

# Evaluating Training Methods for Future Technical Specialists

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## Abstract

This study evaluates the efficacy of current training methods for technical specialists in higher education, focusing on the development of professional competencies, skills, and personal qualities. Utilizing a mixed-methods approach, including questionnaires and interviews among students of National Technical University "Kharkiv Polytechnic Institute" and National University of Civil Protection of Ukraine, the research identifies gaps in traditional educational frameworks and the challenges posed by distance learning. Key findings reveal a significant satisfaction with the quality of professional training among students, underscored by the effective use of modern teaching methods and technologies. However, difficulties with distance learning and technology utilization were notable concerns. The study recommends the creation of online laboratories, development of training programs for modern technologies, incorporation of joint student projects, and enhanced collaboration between universities and industry to improve training quality. These recommendations aim to align technical education more closely with industry demands and technological advancements. The implications for Technical and Vocational Education and Training (TVET) suggest a paradigm shift towards integrating interactive, technology-driven methods into curricula, addressing the digital divide, and fostering industry-academia partnerships. This approach promises to prepare a workforce adept at navigating the complexities of modern and future job markets, emphasizing the practical application of theoretical knowledge and the importance of continuous learning and adaptability.

## 1. Introduction

In the era of modernization and globalization, a modern specialist must possess a wide range of knowledge, skills, and personal qualities. The modern labor market needs competitive specialists in the technical field, as their

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activities significantly impact state development and international relations. Future specialists primarily acquire necessary skills in higher education institutions, including professional practice, and through self-improvement. The ongoing war in Ukraine has profoundly disrupted higher education, damaging infrastructure, displacing students and faculty, and necessitating a shift in educational priorities towards cybersecurity, logistics, and reconstruction. This situation underscores the critical role of international partnerships in supporting Ukrainian universities and adapting curricula to meet the urgent demands of post-war recovery and development. Addressing these challenges, higher education institutions are pivotal in equipping future technical specialists with competencies essential for the nation's rebuilding and advancement in the post-conflict era.

So, Bagry (2020), who studied the features of the integrative approach in the training of specialists in technical specialties, noted that the requirements for quality training of future specialists are changing in parallel with changes in modern society, and currently the goal of training is the formation of a purposeful personality capable of self-improvement, self-education and integrative thinking. Sushko and Kolodiy (2021), revealing the issue of distance learning of students of technical higher education institutions, came to the conclusion that high-quality training of future specialists is possible only with the use of innovations, to which scientists attributed the active use of modern technologies by teachers in the educational process and the independent use of the network by students Internet.

Halatsyn and Feshchuk (2021) revealed in their work the issue of motivating students of technical specialties to master foreign languages and noted that teachers who use modern pedagogical techniques in their approach can motivate students to study, and professional training is most effective precisely in a higher educational institution. Speaking about the role of the teacher in the process of professional training of future specialists, Kiriukhina (2020), who studied the model of humanitarian training of specialists in the technical field, came to the conclusion that high-quality professional training in a higher educational institution is possible only through the interaction of all teachers in the formation of a positive attitude to learning among students, thoughtful and active use of innovative technologies.

However, Batechko and Pantaliyenko (2020), who studied modern trends in the professional training of future specialists in technical specialties, believe that the existing system of training students in the technical field does not meet modern needs and cannot train competitive specialists. Sazhko (2021), who revealed in her work the issue of digitalization of the educational process in the training of future engineers, also notes that currently most higher education institutions lack the material and technical base for the modern training of future specialists in the technical field, and the teaching staff of the university is not always ready to application of innovations in one's own activities, which affects the quality of professional training.

Thus, the analysed scientific sources indicate that the basic knowledge and practical skills needed by a modern specialist can be most effectively formed within the framework of a higher education institution, however, existing research does not focus on aspects of professional training, the process, and opportunities for its improvement. In the analysed scientific sources, there are also views regarding the lack of material and technical support, the unpreparedness of pedagogical workers, and the non-compliance of the education system with modern requirements.

## 2. Research Objective

Based on the above, the aim of this study is to evaluate and enhance the professional training of future technical specialists in higher educational institutions by:

1. Assessing the development of professional competencies, skills, and personal qualities among students.
2. Identifying innovative teaching methods and technologies to improve educational outcomes.
3. Investigating the impact of distance learning on training quality and proposing improvements.

