THE USE OF PROJECT TECHNOLOGIES IN THE TRAINING OF STUDENTS

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Abstract: The new millennium is characterized by an unprecedented breakthrough in knowledge and information and communication technologies. The challenges of the XXI century require modernized paradigms of interaction in all spheres of life, including the educational one. To date, one of the most promising teaching methods is project technology. It forms the conditions for creative self-realization of students, increases their motivation to learn, and promotes the development of intellectual abilities that contribute to the acquisition of students' own experience in solving problems of future independent life, which they project in their studies. The professional training of the student is enhanced through the use of project technologies, so students have to develop technical skills to be productive members of society. The research aims – to establish a pattern of promoting the implementation of project technologies in educational institutions by surveying the Internet. Another aim is to establish the ability of educational institutions to provide quality competent training to HEI students. Research methods: comparative analysis; systematization; generalization, and survey. Results. It has been established that as a result of the survey of students, project technologies have a positive impact on the provision of competent training of students (95.5%). A smaller number of students (3.3%) were not confident in the quality of competent training of students by modern project technologies. Whereas the rest of the students have noted that modern project technologies for competent training of students contain certain shortcomings (1.2%). As a result of the study, it was found that students positively evaluate (with scores above 5.0) project technologies as practical, understandable, motivating, etc. As a result of the study, it has been found that the implementation of project technologies for the professional training of university students is a complex process due to the large number of variables that should be taken into account both in the course and at the individual level. Moreover, it has been established that the implementation of the proposed model of integrating project technologies into the process of forming competitive advantages for university students benefits both students and educators by establishing reliable communication between them and stimulating the provision of qualified training.

Keywords: design, training, education applicants, project technologies.

1 Introduction

The XXI century is associated with the active development of information technology, which makes it possible to significantly expand the ways of obtaining and processing information. High-tech information educational environment requires the search for new approaches and fundamentally new learning systems in higher education institutions, due to the intensive development of the digital age. Project technologies for training students in modern conditions are associated with the use of information technologies, which are effective innovative means of improving the quality of teaching at all levels of the educational process (Gorbunova, 2015; Gorbunova, Govorova, 2018).

As part of the application of project technologies, educational institutions that have to prepare qualified professionals for life in the "knowledge society" should integrate project technologies into the educational process (Ghavifekr, Afshari, Salleh, 2012). Along with preparing future professionals for the modern digital era, educators are seen as key players in the application of project technologies in their curricula, due to the ability of project technologies to provide a dynamic and active teaching and learning environment (Arnseth, Hatlevik, 2010; Simin et al., 2014).

Project technologies in the educational process are defined as an objective requirement of the time to ensure sustainable development of the social economy (Adıgüzel, Yüksel, 2012). Acceleration of the process of informatization of education is a key approach for Ukraine to increase the international competitiveness of education in Ukraine, strengthen the connotation of educational development, and promote the reform of teaching models in the educational process (Ainley, Luntley, 2007). Currently, the use of project-based technologies in Ukrainian education faces such problems as weak informatization of education, low information literacy of educators, which still needs to be improved, imperfect mechanism of information protection, and weak internal and external conditions for the use of project-based technologies (Orhan-Goksun, Askım-Kurt, 2017).

The progressive development of project technologies in the educational process requires educators to use learning models integrated into information and communication technologies. Therefore, the use of project technologies in the educational process should be proportional and meet modern learning needs (Aprinaldi et al., 2018).

The research aims – to establish a pattern of promoting the implementation of project technologies in educational institutions by surveying the Internet to establish the ability of educational institutions to provide quality competent training to students in HEIs.

Research objectives of the article:

1. To analyze the key professional competencies that are formed in students of Ukrainian HEIs and determine the program results upon completion of training.
2. To survey students to identify popular design software.
3. To carry out a SWOT analysis of the process of introducing design technologies for the professional training of future students.
4. To analyze the experience of students in the application of design technologies.
5. To survey students about the ability of educational institutions to provide professional and quality competent training to students based on the use of project technologies.
6. To analyze the proposed model of integration of project technologies in the process of forming competitive advantages for students in HEIs.

2 Literature review

The modern stage of development of pedagogical science is characterized by the implementation of innovations as an important factor of social reproduction. It can ensure sustainable economic development based on achieving the country's competitiveness. Implementation of strategic tasks of competent training of specialists in education requires new approaches for the transition from quantitative to qualitative indicators. Of particular importance is the use of appropriate strategies for training students based on the principles of project technologies (Sheludko, 2017).

