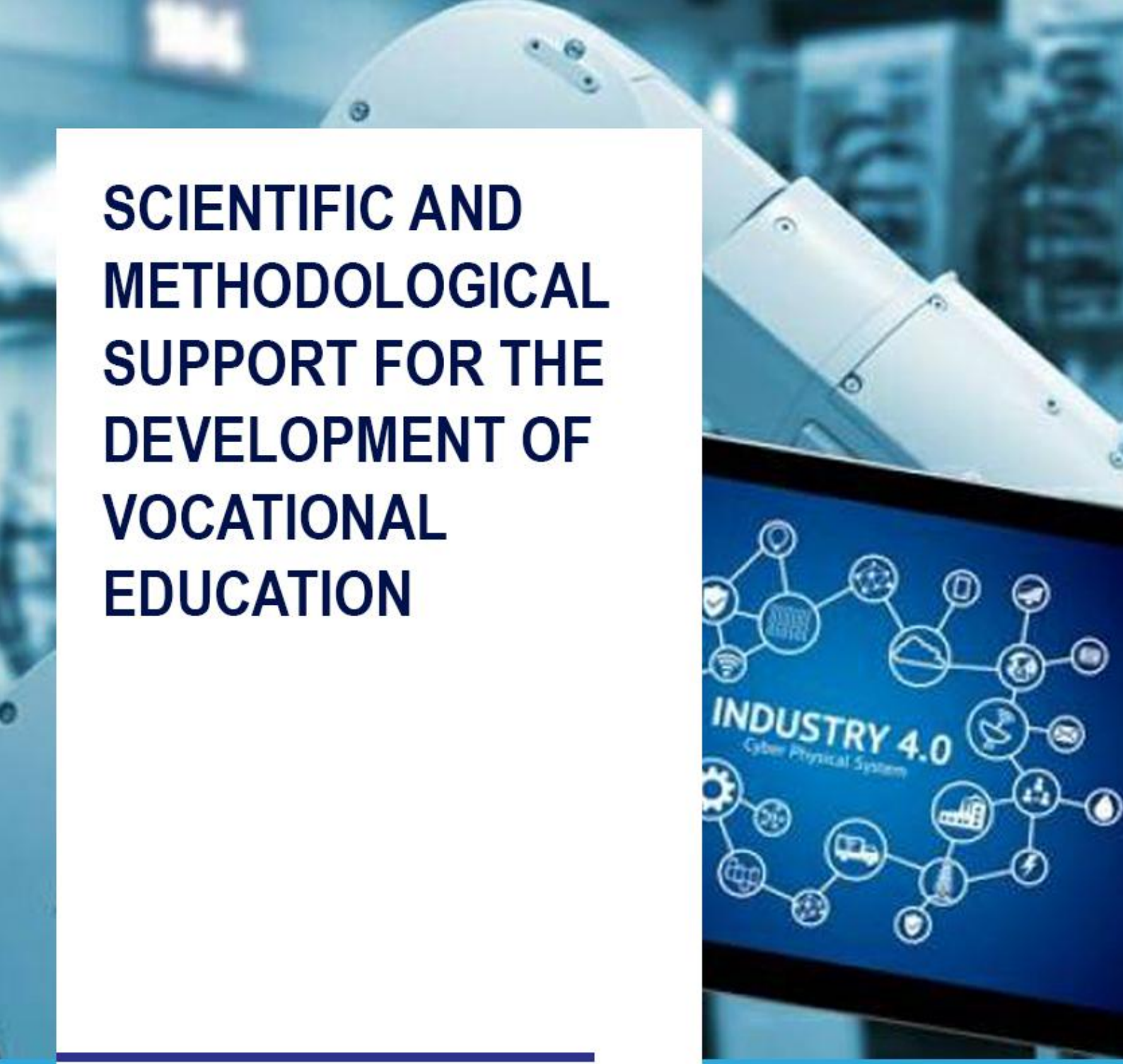

SCIENTIFIC AND METHODOLOGICAL SUPPORT FOR THE DEVELOPMENT OF VOCATIONAL EDUCATION

The University of Technology in Katowice Press, 2025

AKADEMIA ŚLĄSKA
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ACADEMY OF SILESIA

SCIENTIFIC AND METHODOLOGICAL SUPPORT FOR THE DEVELOPMENT OF VOCATIONAL EDUCATION

MONOGRAPH

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PREFACE

This monograph, Scientific and Methodological Support for the Development of Vocational Education, is the result of comprehensive scientific research and practical developments carried out by leading scholars of the Institute of Vocational Education of the National Academy of Educational Sciences of Ukraine. It presents the current scientific and methodological foundations for the modernization of vocational education in Ukraine in the context of post-war recovery, global technological transformations, and the implementation of European integration priorities.

The monograph reflects the collective efforts of researchers aimed at identifying innovative approaches to the professional training of future skilled workers who will contribute to the reconstruction and sustainable development of Ukraine. In particular, special attention is paid to the development of competencies in the construction and energy sectors within the framework of Industry 5.0, which places a strong emphasis on human-centricity, resilience, and sustainability.

The publication also explores the specific conditions of educational activity in wartime, including the urgent need to ensure the continuity of vocational education and the professional development of pedagogical staff in challenging circumstances. The authors present effective technologies and principles for developing the professional

competence of vocational college teachers, emphasizing their key role in preparing competitive specialists.

A separate focus is given to mechanisms for strengthening public-private partnerships and ensuring the quality of vocational education through the study of international practices and domestic reforms. This comparative analysis provides a foundation for adapting best practices to the Ukrainian context.

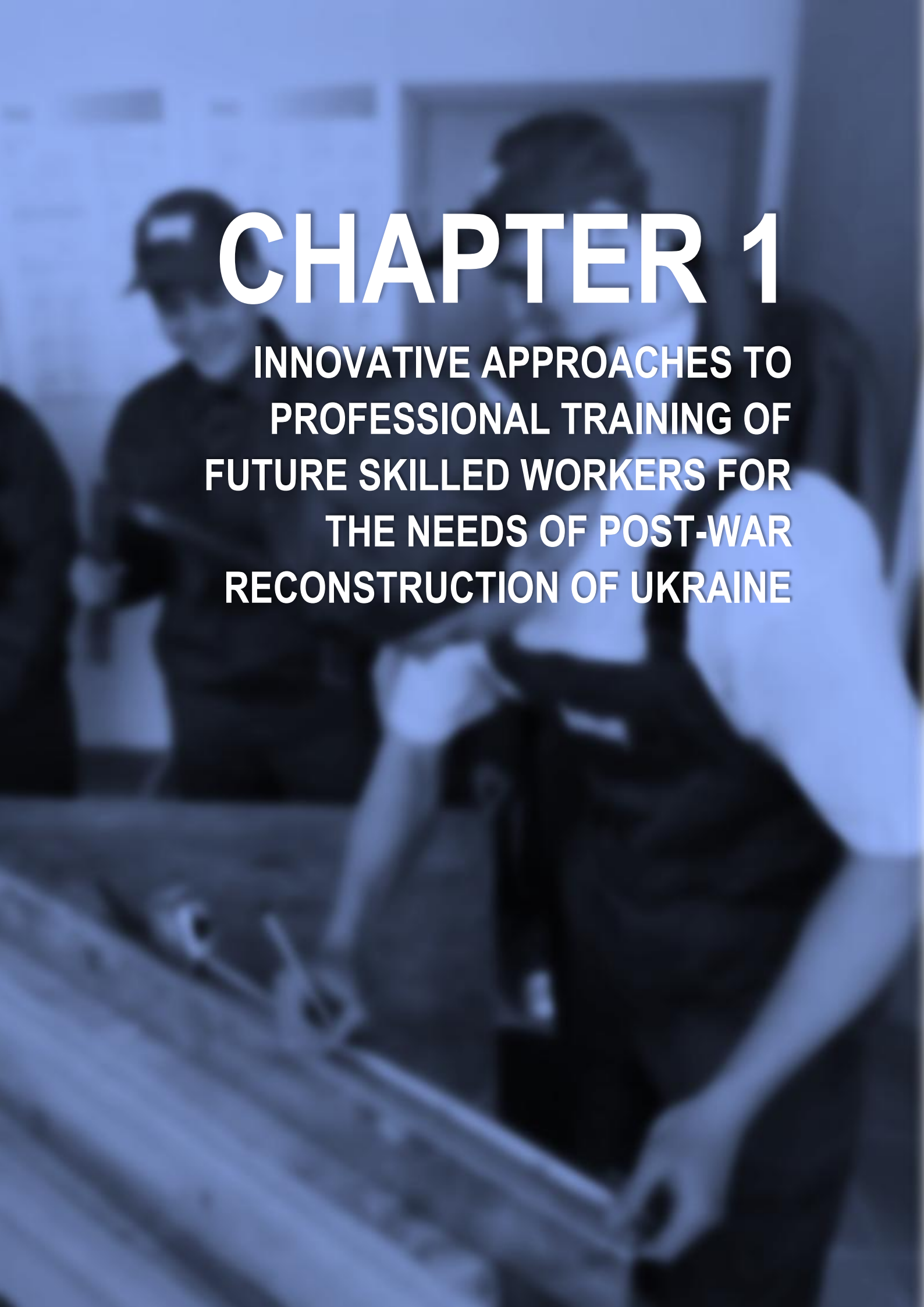
Another essential aspect of the monograph is the integration of career guidance and entrepreneurship education into vocational training. The proposed methodological foundations promote the formation of entrepreneurial competence among young people, particularly in priority sectors of the national economy, such as energy.

The final chapter is devoted to the challenges and prospects of digital transformation in vocational education. The application of artificial intelligence, big data analytics, and digital platforms is analyzed as a response to the demands of modern industry and as a means of ensuring accessibility, flexibility, and innovation in the educational process.

This monograph is intended for researchers, educators, and policymakers who are engaged in the development of vocational education and training systems, and who seek effective solutions for preparing a skilled workforce capable of meeting the needs of Ukraine's recovery and future growth.

The authors express their sincere gratitude to the University of Technology in Katowice for their support and cooperation in the publication of this monograph. The opportunity to present the results of Ukrainian scientific research to a wider international academic and professional community is an important step toward strengthening educational and scientific partnerships, deepening European integration processes in vocational education, and promoting joint efforts in rebuilding and modernizing Ukraine's human capital.

Editors



CHAPTER 1

INNOVATIVE APPROACHES TO PROFESSIONAL TRAINING OF FUTURE SKILLED WORKERS FOR THE NEEDS OF POST-WAR RECONSTRUCTION OF UKRAINE

1.1. PROFESSIONAL AND PRACTICAL TRAINING OF FUTURE CONSTRUCTION PROFESSIONALS FOR INDUSTRY 5.0

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Based on a comparison of the purpose, objectives and main characteristics of the fourth industrial revolution (or Industry 4.0) and Industry 5.0, the requirements for the organisation of professional education of future specialists are revealed. The list of competences that will be most in demand in the labour market over the next five years is highlighted. The results of the analysis of the peculiarities of the organisation of professional and practical training of future specialists in the construction industry in vocational (vocational-technical) and professional higher education institutions in the context of the implementation of the Industry 5.0 concept are presented. Recommendations for improving the system of training of construction industry specialists in Ukraine are proposed.

Keywords: *professional education, professional training, Industry 5.0, professional-practical training, construction sector, professional competencies.*

1.1. ПРОФЕСІЙНО-ПРАКТИЧНА ПІДГОТОВКА МАЙБУТНІХ ФАХІВЦІВ БУДІВЕЛЬНОЇ ГАЛУЗІ ДЛЯ ІНДУСТРІЇ 5.0

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На основі порівняння мети, завдань та основних характеристик четвертої промислової революції (або Індустрії 4.0) та Індустрії 5.0 розкрито вимоги до організації професійної освіти майбутніх фахівців. Виділено список компетентностей, що будуть найбільш затребувані на ринку праці протягом наступних п'яти років. Представлено результати аналізу особливостей організації професійно-практичної підготовки майбутніх фахівців будівельної галузі в закладах професійної (професійно-технічної) та фахової передвищої освіти в контексті реалізації концепції Індустрія 5.0. Запропоновано рекомендації для вдосконалення системи підготовки фахівців будівельної галузі в Україні.

Ключові слова: *професійна освіта, професійна підготовка, Індустрія 5.0, професійно-практична підготовка, будівельна галузь, фахові компетентності.*

Professional-practical training of future specialists in the construction sector is of exceptional relevance in the era of Industry 5.0. In today's world, the construction sector is undergoing significant transformations under the influence of cutting-edge technologies. Industry 5.0 combines technological innovations with a human-centered approach, creating prerequisites for sustainable development, ecological awareness, and improved quality of life. For Ukraine, these processes open up new opportunities not only for increasing the efficiency of construction processes but also for training specialists capable of working within the technological revolution. Industry 5.0 opens doors for the integration of innovative technologies that radically change traditional approaches to construction. For future specialists in the construction sector during the Fifth Industrial Revolution, it is important not only to be aware of these tools but also to actively apply them in their practical activities.

The professional and practical training of future builders is one of the key prerequisites for the successful implementation of the tasks of modern vocational education. It aims to address urgent issues of state restoration and development, overcome global challenges, and ensure the rapid advancement of scientific and technological progress. Successful organization of professional-practical training for future specialists involves adapting educational and training programs to labor market demands, utilizing innovative teaching approaches, and implementing active cooperation with the construction business. Through the integration of theoretical knowledge with practical skills, future specialists will be able to effectively work with advanced technologies and fulfill tasks aimed at the sustainable development of the construction sector.

Industry 5.0, building upon the foundations of Industry 4.0, introduces new approaches to management and work organization. It creates opportunities for implementing cutting-edge technologies such as robotics, 3D printing, artificial intelligence (AI), Internet of Things (IoT) systems, the development of autonomous construction systems, blockchain, and more, in combination with human-centricity and the greening of production. Future builders must be prepared to work with robots for bricklaying or wall painting, operate drones to monitor construction sites, and utilize blockchain technology to ensure transaction transparency and the accuracy of data regarding buildings and structures. In the context of fostering an innovative culture, students must understand how to use modern technologies for contract management, study methods of logistics management, and efficient

utilization of construction materials and structures. In the construction sector, which is one of the critical components of the national economy, the implementation of Industry 5.0 tasks entails not only automation of production processes but also integration of solutions centered on human safety and well-being, introduction of new standards and technologies ensuring efficiency, eco-friendliness, and innovation in production and labor organization. The presented research sheds light on modern trends in the socio-economic development of the state, particularly the construction sector in the context of Industry 5.0, and identifies key directions for professional training of future qualified workers in construction specialties according to current economic needs.

The current stage of socio-economic development in our country is marked by the peak of Industry 4.0, although some enterprises still operate based on the principles of the Third Industrial Revolution, characterized by initial automation and the introduction of electronics. At the same time, the European Commission is already working on advancing Industry 5.0. The Fourth Industrial Revolution (or Industry 4.0) is an era where technologies such as artificial intelligence, online resources, automation, and robotics come together to create "smart factories" and optimize production processes. In Industry 4.0, computers and machines are focused on interaction and decision-making with minimal human intervention. This allows businesses to enhance efficiency, reduce costs, increase product quality, and adapt to market changes more rapidly. However, Industry 4.0, with its emphasis on technology and automation, often neglects the environmental impact of production and, in some ways, isolates humans from work processes. This leads to a rapid reduction in jobs, the destruction of natural resources, and a disruption of ecological balance.

1) at the same time, Industry 5.0 is a concept that envisions combining the power of modern technologies with people's ability for creative and innovative thinking. It focuses on placing humans at the center and utilizing technologies to support and enhance the quality of work. Industry 5.0 is directed towards ensuring balanced economic development, where technologies improve the quality of life, create new opportunities for business growth, and promote sustainable development of society as a whole. The goal of the Fifth Industrial Revolution (or Industry 5.0) is to unite innovative technological capabilities with human-centricity and the greening of production. Among the key objectives of Industry 5.0 are identified;

2) developing effective and balanced strategies to restore the potential of engineering personnel, science, and education at both the state and community levels;

3) introducing an innovative culture and organizing production where humans actively participate, realize their creative potential, and engage in continuous learning (Sobolevska, 2023).

New socio-economic realities affect not only the development of production and science but also foresee significant qualitative changes in the professional training of future skilled workers in construction. Considering that the foundational principles of Industry 5.0 involve constructive responses to economic and social challenges, strengthening the foundations of scientific and technical innovations, ensuring a systematic cycle of human resource training, knowledge, and capital for innovations, and the development of eco-oriented production processes and technologies, the primary task of the vocational (vocational-technical) education system is to ensure that the content, forms, and methods of professional training for future qualified workers meet the requirements of the modern economy while identifying the leading trends in its development.

According to the World Economic Forum's «The Future of Jobs Report 2025» (Leopold, 2025), it is predicted that over the next five years, the importance of technological competencies will grow most significantly. Competencies related to interaction with artificial intelligence and the analysis of large data sets lead the list of promising skills. This list is followed by the ability to work in a networked space, awareness of cybersecurity issues, and technological literacy. Creative thinking, stress resistance, flexibility in communication, and agility are also becoming increasingly important, along with diverse interests and the ability to engage in lifelong learning. The top ten most in-demand competencies also include leadership and social orientation, self-development skills, analytical thinking, and competencies related to environmental protection. At the same time, business companies are increasingly investing in retraining and upskilling programs for employees to maintain their professional abilities in accordance with rapidly changing economic demands.

Innovations recently introduced in the construction industry fully align with Industry 5.0 strategies, where the principles of sustainable development, resilience, value chains and ecosystems, societal needs orientation, circular economy, and equitable distribution of labor outcomes begin to dominate decision-making. Under such approaches, technologies

are merely tools for achieving sustainable development goals, which fundamentally distinguishes Industry 5.0 from the foundational principles of Industry 4.0, where the primary focus is on improving competitiveness and profitability through the application of new technologies (Sobolevska, 2023).

The main principles of Industry 5.0 in the construction sector are:

– Human-centricity, as in the context of Industry 5.0, humans become the center of all processes – from project development to building operation. Innovative technologies are intended to facilitate human work, reduce risks, and improve productivity. For instance, robotic systems can perform hazardous tasks that pose health risks, leaving humans to take on the role of coordinators;

– Sustainable development, which involves the use of environmentally friendly materials, reduction of energy consumption, and the implementation of solutions that promote waste minimization (Borovyk et al., 2021);

– Technological integration, particularly the use of IoT, AI, robotics, and 3D printing, is becoming a standard in the construction sector. This enables the automation of production processes, improves the accuracy of work, and optimizes costs. For example, IoT systems can monitor the condition of buildings in real-time, providing timely information for management (iOTJI, 2020).

Training specialists to work in the conditions of Industry 5.0 requires not only theoretical knowledge but also practical skills that enable the use of modern technologies, adaptation to rapid changes, and ensuring sustainable development of the construction sector (Alyoshyna, 2025). Serious challenges for professional and practical training of specialists in the construction sector in modern conditions include:

– Rapid technological development, as new technologies emerge annually, changing approaches to construction. For example, the use of 3D printing to create building structures, which has become one of the most innovative technologies, allows for the creation of structures with minimal material and time costs (Buduemo, 2023);

– Insufficient funding, as modernizing the educational process requires significant investments, which are often inaccessible to many educational institutions, complicating the training of qualified personnel for Industry 5.0. According to the Ministry of Education of Ukraine, in 2023, only 40% of vocational (technical) education institutions were able to receive funding to update equipment (Markovets, 2024);

– The training and professional development of teachers are essential, as organizing the educational process and working with modern technologies such as BIM, VR, or robotics require appropriate knowledge and skills from educators.

Due to the rapid development of innovations in construction, the vocational and practical training of specialists in the construction sector requires innovative approaches. Modern technologies and methods allow students to develop practical skills in conditions that closely resemble real production environments. In particular, this involves:

– utilization of virtual reality technologies, considering that simulators based on virtual reality have become indispensable tools in the training of builders. For example, during the design of buildings, students can model various structures and test them in simulated environments, analyzing their stability and functionality. When organizing vocational and practical training, virtual reality technologies allow students to work with construction mechanisms without health risks;

– application of Building Information Modeling (BIM) systems, which transform approaches to construction and project management. Based on BIM technologies, students learn to work with digital building models, calculate materials and costs, and determine the life cycle of structures (DedalSoft, n.d.);

– the implementation of robotics is extremely important in the training of specialists. Future builders learn to work with specialized robots, such as those used for bricklaying or applying plaster, and master the basics of operating automated mechanisms on construction sites (VSN, 2024);

– use of 3D printing in construction, which is actively employed for the creation of both individual elements and entire structures. 3D printing technologies reduce material and time costs in construction. As a result, vocational education institutions are actively integrating specialized courses into the educational process, enabling students to properly master these technologies (Buduemo, 2023).

As previously mentioned, one of the key components of implementing the concept of Industry 5.0 is the greening process and the development of environmental awareness. For the construction sector, this implies the adoption of solutions that minimize the harmful impact on the environment caused by construction activities. In this context, the professional and

practical training of future specialists should include the development of ecological competence to ensure the sustainable development of the industry. The components of ecological competence include:

1) *Energy efficiency capabilities implemented in the design of modern buildings*. Future specialists should learn to design and install solar panels, heat pumps, and other renewable energy sources; and work with intelligent energy management systems that reduce energy consumption (European Commission, n.d.);

2) *The ability to use environmentally friendly materials*. Sustainable development technologies involve the active use of secondary materials, such as recycled concrete, bio-based materials made from agricultural waste, fiberglass, etc. The content of relevant educational courses should include familiarizing students with the properties of these materials and the specifics of their use in implementing construction projects. (Ecodoma, n.d.);

3) *Knowledge of circular economy and waste management*, since modern construction generates significant amounts of waste that can be recycled. Future specialists in the construction sector need to study the principles of the circular economy, methods for sorting and recycling waste for its effective reuse (Masterson, 2024);

4) *Knowledge of environmental standards and certification*. International environmental standards such as BREEAM (Building Research Establishment Environmental Assessment Method) and LEED (Leadership in Energy and Environmental Design) serve as the foundation for evaluating buildings. Future specialists should learn the principles of certification and methods for integrating these requirements into construction projects (Nerukhomi, 2024).

In addition to technical knowledge, specialists in the construction sector must develop psychological readiness to work in the conditions of Industry 5.0. This includes creativity – the ability to find unconventional solutions to complex problems; stress resistance, meaning the capacity to work in a fast-changing environment; and communication skills, the ability to interact effectively within a team and with clients. To develop the mentioned abilities of future builders, vocational training programs should include interactive training sessions and simulations of real production scenarios.

Global practices in workforce training for the construction sector demonstrate examples of effective integration of technologies, innovative teaching methods, and sustainable development. For instance, Germany is among the leaders in implementing dual education, which combines theory and practice and is characterized by close collaboration with businesses. Students spend up to 50% of their time at enterprises, enabling them to gain practical experience. Training centers are equipped with technology used in real-world operations. This approach prepares graduates for the challenges of Industry 5.0 and equips them to work with innovative solutions (Rindfleisch & Manning-Fortman, 2020).

Finland and Sweden place significant emphasis on environmental education for builders. Key elements of this system include eco-oriented construction and the use of sustainable materials. Students study methods for designing "green" buildings, with particular attention paid to recycling and reusing waste. This experience enables graduates to develop projects that meet sustainable development requirements (Hafez et al., 2023).

In the United States, educational programs aimed at utilizing advanced technologies in construction are actively developing. Educational institutions collaborate with technology companies. For example, AutoDesk conducts training sessions for students on the use of software. Courses are introduced that enable future builders to create complex structures using 3D printing (TEG, n.d.). These initiatives promote technological literacy and readiness to work with innovations.

Singapore is renowned for its approach to the digitalization of the construction sector, with active use of BIM (InfoBud, n.d.). All projects must be presented in digital format. Training centers equipped with virtual reality facilities allow students to undertake simulations for honing their design and construction skills. This prepares professionals to work confidently in digital environments.

The presented international experience confirms that the rapid development of science and industrial innovations requires achieving the goals and outcomes of professional training through continuous updating of educational content, contextual pedagogical interaction, designing professional activity processes, developing algorithms for performing production-technical functions, and implementing practice-oriented learning.

To achieve the objectives of vocational education in the rapidly changing innovative economy, it is critically important for the leadership of vocational (technical and vocational) education institutions to establish close ties with construction organizations and business entities in the construction sector. This includes involving leading industry specialists to define the content of educational standards, develop educational and training programs, and conduct lessons, workshops, production training sessions, internships, and final qualification assessments for graduates.

To ensure the relevance and integration of professional training for future qualified workers in the construction sector, in line with the requirements of modern production, it is advisable for vocational education institutions to develop flexible educational pathways that enable lifelong learning, support future graduate employment, and conclude long-term cooperation agreements with various construction enterprises. These agreements should be based on public-private partnerships and other forms of socio-industrial interaction.

Conclusions. The experience of organizing theoretical training and practical work for future skilled workers in the construction field proves that the use of modern methodological approaches in education enables the rapid improvement of the process of developing professional competencies in students. Moreover, methodological support and the implementation of practical training under the guidance of leading experts in their field play a key role in preparing future qualified workers in the construction industry.

Based on the analysis of international practices and current challenges associated with the development of Industry 5.0, the following recommendations can be made to improve the system of training construction industry professionals in Ukraine:

1. *Integrate the latest technologies into the curriculum*. Ukrainian educational institutions should more actively implement innovative solutions that are already successfully used in international practice:

– use of BIM technologies for building modelling and project management;

– introduction of VR simulators to practice construction processes in a safe environment;

– training in robotics to automate construction processes.

With the growing role of digitalization, educational institutions can establish digital campuses and intelligent learning platforms that provide students with access to online courses and resources, virtual laboratories for practicing practical skills, and interactive platforms that utilize AI to personalize the learning process.

2. *Development of Dual Education*. The introduction of a dual education model, which combines learning in educational institutions with practical experience in enterprises, helps students develop practical skills that meet employers' requirements and enhance graduates' readiness to fulfill their job responsibilities in the workplace. This approach is successfully implemented in Germany and can be adapted to meet the needs of Ukraine's construction industry. To make specialist training even more practice-oriented, it is advisable to establish long-term cooperation agreements between educational institutions and construction companies. Such agreements may include the joint development of educational standards, curricula, and training programs, the organization of internships for students in real construction environments, as well as conducting training sessions and master classes by practicing professionals.

3. *Improvement of environmental training*. Taking into account international approaches to sustainable economic development, Ukrainian vocational education institutions should consider including the following in their educational programs:

– Courses on energy efficiency and ecological design;

– Training in the principles of circular economy and construction waste recycling;

– The use of environmentally friendly materials in real projects during practical training.

4. *Development of Emotional Intelligence*. Solving complex problems in construction requires the interaction of specialists from various fields. Emotional intelligence skills are becoming key for successful collaboration with colleagues and clients. Students should master methods of effective team communication, conflict resolution techniques, approaches to building trust within a team, ways to maintain motivation under stress, and strategies for task and role distribution based on the competencies and qualifications of each team member.

5. *Collaboration with International Partners*. To improve the workforce training system, it is advisable to: enhance the participation of Ukrainian educational institutions in international exchange programs, such as Erasmus+, which will allow them to adopt the experience of European countries; establish international educational platforms for joint learning by students and educators. Integration into international educational programs, particularly through participation in Erasmus+ programs and the joint implementation of projects with foreign universities and companies, will enable students to familiarize themselves with the best practices in the field.

6. *Investing in the Training and Professional Development of Educators*. The development of educators' professional skills is essential for the successful implementation of pedagogical changes. This includes conducting training sessions on working with advanced technologies such as BIM, VR, and 3D printing; collaborating with international experts for experience exchange.

7. *Utilizing Big Data Technologies for Economic Forecasting*. Big Data technologies can be used to analyze the demand for specialists in the construction industry, allowing for the updating of educational programs to meet labor market needs and optimizing student recruitment processes. Construction companies actively use «Big Data» to streamline processes. Students should study methods of data collection and analysis, as well as forecasting techniques, such as estimating project completion timelines or cost assessments.

The Economy of Industry 5.0 is based on three fundamental components: human-centricity (fostering talent development, diversity, and empowerment), resilience (focusing on robust and adaptive technologies), and sustainability (a process of structurally building the economy in accordance with the needs of balanced development of production, the social sphere, population, the natural environment, and technological and social progress). Its concept envisages the integration of innovative technologies with people's ability for creative and innovative thinking (Yashchuryk & Zhmuryk, 2023).

The central focus of Industry 5.0 transformations is the human being and the use of technologies to support and improve the quality of work, with significant attention given to education, retraining, and skill development. This ensures that people can effectively use new technologies and adapt to

changes in the production environment. The implementation of these principles in the vocational education system will create favorable conditions for training modern specialists to meet the urgent needs of the national economy, particularly qualified workers in the construction industry.

Thus, the development of Industry 5.0 is transforming approaches to education and creating new opportunities for professional training. Educational institutions and enterprises must collaborate to address contemporary challenges and prepare professionals for the rapidly changing environment of the construction sector.

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1.2. FEATURES OF PROFESSIONAL AND PRACTICAL TRAINING OF CONSTRUCTION INDUSTRY SPECIALISTS IN MARTIAL LAW CONDITIONS

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The features of professional and practical training of construction industry specialists in the conditions of martial law and post-war reconstruction are studied. Key challenges affecting the educational process are analyzed, in particular, the problems of staffing, access to material and technical resources, and the need to implement modern teaching methods. Attention is focused on adapting curricula to the real conditions of reconstruction, in particular, practical training in conditions of active construction. The introduction of innovative eco-

1.2. ОСОБЛИВОСТІ ПРОФЕСІЙНО-ПРАКТИЧНОЇ ПІДГОТОВКИ ФАХІВЦІВ БУДІВЕЛЬНОЇ ГАЛУЗІ В УМОВАХ ВОЄННОГО СТАНУ

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Досліджуються особливості професійно-практичної підготовки фахівців будівельної галузі в умовах військового стану та повоєнного відновлення. Проаналізовано ключові виклики, що впливають на освітній процес, зокрема проблеми кадрового забезпечення, доступу до матеріально-технічної бази та необхідності впровадження сучасних методів навчання. Акцентовано увагу на адаптації навчальних програм до реальних умов відбудови, зокрема практичного навчання в умовах активного будівництва. Окремо розглянуто впровадження інноваційних

technologies in construction, aimed at increasing energy efficiency, minimizing environmental impact and using renewable resources, is separately considered. Modern methods of training specialists are analyzed, which will contribute to the effective restoration of infrastructure, emergency construction of housing, social facilities and strategic structures. Particular attention is paid to issues of safety, psychological training of future specialists, as well as cooperation between educational institutions, construction companies and government agencies to ensure high-quality training of personnel capable of working in crisis situations and post-war reconstruction of the country.

