

Development of Pedagogical Skills of Future Teachers of Labor Education and Technology by means of Digital Technologies

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Summary

The influence of digital technologies on the effectiveness of the development of pedagogical skills of future teachers of labor education and technology has been studied. The essence of the concept of "pedagogical skills of future teachers of labor education and technology" has been clarified. It is interpreted as a higher level of development of the professional characteristics of the individual, which is determined by psychological and pedagogical preparation, the ability to optimally solve pedagogical tasks, innovation, creativity, mobility, a high level of development of pedagogical techniques and pedagogical thinking, professional and pedagogical competence, etc. Digital tools that contribute to the development of pedagogical skills are singled out, namely: Learningapps, Educaplay, Padlet, Flippity (for the development of critical thinking, generalization of the learned material, its verification and consolidation); MindMeister, Cacoo, Bubblus, Mindomo (contribute to the development of group work organization skills, reflection); Glogster, ThingLink (for organizing independent work and self-development), Toki-Toki, Powton, Kahoot, Plickers, PearDeck (tools that promote the development of creative abilities). Attention is focused on the importance of introducing STEM technologies in the process of training future teachers of labor education and technologies; those technologies that contribute to the development of pedagogical skills are highlighted. The results of the conducted experimental research are described. The study included: a survey of teachers of labor training and technologies, a survey of teachers and Masters of the specialty 014 Secondary education (Labor training and technologies) of full-time and part-time forms of education of the Glukhiv National Pedagogical University named after O. Dovzhenko. According to the results of the research, the most effective tools for developing the pedagogical skills of future teachers of labor training and technology, as well as the key problems faced by educators in the process of introducing digital technologies into the educational process are identified: lack of clear instructions on the use of digital technologies; low level of readiness to use digital technologies in professional activities; low ability to share experience with colleagues. The main obstacles pointed out by the respondents are: limited access to the Internet; lack of experience with digital technologies; lack of information about digital technologies; unclear instructions from the administration of general secondary education institutions; lack of motivation.

Keywords:

digital technologies, pedagogical skill, future teachers of labor education and technology, professional training, educational process.

1. Introduction

In today's world, a rapid transformation of education from traditional to digital is taking place, since digital education is the key to building a different reality, the foundation of a new life in society. Modern trends in education reform and the active process of its digitalization give rise to the emergence of the newest forms of training future teachers in the conditions of higher education institutions for the introduction of innovations in practical pedagogical activity.

Among the problems of raising the professional level of the future teacher in the training process, the issues of developing pedagogical skills as a highly professional quality that ensures the organization of professional activity at a high level and on a reflective basis remain relevant [1, p. 37]. Pedagogical mastery is a higher level of development of professional characteristics of an individual, which is determined by psychological and pedagogical preparation, the ability to optimally solve pedagogical tasks, innovation, creativity, mobility, a high level of development of pedagogical techniques and pedagogical thinking, professional and pedagogical competence, etc.

At the legislative level, it is provided by a number of Laws of Ukraine, Resolutions of the CMU and other domestic legal acts, namely: Laws of Ukraine "On Higher Education" (2014), "On Education" (2017), Concept of "New Ukrainian School" (2016), "Concept of Education Development of Ukraine for the period 2015-2025", "National Framework of Qualifications", standards and recommendations for quality assurance in the European Higher Education Area (ESG) (2015) and others. Considerable attention is also paid to issues of informatization of education, implementation of the latest digital technologies in the educational environment in Ukraine. In particular, the Laws of Ukraine are adopted: "On the National Informatization Program" (2011), Concept of Digital Competence Development (2021), etc.

In turn, the implementation of digital technologies is extremely important for all spheres of education, in particular for the training of future teachers, because they serve as a means of continuous personal and professional development, development of educational infrastructure, updating of methodology in education, etc. That is why, the training of graduates for today's conditions – future teachers with new digital competences, necessary for effective professional activity in general secondary education institutions – should take place in higher education institutions. After all, only an informationally competent person can effectively carry out the educational process, ensure the responsible use of digital technologies for information management, communication and the development of innovative educational ideas.