Project-based learning is proving to be a very valuable strategy for developing the competencies addressed during the study of product development subjects in real work experience (Barbero & García, 2011; Berselli et al., 2020; Pindado et al., 2018). Students can develop a specific product within a project using common industrial tools in a learning environment. At the same time, an individual's ability to solve a general problem statement can be enhanced (Stolk & Harari, 2014). On the other hand, when students need to solve complex open-ended design

problems, instructors have less time to devote to each student to solve their specific problem, and it is them who have to deal with them the most (Xie et al., 2018). Since design is defined as an inventive process, therefore, according to Cropley (2016), it is crucial to work on skills that are based on visual and mental images. Recent research on virtual environments encourages the use of project-based learning methods to improve students' competence and motivation (Aslan, Duruhan, 2021; López et al., 2020).

In the process of learning, students perform differentiated projects, so quality training based on the use of project technologies plays an important role. Researchers recommend devoting a significant part of the curriculum each year to differentiated student projects. In the first years of education, students receive all the necessary skills to implement differentiated student projects. The traditional process of mentoring, guiding, and critiquing throughout the learning process is important as projects need to be selected or refined to cover concepts that are emphasized in the learning process (Meyer, Norman, 2020).

New 3D rendering technologies can facilitate the task of visualization in the process of creating various projects. Technologies such as virtual reality (VR) can help the instructor plan strategies that encourage three-dimensional visualization of the project. Research in the field of teaching highlights the potential of virtual reality environments in learning processes (Bailenson et al., 2008; Bowman et al., 2009). Evaluations of VR from an educational perspective have focused on factors such as interaction, sense of immersion (immersive virtual environment, iVE), and motivation, among others (Jia et al., 2012). An immersive virtual environment is defined as "an interactive intelligent computer system that provides a three-dimensional virtual world" (Tcha-Tokey et al., 2016). However, although immersive virtual learning environments (iVLEs) are considered a powerful educational tool (Dede, 2009; Mikropoulos & Natsis, 2011), numerous authors believe that more research is needed in this area (Dede, 2009; Webster, 2014; Ragan et al., 2012; Carbonell-Carrera et al., 2021).

Virtual reality technology is a software modeling system used for projects that follow the three main software, namely AutoCAD, Photoshop, and 3S (RS, GIS, and GPS). Virtual reality technology is widely used in the educational process because of its interactivity, immersion, and imagination, which not only significantly reduces the working time and pressure on the project developer, but also helps to stimulate his imagination (Xu, Kang, Shao, and Zhao, 2015).

Three-dimensional visualization consists of a realistic three-dimensional visualization of the project, which is known as 3D visualization, where the given information can have a complex structure, which, in addition to project information (positioning), contains temporal and thematic data attributes. An example of interactive 3D visualization of spatial data is the work of Balla et al. who have used a new approach that allows the user to manipulate temporal and spatial data (Balla et al., 2020).

Technologies such as virtual reality offer great opportunities for 3D visualization, offering not only a realistic 3D visualization scenario but also providing immersive and interactive capabilities. These capabilities provide an intuitive 3D visualization and interaction scenario that allows different stakeholders with different backgrounds, experiences, and training to work together on a project.

A 3D visualization is a powerful tool for project planning (Newell et al., 2017), and strategies have been developed for collaborative platforms between different stakeholders in 3D visualization scenarios, such as VirCA (Virtual Collaboration Arena) (Galambos et al., 2015). This platform allows the design and implementation of collaborative 3D visualization scenarios in which 3D content is actively shared and manipulated in a collaborative and synchronized manner. The VirCA system is used in fields such as neuroscience research and industrial engineering, among others, and is an example of an interactive collaborative 3D workspace that can be applied in differentiated projects (Carbonell-Carrera et al., 2021).

Analysis of research on this issue shows that many scientists have paid attention to the problem of studying the processes of using immersive technologies in the educational process, such as Virtual Reality (VR) (Pellas et al., 2020), Augmented Reality (AR) and Mixed Reality (MR) (MacCallum, 2021). Scholars have paid considerable attention to the challenges of learning to design projects with VR (Desurvire, Kreminski, 2018), as well as interface design (Wetzstein, 2016).