Keywords: *construction industry, vocational education, qualification, vocational and practical training, adaptation of education, energy efficiency, green building.*

екотехнологій у будівництві, які спрямовані на підвищення енергоефективності, мінімізацію впливу на довкілля та використання відновлюваних ресурсів. Проаналізовано сучасні методи підготовки фахівців, які сприятимуть ефективному відновленню інфраструктури, екстреному будівництву житла, соціальних об'єктів та стратегічних споруд. Особливу увагу приділено питанням безпеки, психологічної підготовки майбутніх спеціалістів, а також співпраці закладів освіти, будівельних компаній та державних структур для забезпечення високоякісної підготовки кадрів, які здатні працювати в умовах кризових ситуацій та післявоєнного відновлення країни.

Ключові слова: *будівельна галузь, професійна освіти, кваліфікація, професійно-практична підготовка, адаптація освіти, енергоефективність, зелене будівництво.*

Modern challenges related to the military situation in Ukraine and the need for post-war reconstruction of the country create an urgent demand for highly qualified specialists in the construction industry.

The large-scale destruction of infrastructure, residential, and industrial facilities, the shortage of building materials, and complex socio-economic conditions create new demands for vocational education, which must be not only high-quality but also adapted to the emergency conditions of reconstruction. Particular attention is needed for the practical training of specialists who must possess not only traditional professional skills (hard skills) but also continuously improve and develop soft skills. All of this requires future construction industry specialists to have a high level of professional competence, readiness for innovation, and mastery of modern sustainable and environmentally friendly construction technologies.

Traditional approaches to the vocational and practical training of construction industry specialists do not always meet the modern demands of the wartime and post-war period, when flexibility, speed of learning, and practical focus are essential. This necessitates new approaches to vocational training, including innovative methodologies for the vocational and practical

preparation of future construction industry specialists, with a focus on energy efficiency technologies, green building, robotic systems, and more. Thus, the research and development of innovative methodologies for the vocational and practical training of construction industry specialists during the wartime and post-war period is extremely relevant. In our opinion, the implementation of innovative methodologies for the vocational and practical training of construction industry specialists during the wartime and post-war period will contribute to the effective formation of the human resources potential necessary for the country's reconstruction, improve the quality of education, and integrate Ukraine's construction industry into global standards.

Issues of restoring and developing vocational education in the post-war period primarily involve ensuring close interaction between education and the domestic labor market to prepare competitive, mobile specialists capable of navigating and making sound decisions in the unpredictable conditions of today. Addressing this task requires concentrating the efforts of educational process participants on the formation and development of professional competencies of future specialists, who are able to work effectively in wartime conditions (Radkevych, 2024, p. 3).

The specifics of modern construction are defined by the fact that, in addition to knowledge and skills in the construction profession, information technologies are becoming a tool of labor for builders (calculations of non-standard building structures, design, planning, and reconstruction of buildings, selection of necessary materials, issues of equilibrium, deformation, strength, etc.). It is precisely informatization that is a common trend in the development of both construction production components and the educational process.

Mastering the construction profession as a science-intensive and high-tech field requires fundamental changes in the content of education. The differentiation of production functions in the process of working towards a common labor result by builders of various specialties necessitates the strengthening of integrative connections between academic disciplines. This outlines the problem of scientifically grounded integration of two promising technologies in education – information and integration technologies. An analysis of the problem's state has shown that one of the means of integrating professional knowledge of future builders is information technology.

The main features of the modern labor market for builders are flexibility and high innovative dynamics. This places new demands on job

seekers, including readiness for continuous self-education and modernization of professional qualifications, professional communication, cooperation, actions in non-standard and unusual situations; the ability to make responsible decisions, critical thinking, self-management of behavior and activities, skills in working with various sources of information and effective behavior in a specific environment, under stress factors. At the same time, employers' requirements are formulated not only in the format of knowledge of graduates from vocational (vocational-technical) education institutions, but also in terms and methods of practical professional activity (skills, ability, readiness). Thus, we are talking about specific educational outcomes of the vocational training system, within which knowledge is a necessary but insufficient condition for achieving the required quality of professional competence.

Libanova (2022) states that currently and in the future, during the post-war reconstruction of the country, the construction industry of Ukraine is experiencing an acute need for highly qualified workers. In the context of the innovative development of the construction industry through new technologies and materials, the need for continuous improvement of workers' qualifications and the implementation of the "lifelong learning" concept becomes a priority. Due to active hostilities in various regions, varying security conditions for participants in educational processes, the obsolescence of the material and technical base of vocational (vocational-technical) education institutions, which has not been updated for many years, the reduction in the number of students and the fullness of training groups, the construction market is releasing workers of the 2nd-3rd category, while it requires workers of the 4th–5th category. Researcher Beletska (2011) states that today's graduate of a vocational (vocational-technical) education institution possesses general theoretical and technical knowledge, but does not possess the competencies, practical skills of working on modern equipment using new building materials, therefore requiring "additional training" for 1–2 years. The share of highly qualified workers in Ukraine is 10%, while in foreign countries it approaches 50%.

The results of the analysis of scientific research and publications have shown that the issue of professional training of future specialists in vocational (vocational-technical) education institutions is not a new phenomenon in pedagogical science and is currently being studied by domestic researchers. It is worth noting that certain aspects related to the disclosure of this problem are highlighted in the research of N. Nychkalo, V.

Oliinyk, L. Serheieva (conceptual foundations of the development of the vocational (vocational-technical) education system), S. Vitvytska, O. Kovalchuk, O. Usata (problems of modeling professional training of specialists in the context of European integration processes), V. Kovalchuk, T. Stoichyk (processes of organizing educational activities in vocational (vocational-technical) education institutions), V. Radkevych, T. Sorochan (aspects of the development of continuous professional education).

The problems of professional training in crisis situations have also been partially addressed in scientific research dedicated to adapting educational programs to the labor market, implementing dual education, and introducing innovative technologies in construction. However, the issues of integrating eco-technologies into the educational process, safety during training in wartime conditions, and effective interaction between educational institutions and the construction industry in the post-war period have not been sufficiently explored.

The purpose of this study is to analyze the current trends in the vocational and practical training of construction industry specialists in wartime conditions, to study the specifics of vocational and practical training for future workers for the country's reconstruction, to formulate tasks for the innovative development of the educational process and forms of its implementation, and to consider interactive teaching methods for acquiring professional competencies by students of construction professions. Particular attention is paid to the adaptation of educational programs, the use of innovative eco-technologies, as well as mechanisms for training specialists capable of working effectively in the country's reconstruction and creating safe and energy-efficient infrastructure facilities.

The active reform of vocational (vocational-technical) education in Ukraine began in 2019 and continues even under the conditions of full-scale war. Equally important today is the renewal of content and improvement of the quality of vocational education, the development of new educational standards, short-term training programs, increased attention to the work of educational and practical centers based on vocational (vocational-technical) education institutions, modernization of existing teacher training programs, development and adaptation of online training courses and materials. All these steps are aimed at the final result – a competitive graduate of a vocational (vocational-technical) education institution. Now, more than ever, Ukraine needs specialists in working professions who will rebuild the country (Oliinyk et al., 2024).

The war has caused a crisis in the construction industry: there is a catastrophic shortage of labor, especially qualified specialists. Even those companies that have received investments are unable to ensure quality work. Ukraine faces the problem of training professional personnel for all areas of construction. And with each passing day, this problem becomes more acute.

Analyzing the current trends in the construction industry in wartime conditions, several key areas can be identified, one of which is the priority of reconstruction construction. The war necessitates specialists capable of quickly restoring destroyed buildings and infrastructure. Given the need for rapid reconstruction of the country, the implementation of the Sustainable Development Goals in reconstruction according to the principles of green building becomes extremely relevant. The construction, operation, and maintenance of green building facilities require specialists who possess modern green technologies. Accordingly, educational programs for the training of such specialists, including methodologies for the vocational and practical training of future construction industry specialists, must be modernized and adapted to current realities. Special emphasis here should be placed on the study of:

– quick construction technologies, including modular and frame structures; restoration of critical infrastructure (bridges, roads, residential complexes, energy facilities), use of local materials to minimize logistical costs;

– green building technologies, focused on saving material resources, economical consumption of natural and energy resources, reducing negative impacts on the environment, preserving human health, etc.;

– energy-efficient technologies.

Another important direction in the context of modern trends in the vocational and practical training of construction industry specialists is the implementation of modern information technologies.

Creating a modern digital space is a priority direction in construction in the near future. Therefore, for the further effective digital transformation of the construction business, it is necessary to improve the tools designed to increase the accuracy of planning construction processes, their optimal organization and control (Marchenko & Koliadenko, 2023).

Due to limited resources and the danger of traditional construction, digitalization and automation are actively developing: Building Information Modeling (BIM) for effective reconstruction planning; drones for assessing damage and monitoring construction; 3D printing of building structures for

the rapid erection of temporary housing. Simulators, trainers, virtual and augmented reality open up new opportunities for training and educating future construction industry specialists. They can significantly increase the level of safety in production.

Another potential direction is the use of the Internet of Things (IoT). IoT allows connecting various devices to the Internet and exchanging data between them. For example, IoT can be used to monitor and manage the energy efficiency of buildings, optimize the use of water and other resources (Lytvyn & Lakiza, 2023).

In wartime conditions, construction industry specialists constantly work in high-risk zones, so training must be supplemented with courses on mine safety and work in hazardous areas; preparation for emergency engineering tasks, including the construction of fortifications; skills to work in conditions of lack of centralized communications.

The modern construction industry is actively developing in the direction of implementing energy-efficient technologies, which is a necessary condition for reducing energy consumption, reducing negative environmental impact, and ensuring sustainable development. In this regard, there is a growing need for highly qualified specialists who also possess energy-efficient competence and are able to implement modern energy-saving technologies in construction (Kupriievych, 2025). The construction industry is focused on energy efficiency and sustainable construction, including green building, and there is a rapidly growing demand for specialists who possess "green" energy technologies (solar panels, heat pumps); passive building methods to reduce energy consumption; and skills in recycling and reusing materials.

Green building is becoming widespread in Ukraine and is finding its application in the current realities of reconstruction and post-war recovery of the country. Issues of green building are considered in the works of R. Aliyev, O. Bilyk, O. Bondar, M. Vovk, T. Halushkina, M. Danyliuk, M. Dmytryshyn, O. Doroshenko, Yu. Ishchenko, Yu. Kaliukh, T. Kryvomas, S. Mashchenko, H. Myhal, Yu. Orlovska, O. Protasenko, A. Savchenko, L. Sargsyan, H. Farenyuk, V. Chala, and others, which indicates the relevance of this issue.

Ukraine is actively joining international conventions on environmental protection, improving legislation and national standards in accordance with international requirements, in particular, the adopted Law of Ukraine "On the Basic Principles (Strategy) of the State Environmental

Policy for the Period until 2030" (2019). In the field of green building, laws and regulations are in force: the Law of Ukraine "On the Energy Efficiency of Buildings" (2017), which establishes the basic requirements for the energy efficiency of buildings, their mandatory certification, the use of energy-efficient technologies in the construction and reconstruction of structures; 2. The Law of Ukraine "On the Regulation of Urban Development Activities" (2011), which regulates the planning and development of territories, including the inclusion of the principles of sustainable development and green building in the design of new facilities; National standards for energy efficiency and environmental safety of buildings, which define standards and criteria for environmentally friendly construction (use of materials, energy saving, waste management).

Since the life cycle of a green building, from design to construction, operation, repair, and demolition, affects a wide range of people who provide it, specialists are involved not only from various fields of the construction industry but also from different sectors of the economy. The growing demand for green building leads to an increase in the number of employees involved in this area, an increase in employment opportunities, and the emergence of new skills, qualifications, and specialists – green professions.

Professional skills are a set of sequentially deployed actions based on theoretical knowledge and practical skills. Some of these actions can be automated (practical skills). The structure of professional competence includes a set of such categories: motivation, knowledge, abilities, skills of professional culture. The formation of these qualities contributes to the formation of professional competencies. The process of forming the professional competence of a future qualified worker in the construction profile must necessarily include practical activities – in this case, industrial training at construction industry enterprises. The problem of developing the professional competence of specialists in various fields is one of the main tasks of education.

The set of competencies of a specialist is determined by the main customers of the vocational education system – employers, the state, and society, and reflects the current needs and interests of all labor market participants. Indicators of professional competence are not only a common set of objectively necessary knowledge, skills, and abilities, but also the ability to properly manage them when performing their functions, knowledge of the possible consequences of certain actions, practical experience, the result of human labor, flexibility of method and critical

thinking, as well as professional positions, individual psychological qualities. In this context, the essence of the professional competence of a builder is appropriate to consider in the unity of theoretical and practical readiness to carry out activities in the field of construction, while the basis of the structure of the builder's competence consists of numerous relevant skills that characterize this readiness.

In the current realities, without involving the employer in vocational training, without using their resource base, it is impossible to obtain the practical skills and competencies that a modern builder must possess. Due to the obsolescence of the material and technical base of the vocational (vocational-technical) education system, the difficult safety conditions for participants in the educational process, the acquisition of practical work skills by vocational education students should largely be transferred to enterprises or created resource centers at regional modular training centers.

Beletska (2010) states that the process of continuous training of workers in the construction industry, in addition to using the modern resource base of enterprises, also requires innovative teaching technologies and the implementation of continuous vocational training. The modern market of educational services must quickly respond to the needs of the labor market through the constant expansion of competencies, practical skills, and the improvement of the quality of workers. The most important and integral component of the vocational education system is vocational and practical training, that is, industrial training in a vocational (vocational-technical) education institution and internships at enterprises and organizations, pre-diploma (pre-graduation) practice in production or in the service sector.

Vocational and practical training of future specialists is carried out in accordance with the Law of Ukraine "On Vocational (Vocational-Technical) Education" (1998), the Regulations on the organization of the educational and production process in vocational schools (2006). Vocational and practical training of students is carried out in close connection with the production of useful products and the provision of services that are paid for in accordance with the law.

The process of industrial training in vocational (vocational-technical) education institutions is the most favorable platform for ensuring the professional motivation of future qualified workers in the construction profile, as it involves increasing the internal motivation of students for professional self-improvement, professional initiative and self-improvement, awareness of the importance of professional growth in a

reality-approximated competitive market of the construction industry. However, to achieve these personal and professional characteristics, it is not enough to practice labor skills in an industrial training session; there is an urgent need to organize a purposeful process of forming professional motivation, which is determined by both the content of training and the quality of teaching, the ability of the industrial training master to apply innovative pedagogical technologies during classes. Numerous experimental studies on the formation of professional competence, the indicator of which is professional motivation, confirm the pedagogical and professional effect of using innovative pedagogical technologies in the process of professional training of future qualified workers.

Industrial practice aims to familiarize students with the real process in which the knowledge acquired by future construction industry specialists in the process of theoretical training is implemented. Accordingly, forms of organization are selected – excursion visits, practical work in production or at an enterprise in workplaces. At the same time, the initial stage of the future profession is formed, what the future qualified worker must know at the lower stage to realize it at the higher stage, this is what industrial (professional) practice also provides; it also allows the student to perform the duties of a specialist in the workplace, the intern performs the entire cycle of duties in their specialty, understands the mechanism of action of the department in which the industrial practice is conducted, and the general picture of the entire practice object.

Industrial practice for students is conducted at workplaces of enterprises, institutions, and organizations that have modern equipment, a high level of work organization, and use progressive production technologies, to improve acquired practical knowledge, skills, and abilities, to achieve the appropriate level of qualification. The industrial training master selects appropriate workplaces and assists in concluding agreements with enterprises, institutions, and organizations for students to undergo industrial practice, monitors the creation of necessary conditions at the enterprise for the implementation of the industrial practice program, and the compliance of the work performed. Students have the opportunity to independently choose the place of industrial practice, including at their place of residence, which contributes to their further employment. The educational institution and the enterprise providing workplaces for industrial practice for future specialists conclude an agreement on the provision of workplaces for practice. At the beginning of the industrial practice, the enterprise manager

distributes students to workplaces by their order and appoints practice supervisors from among the engineering and technical personnel, qualified workers of the enterprise, who are responsible for its conduct and ensuring working conditions and safety in accordance with the regulatory requirements established by law. Upon completion of the industrial practice, the enterprise provides an industrial characteristic for each student.

Methodological support and organization of practical training play an important role in the training of future builders. It should also be noted that the selection of educational and technological works for students is considered a serious matter in the organization of practical training.

The methodological mechanism for forming the professional competence of qualified construction workers is pedagogical technologies that reproduce didactic goals, content and procedural aspects, and direct training towards a unique production and technological process with a guaranteed result. The achievement of learning goals and results is carried out through activities that are expressed in pedagogical interaction, labor actions of the student, designing professional activities for the performance of technological work, etc. We are talking about strengthening the role of the project-technological approach in updating the content of vocational training for future qualified workers.

The war radically changes the approach to training construction industry specialists, shifting the emphasis to speed, adaptability, and safety. Modern education in this field must be flexible, practically oriented, and integrated into the processes of post-war reconstruction. The organization of industrial training and industrial practice of future qualified workers in the construction profile using modern methodological approaches and teaching technologies allows to improve the process of forming professional competencies of graduates, and methodological support and organization of practical training play an important role in the training of future qualified workers in the construction profile.

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1.3. METHODOLOGY FOR THE FORMATION OF ENERGY EFFICIENCY COMPETENCE OF FUTURE SKILLED WORKERS IN THE CONSTRUCTION INDUSTRY

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In connection with the need for post-war restoration of facilities as a result of full-scale military operations, reducing the energy dependence of enterprises and organizations, and implementing targeted state energy efficiency programs in Ukraine, the problem of training qualified specialists with developed energy efficiency competence is acute. Improving the professional training of future construction workers in energy conservation and energy efficiency involves the study of modern construction technologies, materials, types of energy from renewable sources, resource reuse, etc. An optional course «Formation of energy efficient competence of future skilled workers of the construction industry» has been developed, which includes the content, pedagogical technologies, methods and forms of conducting classes.

Keywords: *energy efficiency, energy saving, competence, pedagogical technologies, methods and forms.*

1.3. МЕТОДИКА ФОРМУВАННЯ ЕНЕРГОЕФЕКТИВНОЇ КОМПЕТЕНТНОСТІ МАЙБУТНІХ КВАЛІФІКОВАНИХ РОБІТНИКІВ БУДІВЕЛЬНОЇ ГАЛУЗІ

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У зв'язку з необхідністю повоєнного відновлення об'єктів внаслідок повномасштабних військових дій, зменшення енергозалежності підприємств і організацій, виконання цільових державних програм з енергоефективності в Україні гостро постає проблема підготовки кваліфікованих фахівців зі сформованою енергоефективною компетентністю. Удосконалення професійної підготовки майбутніх робітників-будівельників з питань енергозбереження та енергетичної ефективності передбачає дослідження сучасних будівельних технологій, матеріалів, видів енергії з відновлюваних джерел, повторного використання ресурсів тощо. Розроблено факультативний курс «Формування енергоефективної компетентності майбутніх кваліфікованих робітників будівельної галузі», який включає зміст, педагогічні технології, методи та форми проведення занять.

Ключові слова: *енергоефективність, енергозбереження, компетентність, педагогічні технології, методи та форми.*

The need to form energy-efficient competence of future skilled workers is largely related to the complexity of extraction and shortage of basic energy resources, their constantly growing cost, and global environmental problems. Energy-efficient competence should ensure people's conviction that the introduction of energy-efficient and energy-saving materials and technologies into the economic activities of enterprises and individuals at the household level will make it possible to solve many environmental problems: climate change, environmental pollution, depletion of natural resources, etc.

The purpose of the article is to substantiate the necessity and feasibility of forming energy-efficient competence of future qualified workers in the construction industry in vocational education institutions using modern pedagogical technologies.

Research methods: theoretical – analysis of scientific works, regulatory documents, educational and methodological literature; comparison, systematization and generalization of data; empirical – observation, modeling of educational situations, conversation, survey.

In their works, scientists, in particular V. Barannik, M. Zemlyanyi, U. Marushchak, M. Sanytskyi, O. Sukhodolya, O. Poznyak, A. Shevtsov, O. Shevchuk and others, investigated theoretical and practical aspects of energy efficiency and energy saving.

The results of this work determine the directions of energy saving and strategic objectives: the use of modern building materials, technologies, energy consumption accounting devices at the stages of design, construction and operation of facilities, modernization and insulation of residential buildings, the use of alternative renewable energy sources, waste recycling and others.

According to the «Association Agreement between Ukraine and the EU…» our state has undertaken to implement directives in the field of energy efficiency, in particular Directives 2012/27/EU «On Energy Efficiency» (European Parliament and Council of the European Union, 2012) and 2010/31/EU «On the Energy Performance of Buildings» (European Parliament and Council of the European Union, 2010).

Today, Ukraine has a significant need to restore destroyed residential, industrial, and educational facilities as result of full-scale military operations, implement energy efficiency and energy saving measures at enterprises, and implement state programs to reduce energy dependence. At

the same time, the problem of training qualified specialists with formed energy efficiency competence is acute.

It should be noted that the formation of professional (and energy efficiency as part of it) competence of future qualified workers in vocational educational institutions of the construction industry takes place in accordance with educational standards. However, most of them do not include (or partially include) requirements for energy efficiency competence of future workers, in particular:

– the standard of professional (vocational and technical) education of SP(PT)O in the profession of tiler in the content of general professional competencies ZPK-2 «Mastering the basics of market economy, ecology, energy saving» provides for the acquisition by applicants of knowledge of «the basics of preserving and protecting the environment in professional activities and the skills to rationally use electricity; use energy-saving technologies». At the same time, the qualification characteristics of tilers of the 3rd-7th categories do not provide for the presence of knowledge and skills of qualified workers on the issues of energy efficiency of buildings (Ministerstvo osvity i nauky Ukrainy, 2017);

– the state standard of professional (vocational and technical) education of SP(PT)O in the profession of manual electric welder includes as a professional basic competence «understanding the basics of industry economics and entrepreneurship, energy management requirements»: knowledge of «the basics of energy management and the skills to rationally use electricity». The qualification characteristics of manual electric welders of 2nd-6th categories do not provide for any requirements for knowledge and skills on energy efficiency in the construction industry in the sections «Tasks and Responsibilities», «Must Know», and «Examples of Work» (Ministerstvo osvity i nauky Ukrainy, 2016).

Individual topics from certain areas of energy efficiency and energy saving are studied according to the profession, in particular the topic of «facade insulation systems» for the profession of «plasterer, facing tiler», the topic of «energy saving» for «manual electric welders». In general, there is no system, a unified plan and program for studying the problems of energy efficiency and energy saving in construction, world experience and the potential of Ukraine. Considering the above, in institutions of vocational (vocational and technical) education in the construction industry there is a need to improve the professional training of future construction workers on energy saving and energy efficiency, which involves studying the areas of

using modern construction technologies, materials, increasing the share of energy from renewable sources, reusing resources, etc., i.e. - the formation of energy-efficient competence.

Scientists identify the following main areas of increasing the efficiency of fuel and energy resources in the construction industry:

− introduction of new and improvement of applied technologies in the production of energy-intensive building materials, products and structures;

− development and implementation of energy-efficient technologies for performing construction and installation works;

− automation of technological processes, implementation of regulated electric drives;

− increase in thermal resistance of housing building envelopes;

− implementation of energy-efficient lighting systems for residential and public buildings;

− increase in the efficiency of boiler rooms;

− installation of low-power turbogenerators in boiler rooms;

− equipping with metering devices and regulating the consumption of main energy carriers;

− use of woodworking waste and local fuels, utilization of secondary energy resources (Sanytskyi et al., 2013).

Energy-efficient competence of future construction workers should include not only knowledge, but also the ability to solve complex technical problems, interact in a team, and quickly adapt to modern technologies. The optional course, as part of the teaching methodology, enables the development of technical, analytical, and creative abilities of students, preparing them for real professional activity.

Therefore, the need to develop a methodology for forming energy-efficient competence in the process of studying the optional course is due to the need to train construction industry specialists with a conscious attitude to the problems of energy efficiency, energy conservation, and the environment, as well as the desire and ability to solve them.

Important methodological approaches that contribute to the development of students' practical and theoretical skills in the formation of energy-efficient competence are as follows:

− interactive – involves the use of interactive methods and technologies of learning, in particular discussions, seminars, case studies (Piatnychuk, 2023), presentations, information and communication, design technologies (Piatnychuk, 2022b), etc., work with real life and production

situations and allows you to clearly see the result. For future builders, interactive learning technologies are especially important, as a set of methods, means and forms of organizing the educational process, which ensure the active nature of interaction between students and teachers, cooperation and creativity;

− the formation of critical thinking and the ability to evaluate existing problems of energy conservation, environmental protection related to the construction industry, which provides not only practical skills, but also an understanding of modern problems;

− a communicative approach is important for the development of teamwork skills, which is necessary for modern specialists and involves the following methods: joint work on projects, tasks; presentation of topic materials and their discussion, because the construction industry involves constant teamwork, which contributes to the development of social and professional skills;

− individualization of learning ensures the selection of effective learning methods: tasks according to the student's level of training; use of additional online resources and platforms to support individual learning;

− a problem-oriented approach involves students completing problem tasks and finding answers to problematic questions focused on real problems of the modern construction industry: analyze the situation, suggest options, etc. This contributes to the development of creative and practical skills, understanding the importance of solving these problems (Piatnychuk, 2022a).

Energy-efficient competence of future construction workers depends on correctly selected methodological approaches that form theoretical knowledge, practical skills and the ability to creatively solve problems, provide for the use of interactive, problem-oriented approaches by teachers and their integration with established teaching methods.

Taking into account the above-mentioned problems of forming energy-efficient competence of future qualified construction workers in vocational education institutions, we consider it appropriate and necessary to introduce into the educational process an optional course «Formation of energy-efficient competence of future qualified construction workers».

The purpose of the optional course is to develop in students the ability to choose optimal solutions when performing production tasks on energy-efficient and energy-saving technologies; analysis of production situations;

desire for professional improvement, the ability to think and act as a professional.

The conceptual idea of forming energy-efficient competence of future qualified workers in the construction industry in the process of elective classes is the provision that today it is necessary to develop their cognitive interests, professional inquiries, and advanced training in solving problems of energy efficiency and energy saving in construction.

The elective program includes the following topics: «The problem of energy efficiency in the construction industry of Ukraine»; «Characteristics of "passive houses»; «Architectural and planning solutions»; «Use of renewable energy sources»; «Application of modern building materials and technologies»; «Energy-saving windows and doors»; «Types of thermal insulation of enclosing structures»; «Energy-efficient heating and hot water supply systems»; «Energy-saving lighting»; «Recycling of construction waste», etc.

Optional classes can be conducted by teaching staff at the expense of hours for extracurricular work, subject weeks, completion of general school projects (Artyushyna et al., 2018), etc.

The presentation of theoretical material is combined with trainings, role-playing and intellectual games, excursions, presentations of projects, etc.

The content of each topic includes technical information on the specified problem and options for using pedagogical technologies, methods, forms for use in the educational process.

It should be noted that the effectiveness of students' educational activities on energy-efficient and energy-saving technologies in construction largely depends on the content of the topics, pedagogical technologies and forms of organizing the process.

Optional classes are proposed to be conducted using problem-based learning technology, information and communication, project technologies, modern methods: discussion, round table, interactive presentations, brainstorming, role-playing games, analysis of stories and situations, case method, etc.

It is envisaged that teachers will use innovative forms of organizing the educational process, organizing non-standard lessons, in particular:

− oral journals, dialogues, reflections, debates with students highlighting environmental problems in the construction industry using computer, multimedia and technical equipment;

– travel lessons with presentations on «ecological use of building materials» in different countries; «green» construction;

– organizing and conducting excursions to enterprises producing building materials and products with a summary of the results in the direction of «compliance with environmental requirements»;

– conducting interdisciplinary lessons on «industrial training», «technology», «materials science», etc.

The content of the optional course complements the curricula and programs of subjects of professional-theoretical and professional-practical training.

Here are several possible options for conducting classes on various topics of the optional course.

Topic «Characteristics of «passive houses».

The purpose of the lesson is to form the ability of students to analyze the advantages and disadvantages of existing «old houses» and modern energy-saving ones, to distinguish between ways of building houses with a zero and positive energy balance; to activate cognitive activity.

Methods of conducting: «brainstorming» method, heuristic (Socratic) conversation, verbal, visual.

Tasks for students based on the results of the lesson:

– identify the signs of energy-inefficient buildings, give examples;

– identify incentives for building houses with a zero and positive energy balance;

– from your own experience, give examples of energy-efficient houses at the place of residence, study, etc.

Content.

Teacher's information: After December 31, 2020, it is recommended in EU countries to build only «houses with zero energy consumption», that is, with heat losses of about 0 kWh/m2 per year. This requirement is declared by the EU directive on the energy performance of buildings 2010/31/EU. Zero energy consumption in houses can be achieved by using renewable energy resources (solar, wind, river energy, etc.).

Even more effective is the construction of houses not with a zero, but with a positive energy balance. Such «active houses» or buildings built according to the «energy plus» standard, not only do not consume energy on an average annual basis, but also produce it using heat pumps, solar collectors, solar panels, wind generators, biogas combustion plants, etc. Such

structures use excess energy to power surrounding structures or feed it into the country's general power grid.

The incentive for such tightening of norms in the European Union is largely explained by considerations of economy, but also by the need to reduce carbon dioxide emissions into the atmosphere (up to 40% of greenhouse gases are produced by residential buildings). Europeans have seriously thought about how to protect the planet from dangerous climate change and global warming.

Construction of energy-saving passive houses is a comprehensive concept. Its implementation involves the performance of work in the following areas: reliable insulation of all building envelopes; thermal insulation of the house according to the principle of a closed thermal circuit, without cold bridges; use of energy-efficient warm windows; use of ventilation systems with heat recovery; high tightness of the building.

Speeches by students expressing opinions, substantiating ideas, and proposals on the problem of building energy-efficient houses in Ukraine.

Summing up.

Topic «Use of renewable energy sources»

The purpose of the lesson is to form the ability to analyze the advantages and disadvantages of energy sources; search for data in the information environment of domestic and world resource repositories, record information about the environment for further use; prepare speeches with audiovisual support.

Methods of conducting: «round table», problem, verbal, visual, independent work of students on preparing speeches.