Digital literacy and readiness to use digital technologies in professional activities are components of the fundamental core that ensures the professional development of skilled teachers who possess universal tools for successful professional activity in the conditions of modern education.

2. Theoretical Consideration

The theoretical analysis of the investigated problem was carried out on the basis of the scientific works of domestic and foreign scientists who direct their research to certain aspects of the outlined problems. In the context of the topic of scientific research, the theoretical developments in which the following problems are highlighted are of scientific interest: theoretical foundations of the development of pedagogical skills (V. Kovalchuk, G. Kobernyk, I. Zyazyun, O. Bartkiv, etc.); the essence of digitalization of education (V. Bykov, A. Gurzhii, M. Zhaldak, N. Morse, O. Spirin, etc.); the use of digital technologies in the educational process of higher education institutions (O. Antonova, L. Familyarska, V. Kovalchuk, etc.); components of digital competence (N. Morse, V. Kovalchuk, A. Zayka, V. Soroka), development of digital competence of future teachers (G. Genseruk, S. Martyniuk).

The results of the mentioned studies show that only a person who is competent in the field of digital technologies and is ready to use them in future professional activities can create a productive educational environment. And such effective professional activity is possible on the basis of a combination of modern digital and pedagogical technologies, which will testify to the high development of pedagogical skills. All this leads to the need for new and innovative approaches to the training of future teachers of labor education and technology in the conditions of a higher education institution.

After all, nowadays, in the period of global changes, the use of digital technologies, built on the

principles of open education, has a decisive influence on the development of education.

Forms of teaching, which include today's widely used concepts: "hybrid learning", "distance learning", "distance education", "elearning", "electronic education (e-education)", "blended learning", "training at a distance" and other related terms appeared quite a long time ago and are associated with the use of digital technologies in education.

At the current stage, the experience of using digital technologies changes the teacher's position (deepens professionalism, expands the field of knowledge). He ceases to be a "source of knowledge" and becomes a creator of the creative process of processing and using information and a more active participant in the formation of the future teacher's personality. The style of learning changes from generation to generation, so mastering digital technologies is no less important for modern education seekers. The professional activity of the future teacher of labor education and technology is closely related to the use of the Internet and new forms of work.

Today, the process of acquiring knowledge takes place in different places: not only in lecture halls, but also in social networks, in electronic form. Therefore, we cannot but agree with the opinion of Ukrainian researchers H. Genseruk and S. Martyniuk, who emphasize that in the process of organizing educational and research activities, it is expedient to use tablet computers, mobile applications, interactive whiteboards together with circuit modeling systems in educational-research environment that will make it possible to increase the level of digital literacy of future teachers, to master natural and scientific methods of cognition, basic research procedures and information processing [4, p.160].

In connection with the forced need for mass implementation of blended and distance learning on a huge scale, which led to their "forced" large-scale approbation, this provided an opportunity to reveal their new features. Concepts and methods of blended and distance learning, which were developed much earlier, are now useful. Cloud technologies, in particular communication tools, made it possible to implement blended learning technologically [13, p. 45].

The use of digital means and technologies, which have acquired signs of mobility, affect the environment where the training of education seekers takes place and which is a mechanism for realizing personal flexibility and adapting the modern personality to changing methods of educational interaction. Such an environment is characterized by dynamism, mobility and adaptability, and the implementation of educational interaction in it takes place without territorial restrictions (at home, on the road, on the street), geographical (from any location), time (at a convenient time and at a convenient pace) [2, p. 13].

A favorable environment promotes the development of creative potential, self-realization of the individual, forms readiness for personal self-improvement, and ensures the implementation of co-creation within the framework of the humanistic paradigm. Indicators of a favorable educational environment are: involvement in joint activities, harmony of all subjects of the pedagogical process, trust and high demands on each other, awareness of the subjects of the pedagogical process about the goals and state of affairs, positive attitude towards the goals of joint activities, satisfaction with belonging to the team, a positive, favorable psychological microclimate, a democratic management style, a state of emotional satisfaction as a result of joint activity, a good material base [8].