A large number of studies have been devoted to the integration of immersive technologies in engineering graphics (CAD and 3D) in the training of students (Grajewski, 2015). Taking into account a significant number of scientific publications devoted to various aspects of the application of design technologies, it can be noted that the problem of introducing the study of design technologies into the process of professional training of students is insufficiently developed (Chemerys et al., 2021; Alekhanovich, Abdurakhimovna, 2020).

Hence, in the process of project-based learning, students need proper training in CAD/CAM/CAE tools in line with industry needs for new product development. Therefore, their university training in this field with virtual environments combining active learning strategies can be an appropriate approach to improve their competencies (Sola-Guirado et al., 2022).

Thus, the problem of implementing project technologies for competent training of students in the educational process, as well as the study of obstacles and prospects for student learning is poorly reflected in scientific publications in the form of theoretical research and practical research. However, the issue of promoting the use of project technologies for the proper preparation of students for future professional activities remains relevant and open for further research.

3 Methods and Materials

The realization of the purpose of this study involves the application of such research methods as:

- systematization of the model of integration of project technologies in the process of forming competitive advantages for university students;
- systematic and logical analysis, method of synthesis of information of key professional competencies that are formed in students of Ukrainian higher education institutions and a list of program results upon completion of training;
- generalization of the latest scientific publications related to SWOT analysis of the process of introducing project technologies for the professional training of future students;
- a comparison method to distinguish between five commonly used design programs and an analysis of students' experience in applying design technologies.

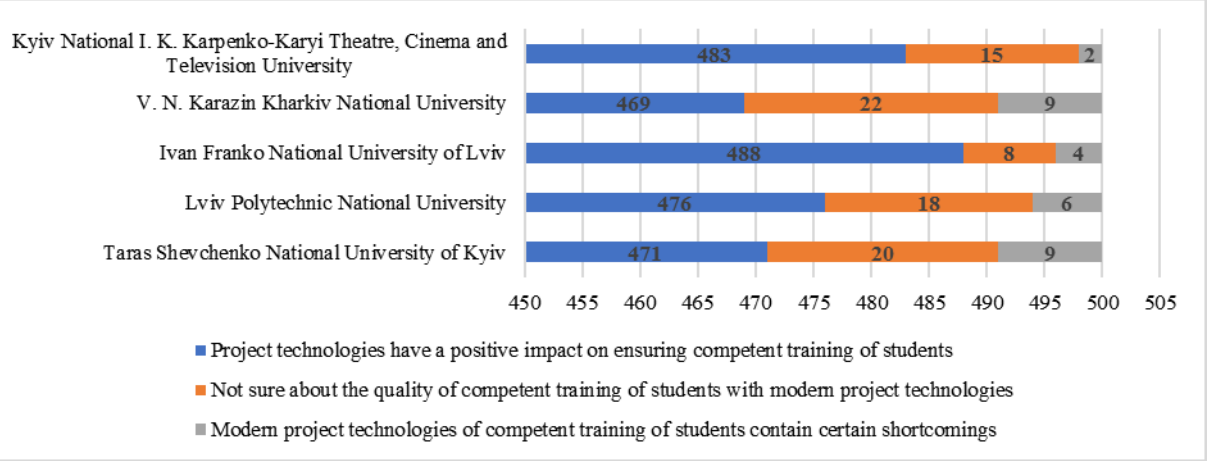
To determine certain features of project technologies, descriptive statistics were used, the data of which were provided as a result of a survey using MS Forms Pro. The survey was conducted to determine the perceptions of educators and students about the ability of educational institutions to provide knowledge and quality competent training to students based on the use of project technologies. An online survey was conducted from September 20 to October 25, 2022, which collected information from 2500 students. These participants answered questions about their learning experience, motivation, expectations, and overall satisfaction with project technologies. The following research questions were addressed in this online survey: 1. what are students' perceptions of project-based technologies to ensure their competent preparation? 2. what is the student's perception of their ability to absorb information in the context of using project technologies to ensure their competent training? 3. Are

there any shortcomings in the use of project technologies to ensure their competent training?

4 Results

To assess the effectiveness of the use of project-based technologies for student training in Ukrainian education in 2022, a significant number of students from Taras Shevchenko National University of Kyiv, Kyiv National I. K. Karpenko-Karyi Theatre, Cinema and Television University, Ivan Franko National University of Lviv, Lviv Polytechnic National University and V. N. Karazin Kharkiv National University were interviewed. They noted that project technologies have a positive impact on the provision of competent training of students (95.5%), a smaller number (3.3%) were not sure about the quality of competent training of students with modern project technologies, and the rest of the students noted that modern project technologies for competent training of students contain certain shortcomings (1.2%) (Figure 1.).