Tasks to be solved based on the results of the lesson (teacher and student reports):

− determine the harm to the environment from the use of oil and gas;

− list the disadvantages of the operation of power plants;

− determine the directions and regions of use of solar, wind, geothermal, bioenergy, tidal energy.

Content of the lesson.

Teacher: In today's world, faced with increasing energy consumption and concern for the environment, alternative energy sources are becoming increasingly important. Instead of traditional sources (coal and oil), humanity is looking for new ways to meet its energy needs, using more sustainable and environmentally friendly methods. Alternative energy

sources use energy that occurs as a result of natural processes: sunlight, wind, water movement and geothermal phenomena.

In addition to the fact that oil, gas and their derivatives harm the environment, they are also non-renewable.

Advantages of using alternative energy sources:

− reduction of greenhouse gas emissions: CO2 and other harmful substances, which contributes to the fight against climate change;

− energy independence: allows countries to become less dependent on oil and gas imports, increasing energy independence;

− creation of new jobs and contributes to economic growth.

− conservation of natural resources: allows for the conservation of natural resources that are depleted by traditional energy production.

Alternative energy sources have great potential to become an important part of the energy system and help reduce dependence on traditional energy sources such as oil and gas (Triniti, 2024).

Student reports:

1st student: Solar energy is obtained by converting sunlight into electricity using solar panels, or photovoltaic cells. They use the photoelectric effect to generate an electric current: when light falls on a solar panel, electrons are "knocked out" of the atoms of the material, which creates a current.

Solar energy is used to produce electricity in regions of the planet where there are the most sunny days. They can be installed on the roofs of residential buildings, commercial buildings, solar farms and other places. Currently, there are technologies that allow solar panels to be used even in places where there is not much sunlight, or in winter. And the excess accumulated solar energy is stored in large-capacity batteries. Solar energy has a wide range of uses, depending on the number of solar panels: from small private houses to industrial complexes and even entire settlements.

2nd student: Wind energy is obtained using wind turbines (wind power plants), which have giant blades that rotate under the influence of the wind. This rotation generates mechanical energy, which is then converted into electricity using generators.

Wind power plants are located in open areas, coastal areas, as well as on offshore platforms, where the winds are strong and stable enough. Electricity produced using wind turbines is popular among a wide range of consumers, from households to industrial enterprises.

Advantages of wind power plants: renewable - wind energy is renewable and does not run out; low emissions - electricity production using wind turbines leads to lower greenhouse gas emissions compared to traditional energy sources; low operating costs - after installing a wind power plant, operating costs are usually low.

3rd student: Geothermal energy is obtained by using the heat contained in the Earth's interior. Two main types of geothermal power plants are used to produce it:

− steam plants – water or steam is extracted from deep wells and used to drive turbines;

− water turbine plants – hot water rises to the surface and is used to generate steam.

Geothermal reservoirs are found in different parts of the world, but are most common in regions with high hot springs, such as Iceland, New Zealand, Fiji and Kenya.

Advantages of geothermal energy: renewable – geothermal energy is a renewable energy source; low emissions – geothermal energy production is associated with lower CO_2 emissions compared to traditional energy sources; production stability – geothermal power plants can operate continuously, regardless of weather conditions, which allows for stable energy production.

4th student: Bioenergy (biofuels) uses the energy contained in organic materials, such as plants and waste. The two main types of biofuels are obtained from different raw materials:

− biodiesel – produced from vegetable oils or animal fats,

− ethanol – obtained from sugar or starch plants: sugar cane or corn.

The process of producing biofuels includes fermentation, distillation and other technological steps.

Biofuels are used in transport, mainly in the form of biodiesel and ethanol, which can be added to conventional fuels. They are also used to produce electricity and heat in specialized power plants.

Advantages of biofuels: renewable – biofuels are produced from organic materials that can be renewed through crop rotation and other agricultural methods; reduced emissions – the use of biofuels can lead to lower greenhouse gas emissions compared to traditional fuels; waste utilization – biofuels can be made from agricultural and forestry waste and residues.

Student 5: Tidal energy uses the natural movement of the tides, caused by the attraction of the moon and the sun, to generate electricity. Technologies used to extract this energy include buoys and platforms that move with the tides, turbines placed on the seabed, or systems that use waves to generate energy.

Tidal energy is usually used on coasts and in places where there is a large difference in the level of the tides. Extraction structures can be located in marine or coastal areas. Any consumers located near the coast, including residential or industrial establishments, hotels, marine infrastructure, etc., can use the energy obtained from the tides.

Advantages: constant availability: the tides are a stable and predictable source of energy, and this allows electricity to be generated without interruption; high efficiency: compared to other renewable energy sources, tidal energy can be quite efficient due to the significant density of water and high current speeds.

Student presentations expressing opinions on the use of different types of energy, substantiating ideas, proposals.

Summing up.

Optional classes make it possible to activate students' cognitive activity in studying the experience of implementing energy-efficient and energy-saving technologies in construction, develop analytical thinking, and a responsible attitude towards the environment. In the future, it is planned to study the levels of development of energy-efficient competence of students.

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1.4. USING ENERGY EFFICIENCY EDUCATIONAL CASES IN THE PROFESSIONAL TRAINING OF SKILLED WORKERS

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The use of energy efficiency educational cases contributes to the development of practical skills and competencies necessary to work in the context of the implementation of energy-saving technologies. The study of the problem allows to identify effective approaches to the integration of energy-efficient solutions into professional education and to develop recommendations for their application, taking into account industry requirements and national educational standards. It is determined that the implementation of the case method contributes to the development of practical skills, critical thinking and the ability to make informed decisions in the field of energy saving. The basic principles of developing educational cases are characterized.

Keywords: *skilled workers, professional training, energy efficiency, methodological support, case-based learning.*

1.4. ВИКОРИСТАННЯ ОСВІТНІХ КЕЙСІВ ЕНЕРГОЕФЕКТИВНОГО СПРЯМУВАННЯ У ПРОФЕСІЙНІЙ ПІДГОТОВЦІ КВАЛІФІКОВАНИХ РОБІТНИКІВ

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Використання освітніх кейсів енергоефективного спрямування сприяє формуванню практичних навичок і компетентностей, необхідних для роботи в умовах впровадження енергозберігаючих технологій. Дослідження порушеної проблеми дозволяє виявити ефективні підходи до інтеграції енергоефективних рішень у професійну освіту та розробити рекомендації щодо їхнього застосування з урахуванням галузевих вимог і національних освітніх стандартів. Визначено, що впровадження кейс-методу сприяє розвитку практичних навичок, критичного мислення та здатності приймати обґрунтовані рішення у сфері енергозбереження. Охарактеризовано основні принципи розроблення освітніх кейсів.

Ключові слова: *кваліфіковані робітники, професійна підготовка, енергоефективність, методичне забезпечення, практико-орієнтоване навчання.*

The relevance of this article lies in its focus on integrating energy-efficient technologies into professional training, which has become crucial in addressing Ukraine's challenges in sustainable development and environmental safety, especially in the context of the ongoing war with Russia. As the country faces the immense task of rebuilding and modernizing infrastructure damaged by the war, there is a growing demand for qualified workers who can implement energy-saving technologies, particularly in the construction sector. The war has highlighted the urgent need for a more energy-efficient economy, making the incorporation of energy-efficiency case studies into vocational education essential for preparing the next generation of workers to meet these demands.

Moreover, one of the strategic objectives of reforming Ukraine's vocational education, as outlined in the concept for implementing state policy in vocational education "Today's Vocational Education" for the period until 2027 (The Cabinet of Ministers of Ukraine, 2019), is the development of educational standards and the design of vocational education content based on a competency-based approach. It correlates with Ukraine's integration into the European education space, which, in turn, actively promotes green technologies.

As can be seen, it is crucial to examine the role of energy-efficiency case studies in professional training of future qualified workers, emphasizing their importance in developing critical thinking, decision-making, and practical expertise within Ukraine's energy sector. By analyzing the integration of modern energy-efficient technologies and real-world scenarios, one can highlight how such educational tools can better equip students to face the challenges of reconstruction in the aftermath of the war and contribute to the country's long-term energy resilience. Emphasis is placed on the significance of case-based learning in fostering an environmentally responsible professional mindset, empowering future workers to play a pivotal role in Ukraine's energy transition and recovery. It is therefore essential to offer effective recommendations to adapt educational approaches to the evolving needs of Ukraine's labour market, ensuring that professionals are well-prepared to drive the country's energy-efficient future in the face of ongoing challenges.

Accordingly, the article aims to explore the integration of energy-efficiency case studies into professional training of future qualified workers, focusing on their potential to enhance practical skills and competencies in energy conservation and sustainability.

The article employs several research methods. The methods of analysis and synthesis are used to outline the conceptual framework of the research. An exploratory method is applied to formulate general conclusions, while a prognostic method is used to justify the application of innovative ideas drawn from the international experience in professional training of future qualified workers in Ukraine.

A review of recent research and publications reveals significant trends and findings in both international and Ukrainian contexts regarding the integration of energy-efficiency case studies into vocational education.

Internationally, numerous studies have underscored the importance of integrating energy-efficiency technologies into vocational training programmes. The European Union, for instance, has recognized the pivotal role of vocational education and training (VET) in achieving energy conservation and fostering a sustainable economy (Barbero et al., 2023; Brychkov et al., 2023; European Commission, 2024; European Training Foundation, 2023; UNESCO-UNEVOC International Centre for TVET, 2017). A key aspect of this strategy is the use of case-based learning to equip future workers with both theoretical and practical knowledge related to energy-efficient technologies (Andrews, 2021; Mosannenzadeh et al., 2017; Stanley, 2021). Studies in countries such as Germany, Denmark, Sweden, and the UK, which are at the forefront of energy transition initiatives, demonstrate that incorporating energy-efficiency case studies into educational programmes enhances workers' competencies in real-world applications (Dyrhauge, 2022; GIZ, 2021; Ibenholt, 2009; Johansson, 2022; MeetMED, 2020; Kemmerzell, 2022; La Fleur, 2019; Prego et al., 2012). Case studies offer students the opportunity to engage with practical scenarios involving energy-saving technologies, such as renewable energy systems, building insulation, and energy-efficient manufacturing practices (Ahamad et al., 2024; Daoudi, 2024; Li, 2024; Morley, 2024; Oyedeji et al., 2023; Pears, 2020; Toogood, 2023). This approach not only improves technical skills but also cultivates an environmentally responsible mindset among future professionals.

In Ukraine, integrating energy-efficiency case studies into vocational education has gained increasing attention, especially as the country faces significant reconstruction efforts following the war with Russia (Leu-Severynenko, 2022; GOPA International Energy Consultants GmbH, 2024). The need for skilled workers capable of implementing energy-efficient solutions in various industries, especially construction and energy sectors,

has never been more pressing (Lisogor, 2024; The NAES of Ukraine, 2020). Research conducted within Ukraine has highlighted the necessity of training workers who can effectively apply modern energy-saving technologies in rebuilding the nation's infrastructure (Diedusheva, 2025; Ukraine Plan 2024-2027, 2023).

Ukrainian researchers also emphasize the need to adapt global best practices in energy-efficiency education to the unique challenges facing the country. While international models have proven successful in countries with advanced energy infrastructures, they must be tailored to meet Ukraine's specific needs, including its energy dependencies and the challenges posed by rebuilding its energy infrastructure.

The training of qualified workers in vocational education institutions is currently based on vocational education standards, which follow a competency-based approach. This approach focuses on developing and strengthening learners' key and professional competencies. Key competencies equip individuals with the ability to understand various situations, achieve success in personal and professional life, gain social independence, and engage in effective professional and interpersonal interactions. Professional competencies define one's capacity to apply specialized knowledge, skills, and abilities within their scope of responsibilities while demonstrating appropriate ethical and professional qualities necessary for performing assigned tasks, continuous learning, and professional and personal growth.

Key competencies are acquired throughout the educational programme and align with general competencies. The essential key competencies in vocational education standards involve environmental and energy efficiency competencies, which include knowledge of a) the fundamentals of energy efficiency, b) legal and regulatory frameworks in energy conservation and environmental protection, c) methods for energy-efficient use of materials, resources, and energy-saving equipment in both professional activities and everyday life, d) energy conservation practices in the workplace, e) waste sorting and disposal regulations, f) principles of sustainable use, restoration, and conservation of natural resources, and g) strategies for environmental protection in both professional and personal contexts.

Additionally, these competencies involve the ability to use energy resources and materials efficiently in professional and daily activities,

operate energy-efficient equipment, and adhere to environmental standards in professional and everyday settings.

Consequently, the use of energy-efficiency case studies within professional training of future qualified workers in Ukraine is particularly relevant as the country develops its energy sector and transitions to sustainable practices. Integrating case studies on energy efficiency into vocational education enhances learning and prepares students for the evolving labour market focused on energy conservation and sustainability (Andrews, 2021).

A key benefit of this approach is the development of practical skills. Case studies offer hands-on learning, engaging students with real-world scenarios directly relevant to Ukraine's context (Ahamad et al., 2024). For instance, students may explore case studies on energy-efficient buildings, renewable energy solutions, and improvements in industrial energy consumption, helping them develop critical skills in analyzing energy use, proposing solutions, and evaluating energy-saving technologies (Mosannenzadeh et al., 2017; Stanley, 2021). These skills are essential in sectors such as construction, manufacturing, and agriculture, which are vital to Ukraine's economy.

Energy-efficiency case studies also foster critical thinking and decision-making. Students are encouraged to evaluate energy challenges in terms of cost, environmental impact, and technological feasibility, equipping them to make informed decisions about outdated infrastructure and modernization needs. By assessing the outcomes of energy-efficiency measures, students can identify successful strategies and adapt them to local conditions (The Veregy Team, 2024).

Moreover, case-based learning enhances knowledge retention by promoting active engagement. Unlike traditional lectures, case studies require students to apply theoretical knowledge to practical problems, making learning more engaging and preparing students for professional settings. Topics such as improving energy use in district heating systems or adopting solar energy in rural areas provide a contextual understanding of energy efficiency (Barbero et al., 2023; Daoudi, 2024).

Energy-efficiency case studies also encourage an interdisciplinary approach, essential in the Ukrainian context, where energy conservation requires expertise from engineering, economics, environmental science, and policy (Repko et al., 2020). By examining how these fields intersect, students develop a broad skill set for solving complex energy challenges. For

example, they might explore the impact of policy changes on energy use or how energy-efficient technologies can be integrated into traditional sectors like agriculture and manufacturing (Brychkov et al., 2023; European Commission, 2024; European Training Foundation, 2023).

Additionally, case studies foster an ecologically oriented professional mindset, which is crucial given Ukraine's environmental challenges, such as high energy consumption and pollution (Ukraine Plan 2024-2027, 2023). Energy-efficiency cases highlight the economic and environmental benefits of conservation, demonstrating how energy-saving measures can reduce costs, improve air quality, and decrease reliance on imported energy, issues critical to Ukraine's energy security and sustainability (The NAES of Ukraine, 2020).

Tailored case studies ensure that training aligns with Ukraine's specific industrial needs. For example, case studies in construction might focus on retrofitting Soviet-era buildings, while those in agriculture could examine energy-saving techniques for farming equipment (GIZ, 2021; La Fleur, 2019). This sector-specific approach ensures students acquire relevant skills for Ukraine's key industries, while local case studies reflect the latest trends, technologies, and policies.

Finally, the practical experience gained through case-based learning enhances students' employability. As Ukraine modernizes its energy infrastructure, the demand for skilled workers in the green energy, construction, and agriculture sectors is rising. Case studies equip students with the problem-solving skills needed for these roles, boosting their employment prospects in a competitive labour market (Pears, 2020).

The principles behind effective educational cases in energy efficiency draw from global best practices. These include integrating modern energy-efficient technologies, using an interdisciplinary approach, and engaging with real production situations (Toogood, 2023). For example, universities in countries such as Germany and the US incorporate renewable energy systems and smart grids into their curricula, preparing students to apply energy-saving solutions in construction and manufacturing (GIZ, 2021; Kemmerzell, 2022; The Veregy Team, 2024). Interdisciplinary programmes in the UK, Denmark and Sweden combine engineering, economics, and environmental science, enabling students to evaluate energy challenges from multiple perspectives (Dyrhauge, 2022; Ibenholt, 2009; Johansson, 2022; OECD, 2024). In Ukraine, case studies could focus on issues such as energy efficiency in agriculture or industrial modernization, offering students

valuable practical experience. By integrating these principles, educational programmes can effectively prepare students to address energy efficiency challenges in their professional careers (Diedusheva, 2025).

Therefore, integrating energy-efficiency case studies into professional training of future qualified workers in Ukraine is essential for aligning with the country's energy sector development and sustainability goals. The following recommendations aim to ensure that these educational cases effectively address industry-specific needs, modern labour market requirements, and technological advancements.

Tailoring educational cases to specific industries. Energy efficiency challenges vary across sectors, and educational cases should reflect the unique needs of key industries: 1) construction (focusing on energy-efficient renovations of Soviet-era buildings); 2) agriculture (exploring energy-saving techniques for farming equipment and irrigation systems); 3) manufacturing (addressing optimization of energy use in industrial processes); and 4) renewable energy (highlighting the implementation of solar, wind, and biomass energy solutions). This approach ensures that students acquire relevant skills and knowledge for Ukraine's economy.

Adopting an interdisciplinary approach. Energy efficiency spans multiple fields, including engineering, economics, environmental science, and policy. Educational cases should encourage students to 1) approach problems from multiple perspectives (technological, economic, and environmental), and 2) foster critical thinking and collaboration across disciplines, enabling students to solve complex, real-world energy challenges.

Incorporating real-world production scenarios. Engaging students with real production situations will enhance practical problem-solving skills. By addressing live industry challenges such as a) conducting energy audits, b) modernizing infrastructure, and c) integrating renewable energy. Students will gain hands-on experience that better prepares them for professional work.

Integrating modern energy-efficient technologies. Case studies should include examples of cutting-edge technologies, such as a) renewable energy systems (solar, wind, and biomass), and b) energy storage solutions. Exposing students to these technologies prepares them to apply energy-saving solutions in various sectors and keeps them aligned with global trends.

Promote ecologically oriented professional thinking. Given Ukraine's environmental challenges, it is crucial to instil an understanding of the long-term benefits of energy conservation. Students should recognize how energy efficiency measures can reduce costs, improve air quality, and decrease reliance on imported energy, as well as support Ukraine's energy security and sustainability efforts.

Regularly updating case studies. Case studies should be updated regularly to reflect technological advancements, policy changes, and market trends. This ensures that students are equipped with the most current knowledge and skills to address dynamic energy efficiency challenges.

By implementing these recommendations, Ukraine can enhance vocational training programmes that not only develop practical skills but also equip future qualified workers with the expertise needed to contribute to the country's energy efficiency goals. These approaches will increase employability, foster sustainable development, and support energy modernization in Ukraine.

Future research prospects include developing more detailed instructional materials for teachers on the implementation of case studies. Additionally, there is potential for exploring the adaptation of international experiences in creating case studies that focus on developing skills for working with energy-efficient technologies.

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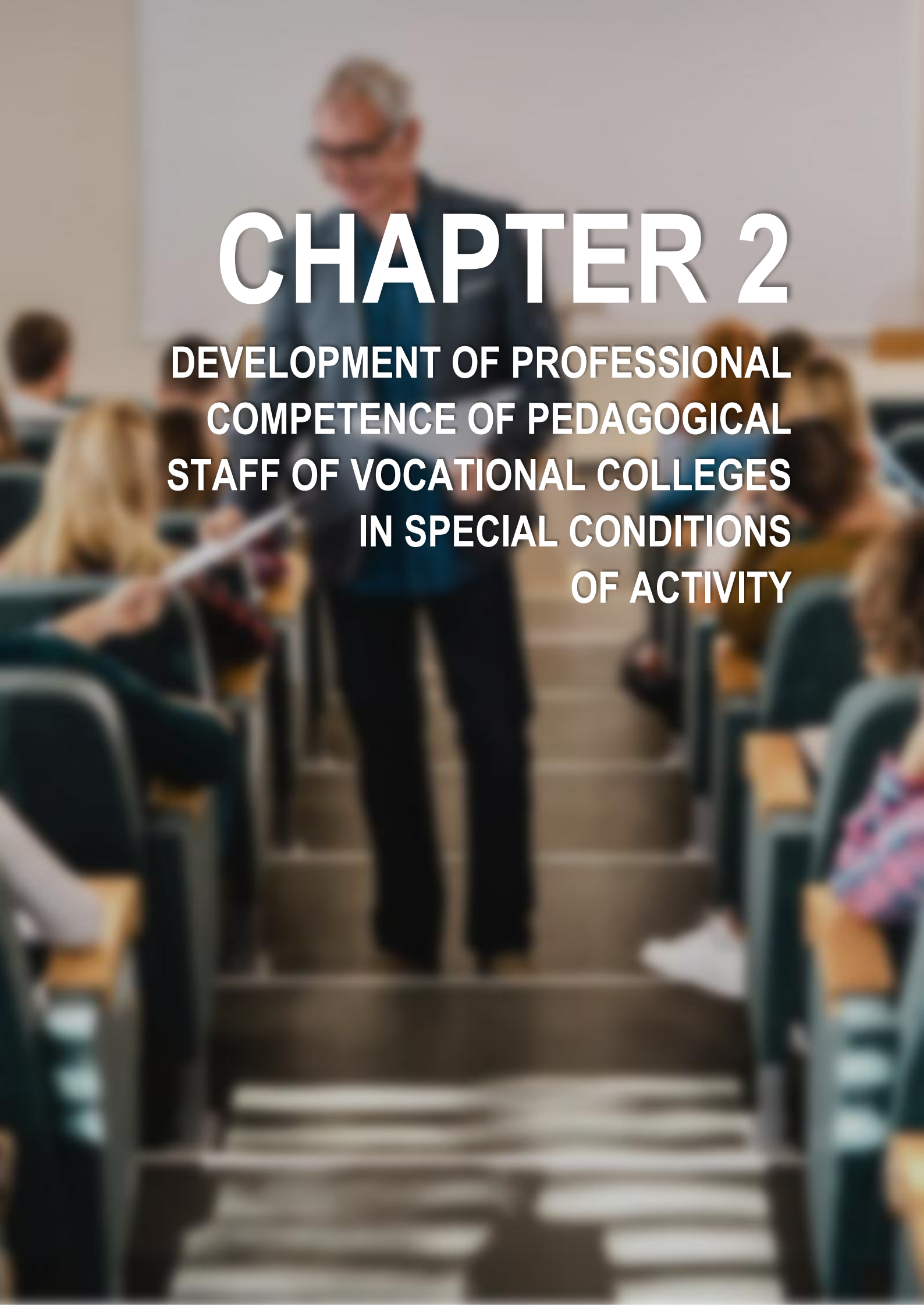

CHAPTER 2

DEVELOPMENT OF PROFESSIONAL COMPETENCE OF PEDAGOGICAL STAFF OF VOCATIONAL COLLEGES IN SPECIAL CONDITIONS OF ACTIVITY

2.1. TECHNOLOGY OF SELECTION AND STRUCTURING OF CONTENT OF PROFESSIONAL COMPETENCE DEVELOPMENT OF TEACHERS OF VOCATIONAL COLLEGES

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There is presented a scientifically grounded technology for selecting and structuring content to develop the professional competence of vocational college teachers. It defines theoretical and methodological foundations, clarifies key concepts, and outlines requirements for educational content modernization. The technology integrates goal-setting, content selection, and structuring stages, aligned with principles of scientific validity, professional orientation, adaptability, integrity, and interdisciplinary links. The implementation of this technology ensures the targeted, consistent and effective development of professional competence of teachers of vocational colleges.

2.1. ТЕХНОЛОГІЯ ВІДБОРУ ТА СТРУКТУРУВАННЯ ЗМІСТУ РОЗВИТКУ ПРОФЕСІЙНОЇ КОМПЕТЕНТНОСТІ ВИКЛАДАЧІВ ФАХОВИХ КОЛЕДЖІВ

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Представлено науково обґрунтовану технологію відбору та структурування змісту з метою розвитку професійної компетентності викладачів фахових коледжів. Визначено теоретико-методологічні засади, уточнено ключові поняття та окреслено вимоги до модернізації змісту освіти. Запропонована технологія охоплює етапи цілепокладання, добору й структурування змісту, що узгоджуються з принципами науковості, професійної спрямованості, адаптивності, цілісності та міждисциплінарних зв'язків. Реалізація цієї технології забезпечує цілеспрямований, послідовний й ефективний розвиток професійної компетентності викладачів фахових коледжів.

Keywords: *professional competence, content structuring, vocational education, college teacher, professional development, educational technology.*

Ключові слова: *професійна компетентність, структурування змісту, фахова освіта, викладач коледжу, професійний розвиток, освітня технологія.*

In the context of the challenges caused by the war with the Russian Federation, the main task of the system of professional pre-higher education is to train civically conscious, professionally competent, patriotic specialists of the middle management level, capable of successfully carrying out production activities from the first days of their work in production. Naturally, the high-quality implementation of this task determines the need for continuous, consistent development of professional competence of college teaching staff, the combination of course and inter-course advanced training measures into a single system of personal and professional growth of all subjects of the educational process.

At the same time, the answers to the problematic questions are very relevant: What should a teacher develop? What should be the content of their pedagogical activity development? What innovative knowledge should be mastered first of all? What skills and abilities, methods of professional activity should a teacher constantly improve? What should be the creative component of the content of the development of his professional competence? These questions accumulate into the problem: what should be the methodological approaches, principles, criteria, features, methods of selection and structuring of the content for the development of professional competence of college teachers', so that in their synthesis they create an effective methodology for determining innovative knowledge, abilities, skills, and methods of implementing creative pedagogical activity by each pedagogical worker for their own effective professional growth.

Recently, Ukrainian scientists have been actively studying the methodological aspects of selecting and structuring the content of education, the student's and teacher's personalities formation and development as one of the key problems of modern pedagogical theory. This problem is not new in pedagogical science: various scientific approaches to determining the principles, criteria, methods of selecting educational information, its structuring have found their reflection in the works of I. Androschuk, O. Borodienko, N. Briukhanova, Yu. Vaskov, S. Goncharenko, O. Glushchenko, O. Dzhezhula, O. Kobernyk, O. Kovalenko, D. Kovalenko,

M. Korets, O. Liashenko, V. Manko, O. Pometun, O. Savchenko, V. Steshenko, V. Ustinova, B. Furtak, A. Tsyna, etc.

Instead, scientists mainly deal with aspects of designing the content of training for students in various educational institutions. The problems of selecting and structuring the content for teacher's professional development in vocational education institutions are poorly studied. In particular, while studying aspects of the development of general education disciplines teachers' pedagogical skills in vocational education institutions, M. Kabysh (2024) concluded that the content of professional and personal growth of this group of pedagogical workers includes several components: *general scientific* (development of methodological knowledge); *psychological and pedagogical* (deepening of the psychological and pedagogical training of the teacher); *methodological* (growth of the teacher's competencies in the field of teaching methods); *subject* (expands the teacher's preparedness in a specific subject); *branch-wise* (contributes to deepening knowledge about the future professional activities of students). Despite a certain integrity of the proposed model of teacher professionalism development, in our opinion, there is a lack of specifics, real approaches to designing the content aspects for the teacher's professional growth.

Kurok's (2022, p. 309) approach to selecting the content for the development of legal competence of teaching staff at economic colleges is relevant to the current research. The author suggested taking into account the following factors when designing the content: social demand for teachers with developed legal competence, capable of ensuring a high level of legal education of students; perception of the system of goals and objectives that society puts forward for the educational sphere; scientific, technical and technological development; educational needs of pedagogical workers and students of institutions of professional pre-higher education; opportunities for creating a favourable educational environment to meet these needs; the level of professional training of teachers, their ability to master new legal knowledge and skills; the general level of legal competence of society; targeted state policy in the field of legal education of the population.

The approaches, principles, sources, criteria, and methods of designing educational content, substantiated by scientists (Holovan, 2012; Honcharenko, 2002; Diachenko, 2016; Radkevych, 2010; Radkevych, 2020; Stepanova, n.d.), in our study are defined as the theoretical and methodological basis, the basis for developing a methodology for selecting

and structuring the content of developing professional competence of teachers of professional colleges.

Therefore, the purpose of the research is specified by a number of the following tasks: based on the analysis of existing scientific research, to characterize the main ideas, directions, approaches, principles, requirements and sources of selection of the content of teacher's professional growth; to determine the goals, objectives, methods and techniques of structuring the selected information and, on these principles, to develop a technology for phased design of the content of professional competence development of teachers of a professional college.

Focusing on the labour market, on overcoming the challenges of today, currently professional pre-higher education is aimed at training professionally mobile, highly qualified, versatile professional junior bachelors, expected to act innovatively, work selflessly for the development of the Ukrainian economy. And to ensure such high-quality training of specialists is a teacher who has thorough knowledge of his academic discipline, innovative methods and technologies of teaching and upbringing, a person with high creative potential. Therefore, the development of professional competence of teaching staff in the context of a systematic combination of opportunities for formal, non-formal and informal education, selection and structuring of the content of continuous growth of college teachers' professionalism is an extremely urgent problem of professional pedagogy.

First of all, we should note that the methodology of our study was based on the unity of the following basic scientific approaches: *systemic* (the content of the development of a teacher's professional competence should be considered as a system of interconnected and interdependent elements); *activity* (only in activity can the content of the development of professional activity be mastered); *personality-oriented* (strengthening the content of humanistic, personally significant material); *competence* (the main result of a teacher's professional growth is the development of his competencies); *environmental* (provides the opportunity to recognize the educational environment as an important factor in the assimilation of the content of personal and professional development); *informational* (effective use of the potential of information activity, modern digital technologies in the acquisition of innovative knowledge, in particular in the system of informal education); *integrational* (when designing the content of the teacher's personal and competence development, it is important to provide for the

integration of the knowledge system, general intellectual and practical skills and abilities, experience of creative activity; understand and technologically predict their relationship in that the assimilation of each affects the level and quality of the assimilation of other elements of the content); *cultural* (contributes to the creation of optimal conditions for the acquisition of new cultural layers by the subjects of the educational process, allows organizing professional activity in the context of the integration of pedagogy and culture); *functional-targeted* (based simultaneously on the analysis of goals (tasks) and functions (measures) for their achievement).