The research investigates the following questions based on the conclusions provided: How effectively do current training methods in technical specialties prepare future specialists with the necessary professional competencies, skills, and personal qualities? What modern methods and technologies are most beneficial in enhancing the quality of professional training for these specialists? How do students of technical specialties perceive the quality of their professional training, particularly in the context of distance learning, and what challenges do they face?

## 3. Materials and Methods

The design of this research focused on assessing the effectiveness of current training methods for students pursuing technical specialties at higher education institutions. A mixed-methods approach was employed to gather both quantitative and qualitative data, providing a comprehensive understanding of the training's impact on the students' readiness for their future professional careers. The quantitative component involved a structured questionnaire distributed to students enrolled in technical specialties. For the qualitative part of the study, semi-structured interviews were conducted with a select group of students and faculty members from the aforementioned institutions. The research design also included an analysis of the curriculum and teaching

methodologies employed by these institutions, with a particular focus on the use of interactive methods, project-based learning, and the incorporation of digital tools and software relevant to the technical specialties.

To analyse the state of professional training of future specialists in technical specialties in higher education institutions, a study was conducted among students of National Technical University “Kharkiv Polytechnic Institute” and National University of Civil Protection of Ukraine. The participants of the study were students of the fourth (future bachelors) and fifth (future masters) courses who had experience of professional practice. 122 people took part in the study, including students of the Faculty of Mechanical Engineering, the Faculty of Mechanics and Engineering, and the Faculty of Engineering and Physics of the National Technical University “Kharkiv Polytechnic Institute” and the Faculty of Fire Safety, and the Faculty of Operational and Rescue Forces of the National University of Civil Protection of Ukraine. The majority of respondents (90%) are male. The age of the subjects is 21-26 years. The author’s questionnaire on the quality of professional training of future specialists in technical specialties in higher education institutions was used to conduct the research. This questionnaire contains 20 statements about the educational process of a higher educational institution, each of which the studied students should rate from 1 (one) to 5 (five) points, where 1 is completely disagree/disagree, and 5 is completely agree/agree. Respondents also had the option not to rate a particular item at all if they did not have a final opinion about it. The number of points for all statements is summed up and makes it possible to draw a conclusion about the quality of professional training of future specialists in a higher educational institution (Table 1).

**Table 1** Form for the author’s questionnaire regarding the quality of professional training of future specialists in technical specialties in higher education institutions

No.	Proposed statement	1	2	3	4	5
1	I am completely satisfied with the quality of professional training I receive.					
2	My professional training at a higher educational institution is comprehensive and comprehensive.					
3	Communication with teachers and the management of the educational institution takes place at a high level.					
4	I receive quality feedback from teachers about my projects and completed tasks.					
5	Teachers at the higher educational institution use modern teaching methods.					
6	The higher education institution is equipped with material and technical support at a high level.					
7	I have access to logistics.					
8	Despite the distance learning, I get a full range of knowledge and practical skills.					
9	I am familiar with modern computer technologies, and distance learning comes easily to me.					
10	I feel that training at a higher educational institution forms the main professional competencies in me.					
11	I feel that training in a higher education institution is forming in me the skills that are necessary for a modern professional.					
12	I feel that training at a higher educational institution forms certain personal qualities in me that will help me in my professional activities.					
13	In a higher education institution, I get the opportunity to apply my knowledge and skills in practice.					
14	The acquired knowledge helped me during professional practice.					
15	I showed high results during professional practice					
16	I understand the importance of my future activities for the social, economic, industrial and international development of the state.					
17	I strive for self-improvement and continuous improvement of acquired skills.					
18	Studying at a higher educational institution, completing tasks, extracurricular activities, communication with management and teachers, evoke positive emotions in me.					
19	The learning process is easy for me and does not cause difficulties.					
20	I acquired most of my knowledge and skills precisely within the framework of professional training at a higher educational institution.					

Key to the author’s questionnaire:

- 1-20 points – complete dissatisfaction with the quality of professional training;
- 20-40 points – a low level of satisfaction with the quality of professional training;

- 40-60 points – average level of satisfaction with the quality of professional training;
- 60-80 points – a high level of satisfaction with the quality of professional training;
- 80-100 points – complete satisfaction with the quality of professional training.