Figure 1: Analysis of trends in project technologies for competent training of HEI students in 2022



Source: Compiled by the authors.

A comparative analysis of the professional competencies of students of Taras Shevchenko National University of Kyiv, Kyiv National I. K. Karpenko-Karyi Theatre, Cinema and Television University, Ivan Franko National University of Lviv, Lviv Polytechnic National University and V. N. Karazin Kharkiv National University has been carried out (see Table 1).

Tab. 1: List of program outcomes and professional competencies that are formed in future students of HEIs in Ukraine

Academic disciplines	Modern design technologies	3D modeling	Information and digital technologies	Project graphics	Computer-aided design
Program learning outcomes defined by the educational standard					
1. Apply the acquired knowledge and understanding of the subject area and the field of professional activity in practical situations.	+	+	+	+	+
2. Create objects through design and graphic modeling.		+		+	+
3. Develop a compositional solution for project objects in appropriate techniques and materials.	+			+	+
4. Take into account the properties of materials and structural constructions, and apply the latest technologies in professional activities.	+	+	+	+	+
5. Apply modern general and specialized software in professional activities.	+	+	+	+	+
Professional competencies					
1. Ability to succeed in a professional career, develop and present visual presentations, portfolio of own works, and have entrepreneurial skills to carry out design activities.	+	+	+	+	+
2. Ability to use modern software to create project objects.	+	+	+	+	+
3. Ability to carry out shaping, layout, and modeling of project objects.	+	+	+	+	+
4. Ability to carry out compositional construction of project objects.		+		+ +	
5. Ability to apply special techniques and technologies of work in appropriate materials to design and artistic activities.	+	+	+	+ +	
6. Ability to apply project graphics skills in professional activities.	+	+	+	+ +	
7. Ability to carry out technical calculations in projects, feasibility studies, and functional and cost analysis of the effectiveness of the projected measures.	+		+	+	

Source: Compiled by the authors based on official data.

A SWOT analysis has been conducted, the results of which made it possible to determine the hierarchy and positioning of opportunities and threats for the implementation of the study of project technologies in the process of professional training of future specialists (see Table 2).

Tab. 2: SWOT-analysis of the process of implementation of project technologies of professional training of future students

Strengths (S)	Weaknesses (W)
- high level of scientific and pedagogical staff involved in teaching project technologies; - increasing the level of motivation and productivity of educational activities of future specialists by focusing developments on the attractiveness and image of project technologies; - demand for skills in the development of project technologies; - strengthening the position of the future specialist in the labor market, including the global one; - the high price of remuneration for the project in which design technologies were applied.	- the high cost of equipment of educational institutions for the development and testing of project technologies; - loss of motivation among future specialists due to the complexity and a large amount of time spent on the process of studying a software product based on project technologies; - niche development of project technologies contributes to the emergence of a small number of projects with high prices.
Threats (T)	Opportunities (O)
- low interest of educators in mastering new project technologies; - shifting attention from creative solutions to technical skills; - insufficient level of multimedia competence necessary for the successful development of students as future professionals.	- opportunities for academic and professional mobility; - opportunities to adapt to current changing market realities; - advanced training, including in the field of project development through project technologies.

Source: Compiled by the authors based on official data of Chemerys et al., (2021).

The general judgment of students about the experience of using project technologies for modeling and project activities is shown in Table 3.

Tab. 3: Questionnaire on students' experience in the use of project technologies

Question	Assessment (1–10) (s.d.)
1. "I would say that project technologies are practical"	8,16 (1,70)
2. "I would say that project technologies are clear"	7,52 (2,54)
3. "I would say that design technologies have a positive impact on modeling"	8,24 (1,96)
4. "I discovered that project technologies contribute to original modeling"	7,20 (2,55)
5. "I found that the project technologies are modifiable to facilitate the work"	6,36 (2,94)
6. "I found the project technologies to be easy (1) / difficult (10) in the course of the activity"	4,00 (3,06)
7. "I found the project technologies unpleasant (1)/pleasant (10) to use"	7,00 (2,16)
8. "I found this virtual environment to be (1) discouraging (1)/motivating (10)"	6,64 (SD = 2,29)

Source: Compiled by the authors based on official data.