Digital technologies actively influence the learning process, as they change the scheme of knowledge transfer and learning methods. Their use in the educational process stimulates interest in educational activities, contributes to the formation of logical and creative thinking, generally contributes to the development of students and the formation of information culture. Technologies make it possible to change the formats of learning and teaching. Information becomes a connecting link between a student and a teacher in the education process, including all information or messages transmitted in one or another material form. At the same time, education acts as an organizer (method) of information transfer and student development [10].

For a modern student of education, the educational process using digital technologies is as accessible and understandable as possible. Such tools are motivating for students when mastering new knowledge, allow the teacher to organize the educational process, adjust this process if necessary and monitor the success of each student [15].

Pedagogical mastery in the era of the development of digital education is manifested primarily in the pedagogically appropriate actions and deeds of the teacher, combined with the ability to effectively organize the educational and cognitive activities of students and establish pedagogical communication with all participants of the educational process, as well as in the skills and abilities of self-improvement of one's pedagogical abilities and other important professional-pedagogical properties and qualities in the digital educational environment.

The new demands of society for the educational space caused the formation of a new paradigm of STEM education (science, technology, engineering, math), which is one of the factors in the formation of an "innovative" teacher of labor training and technology, who is expected

to have a complex of general and professional competences, which meets the requirements of today [19, p. 144].

In the digital age, STEM elements can be physical or virtual (digital). The digital component of STEM education involves the wide use of digital technologies to ensure the educational activities of its participants and the development of relevant network communities for effective communication in virtual space [5].

A STEM laboratory is a study room or premises of an educational institution, equipped with modern teaching aids and equipment, to involve students in educational-research, research-experimental, design, invention and search activities in accordance with the standards of education, educational and training programs using project technologies in the educational process [17].

In accordance with the order of the Ministry of Education and Science of Ukraine No. 574 dated 04/29/2020 "On the approval of the Standard list of teaching aids and equipment for classrooms and STEM laboratories" from a wide list of aids, taking into account the specifics of the activities of teachers of labor training and technology, we consider it appropriate to highlight those that are in our opinion, contribute to the development of pedagogical skills, namely: 3D printer, 3D scanner, 3D pens, digital milling machine, digital lathe, digital laser machine, embroidery machine/embroidery machine with computer control.

A modern teacher of labor education and technology must fully use the opportunities that digital technologies provide us in order to increase the effectiveness of pedagogical activities.

3. Experimental Consideration

In our previous studies, it was found that university teachers have different levels of digital competence: from low to high, which characterizes the variety of features of its manifestation and ways of thinking when operating the specified competence [14].

In order to investigate the effectiveness of digital technologies as a means of developing the pedagogical skills of future teachers of labor education and technology, we conducted the following experimental study, which included: questionnaires of teachers of labor education and technology, survey of teachers of the Glukhiv National Pedagogical University named after O. Dovzhenko and Masters of the specialty 014 Secondary education (Labor training and technologies) full-time and part-time, who studied at the same higher education institution.

At the first stage of the research, the study of the current state of use of digital tools in the educational space of general secondary education institution, the determination of the attitude of teachers towards their use in labor training and technology lessons, the identification of the main difficulties during their use were carried out. We conducted a questionnaire of labor training and technology teachers in twelve such institutions.

As the results of the survey have shown, there is an opinion among teachers that the implementation of digital technologies in the system of general secondary education is not very effective, but 94 % of respondents answered that they use digital technologies in their professional activities (Fig. 1).