This questionnaire proved not only the quality of professional training of future specialists in technical specialities, but also the degree of satisfaction with the educational process, the state of material and technical support in the higher educational institution and its relevance for students, demonstrated the attitude of students to modern technologies and the ability to use them in the educational process, revealed the role of teachers in professional training of future specialists. The obtained data demonstrated the main aspects of the educational process. Based on them, conclusions were made about its quality and the quality of professional training of future specialists in technical specialities. These findings had a decisive role in providing recommendations for improving the professional training of students.

## 4. Results

### 4.1 Assessing Student Satisfaction and Competency Acquisition in Technical Education

Students were sent a form of the author’s questionnaire and were asked to evaluate the statements made in it on a five-point scale, or not to evaluate them at all, if students did not have a certain opinion about some of them. It was assured that the survey is completely anonymous, and its results will not be evaluated and will not affect their points for academic subjects. The results of the study showed that 56 students are completely satisfied with the quality of professional training. 23 persons have a high level of satisfaction with professional training at a higher educational institution. 40 respondents have an average level of satisfaction with the quality of professional training. According to the results of the research, only 3 people have low satisfaction with the quality of professional training at a higher educational institution, and no students were found to be completely dissatisfied with professional training (Figure 1).



**Fig. 1** Results of the study on satisfaction with the quality of professional training of students of technical specialities in a higher educational institution

The results of the study showed that 83 people (68%) communicate with teachers and the management of the higher educational institution quite effectively, more than half of the respondents also noted that they can receive quality feedback from teachers regarding their projects and completed tasks. 43 students (35%) believe that teachers use modern teaching methods, and 47 respondents (39%) noted that the higher education institution is equipped with the necessary material and technical base. However, only 35 people (29%) indicated that they have access to this material and technical base. Distance learning turned out to be a problem for the interviewees. 62 students (51%) noted that they cannot fully acquire knowledge through remote technologies, because they do not have sufficient skills to use them. Almost a quarter of the respondents (29 people) noted that distance learning is difficult for them. In general, according to the results of the research, students believe that a higher educational institution forms in them the basic competencies, skills, and personal qualities necessary for professional activity. 72 students (59%) believe that the training they received helped them in their professional practice, and 56 students (46%) showed high results during it. In addition, the majority of respondents strive for self-

improvement, continuous development, understand the importance of their activities for the development of the state and international relations.

In the course of the study, students were asked to leave additional anonymous comments about aspects of their professional training at a higher education institution. The analysis of these comments showed that the distance form of education significantly limits the circle of communication of students, because they strive for greater communication with each other, joint projects. Students consider innovative technologies to be the most effective in the educational process and note that they increase motivation to study and make the educational process more interesting. However, students still note that they have problems when passing tests or tests due to insufficient understanding of the software with which the training takes place. Some interviewees noted that their motivation to study, their ability to receive professional training decreased due to stress and negative emotional states, which may be related to the military situation in Ukraine. About 20 people (16%) indicated that they are worried about the possibility of employment after completing their studies. The lack of offline communication with other students, the low level of preparedness for the use of remote technologies, and the difficulty of perceiving information in this format for some students are problems of distance education and affect the quality of professional training of future specialists. In addition, 16% of respondents are worried about the possibility of employment after completing their studies.

Based on the results of the research, a number of problems that currently arise in the professional training of future specialists have been determined, and recommendations have been made for improving the process of professional training of specialists in technical specialties in higher education institutions:

1. Creation of online laboratories. Since access to offline laboratories can currently be limited, it is advisable to create online laboratories that can be used for practical training of specialists. Online laboratories can be implemented in the form of a website or application, which will collect lecture notes and presentations, video materials, separate sections with modelled 2D or 3D figures, tools, details, and products that are important for the professional training of specialists in certain technical specialties. Virtual reality can also be used to increase the efficiency of these laboratories (for example, to conduct online tours of enterprises, to demonstrate the work process and to develop practical skills).

2. Compilation of a training program on the use of modern technologies. The results of the study showed that 51% of students do not possess remote technologies at a level sufficient for quality acquisition of knowledge. Based on this, in order to improve the professional training of future specialists, it will be appropriate to develop a training program on the use of modern technologies, in particular, technologies used during distance learning. The training program should include both a theoretical unit and practical tasks, the implementation of which will form students' skills in mastering modern technologies.