To identify the currently popular design software, a survey of students has been conducted and their comparison is presented in Table 4.

Tab. 4: Comparison of five commonly used design programs

Software	Modeling Speed	Modeling Ability	Modify the Convenience	Whether design-oriented
CAM	slow	Strong	Convenient	yes
CAE	slow	Very strong	Convenient	yes
3D	very fast	Strong	Very convenient	yes
2D	fast	Strong	Convenient	no
CAD	fast	Very strong	Convenient	no

Source: Compiled by the authors.

Based on the experience of applying the project method, we have developed a model for integrating project technologies into the process of forming competitive advantages for HEI students (Figure 2).

5 Discussion

The results of the study of project technologies for student training led to the following conclusions. The planning and implementation of project-based technologies and resources that would provide purposeful and competent student learning are in great demand. Pindado et al. (2018) and Berselli et al. (2020), noted that educational institutions are increasingly obliged to use the potential of project technologies that ensure the development of the creative potential of the educational process and contribute to the provision of quality knowledge and the development of relevant skills and abilities of students.

The obtained results indicate that, despite the significant achievements in this area and the development of the problem as a whole, the possibilities of optimizing student training based on the use of project technologies as a stimulus for the development of the creative potential of the educational process are not sufficiently studied. There was no comprehensive analysis and classification of the relevant educational software, and there are no clear methods for assessing the quality of project resources and technologies used in the educational process.

The operation of CAD/CAM/CAE tools, which usually require significant computing resources, worked well in the virtual environment with very good results in the survey. The students' feedback on the design technologies used by educators in HEIs was very interesting and positive. It was found that the evaluation subscale measures the "general judgment of experience in the use of project technologies". In this subscale, a mean value of 8.16 (SD = 0 1.70) stands out in the item "Personally, I would say that project technologies are practical", as well as a mean value of 7.52 in the item "I would say that project technologies are understandable (not confusing)". We also find values such as 6.64 (SD = 2.29) in the item "I found this virtual environment to be discouraging (1)/motivating (10)". It is interesting to know that students evaluate positively (with scores above 5.0) project technologies and define them as practical, understandable, manageable, motivating, etc. (Carbonell-Carrera et al., 2021).