Thus, the provisions of the above-mentioned scientific approaches, in particular the functional-targeted approach, require the definition of the goals of the teacher's professional growth. These aspects are pointed out by scientists (Diachenko, 2016; Radkevych, 2020; Stepanova, n.d.), proving that the design of the content of the development of competencies, professionalism, and teacher's skills is based on goal-setting (setting scientifically substantiated and practically achievable goals) and goal-fulfillment (step-by-step implementation of a system of actions aimed at achieving goals). Following Androschuk (2017), Koshuk (2019), Kurok (2022), Kabysh (2024), we defend the position that the basis of the system of goals for the professional development of a teacher of a professional college is a general goal, which is detailed by a number of strategic, tactical, and operational goals and determines intermediate results at each level of goal-setting.

In turn, the achievement of the general goal is ensured through the implementation of lower-order goals. A similar approach to the "hierarchy" of goals was applied in the study by Borodienko (2018), which substantiated the system of development of professional competence of managers of structural units of enterprises in the communications sector. The scientist, based on the well-known taxonomy of goals by Bloom (1956), argued that the "tree of goals" should combine strategic goals (allocated on the basis of the requirements of professional standards, qualification characteristics of these specialists), tactical level goals (development of structural components of professional competence of managers of structural units of enterprises in the communications sector) and goals of the "level of operational goal setting" (Borodienko, 2018, p. 283) (setting individual tasks, conducting control and evaluation measures, etc.). Agreeing in general with such a hierarchy of goals, it is worth pointing out the possibility of partial comparison of some strategic and tactical goals (for example, regarding the

volume of knowledge or intellectual abilities and skills).

The scientists indicate (Kabysh, 2024; Radkevych, 2020; Titova, et al., 2023) that when setting goals, it is important to adhere to certain requirements. Most often, such requirements for the formulation of these motivational and semantic formations of the personality are called clarity, diagnosticity and hierarchy. The clarity of goals reflects the completeness of understanding, clarity and specificity of ideas about the predicted result, characterizes the reality (or unreality) of its achievement; diagnosticity (measurableness) of goals requires their formulation as the results of a certain activity, which can be recognized, measured according to the accepted assessment scale; the hierarchy of goals involves considering imaginary results from the standpoint of subordination of lower levels to higher ones, when stages of achieving lower-order goals are planned to achieve the main (leading) goals. In addition to the above requirements, when formulating goals, scientists suggest keeping in mind their following characteristics: *instrumentality* (goals should be defined in terms of the process under study, professional training of specialists, development of teacher professionalism, etc.); *realism* (requires taking into account the means of achieving goals, thereby guaranteeing the possibility of their achievement); *adequacy* (guarantees compliance of the goals with the educational results obtained, i.e. directs pedagogical interaction to the implementation of the requirements and educational levels defined in the standard).

Finally, it is worth mentioning SMART, a method of goal setting, developed in 1954 by New York University professor P. F. Drucker (SMART-goal setting or how to make any task achievable?, n.d.). The requirements for correct goal setting in any activity are written out by the letters of the abbreviation of the name of the method, in particular: S (specific) means the goal must be precise, clearly defined, concrete, unambiguous and single-vector in terms of its achievement; M (measurable) means it is necessary to clearly justify the criteria for achieving the goal to measure the results of its achievement: if such measurement is possible, the effectiveness of each stage of goal fulfillment should be assessed; A (achievable) means that even at the stage of goal setting, it is necessary to make sure of its reachability. However, the goal should be neither easy nor too difficult to achieve: before accepting the goal, it is important to take into account your capabilities and resources, to act according to the principle “although it is difficult, but possible!”; R (relevant), when the goal must be

realistic: we set ourselves only such tasks that we can solve (we should not plan to create a Perpetuum Mobile, a perpetual motion machine, because we know in advance that this project will fail); T (timed), when we should fix the time by which the goal must be achieved, the task set must be completed; but at the same time, we should not exaggerate or underestimate the time for completing the task.

Finally, at this stage of the study, we must make the following generalizations: to select the content of the college teachers' professional competence development, it is necessary to determine the goals of this process, which we must formulate through the results; at the same time, to achieve the results of the professional development of teaching staff, it is necessary to develop a "pedagogical taxonomy" that reflects the structure of goals as a construct of successive hierarchical levels; it is necessary to clearly, specifically and understandably describe the goals of each level of the hierarchy.

Based on the above-mentioned provisions and the approaches of scientists to justifying the goals of increasing the professionalism of specialists (Diachenko, 2016; Kalenskyi et al., 2018, Stepanova, n.d.), we conclude: the basis of the system of goals for the development of professional competence of college teachers is the main goal, which, on the one hand, is detailed by a set of strategic, tactical and operational goals and determines intermediate results at each level, and on the other hand, is achieved through the consistent, phased implementation of lower-order goals. At the same time, we understand the professional competence of a teacher of a professional college as "… an integrative property of the personality, which is manifested in the pedagogical activity, behaviour and actions of a specialist and determines his readiness and ability to competently perform his professional functions due to a balanced combination of a complex of methodological, psychological-pedagogical, methodological, organizational, subject-industry (special), environmental, legal, etc. knowledge, skills of educational and methodological work, skills of education and development of students' personality, necessary pedagogical abilities, moral and ethical values and professional qualities (creative attitude to educational activity; reasonable love for students; perseverance and purposefulness; responsibility; endurance; self-control; tolerance, kindness; pedagogical observation and attentiveness; perfect command of language and thinking; inspiration and intuition; optimism; pedagogical tact; health and appearance, etc.) and determines sufficient levels of upbringing and

education of applicants for professional pre-higher education" (Titova, et al., 2023, p. 32).

To formulate the main goal of developing the college teacher's professional competence, it is appropriate to recall that Article 62 of the Law of Ukraine "On Professional Pre-Higher Education" contains the following requirement (2020): "Pedagogical, scientific-pedagogical and scientific workers are obliged to: constantly improve their professional and general cultural level and pedagogical skills, ensure continuous professional development". We support the views of Kurok (2022) that the main goal of developing the pedagogical activity of teachers is always set from the outside and is formulated taking into account the requirements of legislative or subordinate regulatory legal acts, professional standards, the mission and strategy of the activities of professional colleges, factors that determine the directions and content of the professional growth of pedagogical workers. Therefore, *the main goal* of the studied process is the continuous development of the professional competence of pedagogical workers of professional colleges in order to ensure high levels of growth of their skills, creative abilities, and abilities to effectively organize a holistic educational process.

As mentioned above, to achieve the main goal, it is necessary to isolate the elements of the lower-level "taxonomy", in particular strategic goals. Naturally, in order to holistically develop the professional competence of a teacher as an integrative property of a person, it is necessary, in our opinion, to recognize the components of the phenomenon under study as objects of pedagogical influence such as motivational-value, cognitive-informational, behavioral-activity, personal-reflective, emotional-volitional components (Titova, et al., 2023).

Accordingly, *the strategic goals* of developing the professional competence of teaching staff of professional colleges are: a) the formation of motives, aspirations for innovative pedagogical activity, value orientations of the teacher to master high levels of professionalism; b) a complex of versatile theoretical and empirical knowledge (pedagogy, psychology, teaching methods, digital technologies, in the scientific field being taught, etc.); c) a wide range of cognitive and practical skills/skills for performing actions and operations to implement labour functions in the educational process of a professional college; d) developed personal and professional qualities (pedagogical observation and attentiveness; inspiration and intuition; optimism; responsibility; self-control; tolerance,

kindness; pedagogical observation and attentiveness; pedagogical tact, etc.), the ability to regulate one's own life activities, the formation of reflective qualities; e) persistence in self-improvement, emotional stability, determination, endurance, the ability to understand one's own emotional state when solving problematic pedagogical situations.

Analysis of strategic goals shows that they are long-term, calculated and long-term, and determine more specific tasks and ways to achieve them - tactical goals. In the proposed taxonomy (Figure 2.1), these goals should determine a certain level of development of components-varieties of the teacher's professional competence. Such components are distinguished on the basis of the functions of pedagogical activity (educational, methodological, educational, communicative, etc.). Accordingly, tactical goals are aimed at the development of abilities, which in synthesis determine the level of growth of the teacher's professional competence.

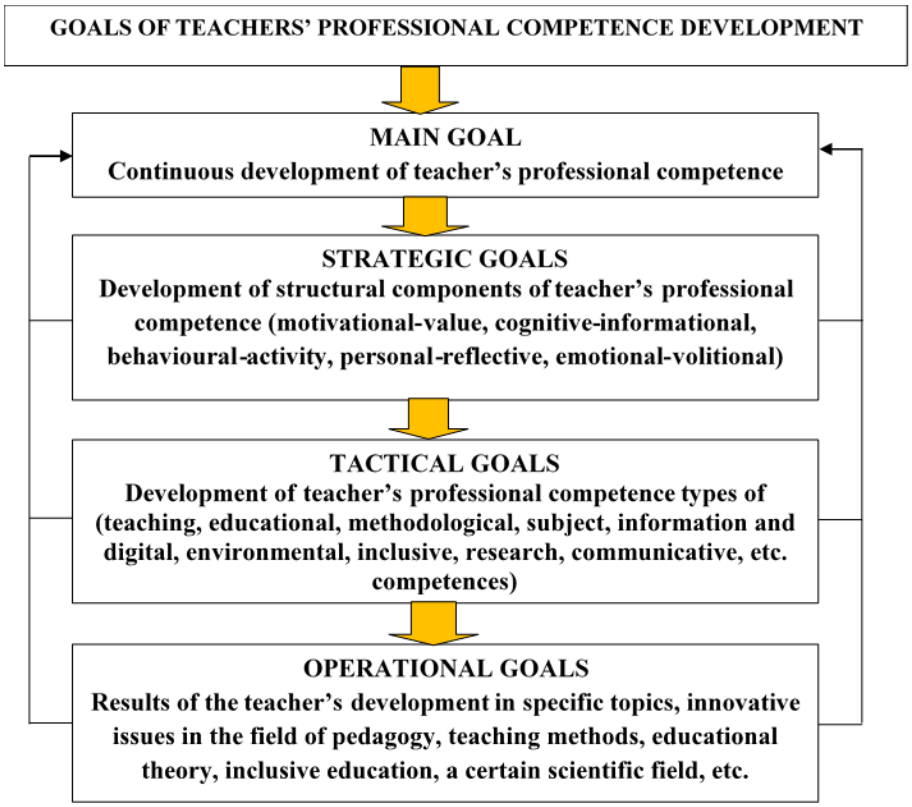

Figure 2.1
Hierarchy of goals for the college teacher's professional competence development.
Note. Created by the author.

The main ones are the following (Titova, et al., 2023, p. 33–34): *teaching* competence as the teacher's ability to teach others, that is, to transfer their own knowledge, to form skills and abilities in students, as well as the ability to learn, that is, to improve their professional level; *educational* competence is an integrative personal and activity quality of a teacher, which ensures his theoretical and practical readiness and ability to effectively implement the educational function in a holistic educational process; *methodological* competence is the teacher's ability to develop educational and methodological documentation, methods of preparing and conducting educational classes, other didactic materials and teaching aids; *subject* competence is the teacher's theoretical and practical readiness to teach a separate discipline, course, etc.; *information and digital* competence as the teacher's ability to navigate in the information space, receive and operate information, and apply digital technologies in the college's educational process; *environmental* competence is the ability of a person to apply environmental knowledge and experience in professional and life situations, guided by the priority of environmental values and non-pragmatic motivation for interaction with the environment; *inclusive* competence is the teacher's ability to pedagogically support students with special educational needs, taking into account their individual needs, capabilities, abilities and interests, to create conditions that ensure the functioning of an inclusive educational environment of the college; *research* competence involves the ability of an individual to conduct scientific research in a certain field of science, in a certain specialty, using general and special scientific methods; *communicative* competence of a teacher is the ability of a person to choose and technologically effectively apply an adequate method of oral and written communication.

In the proposed structure, operational goals are at the lowest level and ensure the achievement of tactical and strategic goals for the development of professional competence of a college teacher. They are short-term and reflect the results of teachers' work on specific topics, innovative issues in the field of pedagogy, teaching methods, educational theory, inclusive education, a certain scientific field, etc. Usually, such goals are achieved by means of self-development or in the system of methodological work of a college, while strategic and partially tactical goals are achieved comprehensively, in particular in postgraduate education.

Analysis of the main theories of designing the content of education (theory of material education; theory of formal education; utilitarian concept

(didactic utilitarianism); didactic exemplarism, theory of the unity of material and formal education; theory of the cultural orientation of education, etc. (Haluziak et al., 2007)), modern approaches to solving the specified problem (Zmist osvity v natsionalnii shkoli, n.d.), Kalenskyi et al., 2018, Pukhovska et al., 2015), own scientific research allow us to highlight the following main principles of designing the content of developing the professional competence of teachers: *humanism* (compliance with this prescription ensures the priority of universal human values and personal values); *scientificity* (the content of training, education and development of the personality is built on a scientific basis, corresponds to the latest achievements of science, is characterized by demonstrability, objectivity, accuracy and clarity of conclusions); *sequence* (planning and logic of content deployment is carried out so that new knowledge is based on and follows from the previous one; *systematicity* (the content of the programs for the development and self-development of the teacher's professional competence should combine the possibilities of formal, non-formal and informal education); *connection with life* (the content should reflect the connection between theory and practice, and intellectual and practical skills should be the goal of mastering the educational material; *accessibility* (the complexity of the content should be such that the students can overcome it with their cognitive abilities: not easy, but not too difficult); *expediency* (the volume of the content of the educational material should correspond to the allotted time for its mastery; be sufficiently informative to meet the needs of both the teacher's personality and society as a whole; be useful, necessary, relevant for the organization of the teacher's pedagogical activity in this college; *individualization and differentiation* (the content should be selected so that independent work can be individualized according to the interests and abilities of each pedagogical worker); *historicism* – (the foundations of sciences should be highlighted in the sequence of their historical development, and the contribution of Ukrainian scientists to solving scientific problems should be shown).

The criteria for selecting the content of education are, in comparison with the principles, less general in nature, they are those distinctive features that should be taken into account when informatively filling certain content components. In accordance with the basic principles, requirements for designing the content of education (Androshchuk, 2017; Holovan, 2012; Kurok, 2022), the following criteria for selecting and structuring the content of the development of professional competence of pedagogical workers of

professional colleges have been determined: a holistic reflection in the content of education of the goals (strategic, tactical, operational) and tasks of personal and professional development of teachers; scientificity and practical significance of the content included in the programs of advanced training, professional self-improvement of teachers; correspondence of the volume of content to the time available for its mastery both in course training and in the inter-course period; consideration when designing professional development programs for teachers of the availability of pedagogical education among students; taking into account positive international experience of corporate training (such as the concept of a "learning organization" (Zholonko, 2020; Pukhovska et al., 2015; Hernandez, 2001; Kritsonis, & Smith, 2006), technologies for professional development of teachers/instructors/trainers (Borodienko, 2018), etc.; compliance of the content of education with the existing material and technical base of the professional college, etc.

A well-founded taxonomy of goals, defined principles and criteria encourage the development of a detailed technology for selecting and structuring the content of professional competence development of college teachers. In this case, along with the term "selection and structuring", we will use the concept of "designing" content, which is defined as "… the activity of selecting adequate pedagogical solutions, the effectiveness of which has theoretical and practical confirmation, as well as their detailed, consistent and substantiated presentation, which embodies the concept of a pedagogical project" (Ilin et al., 2010, p. 301). In the process of experimental work, the technology of designing the content of professional competence development of the studied group of pedagogical workers was tested, consisting of 5 stages and 10 steps (Figure 2.2).

To develop an effective, targeted technology for designing the content of professional competence development of teachers of a professional college, it is necessary to:

1. Study and analyse in detail: the sources of selection of the content of teachers' education (science, spiritual values, forms of social consciousness, production of material and spiritual goods, experience of social relations, areas (types) of activity of a specialist, etc.); take into account when developing the technology subjective and objective factors that influence the content of education and self-education of teachers (current and prospective needs of society in teachers; ideology and politics: through professional pre-higher education, some groups try to strengthen their

influence on society; state strategy for the development of professional education; system of social and scientific achievements; theories of education, methodological positions of scientists, their interpretation of the problem of the development of pedagogical activity; real possibilities of the modern educational environment of the college; pedagogical experience of teachers; level of development of the relevant scientific field, technology, production); taxonomy of the goals of the development of professional competence of teachers of a particular professional college;

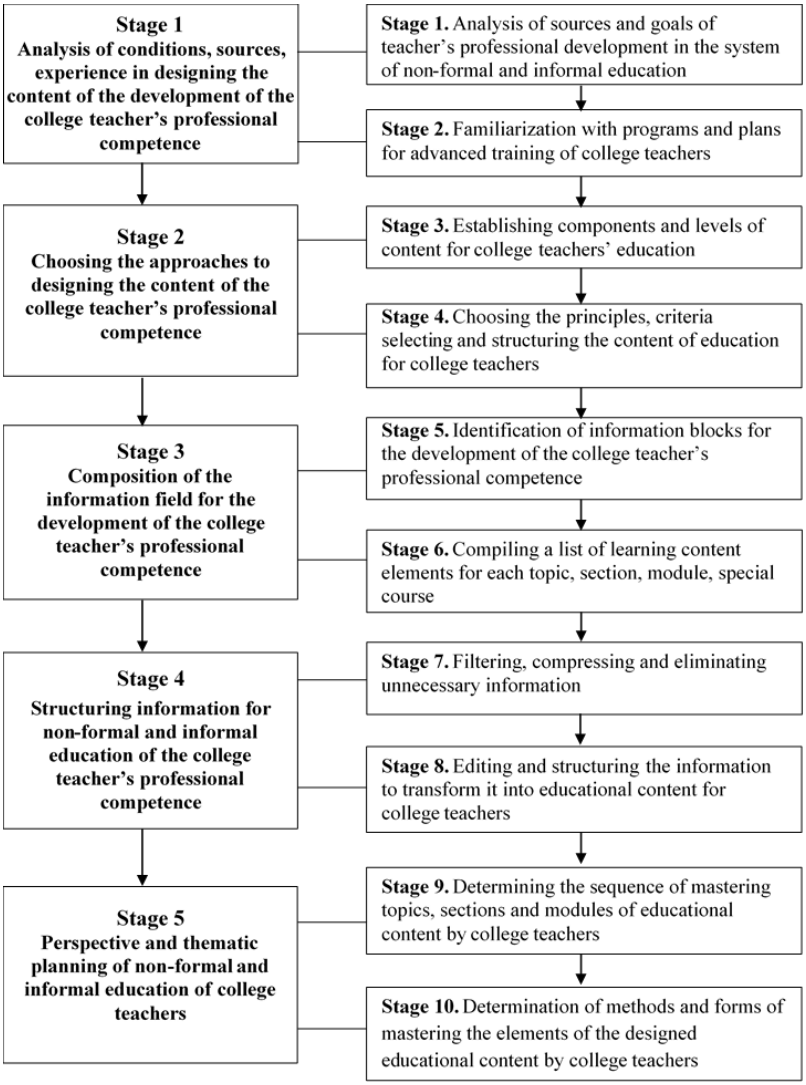

Figure 2.2
Technology of designing content for the development of professional competence of a college teacher.
Note. Created by the author.

2. Get acquainted with the programs of advanced training courses for teaching staff in postgraduate education institutions, the relevant practice of organizing methodological work in professional colleges, the positive experience of advanced training for teaching staff through non-formal education (preparation and conduct of seminars, trainings, workshops, intensives, interactive classes in schools of pedagogical skills, organization of mentoring, etc.), existing self-improvement programs for teachers, etc.

3. Determine the structure of the content of education, its components (types); the components of the types of education include (Kabysh, 2024): a) a system of knowledge about nature, society, thinking, technology, methods of activity, the assimilation of which ensures the formation and development of a scientific worldview, equips a person with a dialectical-materialist methodological approach to cognitive and practical activity; b) a system of general intellectual and practical skills and abilities, experience of the implementation by a person of known methods of activity; c) experience of creative, exploratory activity in solving new social problems; d) experience of emotional-volitional attitude to the world, to oneself, to people, which, together with skills and abilities, is a necessary condition for the purposeful development of a system of personal values.

4. Determine the principles and criteria for selecting and structuring the content of professional competence development for teachers of a professional college (see above);

5. Based on the analysis of the functions, goals of pedagogical activity, requirements of the professional standard (qualification characteristics), structure of types of professional competence, select information for professional development (self-development) of a certain group of pedagogical workers (general education teachers; teachers of professional disciplines; masters of industrial training, etc.); in the content of the special course, module, topic, the following blocks should be distinguished (Zmist osvity v natsionalnii shkoli [Content of education in the national school], n.d., 308): a) basic terms and concepts, without which no provision of science can be understood and consciously mastered; b) scientific facts, without knowledge of which it is difficult to understand the laws of science, form beliefs; c) basic laws, provisions, principles that reveal the essence of phenomena considered by a certain scientific field, objective connections between them; d) theories that contain the system of scientific knowledge, methods of explanation and prediction of phenomena of the field being

studied; e) knowledge about the object and subject of a certain science, methods of cognition and the history of its development.

6. Based on the selected information, compile a list of elements of the learning content of each topic, section, module (concepts, phenomena, properties, objects, facts, events, statistics, examples, quotes, analogies, laws, patterns, connections, dependencies, principles, rules, formulas, algorithms, schemes, proofs, techniques, methods, procedures, instructions, etc.). For example, we will give selected elements of the learning content from the disciplines: "Inclusive Education", "Pedagogy". "Agricultural Machinery":

A. The elements list for the content of the training on the topic ***"Learning technology in an inclusive educational environment. Cooperative learning"*** (Chapter 4. "Organization of the educational process in inclusive education" Poroshenko, 2019): *cooperative learning (CL); small groups; organization, stages of CL; criteria for successful CL (positive dependence; direct support; responsibility; social competence; self-assessment); forms of CL (basic, formal, special, informal groups); tasks of the teacher in CL; the role of the teacher as a facilitator; planning, conducting, analysis of the lesson; types of technologies (exercises) of CL ("Circle of Consent"; "Surround a Wise Person"; "Find Someone Who..."; "True or False"; "Flash Card Game"; "Formation"; "Brainstorming for Four"; "Internal and External"; "Puzzle"; "Line Up"; "Repeat After Me"; "Discussion in Pairs"; "Traveler"; "Check in Pairs"; "Comparison in Pairs"; "Paraphrasing"; "Partnership"; "Poems in Two Voices"; "Send a Problem"; "Let's Spend a Quarter"; "Talking Chips"; "Team Interview"; "Team Consulting"; "Team-Pair-Solo"; "Team Statements"; "Word Network"; "Telephone"; "Let's Think and Exchange"; "Exchange with three"; "Exchange in pairs with limited time"; "Who am I"); distribution of exercises; features, advantages of CL.*

B. The list of elements of the content of the training on the topic ***"Control of students' educational and cognitive activities"*** (Ilin et al., 2010): *"Control, diagnostics, monitoring, accounting, verification, evaluation, assessment, control functions (educational, diagnostic, educational, developmental, stimulating, managerial), control principles (systematicity, objectivity, comprehensiveness and comprehensiveness, individual approach, differentiation, variety of forms and methods), types of control (preliminary, current, thematic, periodic, final, machine, individual, group), classifications of control types, control methods (oral survey, written*

control, graphic control, practical control, test control, computer testing), forms of control (exam, credit, course work, course project, diploma thesis, industrial practice), types and types of standardized test tasks, levels of educational achievements (receptive-productive, reproductive, constructive-variative, creative; according to B. Bloom, knowledge, understanding, skills, analysis, synthesis, evaluation), assessment criteria, quality of knowledge, rating, intermediate rating, final rating, grades on the ECTS scale".

B. List of elements of the content of the training on the topic ***"Machines for soil cultivation: plowshares, machines for soil protection system of agriculture"*** (Ilin, Luzan, & Rudyuk, 2010)**:** *soil cultivation; soil cultivation machines; types of soil cultivation (main; surface, special); method of soil cultivation (crushing, cutting, loosening, compaction, mixing, leveling, rotation); soil cultivation system (traditional, conservation, mulching, with mini-till elements); classification of soil cultivation machines (machines for main soil cultivation, surface and special purpose); plow; agrotechnical requirements for plows; plowshares; working bodies and auxiliary elements of plows (housings, skidders, knives, soil deepeners); purpose of the plow body components (share, shelf, field board, post, shoe); types of share (trapezoidal; chisel-shaped); shelves with a cultural surface (semi-screw, screw, cylindrical, rhombic); safety mechanisms and devices, their types and principle of operation; general structure, working process and adjustment of the share-shelf plow (PLN-5-35; PLN-3-35; PUM-5-40); reversible plows – structure, work process (PO-3-40, Vari-Diamant 160; plow-huller PL-4-30 (structure, work process); row plow PNYA-4-40; machines for the soil protection system of agriculture – flat cutters-deep cultivators, chisel plows, ridge cutters, needle harrows: purpose, general structure, working bodies, work process, adjustment; layout schemes of working bodies and auxiliary parts on the plow frame; preparation of the plow for work; safety measures; prospects for the development of plow designs.*

It is important to emphasize that the content of both humanitarian and technical disciplines should cover various types of knowledge, which in the system are aimed at creating a general picture of the world, and subsequently serve as effective tools for carrying out practical and cognitive activities.

Filtering, compression and exclusion of unnecessary information that is not directly related to the achievement of educational goals: here it is necessary to make sure whether the planned volume of educational information can be mastered by the pedagogical worker in a certain time; if

not, then from the entire information array only that information is selected that will contribute to the achievement of the set goals; if necessary, a procedure is carried out to reduce some messages without significantly changing their content (information compression) (Koshuk, 2019).

Editing and structuring information: at this stage of designing the content of education, information is edited (restructuring facts, detailing, supplementing with examples of practice, explaining complex objects, phenomena, processes) and a structural and logical scheme (Koshuk, 2019) of the content of the training of a certain topic, section, module is developed;.

Determining the sequence of mastering topics, questions, content elements by those who study (matrix analysis, graph-analytical method, expert assessment, pedagogical experiment, etc.);

Establishing relationships between content components and methods, forms of its mastery by students.

Undoubtedly, the selected content is an extremely necessary, but far from sufficient means of achieving the set goals. The results of our research convince us that the effectiveness of the professional development of teaching staff is influenced by a number of interrelated and interdependent factors, in particular: the content of education (*what knowledge, skills, abilities, personal qualities, values should be formed, deepened, expanded?*); methods of teaching, self-education (*what methods, techniques should we use to achieve the set goals?*); forms of learning, upbringing, personality development (*where, when, how and for how long should the purposeful development of the teacher's creative potential be carried out?*); means of education (*which subjects of the college educational environment or subject situations should be used in the process of personal and professional growth of the teacher be carried out?*); pedagogical activity of the teacher (*is the teacher sufficiently motivated and continuously developing his pedagogical skills, does he have the skills to independently master innovative knowledge?*); professionalism of teachers – mentors, coaches, tutors, trainers (*who is involved in giving lectures, conducting seminars-webinars, trainings, is their level of pedagogical skills sufficient?*); educational environment of the college (*does the college have an effective system of advanced training of pedagogical staff, are novice teachers and young teachers involved in training in schools of pedagogical skills, pedagogical workshops; how productively does the college's methodological service organize "corporate training" of pedagogical staff?*), etc.

When designing the content of education, it is extremely important to take into account the methods by which the knowledge, skills and abilities of those who study should be formed/developed. This means that it is necessary to reveal the interrelationships of the methods and types (components) of assimilation of the content, to show what methods and techniques of learning should be provided for the assimilation of the proposed material by teaching staff.

The types of educational content just indicated are those elements with which scientists recommend saturating cognitive and practical tasks for those who study. This means that educational results should include not only knowledge, skills and abilities, but also the experience of creative activity acquired by students. In addition, the content of educational tasks should take into account the emotional factor, the level of development and the nature of the cognitive needs and motives of the individual. The question rightly arises: how to do this methodically?

First of all, when constructing educational tasks, one should foresee the content of the methods of activity determined by the methods of teaching. Let us recall: teaching methods are methods of orderly interconnected activities of teachers and pupils (students, listeners), aimed at achieving the set goals; by the nature of the cognitive activity of those who learn, the methods are classified into explanatory-illustrative, reproductive, problem-based, partially-search, and research. Without commenting on the classification of methods by other features, let us briefly dwell on the content of the listed methods of educational activity.

It is worth agreeing that the acquisition of knowledge and skills is carried out at three levels (Haluziak et al., 2007; Kozakov et al. 2003): conscious perception, understanding and memorization, which is manifested in sufficient accuracy of reproduction; application of knowledge (skills) according to a model or in a familiar situation; creative application of knowledge (skills) in a new, previously unfamiliar situation. Naturally, these three levels of learning the content of education are closely interconnected, but can be successfully implemented separately. In any case, they should be clearly distinguished. Otherwise, there is a risk that the creative application of knowledge and skills will not be given enough attention (usually educational practice uses, unfortunately, the first two levels of learning educational information). This is first. Secondly, when learning knowledge and methods of activity at any level, it is necessary for students to learn emotionally, to experience acts of cognition as a personally meaningful

activity. In other words, it is necessary to constantly “feed” interest in both the knowledge itself and the process of mastering it. And, thirdly, the interest just mentioned in learning and in the objects of learning should be considered an educational result along with the results of other levels of learning information.

At the first level of assimilation of educational content, learning is divided into the following general links: a) communicating the conditions of the cognitive task (task), creating learning stimuli in students; b) perception by those who are learning of new material from various sources, comprehension and generalization of new knowledge (new methods of activity); c) consolidation and improvement of new knowledge (methods of activity) – memorization. In this case, the activity of the teacher and the student (student, listener) has all the signs of explanatory-illustrative (informational-receptive) learning - listeners are informed of ready-made information by various means, they must perceive, comprehend, consolidate in memory terms, scientific facts, basic laws, provisions, principles of a certain theory, etc.

Established for centuries, explanatory and illustrative teaching is called the most economical (I. Lerner) way of “transferring” knowledge, mastering methods of activity. For this, a palette of teaching tools and methods is used: oral word (explanation, story, information message, lecture); printed word (textbook, teaching manual, methodological recommendations, reading books, etc.); visual aids (natural objects, pictures, maps, presentations, etc.); practical demonstration of methods of activity (demonstration of methods of proving theorems, deriving formulas, drawing up business plans, demonstrating work on a machine tool, operations of technological adjustment of units, etc.).