3. Introduction of joint student projects into the educational process. The researchers noted a lack of communication with other students, that is why, in order to increase the efficiency of the educational process and improve the emotional state of future specialists, it is advisable to introduce a greater amount of student interaction into the educational process. It will be effective to introduce into the educational process joint projects, brainstorming, online meetings through remote platforms Zoom, Webex, Microsoft Teams, where students can communicate, share professional experience and seek solutions to problems that arise both in the educational process and during passing professional practice.

4. Interaction of higher education institutions and enterprises. 16% of respondents noted that they have certain worries about employment after completing their studies. Management and employees of enterprises can hold meetings with students, lectures on certain topics, practical, and laboratory classes. Cooperation between higher education institutions and enterprises can not only provide employment guarantees for students who have shown high results during their studies, but also improve the educational process.

Therefore, according to the results of the research, future specialists in technical specialties are mostly satisfied with the quality of professional training in a higher educational institution. However, the provided recommendations can significantly improve this process, modernize it and increase the quality of professional training and, as a result, the quality of professional work, which will affect the development of the economy, industry and international relations.

## 4.2 Innovative Approaches and Challenges in Technical Specialist Training

The professional training of future specialists in technical specialties should include both the acquisition of theoretical knowledge and the ability to effectively apply it in practice. The main elements of the professional training of future specialists in the technical field are the acquisition of professional competencies necessary for the successful operation of skills and the formation of certain personal qualities that can positively affect the work process. The professional competencies that must be formed in the future specialist of the technical field include a deep understanding of one's own professional activity and its strategic orientation, the ability to conduct competitive activities in synergy with modern challenges, high knowledge of fundamental technical disciplines, a systematic approach to the work process, and the ability to manage each of its stages, the ability to analyse one's

own activity and the entire work process, improving it and understanding its advantages and disadvantages, the humanistic orientation of activity (Asieieva, 2017). Skills needed by today's technical industry for successful professional activity may include (Byrne et al., 2021):

- technical skills (ownership of software, ability to use equipment and tools used in the professional activities of representatives of certain specialities, ownership of modern computer technologies);
- compliance with rules and protocols (ability to take into account basic work standards, safety rules and health-preserving rules);
- communication skills (ability to effectively communicate with colleagues, express your opinion, resolve conflicts that may arise during the work process);
- management skills (ability to motivate colleagues, organize their activities, ability to fully plan the work process and bring it to the final goal);
- social skills (ability to directly or indirectly influence society, interact with it, influence ecological processes and environmental preservation).

A great role in the professional training of future specialists in the technical field is played by the formation of certain personal qualities in them, which can positively affect the quality of the work process, its improvement, as well as the development of the specialist as an individual. The personal qualities necessary for a future specialist in a technical speciality include the ability to self-organize and self-improve, flexibility and the ability to adapt to modern trends, the ability for healthy criticism of one's actions and decisions, the ability to analyse them and improve one's own activities, high logical and analytical abilities (Asieieva, 2017).

One of the methods of forming the described competencies, skills and personal qualities can be the use of innovative technologies and methods by teachers in the professional training of future specialists. Interactive methods, game methods, training methods, discuss methods, the technology of person-oriented training, project training, and the portfolio method are among the innovative methods that can be actively used in the professional training of specialists in the technical field (Asieieva et al., 2018). Interactive methods include the method of solving research problems, which includes the search for a problem, and later – the search for its effective solution under the supervision of teachers, as well as employees and management of enterprises that are ready to take on internships and additional training those students who show high results when solving the given problem (Tan & Zhang, 2014).

The application of this approach can improve the process of professional training, because in addition to teachers and other students, the management and employees of leading enterprises will be actively involved in the educational process, who can share their experience with future specialists, as well as provide the opportunity for internships and additional training for the most promising students, which will increase their motivation to study. Game methods that can be used in the professional training of future specialists in technical specialities include a business game, the use of which will help simulate professional activity with all its key stages and problems (Yekimov et al., 2023). The business game will help students develop communication skills, professional competencies, develop certain character traits, such as perseverance, the ability to defend their opinion, logical and strategic thinking. The use of dialogue methods in the professional training of future specialists can be implemented by introducing certain software, for example, the development of the Dutch university "Talk!", which will help generate dialogues with a random character on the required topic (Hulsbergen et al., 2023). The use of similar software in the professional training of students of technical specialities will help in the formation of communication skills, as well as in modelling real life situations and dialogues that specialists may encounter in their work.