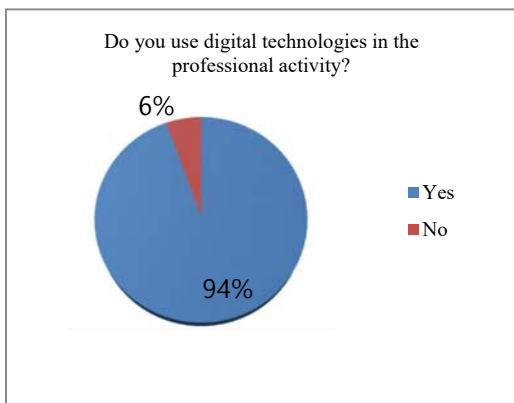
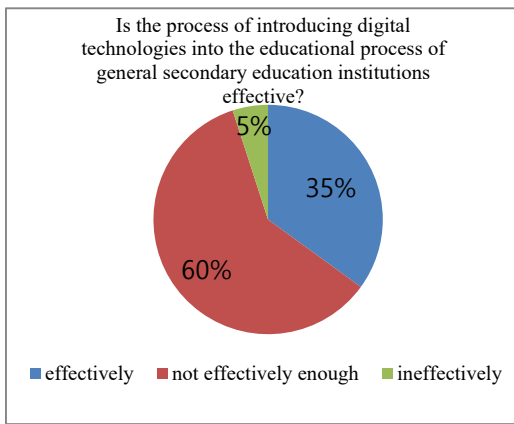


Fig. 1. The results of a survey of teachers regarding the use of digital technologies in the educational process

A positive trend is also observed in the fact that 75% of respondents are actively engaged in self-education to ensure and organize the educational process using digital technologies. At the same time, materials presented on the YouTube channel – 49.2%, materials for educators on EdEra – 35.6%, and Prometheus – 15.2% are in demand among teachers of labor education and technology (Fig. 2).

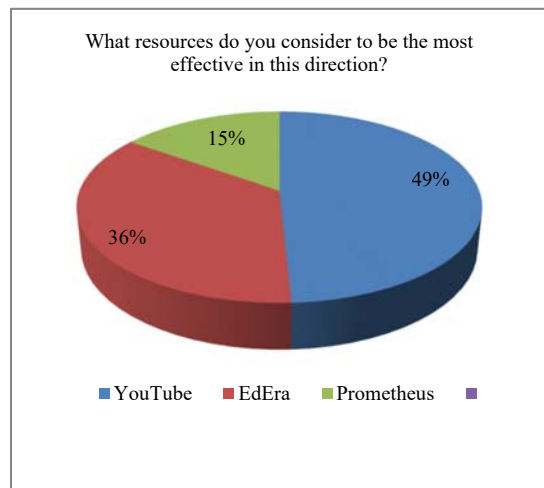
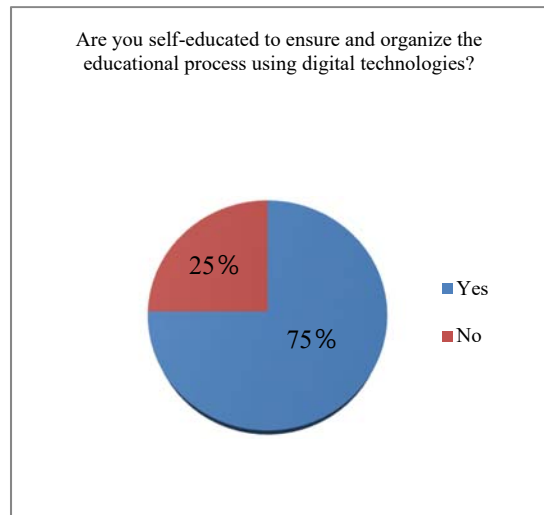


Fig. 2. The results of a survey of teachers regarding self-educational activities in the context of the use of digital technologies

The main obstacles pointed out by the respondents are: limited access to the Internet — 18.5%; lack of experience working with digital technologies — 50.8%; lack of information about digital technologies — 16.9%; unclear instructions from the general secondary education administration — 7.9%; lack of motivation — 5.9% (Fig. 3).

According to the results of the received information, the problems and needs of teachers regarding the introduction of digital technologies into the educational process and increasing their awareness of their use are identified: lack of clear instructions on the use of digital technologies; low level of readiness of teachers of labor education and technology to use digital technologies in professional activities; low ability to share experience with colleagues. The main obstacles pointed out by the respondents are: limited access to the Internet – 18.5%; lack of experience working with digital technologies –

50.8%; lack of information about digital technologies – 16.9%; unclear instructions from the general secondary education institution administration – 7.9%; lack of motivation – 5.9% (Fig. 3).