Separately, it should be said about modern teaching aids that use digital technologies, electronic educational resources. According to their functional characteristics, they are divided into electronic educational publications (electronic version of a printed textbook, electronic textbook, electronic workshop, electronic reader, electronic lecture course, electronic training manual, etc.); electronic reference publications (electronic reference book, electronic encyclopedia, electronic dictionary, etc.); electronic practical publications (collection of virtual laboratory works, electronic methodological recommendations, electronic workbook, etc.). The use of electronic educational resources provides “... the content filling of the educational space, providing equal access to participants in the educational

process regardless of their place of residence and form of education in accordance with high-quality educational and methodological materials created on the basis of information and communication technologies" (On amendments to the Regulation on electronic educational resources, 2019). Much attention has been paid to electronic educational resources in scientific and methodological literature, and the task is to ensure that the use of these modern teaching aids is didactically competent, benefiting the development of intellectual abilities, cognitive independence, and initiative of those who study.

Mastering the content of education when using explanatory and illustrative methods does not involve the formation of skills and abilities to apply the acquired knowledge in practice. However, without this method, it is impossible to form any intellectual or practical skills: the performance of an action must always be based on a certain minimum of knowledge about the object (subject), conditions, means of performing operations, etc. Therefore, the explanatory and illustrative method fundamentally precedes the reproductive method, which is intended to achieve the second level of mastering the content of education. Its essence is explained by the following procedure: the teacher, using a system of educational tasks, organizes the educational and cognitive activity of students regarding the repeated reproduction of the communicated knowledge or the shown methods of activity. Therefore, the reproduction and repetition of intellectual or practical action during the organizing, motivating activity of the teacher is the main feature of the reproductive method (I. Lerner).

Instead, the exercise should not be a mechanical, automatic repetition of intellectual or practical actions, but a conscious active activity of the one who masters a certain skill. In this case, psychologists advise (Kozakov et al. 2003) to avoid monotony of actions, to diversify the course of exercises through the gradual complication of the content of the tasks, changing the speed of performing the exercises, using competition between the participants in the exercises, etc.

Here is an example of using exercises in the development of teachers' research competence (*Advanced training. Topic "Methodology of pedagogical research". Detachabloed Subdivision "Nemishayeve Professional College of National University of Life and Environmental Sciences of Ukraine", October 2024*). After a detailed explanation of the expert assessment methodology, in particular ranking (arranging factors, conditions, criteria, principles, etc. in ascending or descending order

according to their significance in the formation or development of the studied object, phenomenon, process), the students were involved in performing exercises to develop skills in compiling a rank matrix. During the instruction, the students were instructed: *"To correctly use the results of the examination and predict solution options, the researcher must learn to summarize, group and analyse the information received from the experts. When experts perform the ranking, it is necessary to correctly, without any errors, compile a rank matrix and determine the dominant objects under consideration. Each of you received a table with ranking data of 11 factors of activating students' educational and cognitive activity by 10 conventional experts. We observe that the experts were unable to distinguish some factors by weighting-significance. Let's try to determine the values of the "linked" ranks and, accordingly, create a matrix - fill in table 2 of the results of the experts' ranking of factors."* For the sample, the initial data for performing the exercise by an individual listener are given in Table 2.1, and the results of converting this data into factor ranks are in Table 2.2.

Table 2.1

Summary of the expert examination of factors activating students' educational and cognitive activity

No. of an expert	No. of a factor										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
I	1	8	2	1	7	10	5	3	6	4	9
II	2	7	1	2	8	9	6	4	5	3	10
III	3	9	2	1	7	8	6	5	4	3	10
IV	1	7	1	1	6	9	5	3	4	2	8
V	1	7	1	2	5	8	6	4	3	2	9
VI	1	5	2	1	3	6	4	2	2	1	7
VII	2	6	1	2	4	6	5	3	3	1	7
VIII	1	6	1	1	4	5	3	2	2	1	7
IX	1	9	2	3	5	4	8	7	6	6	10
X	1	7	2	4	6	5	8	8	7	3	8

Note. Created by the author.

Table 2.2
Factor ranking matrix (created based on data from Table 2.1)

No. of an expert	No. of a factor											$\sum_{ij}^{n} F$
	1	2	3	4	5	6	7	8	9	10	11	
I	1,5	9	3	1,5	8	11	6	4	7	5	10	66
II	2,5	8	1	2,5	9	10	7	5	6	4	11	66
III	3,5	10	2	1	8	9	7	6	5	3,5	11	66
IV	2	9	2	2	8	11	7	5	6	4	10	66
V	1,5	9	1,5	3,5	7	10	8	6	5	3,5	11	66
VI	2	9	5	2	7	10	8	5	5	2	11	66
VII	3,5	9,5	1,5	3,5	7	9,5	8	5,5	5,5	1,5	11	66
VIII	2,5	10	2.5	2.5	8	9	7	5,5	5,5	2.5	11	66
IX	1	10	2	3	5	4	9	8	6,5	6,5	11	66
X	1	7,5	2	4	6	5	10	10	7,5	3	10	66
$\sum_{ji}^{m} F$	**21**	**91**	**22,5**	**25,5**	**73**	**88,5**	**77**	**60**	**59**	**35,5**	**107**	660

Note. Created by the author.

It is not difficult to notice that each student had to perform the same action (transforming expert data into ranks) at least 11 times (this is in the case when at the end the sums of columns and rows are equal to $\sum_{ji}^{m} F=\sum_{ij}^{n} F=660$; otherwise, it is necessary to find an error and repeat the procedure again). Practice shows that only conscientious practice in determining ranks allows you to consolidate this simple, at first glance, method in memory. An interested reader can verify the correctness of what was said by trying to perform the exercise on their own. As can be seen from Figure 2.3, explanatory-illustrative and reproductive methods are used to master 1 and 2 types of educational content. At the same time, applicants master ready-made and reproduce (reproduce) methods of activity already known to them. But neither a significant amount of knowledge mastered in a ready-made form, nor skills and abilities mastered according to a model, provide the disclosure and growth of a person's creative abilities. Experience of creative activity in solving new problems is acquired by students when applying problem-based learning methods – problem presentation, partial search (heuristic) and research methods. These methods are described in

sufficient detail in the methodological works of modern scientists (Luzan et al., 2016), so we will focus only on their general features.

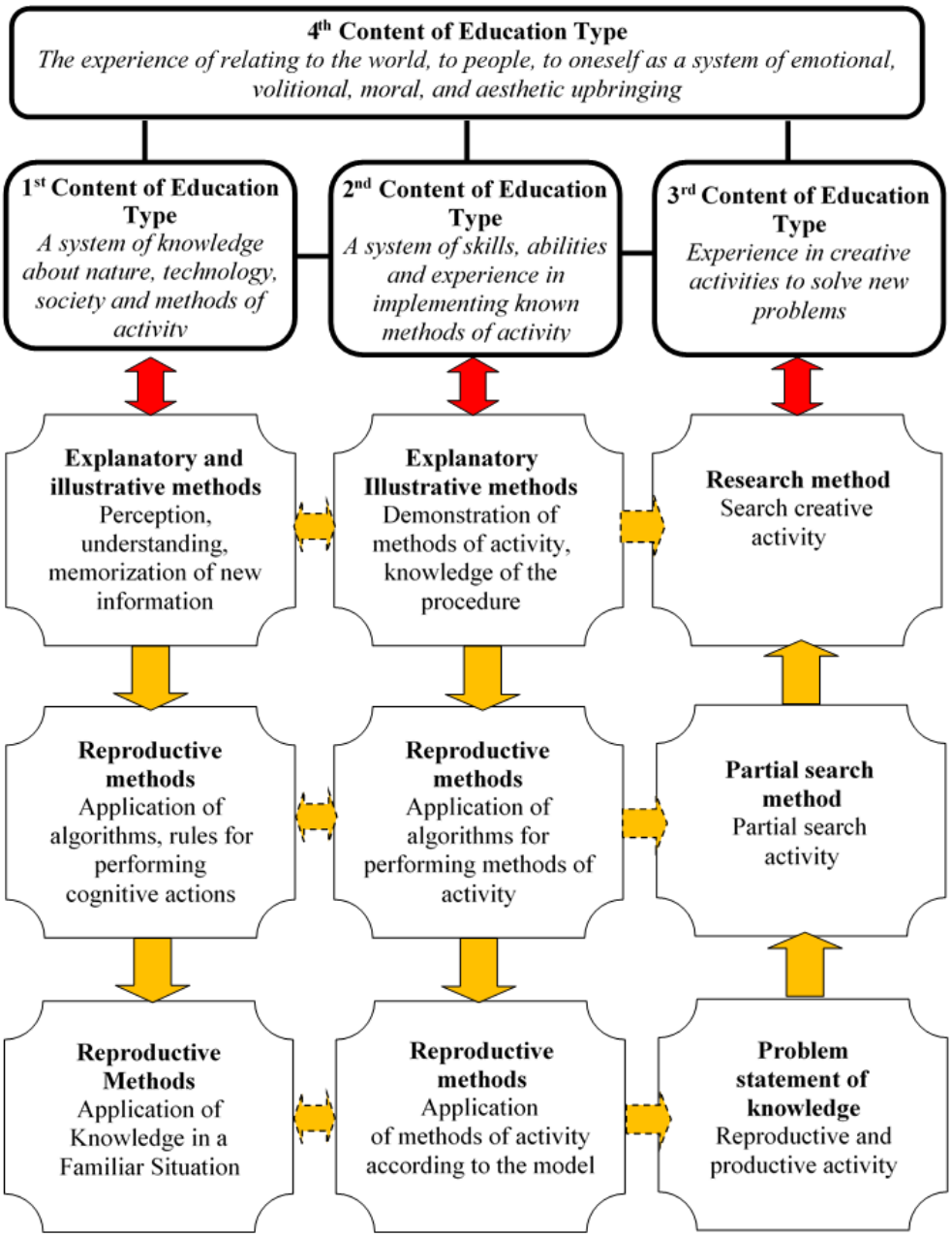

Figure 2.3
Diagram of the relationship between methods and levels of mastering the content of education.
Note. Created by the author.

The content of education in the form of experience of creative activity does not coincide in essence with the content of the first two types. The fact is that a student who has mastered knowledge in a "ready-made" form, according to a model, does not have experience in solving problems independently, he is usually not able to apply his creative abilities in non-standard, new situations. Here it is advisable to support those psychologists who claim that every person has natural creative abilities: "… creative inclinations exist in the brain of every person… spontaneous manifestation of the need and ability to be creative manifests itself when combining some favorable neurophysiological predispositions" (Amelkin et al., 2010, p. 12). Therefore, creativity should be taught by means of any subject, constantly and systematically preparing, in particular, graduates of a professional college for creative professional activity.

The special features of such activity are (Amelkin et al., 2010, p. 12; Haluziak et al., 2007): independent transfer of knowledge and skills to a new situation; vision of a new function of the object; alternativeness, flexibility of thinking; speed of thought, originality, curiosity, accuracy and courage; high efficiency, subordination of creativity; spiritual motivation, resilience, stubbornness, passion for work; ability to find contradictions; independence; ability to self-manage.

Conclusion. So, the proposed technology for selecting and structuring the content of education gives an answer to the question: what information needs to be selected so that its mastery by pedagogical workers will allow achieving the set goals, developing educational, methodological, educational, inclusive, environmental and other types of professional competence of a teacher of a vocational college. The use of the proposed technology by the management of institutions of vocational pre-higher education, methodological services allows, in our opinion, not intuitively, but on a scientific basis, systematically and purposefully to design the personally-oriented content of the development of the professional competence of each teacher or master of industrial training in accordance with his needs, motives, preferences. The prospects of further scientific explorations will be devoted to the development of a detailed technology for the development of innovative competence of college teachers.

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2.2. PRINCIPLES OF IMPLEMENTATION OF TECHNOLOGIES FOR THE DEVELOPMENT OF PROFESSIONAL COMPETENCE OF PEDAGOGICAL STAFF OF VOCATIONAL COLLEGES

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Based on the analysis of current approaches to the implementation of educational technologies, taking into account the methodological foundations for the professional development of college teachers and the experience of implementing educational innovations in institutions of professional pre-higher education, the principles of implementing technologies for the development of college teachers' professional competence were identified and substantiated. It was emphasized that implementing those principles contributed to the teachers' professional development effectiveness, their adaptation to current challenges and the introduction of teaching innovations into the educational process.

Keywords: *professional pre-higher education, educational technology, teacher's professional development, principles, teaching innovations.*

2.2. ПРИНЦИПИ РЕАЛІЗАЦІЇ ТЕХНОЛОГІЙ РОЗВИТКУ ПРОФЕСІЙНОЇ КОМПЕТЕНТНОСТІ ПЕДАГОГІЧНИХ ПРАЦІВНИКІВ ФАХОВИХ КОЛЕДЖІВ

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На основі аналізу сучасних підходів до реалізації педагогічних технологій, урахування методологічних основ професійного розвитку викладачів фахових коледжів та досвіду впровадження освітніх інновацій у закладах фахової передвищої освіти виокремлено та обґрунтовано принципи реалізації технологій розвитку професійної компетентності викладачів фахових коледжів. Наголошено на тому, що реалізація зазначених принципів сприяє ефективності розвитку професійної компетентності педагогів, їхньої адаптації до сучасних викликів та впровадженню педагогічних інновацій у освітній процес.

Ключові слова: *фахова передвища освіта, педагогічна технологія, професійний розвиток педагога, принципи, педагогічні інновації.*

Continuous professional growth of teaching staff is one of the determining factors in the effective modernization of professional pre-higher education. In the context of ongoing educational reforms and global challenges, the role of teaching staff as agents of educational change is steadily growing. Following the Laws of Ukraine "On Education" and "On

Professional Development," teaching staff involved in the educational process are required to systematically enhance their competencies, improve professional qualifications, and master innovative teaching methods, forms, and tools. This requires the integration of mechanisms and tools across all forms of education, formal, non-formal, and informal education, which could ensure that teachers have access to diverse pathways for professional development. Thus, modern educational practice must systematically engage the resources of postgraduate education institutions, the methodological services of colleges themselves, and, no less importantly, self-education and self-improvement strategies by teachers in the process of their professional growth (Titova, et al., 2024).

Within this context, the technologization of the process of the college teacher's professional competence development becomes a key approach. It is based on the idea that education should be transformed into a purposeful, structured process involving the active participation of all stakeholders (Sysoieva, 2001). Educational technologization emphasizes predictability, reproducibility, and a guarantee of results through the structured implementation of pedagogical strategies and tools. As noted by Prokopenko and Yevdokimov (1995, p. 11), the learning process must be oriented towards the "guaranteed achievement of educational outcomes," which presupposes a systematic sequence of stages, goal-oriented activity, and methodological consistency in educational interventions. In this context, educational technologies are not only tools for content delivery but also comprehensive systems that ensure the quality and effectiveness of teacher training and continuous professional development.

Current trends in teacher professional development point to the increasing role of educational technologies that are structured, results-oriented, and adaptable to diverse learning contexts. Particularly in colleges, which function under dynamic social and economic conditions, there is a need to implement innovative approaches that foster the sustainable development of professional competence among educators (Titova, et al., 2023). The importance of providing a technological approach in the process of college teacher professional development is rooted in the requirement for measurable, consistent and efficient professional development trajectories. This includes applying such educational technologies in the professional and personal development of teachers that are characterized by procedural clarity, consistency of implementation and a focus on outcomes.

Moreover, educational technologies suitable for college teachers' professional development must integrate adult learning principles, be sensitive to their professional realities and promote active involvement in constructing their learning paths. This necessitates defining a set of core principles that should guide the implementation of technologies for teachers' professional competence development. These principles should ensure alignment with educational policy, respond to institutional and individual needs, and enable college teachers to integrate new knowledge and skills into their everyday pedagogical practices. Therefore, the current research aimed to identify and substantiate the principles for the implementation of technologies for the development of college teachers' professional competence as a necessary step in creating an effective methodological foundation for the up-to-date teacher's professional development within the system of professional pre-higher education.

In the Ukrainian scientific and pedagogical field, a significant contribution to the study of the problem of technological approach in the educational process was made by such well-known scientists as A. Aleksiuk, M. Artiushyna, A. Asherov, S. Goncharenko, V. Yevdokimov, O. Kovalenko, A. Nisimchuk, M. Nosko, O. Padalka, O. Pehota, I. Prokopenko, L. Romanyshyna, G. Romanova, Ya. Rudyk, S. Sysoeva, M. Chepil, M. Fitsula, D. Chernilevsky, O. Shpak and others. To create a definition of the concept of "the technology for the development of the college teachers' professional competence", it is first worth stating that per se it is the educational technology. Therefore, it is necessary to start with the examination of this generic concept. First of all, we should note that few works highlight the theoretical foundations of educational technology. They all state that educational technology refers to the structured application of technological tools and processes within instructional settings to enhance learner outcomes. It involves a systematic approach to identifying learners' needs, integrating technology into instruction and monitoring educational progress.

Educational technology also supports differentiated instruction by offering self-paced materials that cater to both advanced and struggling students. As emphasized by Galbraith (1967), technology in education must adhere to two essential features: the systematic application of scientific knowledge and the division of tasks into functional components.

In this respect, Nosko, Harkusha, & Tsyhura, (2023) proposed a thorough definition, which could be considered in the current research. The

authors, based on the generalization of the scientific approaches to the interpretation of the term *educational technology*, reveal the structure and content of the concept distinguishing four dimensions – scientific, procedural-actional, procedural-descriptive and systemic – which should be considered for the term. Moreover, we accept the authors' conclusion that educational technology should be considered broadly, both as a new branch of pedagogy as a model of the real educational process, and as a pedagogical system.

Similar ideas could be traced in the research of Loboda (2023), which also focuses on four separate definitions of educational technology. One of the first definitions (perhaps therefore rather narrow, in our opinion) is given by UNESCO (ICSU Committee on Science Education, 1974): "a systematic way of designing, carrying out and evaluating the total process of learning and teaching in terms of specific objectives and employing a combination of human and technical resources to bring about more effective instruction."

To appeal to the root of the key principles for the implementation of technologies for the development of college teachers' professional competence the analysis of the main (generic) features, which the scientists used to define the phenomenon, was made. Therefore, educational technology is defined as: the science of development, learning and upbringing of the individual (Nisimchuk, Padalka & Shpak, 2000); a pedagogical system in which the use of teaching aids increases the effectiveness of the educational process (Prokopenko & Yevdokimov, 1995); a new branch of pedagogical knowledge; a real educational process built on a certain technology in order to achieve pre-planned goals; a model (algorithm, construction, strategy, etc.) of the educational process, developed in accordance with the basic provisions of the technological approach (Nosko, Harkusha & Tsyhura, 2023); the process of developing and implementing a pedagogical project in an educational institution that reflects a certain system of pedagogical views (Sysoieva, 2001); a complex integrative system that contains an ordered series of operations and actions that provide pedagogical definition, content, information-subject and procedural aspects aimed at the assimilation of systematized knowledge, acquisition of professional skills and formation of personal qualities of students, given the purpose of learning (Chernilevskyi, Dzhedzhula, & Hunko, 2013); an algorithm of joint actions carried out by teachers and students, which are systematically diagnosed and aimed at ensuring that the result corresponds to the defined goal (Mykhailichenko & Rudyk, 2016), etc.

Any scientifically based technology has a number of characteristic features. In particular, it involves dividing the process into interconnected stages, coordinated and consistent execution of actions to achieve a specific goal and obtain expected results. An important condition for the effectiveness of the technology is the clarity and unambiguity of all envisaged procedures and operations. In addition, it must ensure the possibility of multiple reproduction of the process with stable results (Morska, 2008, p. 10).

Therefore, technology is the sequential execution of pre-designed technological operations with the aim of guaranteed obtaining a specific product (Luzan, 2021).

According to Morel & Spector (2022) the process of educational technology can be delineated into three stages. According to Galbraith (1967) there are two main characteristics of every technology: the systematic application of scientific knowledge to practical tasks and the breakdown of these practical tasks into sections and sub-sections. The second characteristic involves selecting or designing the optimal plan for teaching students, enabling them to meet the teaching objectives. After that, it is necessary to evaluate the learner's performance to determine whether the educational objectives have been met. If the objectives are not achieved, there is a need to modify the teaching strategy or strategies in a way that ensures the teaching objectives are accomplished. Therefore, the process of educational technology can be divided into three distinct stages:

1. Analysis of instructional components means identifying and examining the elements to be utilized as inputs in the teaching-learning process.
2. Organization and implementation require arranging and applying these components effectively during instruction.
3. Evaluation and feedback include assessing learner outcomes to determine if educational objectives are met. If not, instructional strategies are revised to achieve the desired goals.

This cyclical process ensures continuous improvement in educational practices. However, a real attempt to technologize the process of mastering knowledge and skills was programmed learning (ICSU Committee on Science Education, 1974) with certain characteristic features:

– division of the process into interconnected stages;

– coordinated and phased implementation of actions aimed at achieving the set goal and obtaining the corresponding results;

– unambiguous implementation of procedures and operations included in the technology, which is a crucial condition for achieving results;

– repeatability and reproducibility of the process of obtaining the product.

In Ukraine, elements of programmed learning began to be used in the 1920s, when scientists substantiated the scientific method of labour pedagogy, which was based on special programs. According to these programs, the entire volume of work was divided into certain operations, the duration of their execution was indicated and continuous control (constant feedback) was provided. The following features of programmed learning (Luzan, Ilyin, Ishchenko, & Pastushenko, 2005):

– educational material is presented to students in small parts;

– each part (portion) of educational material is accompanied by instructions or tasks to perform certain actions aimed at its assimilation;

– the assimilation of each portion of the educational material is checked using a special control task;

– after completing each control task, the student immediately finds out whether he answered correctly or incorrectly (feedback);

– depending on the student's answer, the possibility of his further advancement is determined;

– each student works independently and masters the educational material at a pace that is feasible for him;

– the results of all control tasks are recorded, they become known to both the students themselves and the teacher;

– the teacher organizes training, provides assistance and consultations in case of difficulties for students and implements an individual approach;

– specific means are used in the educational process - programmable teaching aids, simulators, computers, etc.

We should agree with the scientists that precisely those features of the technology liken learning to a production and technological process. Focusing on the above features, features and characteristics of the phenomenon under study, we will try to identify the principles of implementing technologies for the development of college teachers' professional competence. From the above considerations, we should clarify the essence of the concept of *technology for the development of college teachers' professional competence* in the following aspects:

– it is a special organization for the development of college teachers' professional competence;

– with a technological approach, the process of the college teachers' professional development should be clearly aimed at achieving the set goals;

– to implement the technology for the development of college teachers' professional competence, it is necessary to develop a project in advance, on a scientific basis;

– the project should reflect the technology for the development of college teachers' professional competence as a system with detailed components, stages, procedures, etc.;

– we must take into account that guaranteed achievement of learning outcomes can be made by combining the mechanisms of formal, non-formal and informal teachers' education into a single system.

Most scientists who study the problem of technological learning clearly emphasize that the orientation of educational goals, and with them the entire course of learning, to the guaranteed achievement of results, is the leading feature of educational technology. In addition, educational technology should provide for the formulation of goals through learning outcomes, which are expressed in the actions of the student, constantly checked for correction of both the methodology and the results themselves. Therefore, the next essential feature of educational technology is the specificity of educational goals.

Naturally, educational technology should be created on the ideas of reproducibility: every mentor or instructor should be able to apply it effectively. Given this, an essential feature of educational technology is specifically written clear procedural characteristics, the application of which guarantees the achievement of results. So, on a scientific basis, it is first necessary to develop a project for such an organization of the educational process, which provides for clear and consistent implementation of certain educational actions in conditions of operational feedback. And if such a project is developed, then educational technology can be replicated, transferred to other conditions, reproduced, etc.

However, it is worth saying that the achievement of educational results primarily depends not only on the quality of the didactic project, the detailing of educational tasks, operational feedback, or technical means of teaching but also on the mentor's skill in creating personal and developmental situations. In confirmation of this, we emphasize that the educational process is a pedagogical interaction between mentors and teachers, aimed at achieving the set goals. Pedagogical interaction is unique: its content and methods are determined by the tasks of teaching, upbringing and

development of the personality of students. Undoubtedly, this position should also be taken into account in defining the category under study.

The principles for the efficient implementation of educational technology serve as foundational ideas and initial provisions that determine the content, forms, and methods of organizing the educational process in alignment with the established goals. These principles must take into account the regularities of the learning process and play a regulatory role in the educational system. They are formulated based on an analysis of the corresponding patterns. The accuracy of modelling didactic theories and methods for regulating the practice of learning is ensured by adhering to the principles of the technological approach in education, which are grounded in theoretical foundations. The main sources for deriving such a system of principles include the experience of organizing educational activities, the theory of cognition, the functioning of the human psyche, and the regularities of the didactic process, among others. The teaching and upbringing principles developed within scientific and pedagogical theory form the basis for developing a system of professional methods. In this context, didactic principles are specified during the process of studying specific subjects, considering their particular characteristics. This specification is a necessary and natural occurrence when transferring general scientific knowledge into specific, typical, or exceptional situations. General didactic principles are initial recommendations for selecting methods to achieve learning objectives, and these recommendations mainly address the regulation of interpersonal relationships among the participants in the educational process. They also focus on organizing favourable conditions for achieving educational goals, without highlighting special additional conditions for fulfilling individual educational and developmental objectives. A complete and logically structured set of principles for organizing the educational process ensures that the process is scientific, consistent, systematic, and, therefore, effective.

The system of principles governing the functioning of educational technologies is rooted both in the patterns of organizing the pedagogical process and in the diagnostically defined goals of educational technology. When introducing a new educational technology into the pedagogical process, the goals of its organization are clarified. The identified goal determines an appropriate method to achieve it, which may be based on a system of original patterns and principles. A thorough understanding of the multifaceted goals of teaching and education has led to the selection, based

on the analysis of natural relationships among the elements of the pedagogical system, of the system of principles for the functioning of educational technology.

The system of principles for the functioning of the pedagogical system (or educational technology efficient realization) does not negate the well-established didactic and educational principles in pedagogy. Instead, it requires a detailed study and adherence to these principles to ensure a high-quality organization of the educational process using educational technologies.

The system of principles for the functioning of educational technology includes the following: *The principle of integrity; The principle of diagnostic purposefulness; The principle of completeness; The principle of intensity in constructing the educational process; The principle of correspondence; The principle of correspondence with nature; The principle of professional and ethical correspondence; The principle of modernity; The principle of optimization of the educational process.*

When introducing an individual author's educational technologies, this system of principles should be comprehensively considered. Ignoring any of these principles may fail to achieve the diagnostically defined goal.

The role of technology in learning encompasses not only the tools, such as hardware, software, networks, and web applications, but also the processes, including methods and strategies used for instruction, assessment, and tracking student learning (TeachOnline, 2020). Technology, in this context, refers to the various ways educational organizations employ these tools and processes, including learning management systems, to enhance and manage the educational experience. The authors offered the following principles as a guide to help reflect on the purpose and application of technology in learning, although it is important to note that these principles are far from exhaustive: *Adding value* (educational technology should enhance the learning experience by adding value, improving the quality and effectiveness of educational practices); *A pedagogical focus* (the integration of educational technology must be driven by pedagogical goals, ensuring that it is used to support teaching and learning processes effectively); *Quality* (educational technology used must contribute to maintaining or improving the quality of learning outcomes, offering tools and resources that facilitate deeper learning and understanding); *Sustainability* (the adoption of educational technology should be sustainable over time, both financially and in terms of its integration into the educational ecosystem, ensuring that it

continues to provide long-term benefits); *Access* (educational technology should increase access to education, providing opportunities for learners to engage with materials, instructors, and peers, regardless of their location or background); *Scalability* (applied educational technology should be scalable, able to accommodate the growing demands of education and adapt to different class sizes, learning environments, and institutional needs); *Sharing* (educational technology fosters collaboration and sharing among students, teachers, and educational institutions, supporting the exchange of ideas, resources, and experiences); *Choice* (learners should be given the opportunity to choose how they engage with educational technology and the learning content, allowing for personalized and flexible learning experiences); *Continuous, lifelong learning* (educational technology should be integrated into a lifelong learning framework, supporting learners in their educational journeys beyond formal schooling and throughout their careers); *Customization* (educational technology enables the customization of learning experiences, allowing for tailored approaches that meet the individual needs and preferences of students, enhancing engagement and effectiveness).

The principles for the implementation of educational technologies aimed at developing college teachers' professional competence should reflect both the unique needs of educators and the broader goals of educational improvement. These principles are based on current pedagogical frameworks, advanced technologies, and an understanding of the dynamic nature of professional growth in teaching. Here are ten essential principles that can guide the implementation of educational technologies for developing the professional competence of college teachers:

1. The principle of professional orientation. The professional development of college teachers must align with the specific demands of their teaching environment. Technologies used in this context should support not only the enhancement of teaching skills but also foster a deeper understanding of contemporary educational requirements. By focusing on both pedagogical reflection and innovation, these technologies enable teachers to adapt to evolving educational standards.

2. The principle of interactivity and cooperation. Interactive teaching methods are crucial for fostering collaboration among educators. Technologies that promote joint problem-solving, group discussions, case methods, and mentorship can help create a professional community at a

college. This cooperation improves the sharing of knowledge and enhances the effectiveness of the learning process.

3. The principle of continuity of professional development. Given the rapid pace of change in educational methods and tools, continuous professional development is essential. Technologies that support a systematic, phased approach to professional training allow college teachers to keep up-to-date with new challenges, standards, and pedagogical innovations, thereby enhancing their overall competence.

4. The principle of individualization and differentiation. Teachers come from diverse backgrounds, with varying levels of experience and professional needs. Educational technologies that enable personalized learning trajectories, modular learning systems, and adaptive approaches can address these individual differences, ensuring that each teacher's development is both relevant and effective.

5. The principle of reflective self-regulation. Self-reflection is a critical skill for professional growth. By incorporating such instruments as e-portfolios, self-assessments, peer-assessments and reflective journals, college teachers can monitor and analyse their own teaching practices, identifying areas of strength and opportunities for improvement. This principle promotes a conscious approach to developing teaching competencies.

6. The principle of practical significance. The professional development process should prioritize the practical application of pedagogical knowledge and skills in the educational process at a college. Technologies that simulate real classroom scenarios, encourage problem-solving through case studies and integrate new teaching methods into everyday practices ensure that learning is meaningful and directly applicable to teachers' roles.

7. The principle of technological integration. Advanced educational technologies, which use digital platforms, adaptive learning systems, simulation modelling and distance learning courses, can significantly enhance the effectiveness and accessibility of professional development for college teachers, particularly under specific conditions (pandemic, wartime, unstable educational environment, etc.). Incorporating these tools into the training process ensures that college teachers develop the necessary skills to use technology effectively in their classrooms.