Innovative technologies that can help specialists work on solving work issues include 2D and 3D technologies, virtual reality, artificial intelligence and machine learning. These technologies can be used by future specialists in technical fields for designing and modelling, creating schemes, for visualizing their projects and creating their prototypes. In addition, these technologies can be applied by teachers in the educational process to improve the professional training of future specialists. However, introducing the full range of described methods and technologies into the professional training of future specialists is a rather complex process. There are studies that reveal the problem of the inadequacy of the current education system with modern needs, the lack of a material and technical base, and the unpreparedness of teachers for modern professional training of future specialists in technical specialities (Batechko & Pantaliyenko, 2020; Redziuk & Riznyk, 2021; Sazhko, 2021).

## 5. Discussion

The discussion of the research on the professional training of future specialists in technical specialties integrates findings from various studies to compare and contrast with the current study's results. The current study emphasizes the need for developing not only technical skills but also soft skills and personal qualities in future specialists. Holik and Sanda (2021) highlight the importance of courses focusing on self-knowledge, cooperation, and empathy, which aligns with our findings that future specialists require openness, communication, and cooperation skills. Similarly, Subramaniam, Noordin, and Nor (2021) discuss the necessity of future-proof non-

technical skills for engineers, underscoring the importance of resilience, values, ethics, and creativity. These insights complement our research, suggesting that a holistic approach to education, incorporating both technical and soft skills, is crucial for the comprehensive development of technical specialists.

Our research identifies the effectiveness of innovative training methods, such as project-based learning and remote experimentation. Colim et al. (2022) and Masar, Bischoff, and Gerke (2004) both advocate for project-based learning and virtual labs as effective methods for engaging students and enhancing their practical skills. These studies support our recommendation for incorporating online laboratories and interactive methods to simulate real-world challenges, thereby enhancing the practical training of technical specialists. The integration of digital technologies in education is a recurrent theme. Trunova et al. (2023) discuss the sustainable approach for the education of electrical engineers in online settings, which resonates with our findings on the challenges and potential of distance learning. Xiong (2022) further elaborates on the need for integrating AI into vocational education, highlighting the necessity for an education system that evolves with technological advancements. These perspectives reinforce our study's observations on the importance of developing digital competencies and the utilization of AI and machine learning in educational processes.

The concern for employability and the need for university-industry collaboration is evident in our research. Wu (2014) and Zhao et al. (2020) stress the significance of aligning education with industry needs and fostering partnerships between educational institutions and enterprises. This aligns with our recommendations for enhancing employability through practical exposure and collaboration with industry professionals, ensuring that students are well-prepared for their future careers. The emphasis on innovative teaching methods and technologies in the current study resonates with findings from Tan and Zhang (2014), who advocate for an interactive training model of TRIZ for mechanical engineers in China. The success of such interactive models in enhancing engineers' innovative abilities underscores the importance of adopting diverse and innovative approaches to technical education. Similarly, Redziuk and Riznyk (2021) highlight the significance of digital competence among future vocational training pedagogues, further reinforcing the need for incorporating modern technologies and digital literacy into the curriculum for technical specialties. The challenges associated with distance learning, as identified in the present research, are echoed in the study by Batsurovska and Dotsenko (2022), who examined the formation of professional competencies in the study of biophysics in bachelor students of technological specialties. The necessity of a well-structured distance course that includes virtual practical simulators and test tasks is crucial for maintaining the quality of education in technical disciplines, especially in the context of remote learning.

The current study's focus on professional competencies and workplace skills finds support in the work of Wipulanusat et al. (2020), who identified transformational leadership and innovative culture as key drivers for engineer creativity. This alignment suggests that educational institutions should not only focus on technical skills but also foster an environment that encourages leadership and innovation. Adams (2023) further elaborates on the shifting landscape of workplace training for Canadian engineers, highlighting the decrease in on-the-job learning opportunities and underscoring the importance of formal education in compensating for this gap. The recommendation for closer collaboration between educational institutions and enterprises is underpinned by Leonard and Tyers (2023), who explore the impact of new digital technologies on infrastructure work futures. Their findings suggest a slow real change despite a technocentric utopian vision, indicating the necessity of bridging theoretical knowledge with practical applications through such partnerships. This collaborative approach ensures that students are not only technically proficient but also adaptable to the evolving demands of the industry.