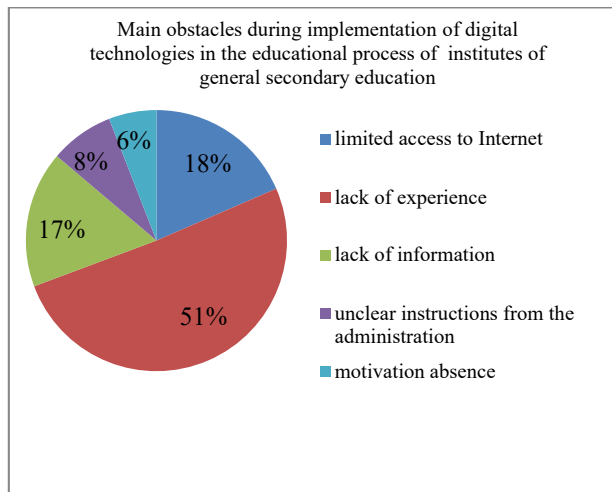


Fig. 3. The results of the survey on the main problems and needs of teachers of labor education and technology in the context of the use of digital technologies in professional activities

Among the most effective means of learning in the lessons of labor training and technologies in the context of implementing the ideas of STEM education, the respondents noted designers (57%), robotic systems (41%), models (48%), measuring complexes and sensors (24%), laboratory devices (42%), electronic devices: 3D printers, computers, digital projectors, projection screens of various models, overhead projectors, copy boards, interactive boards, document cameras, projection tables, etc. (85%) (Fig. 4).

The interest in the group of digital tools for 3D printing is explained by the fact that this technology makes it possible to create any three-dimensional models that can be used to visually study the objects studied in the curriculum. 3D printers in education make it possible to obtain visual models, real prototypes for research, speed up and reduce the cost of production of various types of physical objects. There are many digital tools for creating 3D objects.

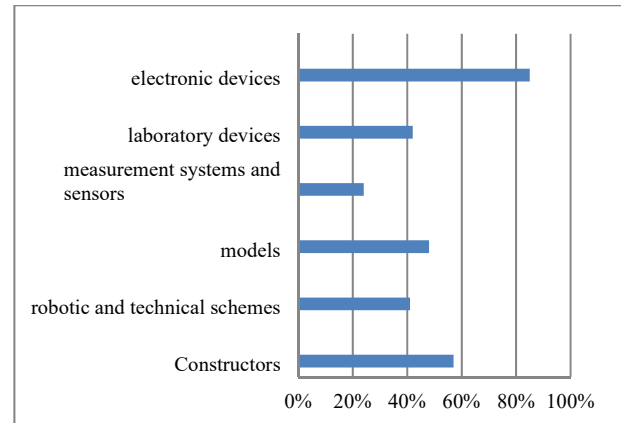


Fig. 4. The results of the questionnaire regarding effective teaching aids in labor training and technology lessons.

Examples of resources where you can find ready-made models are: Sketchfab, Grabcad, Thingiverse. Tools for creating 3D models: Tinkercad, SketchUp, Blender. After downloading or creating a model, you need software to slice the object: Cura, Repetier, Slic3r. During 3D printing, sometimes there is a problem with the object (poor model, software problems, etc.), so you need programs that check files for common errors and help correct them: Makeprintable, Netfabb Basic [5, p. 18].

Therefore, based on the results of the survey of teachers of labor training and technology, it can be concluded that digital technologies are introduced into the educational process of general secondary education institutions, the vast majority of respondents actively use them in their professional activities, but do not yet consider this process effective enough. According to the results of the received information, the problems and needs of teachers regarding the introduction of digital technologies into the educational process and increasing their awareness of their use are identified: lack of clear instructions on the use of digital technologies; low level of readiness of teachers of labor education and technology to use digital technologies in professional activities; low ability to share experience with colleagues.

We believe that every modern teacher should understand how digital technologies can support communication, collaboration, creativity and innovation, be aware of their functional features, limitations, consequences and risks of use; general principles, mechanisms and logic underlying the creation of digital services that are constantly evolving, as well as to know the basics of the functioning and use of various digital devices, computer programs and networks. Therefore, it is important to develop digital literacy even during the period of training of future teachers in higher education institutions.