8. The principle of openness to innovation. A commitment to innovation is vital for college teachers' continued professional development. Exposure to new educational technologies, research, and international teaching practices helps teachers stay current with educational trends and challenges as well as advances in their subject domains. This principle encourages educators to remain open to new ideas and methods that can improve their professional practices.

9. The principle of forms and means diversity. Using a variety of learning formats (such as workshops, online courses, internships, and seminars) and resources (including digital tools, simulations and learning platforms) ensures that college teachers have diverse development opportunities. This approach increases accessibility, engagement and effectiveness of the professional development process.

10. The principle of positive reinforcement and creation of success. A motivating environment, where college teachers feel supported and recognize their professional growth, is crucial for continuous development. Educational technologies that emphasize successes, encourage active participation in professional communities, and create opportunities for teachers to feel accomplished are key to fostering motivation and a commitment to lifelong learning.

These principles, when integrated into the design and implementation of educational technologies, provide a structured yet flexible framework for enhancing the professional competence of college teachers. Each principle supports a holistic approach to teacher development, emphasizing the need for individualization, interactivity, and the practical application of learned skills. This comprehensive model will help ensure that teachers not only improve their competencies but are also equipped to adapt to the evolving demands of the educational landscape. Self-instructional materials provided through educational technology enable both advanced and struggling students to learn at their own pace, accommodating individual learning speeds and styles.

The integration of educational technologies into the professional development of college teachers represented a strategic response to contemporary educational demands and reforms. Grounded in the theoretical foundations of pedagogical technologization, the identified principles consider such specific of a college teacher's professional development as

professional orientation, interactivity, continuity, individualization, reflective self-regulation, technological integration, etc., which offer a comprehensive framework for fostering educators' professional competence. These principles were designed to ensure that technologies support structured, goal-oriented, and diagnostically effective learning (teachers' professional development) processes while remaining adaptable to the diverse needs and contexts of college teaching.

The outlined approach emphasized that educational technologies did not have only to facilitate knowledge acquisition but also promote pedagogical innovation, self-directed growth, and collaborative learning cultures. Furthermore, attention to ethical considerations, inclusivity, and the relevance of practical application ensures that the development process aligns with both institutional goals and individual teaching realities.

Future research should explore empirical validation of the proposed principles in diverse college environments, assess the long-term impact of specific technologies on teacher performance and student outcomes and investigate strategies for overcoming implementation challenges. Comparative studies across international contexts could also contribute to a deeper understanding of global best practices in technology-enhanced professional development for college educators.

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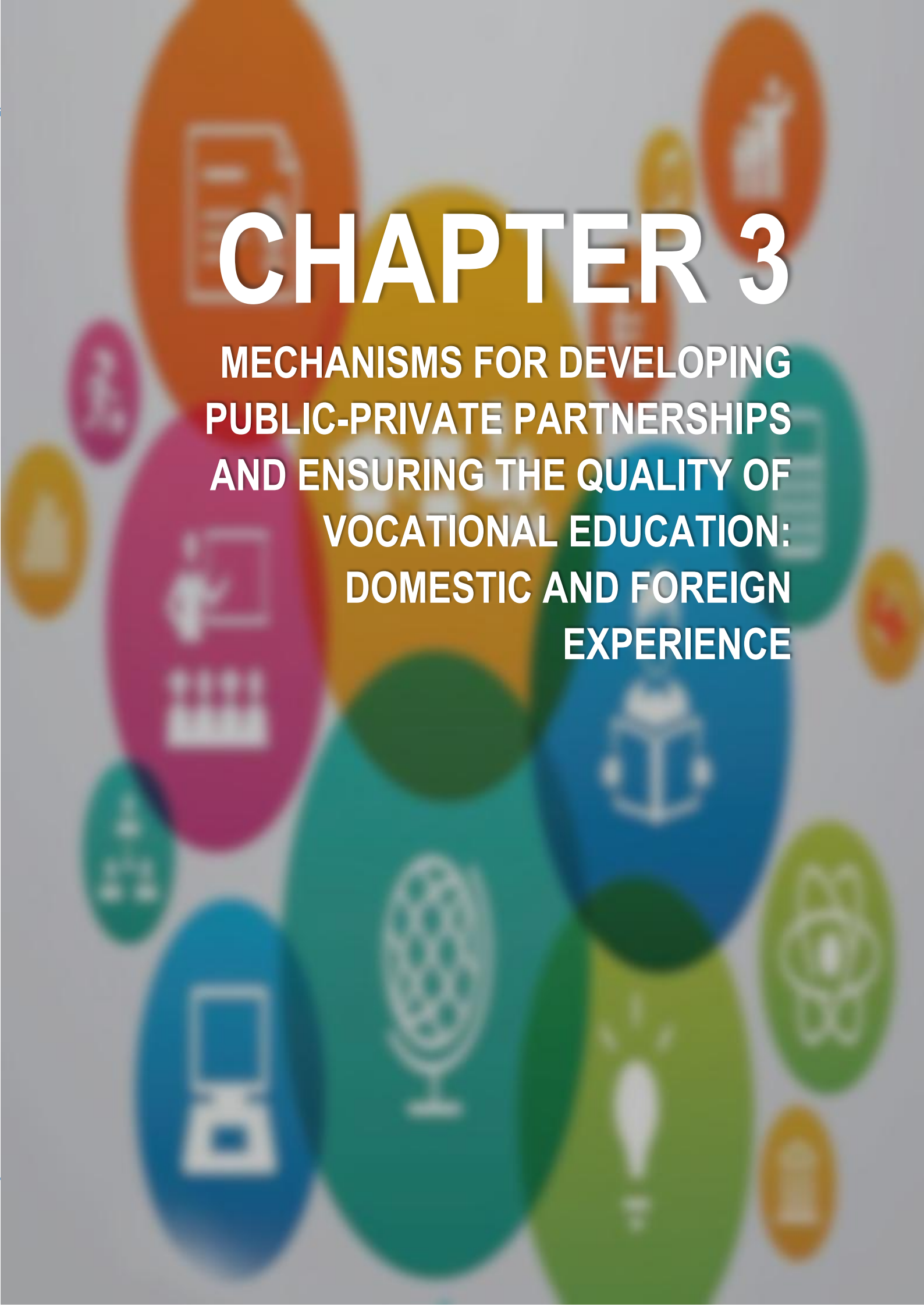

CHAPTER 3

MECHANISMS FOR DEVELOPING PUBLIC-PRIVATE PARTNERSHIPS AND ENSURING THE QUALITY OF VOCATIONAL EDUCATION: DOMESTIC AND FOREIGN EXPERIENCE

3.1. LEGISLATIVE INSTRUMENTS FOR ENSURING THE QUALITY OF VOCATIONAL EDUCATION AND TRAINING IN THE UNITED KINGDOM

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This article substantiates the legal framework for the development of the vocational education and training (VET) system in the United Kingdom. It analyzes the legislative instruments aimed at ensuring the quality of VET, along with the corresponding regulatory norms that establish clear standards for specialist training and define require ements for their competence. The powers and functions of key state institutions, such as Ofsted and the QAA, in monitoring, evaluating, and enhancing the quality of educational programs are elucidated. The mechanisms of interaction between government bodies, educational institutions, and representatives of business and employers, designed to align vocational training with current and future labor market needs, are characterized.

Keywords: *legislative instruments; quality of vocational education and training; monitoring; accreditation; educational programs; United Kingdom*

3.1. ЗАКОНОДАВЧІ ІНСТРУМЕНТИ ЗАБЕЗПЕЧЕННЯ ЯКОСТІ ПРОФЕСІЙНОЇ ОСВІТИ І ПІДГОТОВКИ ФАХІВЦІВ У ВЕЛИКІЙ БРИТАНІЇ

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Обґрунтовано правову основу розвитку системи професійної освіти і підготовки фахівців у Великій Британії. Проаналізовано законодавчі інструменти забезпечення якості професійної освіти і підготовки та відповідні регуляторні норми, які встановлюють чіткі стандарти підготовки фахівців і визначають вимоги до їхньої компетентності. Розкрито повноваження та функції ключових державних інституцій, зокрема Ofsted і QAA, у процесі моніторингу, оцінювання та вдосконалення якості освітніх програм. Охарактеризовано механізми взаємодії між урядовими структурами, навчальними закладами та представниками бізнесу й роботодавцями, спрямовані на адаптацію професійної підготовки до актуальних і перспективних потреб ринку праці.

Ключові слова: *законодавчі інструменти; якість професійної освіти і підготовки; моніторинг; акредитація; освітні програми; Велика Британія.*

In Western European countries, the issue of ensuring the quality of professional education and training (hereinafter referred to as PET) has gained particular significance, as the competitiveness of these economies

depends on the level of workforce preparation and is regarded as a fundamental factor in the development of human capital in modern society. Specifically, legislative mechanisms serve as a successful example of a systemic approach to the professional training of specialists capable of working with contemporary production technologies, tools, and resources (Rojewski, 2009). Evidence of this can be seen in the United Kingdom's experience with effective legal regulation of PET for competitive specialists, based on a comprehensive system of legislative instruments that establish quality criteria for PET. Such approaches align with the global aspiration to maintain a flexible and adaptive educational model oriented toward labor market needs. The dynamics of change across various economic sectors have prompted British lawmakers to introduce regulations that enable rapid responses to challenges and facilitate the modernization of educational program content. Relevant documents emphasize the development of key competencies that integrate theoretical and practical components of PET content (McGrath & Yamada, 2023). Through the application of accreditation mechanisms and regular monitoring of educational institutions' activities, conditions are created for independent evaluation of learning outcomes. This model enhances the credibility of educational institutions and fosters trust in the PET system among society and employers. Viewed through the lens of legal regulation, there is a clear commitment to promoting openness and transparency in the educational process, providing institutions with a clear framework for improvement.

The heightened focus on quality control in PET is driven by the growing demands of employers, spurred by rapid technological advancements and evolving socio-economic conditions (Galguera, 2018), as well as the need to meet international standards. Research on PET quality in the United Kingdom requires an understanding of key concepts: «legislative instruments» (encompassing government decrees, regulations, directives, and recommendations from specialized agencies with official status) and «quality control» (the assessment of learners' knowledge and professional skills, which impacts the overall reputation of educational institutions) (Romanov et al., 2015). When examining legislative instruments, it is also essential to consider the diverse components involved, including licensing, accreditation, public funding, and regulation of educational program content. Each of these elements is subject to strict oversight to ensure stable and effective PET outcomes. Licensing procedures establish the conditions under which educational institutions may operate, while accreditation requirements

define the criteria for recognizing learning outcomes. This interconnectedness of components contributes to the formation of a cohesive quality assurance system. Analyzing these concepts necessitates consideration of not only formal requirements but also substantive characteristics that align PET with contemporary trends. Consequently, the PET system in the United Kingdom is viewed both as a mechanism for skill acquisition and as a means of promoting social mobility and economic development (Bartlett, 2009). Legislative norms governing this domain reflect the need to train highly competent specialists capable of swiftly adapting to technological changes, adhering to quality standards, and enhancing educational program content aimed at developing professional competencies across various fields. This focus on quality becomes even more critical in light of global challenges, including heightened competition and the necessity of lifelong learning.

The VET system for specialists in the United Kingdom is characterized by its multi-tiered structure and close alignment with labor market needs (Department for Education, 2021a). Unlike purely academic pathways, VET is designed to equip graduates with specific professional skills and competencies that meet employer requirements (Ofqual, 2022). While there are certain differences in the organization and naming of qualifications across the various regions of the United Kingdom (England, Wales, Scotland, and Northern Ireland), the overarching principles of VET remain consistent. Following the compulsory school education cycle (up to age 16), students can choose between an academic route (A-levels) or a vocational pathway, pursued through Further Education (FE) Colleges or apprenticeship programs (Institute for Apprenticeships & Technical Education, 2023). Among the most common formats of vocational training are BTEC, City & Guilds, and National Vocational Qualifications (NVQ), offered by various types of educational institutions (City & Guilds, 2021). The primary hubs of VET are FE Colleges, where students can obtain initial certificates, diplomas, and even Higher National Diplomas (HNDs). Universities also contribute to practical specialist training by offering Foundation Degrees and Degree Apprenticeships–models that enable students to combine academic study with hands-on experience in the workplace (Department for Education, 2021b). In addition to public educational institutions, the UK hosts a range of private VET providers specializing in short-term or niche courses.

A cornerstone of the British VET system is the apprenticeship model, which integrates theoretical learning at colleges or through courses with practical training in a company, accompanied by a salary and the acquisition of tangible professional skills. Apprenticeship levels range from intermediate (Level 2) to higher (Levels 6–7), allowing individuals to progressively advance their careers. The Institute for Apprenticeships & Technical Education develops VET and apprenticeship standards in collaboration with employers to ensure graduates acquire the precise competencies demanded by the labor market (Institute for Apprenticeships & Technical Education, 2023). Professional associations and councils (e.g., in fields such as construction, engineering, finance, and healthcare) also influence the content of training programs, aligning them with industry-specific requirements. As part of ongoing technical education reforms, the government continues to enhance the vocational sector, including the introduction of two-year programs for 16–19-year-olds focused on in-depth study of specialized disciplines and extended practical training (Department for Education, 2021c). Degree Apprenticeships, which combine university degrees with paid work and practical experience, are also expanding. Furthermore, online courses and remote learning formats are gaining popularity, reflecting contemporary trends in digitalization. Regular inspections by Ofsted encourage colleges and private providers to improve the quality of educational services (Ofsted, 2022). Through such oversight and active engagement with employers, the UK's VET system remains one of the most effective in Europe. Graduates of VET programs integrate quickly into the labor market, as their knowledge and skills are relevant to employers, while the structured qualification framework (based on the Regulated Qualifications Framework, RQF) ensures transparency in competency levels.

New global challenges in the field of VET necessitate an increased level of flexibility and technological adaptability in the educational process. Accordingly, legislative changes in the United Kingdom reflect a focus on fostering innovative approaches, where theory is integrated with practical experience to ensure high-quality preparation of specialists for professional activities. The development of policies in this domain is based on consultations with employers, experts, and learners themselves (Zadorozhna-Kniahnytska & Khadzhinova, 2023). Such collaborative interaction facilitates the creation of legal documents that align harmoniously with the European and global educational context. A

significant aspect of shaping the British VET system is the involvement of independent bodies in establishing quality criteria for VET. These bodies serve as guarantors of transparency and objectivity in assessment, as they interact with educational institution staff with clearly delineated responsibilities. They propose amendments to regulatory acts based on inspection outcomes, enabling prompt improvements to educational and training programs. The systemic approach to monitoring VET quality is reinforced by the experiences of other countries, which recognize the British standard as exemplary.

The legal framework for VET in the United Kingdom supports the continuity of the educational process and enhances the qualification levels of teaching staff. Legislative provisions regulate the qualification requirements for educators and encourage their professional development through mandatory enhancement of professional competence. Simultaneously, efforts are underway to align the content of educational programs with updated standards that reflect the real needs of the labor market. Within this framework, conditions are created for close collaboration between educational institutions and employers to ensure that the practical component aligns with modern technologies and methodologies. National VET development strategies play a pivotal role in shaping the legal framework, laying the foundation for long-term prospects in this field (Harris & Jones, 2025). These strategies focus on cultivating a unique blend of digital and interdisciplinary competencies essential for the competitiveness of the British economy. Particular attention is also given to the role of social partners, enabling better identification of forward-looking directions for modernization and support for the financial stability of educational institutions. Renowned British colleges offer extensive professional retraining programs, concentrating on the current demands of employers.

Conceptual approaches to the legal framework ensuring the quality of VET in the United Kingdom encompass a range of principles, mechanisms, and institutions that shape the regulatory foundation and maintain a high level of specialist training. A key feature to highlight is the decentralized model characteristic of the United Kingdom. Each of its four constituent parts–England, Scotland, Wales, and Northern Ireland–enjoys a degree of autonomy in organizing educational processes and adopting its own regulatory acts. Nevertheless, at the central level, a unified «ideological framework» persists regarding core quality standards and interregional coordination (Department for Education, 2021c).

A critical element in ensuring the quality of VET in the UK is the principle of partnership between the state, employers, and professional organizations. Employers, united in sector councils and similar structures, play an active role in shaping educational and training programs. Professional associations and councils establish requirements for specific occupations, conduct course accreditation, and certify graduates. The quality control system, including the inspection of educational institutions in England, is managed by Ofsted, which ensures compliance with necessary standards and transparency in the educational process (Ofsted, 2022). To standardize requirements and assist labor market stakeholders in understanding the content of qualifications, the UK employs qualification frameworks such as the Regulated Qualifications Framework (RQF) for England, Wales, and Northern Ireland, and the Scottish Credit and Qualifications Framework (SCQF) for Scotland (Ofqual, 2022). Professional qualifications typically span levels 1 to 3, though they can extend to level 8, equivalent to a doctoral degree with a vocational focus. Accordingly, training programs are designed across varying levels of complexity–from introductory courses to doctoral degrees–reflecting the core concept of lifelong learning.

Financial mechanisms also play a significant role in maintaining and enhancing standards. The government provides additional funding to educational institutions that demonstrate high graduate success rates and employment outcomes, while also introducing grants and subsidies to support innovative projects and the delivery of short-term professional courses (Department for Education, 2021b). Access to certain professions (e.g., medicine, law, or architecture) is regulated through professional registers, licensing, and requirements for Continuous Professional Development (CPD). Breaches of ethical or professional standards may result in the loss of a license to practice. This control model is closely tied to the quality of educational programs, which must be recognized by relevant bodies and align with industry standards (Institute for Apprenticeships & Technical Education, 2023).

Another key principle is the internationalization of the VET system, aimed at mutual recognition of qualifications and attracting international students, thereby reinforcing the global reputation of British educational programs (Ofqual, 2022). Increasing emphasis is placed on the flexibility and individualization of educational offerings, including modular formats, online courses, condensed certification programs, and apprenticeships,

through which learners acquire practical skills directly in the workplace. These are governed by relevant legislation and statutory instruments, such as the Apprenticeships, Skills, Children and Learning Act of 2009.

The quality of VET specialists in the United Kingdom is ensured through a variety of legislative instruments and specialized regulatory bodies. These bodies perform functions related to oversight, regulation, and accreditation, enabling the maintenance of high standards in educational programs (Department for Education, 2021a). The UK has a comprehensive education management system that encompasses multiple institutions responsible for different aspects of specialist training. Some of these organizations focus primarily on quality standards, while others address funding and the monitoring of educational program effectiveness. This systematic delineation of responsibilities enhances the transparency and efficiency of the VET quality assurance process. However, the multi-tiered structure necessitates clear coordination among all involved entities (Ofsted, 2020a). Specifically, the monitoring and evaluation of VET quality are conducted by the Office for Standards in Education (Ofsted) and the Office for Students. Their activities facilitate the implementation of accreditation mechanisms, the development of evaluation methodologies, and the establishment of transparent procedures for assessing effectiveness. At the same time, the legislative framework remains flexible, allowing timely responses to critical feedback and recommendations from various stakeholders. These processes are supported by continuous alignment with international practices, ensuring a high level of compliance with global standards. Within the UK's legal framework, there exists a robust system of accountability, where each participant in the educational process contributes to upholding high standards. Government bodies establish evaluation criteria, while independent agencies conduct inspections and accreditations, ensuring the public availability of inspection results (Office for Students, 2020). This division of responsibilities promotes transparency and helps avoid conflicts of interest, as VET quality assessments are carried out by external experts. Concurrently, educational institutions implement internal self-monitoring mechanisms, enabling the prompt identification of shortcomings and the adjustment of educational activities.

One of the key institutions overseeing VET quality is the Office for Standards in Education, Children's Services and Skills (Ofsted). It is responsible for inspecting educational institutions offering vocational-technical and other types of educational programs (Ofsted, 2020b). Ofsted's

primary focus is on ensuring that courses meet established standards and verifying the extent to which they address employers' needs. Following inspections, Ofsted publishes reports containing recommendations and assessments of program and institutional quality. These reports serve as a foundation for improving teaching quality and learning conditions. Additionally, they play a critical role in informing managerial decisions within VET institutions. Another vital component of the VET quality assurance system is the Office of Qualifications and Examinations Regulation (Ofqual). This body regulates qualifications, examinations, and assessments in England, overseeing the quality and reliability of the evaluation system (Ofqual, 2019a). Ofqual establishes criteria and requirements for qualification accreditation, ensuring their recognition in the labor market and alignment with employer needs. It also supervises organizations issuing certificates and diplomas for vocational education. Furthermore, Ofqual enhances public trust in the outcomes of qualification examinations. Regular inspections and audits conducted by Ofqual help identify potential irregularities and enable swift responses. Another influential entity in ensuring VET quality is the Quality Assurance Agency for Higher Education (QAA). Although primarily focused on higher education, this agency also impacts certain VET programs, particularly those partially integrated into universities (QAA, 2021a). The QAA develops and maintains quality standards that serve as a benchmark for universities and colleges offering professional and specialized courses. Regular reviews and audits by the QAA allow for the timely detection of deficiencies and the enhancement of educational practices. Additionally, the QAA provides recommendations on teaching methodologies, knowledge assessment, and the promotion of academic integrity. This approach bolsters the international credibility of UK VET.

In the context of ensuring the quality of VET, the Institute for Apprenticeships and Technical Education (IfATE) plays a significant role. This institute develops standards for VET programs, including those in technical education, aligning them with labor market demands and employer needs (Institute for Apprenticeships and Technical Education, 2022). IfATE collaborates closely with government bodies and industry representatives to ensure the relevance and quality of professional qualifications. Its activities contribute to the establishment of a transparent and effective system of educational and training programs focused on practical preparation. The institute defines requirements for program content, assessment standards,

and learning outcomes. As a result, employers gain confidence in the high level of competence of graduates. Another key institution related to the funding and quality assurance of VET is the Education and Skills Funding Agency (ESFA). This agency manages public funds allocated for the development of educational and training programs and ensures financial transparency within the sector (Department for Education, 2020). The ESFA establishes funding criteria and oversees the allocation of resources to high-quality, in-demand VET programs. Additionally, the agency sets and monitors performance indicators for educational institutions receiving public subsidies. This approach enables the concentration of resources on best practices and incentivizes training providers to enhance the quality of VET.

Legislative regulation of VET quality in the United Kingdom is of paramount importance in maintaining high standards of education and graduate employability. A comprehensive framework of legal acts has been established in this domain, outlining the requirements, powers, and responsibilities of regulatory bodies and educational institutions (Department for Education, 2019). The strategic objective of such regulation is to ensure the competitiveness of British VET on the international stage and to foster innovation (The Further and Higher Education Act, 1992). A balanced integration of legislative requirements and professional standards facilitates the training of qualified specialists capable of adapting to rapidly changing labor market conditions (Ofsted, 2019a). A critical condition for the effectiveness of legal regulation of VET quality is the continuous monitoring and periodic review of the regulatory framework in response to contemporary challenges. Thus, legislative instruments provide a legal foundation for the operation and development of the VET system, ensuring its alignment with global standards. Among the key legislative acts forming the basis for VET quality assurance in the United Kingdom are the Further and Higher Education Act 1992, the Education Act 2002, the Apprenticeships, Skills, Children and Learning Act 2009, and the Technical and Further Education Act 2017 (Apprenticeships, Skills, Children and Learning Act, 2009). Each of these acts addresses specific aspects of VET while collectively establishing a cohesive system of oversight and control (Technical and Further Education Act, 2017). They define the rights and obligations of educational institutions, ministerial departments, regulatory bodies, and employers. A distinctive feature of the British approach is the extensive involvement of stakeholders in the process of shaping standards and curricula (Department for Education, 2017). This ensures synergy

between theoretical and practical training, which is essential for successful employment. Consequently, a comprehensive legal framework creates the conditions for the systematic improvement of VET quality.

The legal foundations for the further development of the post-secondary education sector, including further education (FE), were established by the Further and Higher Education Act (hereinafter referred to as FHEA) (Further and Higher Education Act, 1992). This act delineated the powers of bodies responsible for funding and accrediting educational programs within the further education domain and provided the framework for the establishment and operation of several independent colleges. Under the FHEA, clear mechanisms for quality monitoring were introduced in 1992, which included periodic reporting by colleges and inspections (Ofsted, 2019b). The legislation also facilitated closer collaboration between businesses and educational institutions, aimed at addressing labor market challenges and shaping modern educational and training programs. Furthermore, it encouraged the development of national qualifications frameworks that set standardized requirements for course content and graduate competency levels. Overall, the FHEA served as a starting point for creating a system that harmoniously integrates academic education with vocational training.

Significant additions to the broader legal framework, particularly regarding standards and programs related to FE, were introduced by the Education Act (hereinafter referred to as EA) (Education Act, 2002). This act strengthened the role of state regulation in defining minimum requirements for educational and training programs, as well as mechanisms for assessing and certifying students in vocational colleges. The legislation promoted the development of professional development programs for teaching staff to ensure a high standard of instruction in practically oriented subjects (Department for Education, 2019b). The EA also established principles for partnership-based cooperation between government bodies, educational institutions, and employers to continuously update the content of FE in line with labor market demands. Consequently, a clear hierarchy of responsibility was established, spanning from the formulation of educational policy at the national level to its practical implementation at the local level. The synergy across all levels of governance enhances the quality of FE and creates conditions for its consistent development across all regions of the United Kingdom.

The modernization of the FE system through the introduction of apprenticeship programs was advanced by the Apprenticeships, Skills, Children and Learning Act (hereinafter referred to as ASCL) (Apprenticeships, Skills, Children and Learning Act, 2009). This act expanded access to vocational education for young people by improving funding and introducing additional incentives for employers involved in workforce training. Within the ASCL framework, requirements for the quality and structure of apprenticeship programs were refined, encompassing on-the-job practical training and formal coursework. The legislation also provided for the establishment of a robust system for monitoring and evaluating learning outcomes, enabling employers and government bodies to assess the effectiveness of their investments. This approach ensured greater alignment of training programs with the actual needs of the economy while enhancing the mobility and employability of graduates in the labor market (Department for Education, 2017). Thanks to the ASCL, apprenticeships have become a cornerstone of the United Kingdom's strategy for workforce development.

Regulatory and supervisory bodies, such as the Office for Standards in Education, Children's Services and Skills (Ofsted) and the Office of Qualifications and Examinations Regulation (Ofqual), play a crucial role in implementing the aforementioned laws (Ofsted, 2019b). Ofsted conducts inspections of educational institutions, including vocational colleges, and prepares reports on their compliance with educational quality standards as mandated by legislation. Ofqual, in turn, is responsible for regulating examinations and qualifications, ensuring their alignment with national frameworks (Department for Education, 2019b). These bodies possess extensive powers to intervene in the operations of educational institutions in cases of systemic breaches or non-compliance with requirements. Their activities aim to enhance transparency and accountability within the VET sector while promoting continuous improvement in the educational process. Effective oversight by Ofsted and Ofqual ensures a substantive, rather than merely formal, mechanism for quality assurance.

In the further development of the VET system, with a focus on strengthening the technical component of specialist training, the Technical and Further Education Act (hereinafter TFEA) plays a significant role (Technical and Further Education Act, 2017). This legislation introduced additional safeguards for students in the event of financial instability at colleges, as well as mechanisms to enhance the accountability of governing

bodies. Considerable emphasis is placed on collaboration with businesses to ensure the relevance of programs, particularly in high-tech and innovative sectors (Department for Education, 2017). The TFEA also provided for the modernization of vocational college infrastructure, including through government investments in state-of-the-art equipment and digital resources. As a result, educational institutions have been able to improve students' practical skills and better prepare them for the challenges of modern industry. Consequently, the TFEA has established VET as a strategically vital sector for the nation's economic development.

In 2022, the Skills and Post-16 Education Act (hereinafter SP16EA) came into force in the United Kingdom, strengthening the integration between vocational and academic education (Skills and Post-16 Education Act, 2022). The primary objective of this act was to promote expanded access to post-secondary education programs and to enhance quality through closer alignment with labor market needs. The SP16EA emphasizes the development of new qualification pathways for young people, offering diverse learning trajectories ranging from traditional to innovative approaches (Department for Education, 2019b). Additionally, the legislation encourages partnerships between colleges, universities, and the private sector to create educational and training programs tailored to employer demands. A notable innovation is the enhanced role of digital technologies and learning software, which is particularly relevant in the context of remote and blended VET delivery. Thus, the SP16EA establishes a more flexible and adaptive system capable of responding to dynamic changes in the world of work.

In the legal interpretation of these laws, it is essential to consider the jurisdictional differences between England, Scotland, Wales, and Northern Ireland (Department for Education, 2019b). While the overarching principles and strategic approaches to ensuring VET quality remain similar, each region of the United Kingdom operates within its own unique legal frameworks and regulatory bodies. For instance, Scotland has a distinct qualifications system overseen by the Scottish Qualifications Authority (n.d.), while Education Scotland fulfills the role of inspecting educational institutions. Similarly, Northern Ireland has specific bodies responsible for the accreditation and monitoring of VET programs. Consequently, the legal interpretation of legislative acts often requires accounting for subnational variations, which provides greater flexibility and responsiveness to local needs. Nevertheless,

despite differences in detail, the overarching goal remains consistent: the establishment of a high-quality and competitive VET system.

In the United Kingdom, the mechanisms of external and internal quality control of VET possess a complex structure. These mechanisms are grounded in clear regulatory and legal frameworks that delineate the responsibilities of various bodies and institutions (Department for Education, 2020). External control is aimed at ensuring that educational and training programs align with national standards and the expectations of employers. Internal control, in turn, focuses on maintaining high educational standards within specific institutions. The foundation of this process lies in procedures of self-assessment, monitoring, and enhancement of VET quality. The UK VET system incorporates recommendations from sector skills councils regarding qualifications. It is also oriented toward the current demands of the labor market and potential employers (Ofsted, 2021a). The synergy between external and internal control mechanisms ensures a comprehensive approach to evaluating VET quality. This contributes to the improvement of educational processes and enhances the competitiveness of graduates. Within this system, significant emphasis is placed on the transparency of assessment procedures and the visibility of control outcomes.

A key component of external control in the VET domain is the inspection conducted by Ofsted. This agency carries out evaluations of educational institutions, assessing the effectiveness of teaching, the level of academic preparation, and the quality of the educational environment (Ofsted, 2021b). The results of these inspections serve as the basis for rating assessments, public reports, and recommendations for improvement. The legislative foundation for Ofsted's authority is enshrined in the Education and Inspections Act (2006). Another critical aspect of external control is the accreditation of educational programs, which is undertaken by relevant qualification agencies. Agencies such as Pearson or City & Guilds verify the compliance of program content and assessment methods with general qualification requirements. UK legislation establishes clear criteria by which VET programs must be evaluated (Department for Education, 2019b). Non-compliance with these criteria may result in an institution losing its right to issue certificates and diplomas. Thus, external control not only evaluates but also incentivizes educational institutions to continuously raise their standards. The high level of transparency in inspections enables employers and learners to make informed choices among various educational offerings.