Aligning with the observations by Oyedemi and Okunlola (2023), our study reaffirms the necessity for a structured quality assurance mechanism in technical education, emphasizing the creation of a quality assurance unit and the importance of curricular updates to reflect current industry demands. Similar to their recommendation for increased funding and staff training, our research highlights the need for online laboratories and training programs on modern technologies to bridge the gap between traditional educational models and the exigencies of contemporary technical professions. Moreover, the pedagogical framework posited by Horey et al. (2022) concerning the cultivation of a respectful culture and purposeful assessment design in health research education bears relevance to technical education. Our findings on the positive impact of interactive and game methods on student engagement and competency acquisition echo their advocacy for purposeful assessment and feedback mechanisms. This cross-disciplinary parallel suggests a universal applicability of these pedagogical strategies in enhancing the educational experience across varied fields of study.

Fedoreiko et al. (2022) delve into the dual training model, underscoring the integration of active learning methods for the development of professional competences. This approach resonates with our study's emphasis on innovative teaching methodologies, such as project-based learning and the utilization of STEM environments, as elucidated by Kuzmenko et al. (2023). Both studies accentuate the efficacy of active learning in fostering analytical and professional skills, thereby validating our recommendations for a more hands-on, experiential learning framework in technical education. The study by Geurts et al. (2023) further illuminates the transformative potential of student-driven curriculum negotiation in vocational education. Their findings,

highlighting the enrichment of student and teacher experiences through curriculum negotiation, complement our research's insights on the significance of student involvement and the adaptation of educational content to meet learners' needs. This student-centered approach aligns with our suggestion for joint student projects and enhanced university-enterprise cooperation, advocating for a more participatory and responsive educational model.

The scars of war in Ukraine etch not only into landscapes but also into the fabric of its population. As the nation looks towards a future of reconstruction, the education of its technical specialists takes on a critical new dimension. While current training methods demonstrate encouraging effectiveness in fostering professional competencies, the landscape of post-war reconstruction demands a nuanced approach, sensitive to the evolving needs of a nation rebuilding. Here, the challenges faced by distance learning come into sharp focus. While technology has played a vital role in ensuring educational continuity during wartime, its limitations become stark in the context of practical skill development. Bridging this gap necessitates the creation of online laboratories, virtual spaces where students can hone their technical expertise through simulated environments. But online resources alone are not enough. Industry collaboration becomes paramount. By incorporating joint student projects with real-world partners, future specialists gain invaluable exposure to the demands and complexities of the post-war reconstruction process. This synergizes theoretical knowledge with practical application, fostering a workforce equipped to address the immediate needs of rebuilding (Khrapatyi et al., 2023).

The evolving technological landscape further emphasizes the need for training programs specifically tailored to modern technologies. Equipping students with the ability to leverage emerging tools and methodologies prepares them not only for reconstruction but also for the ever-shifting tides of the global technical landscape. These recommendations paint a picture of a post-war education system that transcends mere training, aiming to cultivate adaptable, lifelong learners. Continuous learning becomes essential in a world defined by rapid technological progress, and fostering a culture of self-improvement within future specialists empowers them to navigate the complexities of an uncertain future. The implications for Technical and Vocational Education and Training (TVET) extend far beyond Ukraine's borders. The nation's experience serves as a potent case study, urging a paradigm shift towards interactive, technology-driven methods. Addressing the digital divide and ensuring equitable access to technology become crucial steps in empowering future generations to participate in the rebuilding of not just nations, but of a truly globalized future. This approach promises a future where technical specialists are not mere cogs in an industrial machine, but architects of progress, their skills honed and minds prepared to tackle the challenges of a world constantly reshaping itself. This is the ultimate aim of education in the aftermath of war: not just to rebuild, but to create a generation capable of building a better, more resilient future (Khrapatyi et al., 2023).

In conclusion, the discussion integrates the current study's findings with existing literature, illustrating the multifaceted nature of technical education. It highlights the importance of a balanced approach that incorporates soft skills, employs innovative training methods, leverages digital technologies, and fosters industry collaboration. This holistic approach is essential for preparing future technical specialists to meet the challenges of the modern workforce and contribute effectively to societal and industrial development.