What digital tools do the teachers of O. Dovzhenko Hlukhiv National University use? What is

their role in the process of developing pedagogical skills? Is there a need for changes and innovations in this area? We get the answers to these questions thanks to a survey in which more than 50 researchers of the University took part.

In view of the digitization of education at the current stage, teachers use their own smartphones and laptops in their work. And if the latter are actively used to prepare and conduct classes, then the smartphone often remains an unused resource. According to the survey, the main tools of the department provision are a projector, a printer and a stationary computer (Fig. 5).

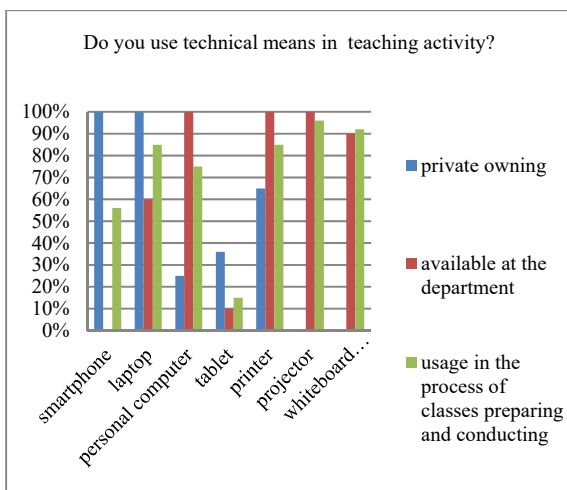


Fig. 5. Results of a survey of teachers regarding the use of technical means in the process of teaching

Due to limited opportunities in the organization of the educational process at the University, training through the video conference services Zoom, BigBlueButton (Open Source Web Conferencing), Google Meet, LMS capabilities (Moodle, Google Classroom, eFront) are used (Fig. 6).

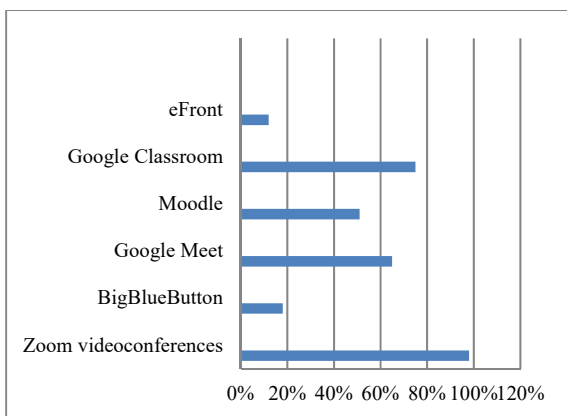


Fig. 6. Results of the survey regarding the services that are used to train future teachers of labor education and technologies in the conditions of distance education

Despite the fact that such steps are forced, investors note positive points –gaining new experience in conducting lectures and practical classes with students outside the university, as well as increasing their own level of digital competence. In addition, the respondents emphasize the development of pedagogical skills – both of their own and of future teachers by means of digital technologies.

In order to identify the effectiveness of the use of digital technologies as a means of developing the pedagogical skills of future teachers of labor training and technology in the educational process of the Glukhiv National Pedagogical University, we conducted a survey of Masters (16 respondents) major 014 Secondary education (Labor training and technologies) full-time and part-time forms of education and analyzed obtained results.

92% of respondents positively assessed the possibilities of using digital technologies in the educational process (Fig. 7).

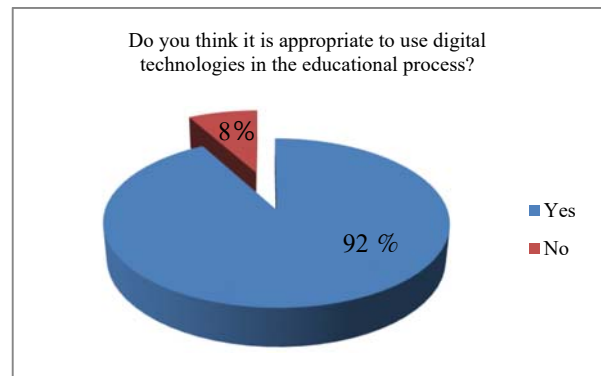


Fig. 7. Results of the survey regarding the attitude of future teachers of labor education and technology to the use of digital technologies in the educational process

Masters noted the improvement of their own digital competence – 64%; understanding the possibilities of using digital technologies in future professional activity – 75%; about the rationalization of one's own methods of information interaction by means of digital technologies – 81% (Fig. 8).