Internal quality control of VET in the United Kingdom is based on the principle of continuous improvement. Educational institutions regularly conduct self-assessments, analyzing the competence of their teaching staff, the effectiveness of teaching methods, and student performance (Tanui & Achoka, 2014). To this end, internal quality assurance boards are established to align policies and procedures for internal audits. These boards comprise representatives from management, academic staff, and student governance bodies. A vital component of internal control is the monitoring of performance indicators, attendance, and student satisfaction. This approach allows for the prompt identification of issues and the planning of corrective actions. Institutions also encourage teachers to engage in professional development through participation in training sessions, workshops, and qualification enhancement programs. This fosters the dissemination of best teaching practices and the creation of a positive educational climate. The results of internal self-assessments are mandatorily documented and submitted to external regulatory bodies upon request. Such transparency facilitates more effective collaboration with Ofsted and the Quality Assurance Agency (QAA) during external audits.

A significant element of internal control is the interaction among teachers, administration, and students. Teachers receive feedback from colleagues and management, which promotes professional growth. The administration, in turn, analyzes data on performance and attendance to formulate institutional development strategies. Students have the opportunity to voice their concerns and suggestions regarding the educational process through surveys or representatives on quality assurance boards (British Council, 2022). These feedback mechanisms contribute to the development of an open communication culture. Additionally, educational institutions actively collaborate with employers to ensure the relevance of educational program content. Employers may participate in designing training modules and offer their experts to conduct masterclasses. All these initiatives align with the standards and recommendations of Ofsted and QAA. Internal control thus complements external mechanisms, forming a cohesive system for ensuring VET quality.

In the context of internal control, the concept of «self-assessment – improvement – implementation» is widely applied (Romanova, 2022). Initially, educational institutions compile a detailed report on their strengths and weaknesses, utilizing both quantitative and qualitative indicators. Subsequently, an improvement plan is developed, outlining specific

objectives, timelines, and responsible individuals. This is followed by the implementation of corresponding measures, the success of which is monitored by management and quality assurance councils for VET. The outcomes of these activities serve as the foundation for subsequent accreditation and successful external audits (QAA, 2019). Self-assessment enables timely responses to labor market trends, facilitating the adaptation of educational programs and curricula. This approach aligns with the requirements of the national strategy for the development of professional skills and competencies. In cases where significant shortcomings are identified, internal control serves as the initial «signal» for corrective actions. Such a system enhances the resilience of educational institutions to external challenges and strengthens their competitiveness. It also lays the groundwork for partnerships with employers, as the quality of specialist training directly impacts their professional suitability. The integration of external and internal control creates a multi-tiered system that encompasses all aspects of VET. External evaluations ensure compliance with national standards and international requirements (Education and Skills Funding Agency, 2020), while internal mechanisms provide ongoing monitoring and quality adjustments at the institutional level. This synergy renders the evaluation process more objective and balanced. On one hand, independent assessments by bodies such as Ofsted or QAA identify potential issues that may not be evident through self-assessment alone. On the other hand, internal control offers flexibility and prompt responsiveness to recommendations from external entities. As a result, educational institutions not only address deficiencies but also implement innovations proposed by external experts. This fosters a culture of mutual learning and the exchange of best practices among various educational establishments. Through the alignment of external and internal mechanisms, society benefits from high-quality VET that meets contemporary labor market demands. Employers also gain from this system, as they can rely on the strong qualifications of graduates.

In the process of ensuring VET quality in the United Kingdom, certain challenges arise. For instance, the rapid advancement of technology necessitates continuous updates to the content of educational programs and curricula, as well as the upskilling of teaching staff (Department for Business, Innovation and Skills, 2016). Consequently, internal quality control mechanisms must swiftly adapt to changes and conduct reviews of educational materials. External bodies, such as Ofsted, also adjust their

evaluation criteria to account for innovative teaching methods. However, financial constraints can hinder the implementation of necessary changes. Some educational institutions lack sufficient resources to rapidly integrate cutting-edge technologies and methodologies. Against this backdrop, partnerships with the private sector become increasingly vital, enabling the attraction of additional investments. Collaboration with student organizations also gains importance, as they can further support innovation in the educational process. Despite these challenges, the VET quality assurance system demonstrates a high degree of flexibility and adaptability overall. As a result, British educational institutions remain attractive to students and employers worldwide.

In ensuring the quality of VET in the United Kingdom, accreditation agencies play a pivotal role by overseeing compliance with standards and providing relevant recommendations. These agencies go beyond mere formal oversight, actively developing practical guidance and encouraging educational institutions to enhance their programs and teaching methodologies (Ofsted, 2020b). Accreditation bodies conduct inspections, leveraging extensive analytical resources and statistical data to assess the effectiveness of the educational process. During these evaluations, emphasis is placed on student achievement levels, teacher qualifications, and the alignment of educational programs with the demands of the modern labor market. In collaboration with professional associations and employers, these agencies help establish contemporary training criteria and identify the most relevant competencies. The high global regard for the UK's VET model is largely attributed to the effective coordination and oversight provided by accreditation bodies (Department for Education, 2021c). They not only enhance the transparency of the system but also promote the adoption of innovative pedagogical technologies by educational institutions. The reliability of specialist training and the ability to meet employers' needs for skilled workers are key factors in the success of this model. This approach renders the UK's accreditation practices appealing to other countries seeking to reform their own education systems.

One of the primary functions of accreditation agencies is the coordination of inspections, which involves aligning schedules and approaches to assessments. This helps avoid duplication of efforts and excessive burdens on educational institutions while maintaining effective monitoring. Coordinated inspections evaluate consistent criteria, creating transparent and uniform conditions for comparing outcomes (QAA, 2021b).

In the UK, various accreditation bodies operate, including the Quality Assurance Agency (QAA) and Ofsted. Each organization has its own specialization and methodologies, yet all adhere to shared principles of objectivity and fairness. This division of responsibilities ensures that every educational sector receives the necessary attention and expert approach. Coordination extends beyond inspection planning to include the exchange of information on identified shortcomings and successful practices, contributing to the overall improvement of VET quality (Department for Education, 2021c). The result is a unified, comprehensive oversight network that prevents gaps in standards. Consequently, students, educators, and employers can rely on the credibility and consistency of educational outcomes.

Inspections involve a thorough analysis of all aspects of an educational institution's operations, including programs, resources, and teaching methods. Accreditation agencies meticulously review curricula, conduct interviews with teachers and students, and observe actual classes to form a highly objective assessment. This process determines whether the program meets national standards and industry needs, as well as whether students acquire modern, relevant knowledge (Ofsted, 2020). Inspection outcomes are typically accompanied by an analytical report highlighting strengths, weaknesses, and suggestions for improvement. This information serves as the basis for decisions regarding the renewal or revocation of accreditation. Additionally, accreditation bodies consider the extent of student engagement in the learning process and opportunities for practical application of acquired knowledge. These insights inform an overall evaluation of VET quality and the formulation of specific recommendations. Should an institution fail to implement proposed innovations, its status may be reconsidered, incentivizing continuous improvement. This oversight mechanism sustains high quality and positions the UK's VET system as a global leader.

A crucial role in the work of accreditation agencies is played by the development of recommendations aimed at optimizing Higher Education Programs (HEPs). Their objective is to provide specific guidance on program content, teaching methods, and assessment approaches. These recommendations are often presented in public reports, which enhances transparency and ensures access to relevant information for stakeholders (QAA, 2021b). For employers, this serves as a convenient tool to evaluate the quality of an educational institution, while for students, it provides an additional data source for selecting an educational program or college. The

recommendations also facilitate the integration of innovative approaches into the educational process, expand the use of technology, and address contemporary market demands. They frequently align with the urgent needs of specific economic sectors, thereby strengthening the connection between HEPs and the professional environment. Furthermore, governments or foundations often offer targeted support to institutions that strive to successfully implement these proposals. Regular monitoring is equally important: when recommendations are systematically applied, the quality of HEPs improves continuously (Hunt & Boliver, 2021). Creating incentives for meeting high standards is another key task for accreditation agencies. They may offer institutions a range of benefits, from additional funding to enhanced rankings and prestigious awards. Colleges with high accreditation levels often gain priority in state funding and can apply for various grants. This, in turn, attracts top-tier faculty and increases applicant interest (Department for Education, 2021c). For faculty and leadership, prestigious accreditation not only improves working conditions but also signifies recognition of their professionalism. Additionally, some agencies publish «exemplary lists» of institutions or programs, motivating others to continuously raise their standards. Alongside incentives, sanctions exist: if HEP quality declines, accreditation status may be temporarily suspended or fully revoked. This «carrot-and-stick» system fosters healthy competition based on quality indicators (QAA, 2021b). As a result, the most progressive and innovative educational institutions gain advantages, advancing further and setting high benchmarks for others.

Accreditation agencies closely collaborate with government bodies, such as the Department for Education, to align reforms and address economic needs. This enables clear prioritization, including identifying essential competencies and learning formats that meet current demands. Governments, leveraging data from accreditation bodies on HEP quality, can swiftly adjust policies or amend legislation (Department for Education, 2021c). In return, agencies receive governmental guidance on key development priorities, including core standards and requirements. This mutual reinforcement ensures that the HEP system remains adaptive and flexible. Clearly defined national standards provide each accreditation agency with a stable reference point for evaluations. This approach bolsters international trust in British education, as standards are consistently monitored, updated, and implemented in response to modern challenges (Hunt & Boliver, 2021). Moreover, joint projects and the exchange of best

practices facilitate innovation adoption. Ultimately, this creates a cohesive framework that not only addresses current challenges but also lays the foundation for the sustainable development of HEPs in the future.

A defining feature of the British system is the partnership-based collaboration between accreditation agencies and educational institutions. Their efforts are not aimed at penalizing non-compliance but at providing tangible support and advice to help institutions improve. Regular meetings and workshops organized by agencies foster constructive dialogue and the resolution of specific issues. This format builds trust and allows institutions to view accreditation bodies as a source of consultancy rather than strict oversight (Ofsted, 2020b). Simultaneously, agencies gain deeper insight into the real conditions of the educational process and can more promptly identify areas for improvement. This influences inspection methods as well: feedback enables continuous refinement of evaluation criteria. The collaboration is rooted in transparency–educational institutions understand how they will be assessed and can prepare for inspections in advance. This approach not only simplifies the accreditation process but also cultivates a culture of quality and self-reflection. As agencies assist in implementing recommendations, HEP quality rises, and students gain more relevant knowledge (QAA, 2021b). However, accreditation agencies face the challenge of systematically updating standards, as the labor market evolves constantly. The British economy adapts quickly to new conditions, meaning employer requirements for professionals can vary significantly across sectors. To stay abreast of trends, agencies engage employers and industry associations in discussions on program content, conducting research and market analysis (Department for Education, 2021c). Yet, overly frequent changes can complicate strategic planning for institutions. Thus, accreditation bodies strive for balance–updating standards to reflect current realities while maintaining a stable foundation for program implementation.

Another challenging aspect is securing sufficient resources to conduct detailed inspections and research activities. Given the demands of comprehensive analysis, agencies require substantial funding, which sometimes necessitates the prioritization of initiatives. Nevertheless, existing mechanisms of state support and a high level of accountability enable the maintenance of an adequate level of oversight (Ofsted, 2020b). The effectiveness of accreditation agencies is often measured by indicators such as student satisfaction with their education, graduate employment outcomes, and employer feedback. By examining the extent to which graduates meet

the real needs of industries, it is possible to assess the performance of accreditation bodies as well (Hunt & Boliver, 2021). The strong interest of employers in workers with British qualifications reflects the quality of training and the relevance of educational and training programs. Additionally, the dynamics of change are significant: when educational institutions that receive recommendations from agencies demonstrate noticeable improvements in their performance, it indicates that the accreditation process has delivered tangible benefits. Further evidence of effectiveness lies in the international recognition of British qualifications, as many overseas applicants choose to study in the United Kingdom, trusting its quality assurance system for VET (QAA, 2021b). Accreditation agencies actively work to align internal standards with global benchmarks, thereby enhancing the competitive advantages of British graduates. Positive trends in this regard stimulate further innovation and improvements within the education sector. Ultimately, this fosters greater trust and loyalty from students and society at large, reinforcing the United Kingdom's leadership position in the field of VET.

In the United Kingdom, a range of professional organizations and associations also participate in the accreditation and certification system. These include entities such as Pearson and City & Guilds, which provide recognized qualifications at various levels (Pearson, 2019). These organizations develop curricula and assessment methods, as well as issue corresponding certificates. They collaborate with employers and industry experts to continually update competency requirements for graduates. The involvement of the private sector in accreditation expands opportunities for innovation and rapid responses to changing market demands. This makes the British VET system flexible and adaptive. The accreditation of VET programs in the United Kingdom often occurs simultaneously at multiple levels. Initial evaluations are conducted by state regulators such as Ofqual or IfATE, followed by independent awarding organizations that issue the relevant certificates (Ofqual, 2019b). This multi-tiered system ensures that each VET program adheres to rigorous standards while remaining relevant to employers. Accreditation criteria may encompass requirements related to teaching staff, educational equipment, the content of learning modules, and learning outcomes. Periodic reviews are conducted to verify compliance with established criteria and to ensure continuous improvement in the quality of VET. As a result, graduates of British VET programs successfully establish themselves both nationally and internationally.

Significant attention in the accreditation process is also devoted to safeguarding students' interests and protecting the rights of consumers of educational services. Specialized institutions, such as the Office of the Independent Adjudicator (OIA), address student complaints and ensure fair resolution of disputes (Office of the Independent Adjudicator, 2018). This promotes transparency and integrity in the educational process, enhancing trust in educational institutions. Furthermore, mandatory standards concerning health and safety in workplaces are also scrutinized by state authorities. These requirements are a critical component of the accreditation process for educational and training programs, particularly in fields with elevated risks. Ultimately, students are assured not only of the academic quality of VET but also of the social responsibility of educational institutions.

In conclusion, the British experience in ensuring the quality of VET is distinguished by a comprehensive legislative framework and clearly defined control procedures. A key feature lies in the collaboration between state regulatory bodies, educational institutions, and employers. Another significant aspect is the role of independent agencies that monitor and accredit programs, ensuring transparency and compliance with established standards (Department for Education, 2021c). The Quality Assurance Agency for Higher Education (QAA) and the Office of Qualifications and Examinations Regulation (Ofqual) play leading roles in shaping requirements for educational programs and the training of specialists. An additional advantage of the British system is the principle of «lifelong learning», which promotes flexible forms and methods of professional education. This approach is enshrined at the legislative level, encouraging continuous qualification updates and workforce retraining. The Education and Skills Act provides for the modernization of educational programs in line with labor market needs (Education and Skills Act, 2008). As a result, the British VET system aligns with international quality standards, fostering the internationalization of educational programs and enhancing the mobility of professionals.

Thus, the legal framework for ensuring VET quality in the United Kingdom enables a decentralized management model, partnerships between the state and businesses, structured qualification frameworks, independent inspection activities, and various financial incentives for educational institutions. A critical role is also played by the regulation of access to professions through licensing and a system of continuous professional

development, flexible educational pathways, and the international recognition of British qualifications. Thanks to this comprehensive legal quality assurance system, the UK maintains a leading position in training competitive specialists capable of meeting the demands of the modern labor market and the requirements of a globalized economy. Indeed, VET in the UK provides opportunities for diverse groups of learners–from those seeking basic qualifications to those aiming to combine work with a university degree. Combined with state reforms and flexible mechanisms for engaging employers, this structure enables rapid responses to contemporary challenges and the development of competitive professionals.

Moreover, the quality control and accreditation system for VET in the UK is well-structured and multi-tiered. The presence of specialized bodies such as the Office for Standards in Education, Children's Services and Skills (Ofsted), Ofqual, QAA, the Institute for Apprenticeships and Technical Education (IfATE), and the Education and Skills Funding Agency (ESFA), alongside the involvement of professional awarding organizations, ensures comprehensive oversight and regular improvement of educational programs (Department for Education, 2021c; QAA, 2021b). Each of these institutions fulfills specific functions, ranging from funding and inspection to the development and implementation of standards. Their coordinated interaction guarantees that programs meet the needs of the labor market, employers, and learners. The outcome of this collective effort is a high level of graduate competitiveness, not only in national but also in global markets. Overall, the British VET system continues to evolve, offering effective quality assurance mechanisms and reliable accreditation.

The mechanisms for external and internal quality control of VET in the UK are both comprehensive and effective. They integrate institutional audits, accreditation, self-assessment, and continuous improvement, ensuring that educational programs adhere to high standards (Department for Education, 2019b). External bodies such as Ofsted and QAA serve as independent guarantors of quality, establishing transparent criteria and providing objective evaluations. Internal self-assessment and monitoring mechanisms facilitate a dynamic approach to enhancing learning processes. This integrated system positively impacts graduate competitiveness by equipping them with relevant skills and competencies. Furthermore, it fosters closer collaboration with employers, who have a vested interest in training highly qualified personnel. Despite challenges related to funding and rapid technological changes, the British model demonstrates

adaptability. It continually evolves by incorporating new assessment and control tools to meet contemporary societal needs, underscoring the importance of balancing state regulation with institutional autonomy. Ultimately, the British experience in ensuring VET quality can serve as a model for countries seeking to reform their own vocational education systems.

Accreditation agencies play a pivotal role in the British VET system, simultaneously coordinating inspections, formulating recommendations, and creating incentives to elevate standards. Through clear and transparent criteria, they facilitate fair assessments, while their thorough recommendations support continuous improvement (Ofsted, 2020b). An effective incentive system encourages educational institutions to remain competitive, adopt innovative technologies, and enhance the professional competence of teaching staff. Close collaboration with the government ensures alignment between national priorities and the actual demands of the labor market, while a partnership-based dialogue with colleges and universities transforms accreditation into a driver of improvement rather than a punitive mechanism. At the same time, accreditation bodies demonstrate agility in responding to contemporary challenges, updating standards in accordance with economic conditions (Department for Education, 2021c). The effectiveness of their work is evidenced by positive graduate employment statistics, student feedback, and widespread global recognition. As a result, the United Kingdom maintains its reputation as a country with an advanced and adaptable vocational education system. It can be argued that the British accreditation model exemplifies a successful integration of governmental priorities, employer needs, and the aspirations of educational institutions for excellence. Its adaptability, transparency, and results-oriented approach are key factors underpinning the UK's leadership in training highly skilled professionals.

A critical component of the success of the British VET system is the continuous professional development of teachers. National legislation supports educators in enhancing their professional skills and acquiring new competencies (British Council, 2021). In many colleges, teachers regularly participate in professional development courses, internships, and masterclasses organized by industry associations. Furthermore, there are explicit requirements for pedagogical excellence, including proficiency in modern teaching methods and the ability to apply innovative technologies in practice. Some educational institutions actively collaborate with employers,

inviting them to deliver guest lectures and seminars, which ensures that teachers remain abreast of the latest industry trends. To maintain the quality of education, the state promotes transparency in the development of curricula and accountability in their implementation (Ofsted, 2019b). Employers contribute to the formulation of standards, ensuring that training programs align with real-world labor market needs. Consequently, students receive high-quality vocational training, while teachers benefit from robust support for their professional growth. This approach not only enhances the reputation of colleges but also facilitates more successful employment outcomes for graduates. British VET educators are regarded as among the best in Europe, a status corroborated by international comparative studies.

The experience of Great Britain serves as a valuable reference point for Ukraine, as the domestic vocational education system is still undergoing reform and requires new quality standards and mechanisms to ensure their implementation (Radkevych, 2021). First and foremost, it is essential to strengthen the legislative framework by clearly defining requirements for the accreditation of vocational education institutions, evaluation criteria, and accountability mechanisms for their leadership. There is a need to establish an independent body or enhance existing institutions tasked with conducting inspections and audits of vocational education institutions, similar to Ofsted (Ofsted, 2019b). Such inspections would help identify issues, provide recommendations for improving the quality of education, and monitor the implementation of these recommendations. At the same time, it is crucial to align the National Qualifications Framework with European and global standards. This would facilitate the international recognition of Ukrainian diplomas and expand employment opportunities for graduates. Legislative acts should mandate collaboration between educational institutions and employers, including through the development of curricula, the provision of practical training, and the organization of professional internships. State incentive programs, such as tax benefits or grants, would encourage businesses to actively participate in workforce training. Additionally, the attractiveness of the teaching profession must be enhanced by introducing mechanisms for professional development, certification, and career advancement. These measures would collectively establish a solid foundation for the development of high-quality vocational education in Ukraine.

Studying and adapting the legislative tools of Great Britain could significantly improve the quality of vocational training for Ukrainian

specialists. A key step could be the introduction of independent evaluation and accreditation bodies, similar to the QAA in the UK (QAA, 2019). This approach would increase trust among employers and society in the outcomes of training future professionals. Simultaneously, the regulatory framework should be updated to promote close cooperation between vocational education institutions and businesses. British practice demonstrates that collaboration with employers ensures the ongoing relevance of educational programs. Mechanisms for rapidly updating educational content would enable the system to address the needs of the modern labor market. Such flexibility is made possible by provisions enshrined in the Technical and Further Education Act (Technical and Further Education Act, 2017). In Ukraine, institutional changes should be supported by expert input and adequate funding. The establishment of an independent agency for accrediting educational programs could serve as a driving force in enhancing the quality of vocational education.

Adapting British legislative tools in Ukraine requires meticulous work on the licensing and accreditation procedures for vocational education institutions. In Great Britain, this area is governed by a broad range of acts that clearly outline requirements for educational programs and qualifications (The Further and Higher Education Act, 1992). Achieving a balance between state oversight and the academic autonomy of educational institutions is a critical factor in successfully reforming the vocational education system. Thanks to their relative freedom, British colleges can swiftly adapt to technological and economic changes. Ukraine needs similar procedures to effectively monitor the quality of the educational process through external audits. However, excessive bureaucracy must be avoided to prevent delays in updating educational and training programs. It would be beneficial to create a national data platform on the quality of educational programs, where inspection results and graduate employment outcomes could be published. Transparency and accessibility of information would foster public and employer confidence in vocational education. Furthermore, establishing international accreditation criteria would enhance the global competitiveness of Ukrainian vocational education institutions. These measures would elevate their reputation and attract more applicants. Clearly defined national standards for assessing learning outcomes are a prerequisite for improving the quality of vocational education. In Great Britain, Ofqual plays a central role in regulating qualifications, examinations, and assessment methods (Ofqual, 2019b). The Institute for Apprenticeships and Technical Education

sets requirements for professional standards across various sectors, ensuring alignment between theory and practice (Institute for Apprenticeships and Technical Education, 2020). This comprehensive approach enables graduates to successfully apply their knowledge in the workplace. In Ukraine, a similar approach could be implemented by developing sector-specific standards that clearly define competencies and learning outcomes. An entity should be established to coordinate the involvement of educational institutions and employers in shaping these standards. Legislative acts must outline evaluation principles that ensure educational programs meet current labor market demands. This would bridge the gap between the theoretical knowledge of students and the practical requirements of employers. Additionally, procedures for promptly updating standards in response to rapid technological advancements should be put in place. Effective coordination of these processes would make Ukraine's vocational education system appealing to both domestic and international audiences.

The modern labor market demands flexible forms of education and the creation of opportunities for continuous professional development of specialists. In the United Kingdom, a wide range of modular programs, short-term courses, and dual education initiatives have been established to facilitate rapid upskilling (European Training Foundation, 2019). In Ukraine, implementing similar approaches requires the introduction of legislative mechanisms to recognize the outcomes of non-formal and informal learning. It is essential to ensure the continuity of educational pathways, enabling learners to progress seamlessly from initial to advanced levels of training. British legislation guarantees flexibility in transitioning between programs and the accumulation of educational credits (Office for Students, 2020). Should Ukraine adopt this approach, its vocational education system would become more responsive to the needs of diverse population groups. Promoting dual education programs and internships could enhance workplace-based learning efficiency. It would be prudent to introduce tax incentives or grants for employers who actively support practical training initiatives. Such synergy between education and business would enable the swift adoption of new technologies and bolster economic competitiveness. Thus, establishing a legislative framework for diverse learning formats is a critical prerequisite for the successful modernization of vocational education in Ukraine.

A significant role in adapting the British experience lies in collaboration with employers and professional associations. In the UK, these

organizations contribute to developing standards and assessment criteria, ensuring the relevance of educational programs (Peresh et al., 2023). In Ukraine, this practice is beginning to take shape but lacks adequate legislative backing. It would be advisable to formalize coordination mechanisms between government institutions, vocational education providers, and businesses to promptly address labor market demands. This approach would facilitate the identification of priority sectors for specialist training and the allocation of resources to their development. Legislation should provide incentives for businesses to engage in the educational process, such as tax benefits or state-funded contracts. In the UK, collaboration with professional associations supports the continuous improvement of programs and teaching methods. In Ukraine, implementing similar principles is feasible provided employers and industry experts are actively involved in reforming vocational education. Such partnerships enhance the quality of vocational training and foster the development of relevant competencies in future specialists. Ultimately, strengthening cooperation with employers would bring Ukraine closer to the level of professional training characteristic of countries with leading global economies.

Continuous improvement of teaching staff is an integral component of enhancing the quality of vocational education. In the UK, clear qualification requirements for educators are in place, and professional development programs are supported at the state level (Department for Education, 2021c). In Ukraine, insufficient attention to teachers' professional development hinders the adoption of modern methodologies and technologies. Legislation should mandate professional development courses for educators, particularly in rapidly evolving sectors. Developing criteria for assessing teaching quality would encourage educators to pursue professional growth. State support and incentives for collaboration between teachers and employers could better integrate real-world production processes into curricula. Adopting the UK's experience in this regard entails ensuring continuous training for educators and access to cutting-edge practices. This would not only update educational content but also increase learners' overall motivation. Certification or licensing of teachers could serve as an additional tool for quality control in education. Ultimately, the professional development of educators directly impacts the training of competitive specialists for the labor market.

In the context of contemporary digitalization, attention should be given to the development of distance learning and the implementation of innovative methods in professional education. British legislative practice supports the deployment of online platforms and digital resources, significantly expanding access to education (Office for Students, 2020). In Ukraine, this format gained popularity during the COVID-19 pandemic, yet it still lacks a sufficient legislative framework. The regulation of online learning should include the recognition of distance course outcomes and the establishment of clear quality standards. This would enable learners, particularly adults, to balance work and education while acquiring new skills without interrupting their professional activities. The legitimization of online examinations and digital tools for knowledge assessment would enhance the transparency and efficiency of evaluation processes. The example of the United Kingdom demonstrates that digital solutions can engage a broader audience interested in career advancement. In Ukraine, it is necessary to upgrade the technological infrastructure of educational institutions and ensure access to high-speed internet. Legislative changes should also address the protection of academic integrity and guarantees of information security. Thus, adopting the British experience in the field of digital technologies in education could serve as a catalyst for improving its quality and accessibility.

Financial support is one of the decisive factors in developing a professional education system based on the British model. In the United Kingdom, flexible funding models combine government subsidies, private investments, and grant programs (Technical and Further Education Act, 2017). Ukrainian legislation currently lacks clear mechanisms for the formation and allocation of funds to meet the needs of professional education institutions. Developing such mechanisms would enable the accumulation of resources for implementing new technologies and upgrading material and technical facilities. Public procurement for training specialists in priority sectors should be shaped with input from employers. This approach would direct investments toward the most promising areas and address the economy’s needs. Providing learners with preferential loans to master strategically important professions would enhance employment levels and professional mobility. The British experience shows that the state benefits from an improved qualification level of the workforce and increased innovative potential. Ensuring transparency and accountability in the use of financial resources is critical to mitigating corruption risks. Consequently, a competent financial policy would lay the foundation for the successful

implementation of British practices in Ukraine's professional education system.

Leveraging British expertise in Ukrainian professional education opens broad prospects for qualitative improvements and enhanced competitiveness on the international stage. Priorities should include the development of independent accreditation bodies, flexible educational standards, and lifelong learning opportunities. Active collaboration with employers and professional associations, which can provide valuable feedback and resources, plays a key role. The widespread use of digital technologies and distance learning formats would allow for reaching a larger audience and accelerating the adaptation of educational programs to market demands. Effective reform also requires the professional development of educators to enable them to teach according to updated standards. The state must ensure adequate funding and create incentives for private sector investment in the education sector. A comprehensive approach encompassing all components of the educational process would yield significant results in a short timeframe. With proper management and rigorous oversight of reform implementation, the new model of professional education would align with international standards. The British experience demonstrates that legislative reforms can have a long-term positive impact on economic and societal development. Ukraine has every opportunity to adopt this experience and establish a professional education system capable of flexibly responding to global challenges and labor market needs.

Another critical direction for reforms in Ukraine should be fostering a closer connection between professional education institutions and the labor market. The British example illustrates that involving employers in shaping educational and training programs and standards ensures their ongoing relevance (CEDEFOP, 2020). In Ukraine, such practices remain fragmented and are not consistently regulated at the state level. Therefore, it would be expedient to legislatively mandate professional education institutions to maintain communication with businesses and incorporate employers' recommendations when developing educational and training programs. This could be facilitated through sectoral councils, professional associations, or career centers within professional education institutions. To encourage greater employer participation, tax incentives, subsidies, or grants for implementing dual education models should be introduced. As a result, students would gain not only theoretical knowledge but also practical skills directly aligned with industry requirements. This approach would improve

graduate employability and reduce imbalances between labor market supply and demand. Furthermore, systematic interaction between professional education and businesses would enable institutions to better understand economic needs and respond promptly to technological changes, ultimately enhancing the competitiveness of Ukrainian specialists in the global market.

Within the framework of reforming vocational education in Ukraine, it is advisable to establish a centralized development strategy that includes clear objectives, timelines for their achievement, and monitoring mechanisms. The example of British government programs, which meticulously define the role of each participant in the educational process (Department for Education, 2018), can serve as a model for this purpose. A specialized coordinating body or council could act as a central platform for drafting regulatory acts, approving standards, and overseeing their implementation. Regular reporting, collection of statistical data, and public evaluations of effectiveness would serve as tools for transparency and accountability. An essential component of such a strategy should be the consideration of regional specificities, as the needs and capacities of regions like Zakarpattia or Donetsk differ significantly. A differentiated approach to shaping curricula and specializations would optimize resource allocation and prepare personnel in accordance with the specific demands of each region. Within this strategy, it would be prudent to introduce financial incentives for vocational colleges that demonstrate high-quality education standards and the adoption of innovations. Monitoring and quality control of vocational education should be ensured at all levels to promptly identify challenges and address obstacles. The coherent functioning of this system would foster trust among employers, students, and society in the quality of vocational training. Ultimately, an integrated strategy would provide a solid foundation for the sustainable modernization of the educational sector.