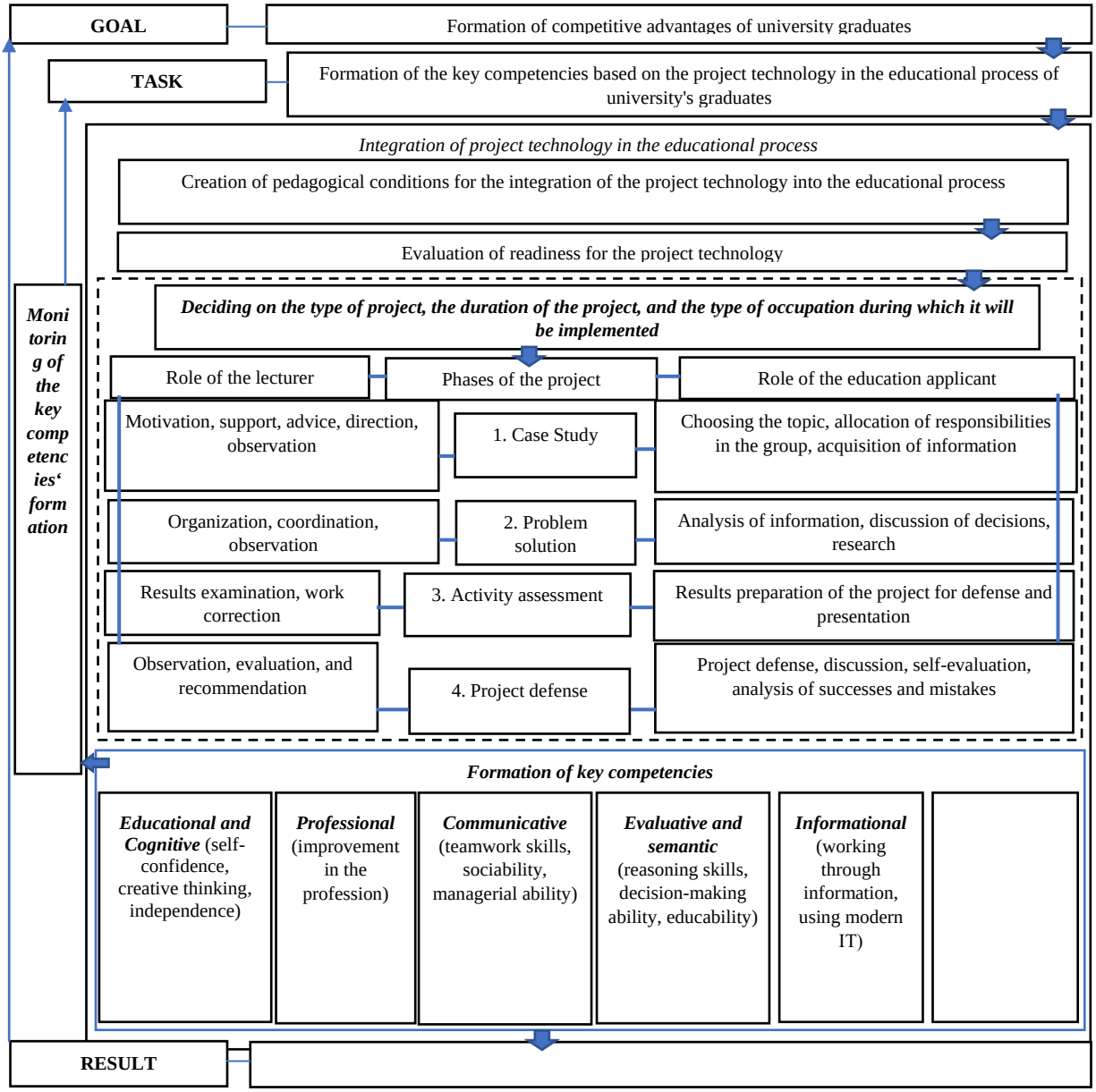
Project technologies have allowed students to learn in practice and deal with many of the skills to be achieved in Master's subjects. The usefulness of design tools has been proven, which contributes to the fact that they can be used outside the classroom to help students manage their projects (Sola-Guirado et al., 2022).

The implementation of the proposed model will facilitate the process of optimization and structuring of information learning by choosing appropriate project technologies and developing methodological support for the educational process. Thus, project technologies allow for the introduction of new and creative pedagogical practices and promote the development of creative thinking.

The study shows that educators will have to work in a more complex educational environment and integrate into the educational information technology space to ensure effective

training of students with project technologies. Consequently, educators and students will face new challenges, as the potential of project technologies is quite high, but insufficiently realized, an in-depth study that will lead to increased attention to improving the educational training of future specialists.

Figure 2: Model of integration of project technologies in the process of forming competitive advantages for HEI students



Source: Compiled by the authors.

6 Conclusion

Based on the study, it was found that the use of project-based technologies in student training undoubtedly requires the development of the technological infrastructure of the educational environment. This means the introduction of computer equipment, network support, information terminals, educational and methodological techniques, and technical support for project technologies, as well as the development of a strategy for equipping educational institutions with the necessary educational software.

It is clarified that educational projects help to solve the following important tasks - the acquisition of skills and knowledge that contribute to the development of communication competence, the development of self-correction skills, the ability to evaluate the effect of decisions, the ability to work in a team, to take responsibility for teamwork, the ability to present the results of their work and evaluate the activities of other participants. Thus, the use of project technologies in the educational process contributes to the formation of key competencies of students, which develop all the knowledge, skills, and abilities that give graduates a competitive advantage in the labor market.

The results obtained in the course of the study allow us to determine the directions of further exploration of the scientific and methodological foundations of the development of the process of applying project technologies to ensure quality training of students. Continuous improvement of the level of digital competence allows the educator to use project technologies as an incentive for the development of the educational process and contributes to the organization of a successful educational process.

The practical significance of the study lies in the fact that the conclusions and recommendations developed by the author and

proposed in the article can be used to: avoid obstacles in the implementation of project-based technology training for students.

Further research can be focused on improving the curriculum with the use of project technologies for student training. It will stimulate the educational sphere and improve teaching activities in the educational information technology space, which will ensure quality education. Expansion of opportunities and widespread use of innovative research approaches to ensure competent training of specialists based on the use of project technologies can become the basis for improving curricula.

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Primary Paper Section: A

Secondary Paper Section: AM