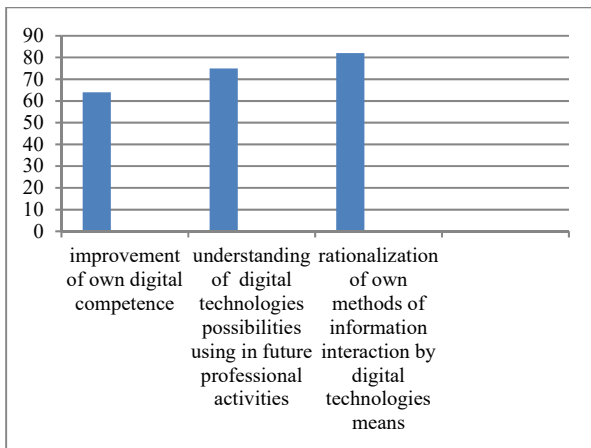


Fig. 8. Results of the survey on the effectiveness of the use of digital technologies in the educational process of the Glukhiv National Pedagogical University

Almost all respondents (96%) actively use the Internet and do not experience difficulties in working with a computer and other digital devices (91%). At the same time, a much smaller part of Masters is interested in new applications, programs and resources (59%), and an even smaller part follows professional social networks (51%).

According to the results of the survey, we found digital tools that provide the best results for the development of pedagogical skills of future teachers of labor education and technology. Among the tools that contribute to the development of critical thinking, generalization of learned material, verification and consolidation of knowledge, respondents noted: Learningapps (54%), Educaplay (32%), Padlet (17%), Flippity (15%); among tools that contribute to the development of group work organization skills, reflection, MindMeister (67%), Cacao (45%), Bubblus (40%), Mindomo (12%) are popular among students of education; for organizing independent work and self-development, according to respondents, the most effective are: Glogster (35%), ThingLink (29%), tools that promote the development of creative abilities: Toki-Toki (29%), Powton (12%), Kahoot (22%), Plickers (10%), PearDeck (37%) (Fig. 9).