## 6. Conclusions

Aspects of professional training of future specialists in technical specialities in higher education institutions were revealed in this work. It was determined that a modern specialist should acquire in a higher educational institution all professional competencies (understanding of his activity, the ability to adapt his activity to changes in the modern world, high knowledge that can be applied in practice), skills necessary for successful professional activity (technical, communicative, management, social skills, the ability to follow rules and protocols, mastery of modern technologies) and certain personal qualities (ability to self-organize and self-improvement, flexibility, healthy criticism, logic and analytical mind-set, persistence, patience, empathy, self-confidence, creativity and creative approach). The teacher can form these competencies, skills, and qualities with the help of modern methods (interactive, game, training methods) and modern technologies (application of 2D and 3D technologies, virtual reality, artificial intelligence and machine learning, as well as the formation of students' skills in working with them).

The results of the research showed that 46% of respondents are completely satisfied with the quality of professional training at their higher education institution, 19% of students have a high level of satisfaction with the quality of professional training, 33% of respondents have an average level of satisfaction with the quality of professional training, 2% of students have low satisfaction with the quality of professional training and none of the interviewees showed complete dissatisfaction with the quality of their professional training at a higher educational institution. Thus, the majority of students are satisfied with the quality of their professional training in higher educational institutions and assessed its effectiveness during professional practice. Most of the respondents noted that it is modern interactive methods and modern technologies used in the educational process that create interest in learning and improve professional training. However, the results of the study showed that



51% of students face problems during distance learning, including a low level of mastery of modern technologies and software used for distance learning, as well as a low level of acquired knowledge. 16% of students worry about their future employment. The interviewees also noted a lack of communication with other students in the process of professional training.

Based on the results of the research, recommendations were made to improve the quality of professional training of students of technical specialties, including: the creation of online laboratories, the conclusion of a training program on the use of modern technologies, the introduction of joint student projects into the educational process, and the implementation of close cooperation between universities and enterprises. The results of the study demonstrated that the professional training of future specialists in technical specialties and the skills and traits acquired by them during training affect the quality of professional activity. Prospects for further research are the analysis of distance learning in the training of future specialists in technical specialties, the study of the role of teachers in the professional training of specialists in technical specialties, as well as the experimental verification of the effectiveness of the recommendations provided to improve the educational process.

## 7. Limitations

The study's reliance on self-reported data through an author's questionnaire introduces potential biases, such as social desirability bias, where respondents might overstate their satisfaction or competencies. The anonymity of the survey, while protecting participant privacy, also prevents follow-up for clarifications or deeper insights into specific responses. Additionally, the study's exploration of distance learning's impact was limited to student perceptions, without direct measurement of learning outcomes or comparison to traditional learning environments. This approach may not fully capture the efficacy of distance learning or identify specific areas within remote education that require improvement.

## 8. Implications

The study's insights have substantial implications for practice and policy in TVET. For practice, there is a clear need for curricula that blend traditional learning with modern, interactive, and technology-driven methods to better prepare students for the technical workforce. This includes the development of online laboratories and training programs on the use of modern technologies, which can significantly enhance the practical skills of learners in a controlled, replicable environment. For policy, the findings advocate for policies that encourage closer collaboration between educational institutions and the industry. This could be facilitated through partnerships that enable internships, apprenticeships, and real-world project experiences for students, ensuring that TVET programs remain relevant and aligned with industry needs. Moreover, policies should support the continuous professional development of educators to equip them with the skills needed to implement innovative teaching methods effectively. Additionally, there is a need for policies that address the digital divide, ensuring all students have access to the necessary technologies for distance learning, which is increasingly becoming a staple of modern education. This holistic approach to improving TVET can foster a more skilled and adaptable workforce, ready to meet the challenges of the contemporary and future job markets.

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## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

## Author Contribution

*The authors confirm contribution to the paper as follows: **Study conception and design:** A Cherkashyn, T Melnyk; **project supervision:** I Asieieva, Yu Panfilov; **ethics application and review:** Yu Koshkarov, T Melnyk; **data collection:** Yu Panfilov; **analysis and interpretation of results:** Yu Koshkarov; **draft manuscript preparation and revision:** A Cherkashyn, I Asieieva. All authors reviewed the results and approved the final version of the manuscript.*

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