M., Trella M., Barros B. (2015). Experiences with tasks supported by a cognitive e-learning system in preschool: Modelling and training on working memory and attentional control. International Journal of Human-Computer Studies. Vol. 75., P. 35-51. URL:https://doi.org/10.1016/j.ijhcs.2014.11.001

7. Grijalvo M.,Segura A., Núñez Y. (2022). Computer-based business games in higher education: A proposal of a gamified learning framework.

Technological Forecasting and Social Change.

8. Hollenstein L., Vogt F. (2024).Digital education through guided pretend play. Learning and Instruction. Vol.93.URL: https://www.sciencedirect.com/science/article/pii/S0959475224000720. https://doi.org/10.1016/j.learninstruc.2024.101945

9. Haake M.,Axelsson A., Clausen-Bruun M., Gulza A. (2015). Scaffolding mentalizing via a play-&-learn game for preschoolers. Computers & Education. Vol. 90., P. 13-23.URL:https://doi.org/10.1016/j.compedu.2015.09.003

10. Lin S-Y., Chien S-Y., Hsiao C-L., Hsia C-H., Chao K-M. (2020). Enhancing Computational Thinking Capability of Preschool Children by Game-based Smart Toys Electronic Commerce Research and Applications. Vol. 90. URL: https://www.sciencedirect.com/science/article/abs/pii/S1567422320300880?via%3Dihub. https://doi.org/10.1016/j.elerap.2020.101011

11. Soldatova G.U., Rasskazova E.I. (2016). Models of digital competence and online activity of Russian adolescents. National Psychological Journal. Vol 2. , No. 2. P.50-60.URL: https://www.researchgate.net/publication/315065184_Models_of_digital_competence_and_online_activity_of_Russian_adolescents.DOI:10.11621/npj.2016.0205

12. Spitzer, M. (2014).Antibrain.Digital Technology and the Brain. Recovered from https://www.livelib.ru/book/1000753446-antimozg-tsifrovye-tehnologii-i-mozg-manfred-shpitser

13. Teo T., Unwina S., Scherer R., Gardinera V. (2021). Initial teacher training for twenty-first century skills in the Fourth Industrial Revolution (IR 4.0): A scoping review. Computers & Education.Vol.170.URL: https://www.sciencedirect.com/science/article/abs/pii/S0360131521001007. https://doi.org/10.1016/j.compedu.2021.104223

14. Yuvarov A., Gable E., Dvoretskaya I.V., Frumin I.D.(2019). Difficulties and prospects of the digital trasformation of education. Ed. House of the Higher School of Economics. Recovered from https://ioe.hse.ru/data/2019/07/01/1492988034/Cifra_text.pdf. doi:10.17323/978-5-7598-1990-5

15. Zwierzchowska I., Lupa P. (2021). Providing contact with nature for young generation - A case study of preschools in the City of Poznań, Poland. Urban Forestry & Urban Greening.Vol.65.URL: https://www.sciencedirect.com/science/article/pii/S1618866721003733. https://doi.org/10.1016/j.ufug.2021.127346