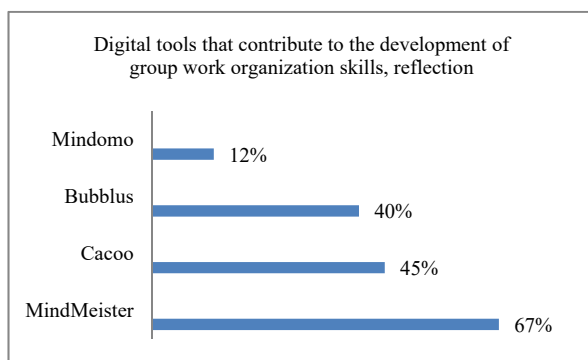
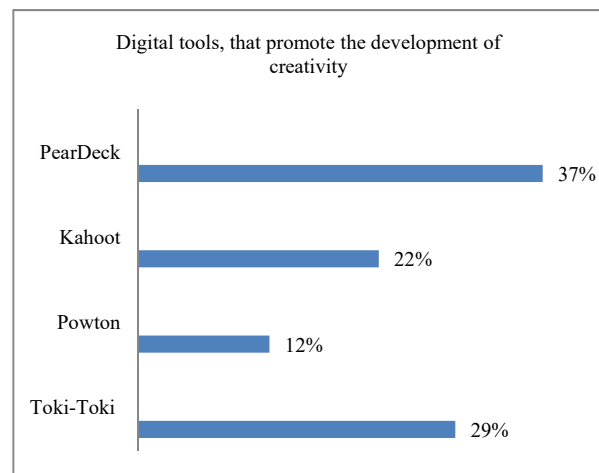
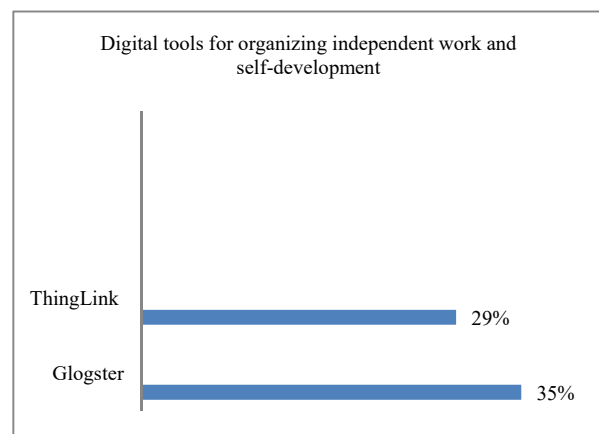
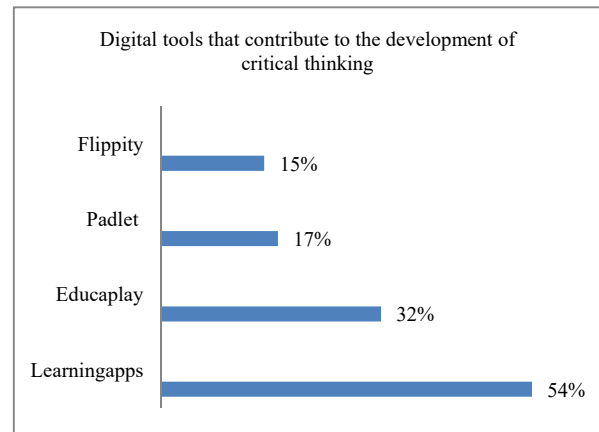


Fig. 9. Survey results on the digital tools that provide the best results for developing the pedagogical skills of future teachers of labor training and technology

Therefore, in the course of the study on the effectiveness of the use of digital technologies as a means of developing the pedagogical skills of future teachers of

labor education and technology, we can state that the vast majority of respondents positively evaluate the use of digital technologies in the educational process, since the latter contribute to the improvement of students' digital competence, open a wide range of opportunities for the use of digital technologies in future professional activities and contribute to the rationalization of own methods of information interaction by means of digital technologies.

4. Conclusion

The results of theoretical and experimental research on the topic of scientific research proved that digital technologies serve as an effective means of developing the pedagogical skills of future teachers of labor education and technology.

In our opinion, the introduction of STEM technologies into the educational process is equally important. It includes programmable electronic modules that can be programmed and create models of "smart" devices. It also includes a 3D farm, i.e. a set of 3D printers, with which you can "print", for example, the details of a smart house or a weather station and models of other measuring devices or even inventions. In addition to the listed solution, STEM can also be equipped with a laser engraver and/or a digital milling machine. Therefore, project details can be made not only from PLA plastic, as on a 3D printer, but also from sheets of wood, metal and other types of plastic, for example, polyethylene. We believe that digital machines in the laboratory open an unprecedented field for the development of pedagogical skills of future teachers of labor education and technology.

The use of digital tools in the process of training future teachers of labor education and technology can take place in various organizational forms: online counseling, online trainings, hackathons, webinars, use of interactive EPs, electronic virtual laboratories, electronic social networks, visits to interactive science museums, creation of presentations, platforms for communication based on scientific interests, international competitions for solving scientific and technical problems, virtual technoparks and others. Electronic educational content includes: library and information resource support for education, upbringing, management, conducting educational and scientific research; resources of library information centers; collections of electronic educational resources, content of the educational institution's website.

In order to create a wide range and pedagogically balanced use of digital technologies and develop the pedagogical skills of future teachers of labor education and technology, it is appropriate, in our opinion, to introduce an industrial approach that takes into account the psychological and pedagogical aspects of building methodical systems of learning and an open computer-oriented learning environment and provides for the

mandatory involvement of students, young scientists, teachers, and the best teachers of educational institutions in the creation of the electronic educational resource.

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