Another critical aspect is enhancing the appeal of vocational education among young people, who often prefer higher education institutions. In the United Kingdom, the idea that vocational qualifications can be as promising as university degrees is actively promoted, as they facilitate faster entry into the labor market (Ofsted, 2019b). This is supported by information campaigns that introduce prospective students to the benefits of vocational colleges and tangible career growth opportunities. Ukraine could adopt this experience by promoting success stories of graduates who have achieved recognition through quality vocational training. Equally important is the development of dual education, where theoretical studies alternate with

practical training at enterprises. This approach enables students to immediately apply their acquired knowledge in the workplace while allowing employers to train personnel according to their own standards. Government bodies could support such learning formats through subsidies, grants, and tax incentives for participating companies. Consequently, vocational education would not only serve as a foundation for theoretical training but also as an effective means of rapidly integrating youth into the workforce. Combining innovative teaching methods, financial support, and clear quality standards would significantly improve the image of vocational education. In the long term, this would strengthen the country's economy by preparing skilled professionals to meet the demands of the modern labor market.

In summary, the British experience in ensuring the quality of vocational education and its application in Ukraine highlights the importance of comprehensive legislative tools and the coordinated efforts of all stakeholders. It is necessary to clearly define the rights and responsibilities of vocational education institutions, teachers, students, and employers, as well as to establish effective monitoring and sanction mechanisms. The experience of Ofsted demonstrates that independent and regular inspections serve as a catalyst for the continuous improvement of the vocational education system (Ofsted, 2019b). Ukrainian reforms should encourage collaboration with businesses, integrate international standards, and implement qualification frameworks to ensure that vocational education remains relevant and competitive. Key to this process is the development of human potential through continuous teacher training, the creation of favorable working conditions, and material incentives. Additionally, efforts should focus on cultivating a positive image of vocational education by emphasizing its role in the dynamic development of the labor market and society as a whole. Information campaigns and employment statistics for graduates could shift public perception, demonstrating that such education offers broad career prospects. Fully implementing these recommendations will require coordinated efforts from the government, parliament, educators, the business community, and international partners. If all elements of the system operate in harmony, Ukraine can establish a truly high-quality and modern vocational education system. Ultimately, this will serve as a cornerstone for socio-economic growth, enhancing workforce productivity and improving the well-being of the country's citizens.

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3.2. THE PROBLEM OF ENSURING THE QUALITY OF VOCATIONAL EDUCATION AND TRAINING IN GERMANY IN CONTEMPORARY SCIENTIFIC DISCOURSE

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The study analyzes the current state of research on the issue, the legal and regulatory framework, terminology, models, methods, and technologies for quality assurance in vocational education and training in Germany. It also substantiates directions for ensuring the quality of vocational (vocational-technical) education and training in Ukraine, taking into account Germany's positive experience. The system for ensuring the quality of vocational education in Germany is one of the most effective and well-developed in the world, and its experience can be useful for many countries, including Ukraine. The key components of this system are dual education, program accreditation, continuous updating of qualifications, and close cooperation with employers. An important factor in the effectiveness of quality assurance in vocational education and training is public-private partnership, which enables the system to adapt to changes in the labor market and contemporary demands.

Keywords: *vocational (technical) education, quality of vocational (technical) education, quality assurance of vocational education and training in Germany*

3.2. ПРОБЛЕМА ЗАБЕЗПЕЧЕННЯ ЯКОСТІ ПРОФЕСІЙНОЇ ОСВІТИ І ПІДГОТОВКИ В НІМЕЧЧИНІ У СУЧАСНОМУ НАУКОВОМУ ДИСКУРСІ

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Проаналізовано стан дослідженості проблеми, нормативно-правову базу і термінологію, моделі, методи і технології забезпечення якості професійної освіти і підготовки в Німеччині, обґрунтовано напрями щодо забезпечення якості професійної (професійно-технічної) освіти і підготовки в Україні з врахуванням позитивного досвіду Німеччини. Система забезпечення якості професійної освіти в Німеччині є однією з найбільш ефективних і добре розвинених у світі, і її досвід може бути корисним для багатьох країн, зокрема для України. Основними компонентами цієї системи є дуальна освіта, акредитація програм, постійне оновлення кваліфікацій і тісна співпраця з роботодавцями. Важливим чинником ефективності забезпечення якості професійної освіти і підготовки є державно-приватне партнерство, що дозволяє адаптувати систему до змін на ринку праці та вимог часу.

Ключові слова: *професійна (професійно-технічна) освіта, якість професійної (професійно-технічної) освіти, забезпечення якості професійної освіти і підготовки в Німеччині.*

Around the world, quality and efficiency are becoming key in the educational policy of states and are becoming a top priority of international strategies in the field of vocational education and training. The relevance of the study of the problem of ensuring the quality of vocational education and training in Germany is due to the growing demands on the competence of specialists in the globalised labour market, the integration of digital technologies into the educational process and the need to adapt to rapid economic and social changes.

The study of German experience is important for improving the vocational education system in other countries, including Ukraine, which is in the process of reforming its education policy in line with European requirements. Germany's active involvement in the development and improvement of the vocational education system at the international level, as well as its support for the reform of vocational education in Ukraine, is evidenced by the visit of the Federal Minister of Education and Research of Germany, Bettina Stark-Watzinger, in February 2023, during which she visited the Kyiv Higher Vocational School of Construction and Design and learned how the institution operates in response to the challenges of russian military aggression. The information report on this diplomatic event states that in 2020, Ukraine launched the EU4Skills: Better Skills for Modern Ukraine programme, under which in 2022 the German Society for International Cooperation provided assistance to 58 hubs based on VET institutions, psychological support, and took measures to purchase 18 buses for VET institutions (Cabinet of Ministers of Ukraine, 2023).

With the support of the above-mentioned programme, a qualitative study was commissioned by the German Society for International Cooperation (GIZ) to plan and implement the national campaign of the Ministry of Education and Science of Ukraine to reform vocational education, in which the author of this text participated as an expert. The results are presented in the subsection "Implementation of a qualitative research project on educational reform in Ukraine within the framework of the EU4Skills programme (online case study)" of the collective monograph 'Hybrid education: models, world practices, Ukrainian implementation" (Liman, I., Semenets-Orlova, I., Polishchuk, E., Romanova, G., Khyzhnyak, O., Ivashchenko, A., Klochko, A., Lebed, N., Tashkinova & O., Zhabin, S, 2023, p. 249–258).

The quality assurance system for vocational education in Germany is one of the most developed in the world, characterised by a high level of

integration between education and industry, a focus on training highly qualified specialists and ensuring their ability to adapt to changes in the labour market. In the field of vocational education, Germany has a long tradition of combining theoretical knowledge and practical experience, and great attention is paid to ensuring the quality of education and compliance with both labour market and social standards, which is implemented through close cooperation between educational institutions, enterprises and government agencies.

The interest of scientists in ensuring the quality of vocational education in Germany is driven by high graduate employment rates and, accordingly, low youth unemployment compared to other EU member states, as well as the desire to adapt educational processes to the challenges of the modern labour market and social transformations.

In the field of vocational education in Germany, the issues of quality assurance have been studied by T. Deisinger, L. Deitmer, P. Kamarainen, S. Manning, M. Mudler, E.-S. Sarv, D. Bridges, S. Alle, R. Alexander, P. Broadfood, E. Wolf, M. Coles, M. Young, etc. Among domestic researchers, O. Borodienko, S. Leu, O. Melnyk, N. Opushko, L. Pukhovska, V. Radkevych, O. Radkevych, O. Samokhval, and others have paid attention to this issue.

In Germany, the term Berufsbildung is used for vocational education and training, which is mostly used in connection with basic vocational education and training and is clearly associated with the dual apprenticeship system. Its official translation: Vocational education and training (VET) (Radkevych et al., 2018b, p. 55, 56).

Studies show that the concept of quality varies depending on the context of individual national education and training systems, but the common feature is that the vocational education and training system meets the needs of the environment in which it operates (Radkevych et al., 2018a, p. 45). In particular, the EU quality assurance concepts include measures aimed at ensuring that education and training meet the expectations of stakeholders.

Modern reforms of vocational education in Germany are primarily focused on ensuring high quality training that meets the requirements of the national and international labour market. They also promote the development of a culture of continuous education among the population and provide state support for young people at the stages of vocational training and employment. Analysing the trends in the development of vocational

education in Germany, O. Samokhval (2020) identifies three areas of reform of German vocational education: social (encouraging the population to obtain educational degrees to ensure a high level of education in Germany; involving the population in lifelong learning as a guarantee of successful employment and self-development of future professionals); economic (Germany's assistance in the employment of young people at home and abroad in cooperation with EU member states; attracting industrial and commercial partners). The researcher states that, realising the importance of vocational education for the future economic growth of the country, Germany is constantly working to improve the state and quality of vocational training of future professionals.

The justification of national systems of quality assurance in education requires the study of relevant models of education, which are formed on the basis of historical traditions, peculiarities of governance, mechanisms of education regulation, etc.

Based on the classification by place of study, the Classifier of the German Institute for Labour Economics (W. Ichhorst, Nuria Rodriguez-Planas, R. Schmidl, K.A. Zimmermann) (Radkiewicz et al., 2018b, p. 59) contains five models of vocational education and training systems: 1) vocational schools; 2) vocational training centres; 3) traditional apprenticeships; 4) a dual system combining education in an educational institution with on-the-job training; 5) non-formal vocational training.

According to another classification of the Berlin University of Technology, (G. Wolf-Dietrich) (Radkevych et al., 2018b, p. 59), the following models of vocational education in Europe are identified: 1) traditional apprenticeship; 2) vocational schools; 3) market-oriented; 4) dual.

The VET system in Germany consists of three sectors (Solga et al., 2014, p. 3):

1. The well-known dual system - a combination of work-based learning and school education (apprenticeships).
2. Full vocational training programmes based on schooling - mainly for middle-level white-collar workers (especially in healthcare, social work and media, which are predominantly female professions, e.g. nurses, kindergarten teachers, medical assistants).
3. The pre-vocational training sector, known as the “transitional system”, includes programmes that do not lead to vocational qualifications.

Both dual and purely school-based vocational education and training programmes are highly specialised and provide full qualifications, which are

confirmed by state-issued certificates. It is important to note that these two sectors train specialists for different professions. That is, the choice of the sector of study is determined by the profession for which a person is studying. In other words, in Germany, the two sectors are not alternative study paths for the same profession as in Denmark (Solga, 2014, p.27).

In contrast to these two sectors, pre-vocational training programmes do not lead to a professional qualification. They usually last one year (sometimes from a few months to two years). Some of them include practical on-the-job training, but most are entirely school-based. It is rare to find a job immediately after graduation in Germany, as in most federal states education (general or vocational education) is compulsory until at least the age of 18.

The authors of the monograph "Quality Assessment Systems of Vocational Education and Training in the European Union" (Radkevych et al., 2018a, pp. 140–142) emphasize several specific features of the development of Germany's quality assurance system in vocational education and training. These include the legislative regulation of standards, curricula, and program updates; the independence of accreditation for education providers and programs; the autonomy of quality assurance systems in the federal states of Germany; and the key role of employers in ensuring the quality of workforce training. In particular, vocational education and training (VET) quality in Germany is governed by the Vocational Training Act (BBiG) and the Crafts and Trades Regulation Code (HWO). These laws set standards for educational institutions, instructors, curricula, and examinations, which are reviewed every two years to stay aligned with technological advancements. Compliance with these requirements is monitored by local educational authorities as well as specialized quality assessment bodies. Despite the fact that each region may have its own characteristics in vocational training, the national standard for upper-secondary vocational education in a specific profession remains unified across the country (Radkevych et al., 2018b, p. 71).

The accreditation of education providers and programs is carried out by private certification bodies operating in accordance with state-defined criteria. The Federal Ministry of Education and Research (BMBF) funds independent evaluations of educational institutions. The Federal Institute for Vocational Education and Training (BIBB) and the German Institute for Adult Education (DIE) administer an online platform that supports lifelong learning and enables annual labor market monitoring.

Each federal state of Germany has its own system for ensuring the quality of vocational education, which includes both external and internal evaluation. External control is carried out by inspection bodies, while internal evaluation focuses on the continuous improvement of quality based on national and European standards, including EQAVET. The annual report of the German Federal Ministry of Education contains data on the quality of VET and is used to make political decisions regarding the further development of the educational system.

Regional branches of the Chambers of Commerce and Industry are responsible for organizing final exams for vocational education students. Although the tasks for the final exams are developed by competent institutions at the national level, regional branches independently determine the extent of their use. In some federal states (Länder) of Germany, centralized written final exams have been introduced for students of initial vocational education at the school level. The Ministry of Education of the respective federal state coordinates the process of developing assessment procedures, within which teachers create task variants. After reviewing these proposals, the Ministry forms the final version of the assessment sheet for all participants in the program with the same specialization (Radkevich et al., 2018a, p. 93).

The active involvement of employers in ensuring the quality of workforce training is primarily implemented in Germany's dual education system. Employers are involved in developing educational standards, programs, and creating modern workplaces. The Federal Association of Employers (BDA) plays a key role in shaping VET policy, while control over vocational education institutions is carried out by craft and trade chambers.

The Federal Government is responsible for organizing vocational training in enterprises, while vocational schools fall under the responsibility of the federal states. However, ensuring the quality of vocational training within the dual system is a shared responsibility of both enterprises and vocational schools. Nevertheless, the primary responsibility for the training process lies with the enterprises (Hippach-Schneider & Huismann, 2016).

In Germany, employers and trade unions jointly define the requirements for worker qualifications within the framework of relevant standards. In practice, any cooperation in the field of vocational education is based on achieving consensus: no regulatory act related to vocational

education or further training can be adopted if it contradicts the position of even one social partner. Therefore, reforms in this area are either initiated by social partners or must have their full support (Hippach-Schneider & Huismann, 2016). Employers who take on trainees are responsible for setting training goals, complying with the Vocational Training Regulations, providing training resources, conducting medical examinations, organizing off-the-job training activities, signing vocational training contracts, registering candidates for exams, etc. At the same time, trainees must complete training tasks, adhere to the internal rules of the enterprise, take care of its interests, maintain confidentiality of trade secrets, keep necessary records, undergo medical examinations, etc. (Hippach-Schneider & Huismann, 2016).

In contemporary scientific discourse, particular attention is given to Germany's dual education system, its regulatory mechanisms, the cooperation between educational institutions and enterprises, as well as the influence of European educational standards on its development.

The German dual system originated from the craft sector and its craft guilds in the nineteenth century, and throughout the twentieth century, it remained the main form of training organization in the industrial manufacturing sector. In the second half of the twentieth century, service sector professions were incorporated into the dual system, but to a much lesser extent than working-class professions, for which training primarily takes place in a school-oriented system (Solga et al., 2014, p. 21).

The legal framework of the dual system of vocational education in Germany is thoroughly analyzed by N. Opushko (2022). The researcher notes that the dual form of vocational education is a strategic direction of the German government's activities and is therefore regulated by laws on vocational training (BBiG), on promoting vocational training (BerBiFG), the Youth Employment Protection Act (JArbSchG), the Vocational Regulations (HWO), and others. Although the focus is on higher vocational education, a general trend is identified, such as the heterogeneity and inconsistency in some aspects of dual training, which is related to differences in the approaches of different federal states.

In the field of secondary vocational education, according to German legislation, the subjects of training in the dual system are subject to the requirements of both the Federal Vocational Education and Training Act and

the State School Act, which obliges students under the age of 18 to attend vocational school until its completion. Additionally, important legal acts for the development of vocational education include the Vocational Education Promotion Act, which regulates the development and statistics of vocational education, the Constitutional Act on Enterprises, which grants their representatives the right to participate in the management of vocational training, and the Regulation on the Protection of Minors at Work, which defines provisions for the protection of students and young workers.

A significant role in the training of specialists in craft professions is played by the Vocational Regulations, which regulate the conditions of vocational training and the use of Vocational Training Contracts. These contracts are concluded between students (or their parents in the case of minors) and employers, and become legally binding after signing. The contracts specify the terms of training, stages and duration of training, the probation period, the amount of wages, and other important conditions. Vocational training must be conducted according to the curriculum, with the provision of necessary training resources to students, and adherence to the educational principles of the training process. Instructors and production training masters are required to carry out vocational training in accordance with approved standards and ensure the safety of students. Students, in turn, must diligently complete professional tasks, adhere to the established order, use tools and equipment safely, and ensure the confidentiality of business secrets of the enterprise where they are undergoing training (Radkevich et al., 2018b, p. 80–82).

Vocational training in the German dual system is organized according to the Regulations on the Organization of Vocational Training, which is developed through close cooperation between entrepreneurs, trade union representatives, and researchers, including the Federal Institute for Vocational Education. These regulations serve as both the legal and didactic foundation for carrying out vocational training in designated professions at enterprises. According to the Vocational Education and Training Act, they describe the following: the name of the profession, training duration, the characteristics of professional skills and knowledge, the typical curriculum, as well as the requirements for taking exams.

The typical curriculum defines the structure and order of training, based on which each enterprise creates its own plan and programs that ensure

a uniform level of preparation for specialists in a particular profession. The duration of training is determined by the complexity of the profession and can range from two to three and a half years, with the possibility of shortening or extending the training period upon the enterprise's request to the relevant authorities, such as the chambers of commerce, craft chambers, or agricultural chambers. The activities of the chambers also include supporting vocational training through advising trainers and trainees, as well as organizing interim and final exams.

Training in vocational schools is based on a "framework curriculum," which includes the goals and content of education, divided into various "fields" of study. The aim of vocational education is to develop technical, social, and personal competencies that enable future professionals to carry out their professional activities independently. The vocational school curriculum consists of 60% of the time dedicated to specialized subjects and 40% to general education subjects. The vocational school complements the practical training by expanding students' knowledge in the humanities and social sciences.

An important aspect is the possibility of updating the curriculum content in accordance with changes in technical and technological requirements that arise in the respective industries. Vocational training consists of studying general professional subjects in the first year of training, while specialized training takes place in the second and third years. Additionally, ensuring the professional mobility of specialists within the European Union is an important element of this system.

Training at enterprises is based on standards that define the set of competencies, minimum training requirements, and exam requirements for the final exams. Industry-specific practical courses allow students to acquire skills working in real production conditions, which fosters their independence and responsibility for task completion. Vocational training includes the development of social skills, such as the ability to work in a team and achieve a common goal, which facilitates the transition to the real labor market.

Innovative teaching methods aimed at developing future professionals' independent working skills are actively implemented in vocational schools, particularly through project-based learning. During project activities, students independently solve complex practical tasks, often working in

groups. Educators strive to make the theoretical part of the training as close as possible to real production situations, for example, by using the case method (Kulalaeva et al., p. 33).

Instructors at vocational schools closely collaborate with production training masters to coordinate curricula and prepare for exams, as well as participate in vocational education committees and examination boards. Production training masters are responsible for the quality of practical training, providing students with tasks that correspond to the level of their training course (Radkevich et al., 2018b, p. 102–103).

The relevant and important issue is the implementation of the experience of Germany's dual vocational education in Ukraine. T. Deissinger (2015) notes that there are fundamental arguments that effectively make it impossible to "copy" the German system of initial vocational education, and he points out that it is unreasonable to attempt to transfer the German experience to both industrialized and developing countries without considering these factors. The researcher suggests that even a vocational training system that closely resembles the German apprenticeship model would likely function differently and have different consequences if implemented in another country, considering cultural and historical specifics. First and foremost, this is related to a key feature of the German system: the involvement of business in both industry and education. In this context, the development of Public-Private Partnerships (PPP) is a necessary condition for the implementation of dual education in Ukraine.

V. Radkevich (2024) emphasizes that dual education in Germany is the result of institutional cooperation between government bodies and the private sector. The creation of an effective system that meets the needs of the country's economy is facilitated by the activities of the Federal Institute for Vocational Education and Training (BIBB), which develops standards, educational and training programs, and coordinates their implementation in collaboration with companies that provide students with opportunities to gain practical experience directly in the workplace. Considering the experience of ensuring the quality of VET in Germany, the system of evaluation and quality control based on PPP in Ukraine should be flexible, multi-level, dynamic, and adaptable to changes in the labor market. Joint development of quality standards, integration of theoretical and practical training content, as well as the active implementation of digital tools and data

analysis, contribute to strengthening the quality of vocational education and ensuring its relevance to the current economic challenges.

The implementation of the Hamburg model as an experiment was carried out in the Baltic states and Hungary (Priedulena, n.d.). The results obtained were generally assessed as positive, although a number of issues were identified, including: businesses being less interested in contributing to the costs of education, particularly during periods of significant unemployment; the limitations of current workplace training, such as a limited number of job positions for young workers and the need for a significant amount of time for practical training; and a high degree of bureaucratization.

Thus, ensuring the quality of vocational education in Ukraine requires comprehensive changes in the educational system, including the implementation of the dual education system, the development of collaboration with enterprises, the improvement of vocational education standards, as well as the creation of a monitoring and certification system. Taking into account the positive experience of Germany in these areas will help improve the quality of vocational training in Ukraine and ensure that educational programs meet the current labor market demands.

Taking into account the positive experience of Germany, several key areas can be identified for improving the quality assurance system of vocational education in Ukraine. First and foremost, it is necessary to establish mutual recognition of qualifications between Ukraine and EU countries, particularly through the harmonization of national educational standards with international ones. It is also important to intensify efforts to improve the regulatory framework that governs the models and mechanisms of cooperation between vocational education institutions and businesses, as well as to create conditions for motivating and involving social partners in the practical training of future specialists within the dual education system. Furthermore, the development of public-private partnerships plays a significant role as a factor in ensuring quality: this includes the development of quality standards, adaptation of educational programs to labor market needs, modernization of the material and technical base, strengthening the dual component, and improving the professional level of educators.

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3.3. MODERN APPROACHES TO ENSURING THE QUALITY OF VOCATIONAL EDUCATION IN UKRAINE

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The article analyzes the legislative acts and regulatory documents governing the quality of vocational education in Ukraine; characterizes the concept of «quality of vocational education» and the components of the system of its provision; defines modern approaches to ensuring the quality of vocational education in Ukraine and the peculiarities of the development and functioning of the internal system of quality assurance in vocational education institutions, taking into account the actual needs of consumers.

Keywords: *education quality assurance system, quality of vocational education, vocational education, approaches to ensuring the quality of vocational education, consumers of educational services.*

3.3. СУЧАСНІ ПІДХОДИ ДО ЗАБЕЗПЕЧЕННЯ ЯКОСТІ ПРОФЕСІЙНОЇ (ПРОФЕСІЙНО-ТЕХНІЧНОЇ) ОСВІТИ В УКРАЇНІ

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Проаналізовано законодавчі акти і нормативно-правові документи, що регламентують забезпечення якості професійної (професійно-технічної) освіти в Україні; охарактеризовано поняття «якість професійної (професійно-технічної) освіти» та складові системи її забезпечення; визначено сучасні підходи до забезпечення якості професійної освіти в Україні та особливості розвитку й функціонування внутрішньої системи забезпечення якості освіти у закладах професійної (професійно-технічної) освіти з урахуванням актуальних потреб споживачів освітніх послуг.

Ключові слова: *система забезпечення якості освіти, якість професійної (професійно-технічної) освіти, професійна (професійно-технічна) освіта, підходи до забезпечення якості професійної (професійно-технічної) освіти, споживачі освітніх послуг.*

The implementation of strategic goals of the state policy in accordance to the national programs of the Recovery Plan of Ukraine, sustainable development, European integration, digitalization, and the development of Industry 4.0 affect the transformation of education significantly, focusing on its quality as the basis for political and economic independence and competitiveness of the state at the international level. The current vocational education and training (VET) system reforms aim to provide Ukrainian

citizens with access to quality VET and a wide range of flexible educational opportunities. For the labor market, these reforms are expected to supply competitive workers to the country's restoration and reconstruction. The responsibility of the state and society for improving the quality of VET is also determined by the growing demands of stakeholders who serve as both providers and consumers of educational services. The common desire for victory and European integration, overcoming political and socio-economic crises, achieving well-being, and ensuring decent working conditions actualize the need to approach modern quality assurance in VET.

According to the national legislation, «quality of education is the compliance of learning outcomes with the requirements established by law, the relevant education standard and/or the contract for the provision of educational services», and «quality of educational activity is the level of organization, provision and implementation of the educational process that ensures that individuals receive quality education» (Verkhovna Rada of Ukraine, 2017a). In the research of the European Center for the Development of Vocational Education and Training, «quality is the degree to which the existing characteristics meet the requirements» (CEDEFOP, 2011), also the essence of the concept of «quality in vocational education and training» is characterized by dynamism with changes in the values, goals, resources of stakeholders, and the context of vocational education and training.

The national VET system in today's conditions is characterized by modernization processes, which are undoubtedly associated with changes in the values and goals of its current and future development. The transformational approach to ensuring the quality of VET is based on the implementation of the tasks of modern national programs in economic and educational development. For example, the Strategic Plan of the Ministry of Education and Science of Ukraine until 2027 «Education of Winners» defines five goals under priority 4: «Transformation of Vocational Education» to: create an effective network of VET and professional pre-higher education institutions with modern infrastructure; ensure the acquisition of educational and professional competencies for personal development and successful career; attractiveness and prestige of VET and professional pre-higher education institutions for studying and working in them; effective use of their own organizational, academic and financial autonomy and obtaining result-oriented funding; establishing partnerships with business (Ministry of Education and Science of Ukraine, 2024).

The defining goals for the period until 2030 include ensuring comprehensive and equitable quality education and promoting lifelong learning opportunities for all; promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all; creating sustainable infrastructure, promoting inclusive and sustainable industrialization and innovation (Verkhovna Rada of Ukraine, 2019a).

The priorities of vocational education transformation and sustainable development goals of Ukraine correspond to the main tasks of the Concept of Implementation of the State Policy in the Field of Vocational Education «Modern Vocational Education» for the period up to 2027 (Verkhovna Rada of Ukraine, 2019b) and the corresponding Action Plan for 2020–2027 for its implementation (Cabinet of Ministers of Ukraine, 2020), which are: decentralization of VET management and financing; quality assurance of VET; public-private partnership in VET and interconnection with the labor market. Implementation of the tasks of ensuring the quality of VET includes: forming the content of VET on a competency-based basis; introducing an internal system of quality assurance and an external system of quality assurance; modernizing the educational environment to ensure innovation, accessibility, transparency, flexibility and openness of the educational process; improving the system of training of teachers in the field of VET with the involvement of highly qualified workers in production and services in the educational process; introducing motivational mechanisms to stimulate the professional activity and development of teachers.

The implementation of tasks to ensure the quality of VET involves their structuring about the priority goals of VET institutions, which are: learning goals (focused on the needs of participants in the educational process, consumers and stakeholders); management and control goals (correlated with the principles of state educational policy and the objectives of national, regional, institutional strategies); goals of partnership and responsibility (use of public-private partnership opportunities and appropriate use of resources to achieve performance results). Achieving VET quality is impossible by focusing only on one aim. After all, quality assurance approaches combine elements of all three goals because each requires various ways to achieve it.

In the process of realizing the learning objectives, the priority is a competence-based approach to ensuring the quality of VET, which involves compliance with the requirements of standards (professional and educational) that define mandatory competencies, a set of knowledge, skills,

and abilities for the quality performance of labor functions in professional activities. In the national VET system, the requirements for the learning outcomes of students of the appropriate level, mandatory key, general and professional competencies, VET content, educational level of applicants, qualification level of a VET graduate, total workload, and the list of basic teaching aids are determined by the State Standard of Vocational Education and Training (Verkhovna Rada of Ukraine, 2021). It is worth noting that the basis for the educational standards development is professional standards – «duly approved requirements for the competencies of employees that serve as the basis for the formation of professional qualifications» (Verkhovna Rada of Ukraine, 2017b).

The interconnection between professional and educational standards ensures that the quality of VET programs meets the needs of the labor market and forms the basis for a gradual transition from qualification characteristics and the grade system to the alignment of professional qualifications with the levels and descriptors of national and European qualifications frameworks. The instruments of the national qualifications framework are also based on competencies, and the processes of confirmation/assignment of professional qualifications in qualification centers, acquisition and/or confirmation of micro-qualifications expand the possibilities of their recognition in different European countries. These processes reflect the European integration approach to ensuring the quality of VET, as both the national and European qualifications frameworks promote the recognition of results achieved in different environments, thus linking formal, non-formal, and informal learning for young people and adults.

The goals of management and control in ensuring the quality of VET are based on compliance with current legislation, adherence to the principles of state education policy, and alignment with the objectives of national, regional, and institutional strategies. A systemic approach to quality management in VET involves considering all influencing factors on priority goals and adapting the characteristics of the elements within the comprehensive quality assurance system. The key directions of the quality assurance system's functioning are reflected in current legislation, which is subject to amendments and additions as required by relevant circumstances. The State Service of Education Quality of Ukraine is responsible for state policy in education, particularly on ensuring the quality of education and educational activities, as well as conducting state supervision (control) over

educational institutions (excluding higher education institutions) to ensure their compliance with legislation.

The components of the national education quality assurance system are: the quality assurance system at educational institutions (the internal quality assurance system); the external education quality assurance system; the system of quality assurance in the activities of governing bodies and institutions that provide external education quality assurance. The processes of improving the criteria for the quality assurance system in the activities of governing bodies and institutions responsible for external quality assurance, as well as the external quality assurance system itself, are based on the results of institutional audits. These processes lead to changes in the development and functioning of other components.

Based on the results of the analysis of the activities of local executive authorities, local self-government bodies, and their structural units on education in terms of compliance with education legislation and ensuring its quality, the State Education Quality Service of Ukraine in 2024 identified the main problems in the field of VET that need to be addressed at the state, regional, and institutional levels. The most crucial issues are: the network of VET institutions is not optimal; funding for training workers in professions that are not in demand in the local labor market; the transfer of institutions subordinated to the Ministry of Education and Science of Ukraine from state to communal ownership has not been completed; conducting the educational process according to curricula that are not approved by the regional education authority and do not meet current professional standards; lack of adequate staffing (especially in non-state-owned institutions); violations in the organization of distance learning; non-compliance with the requirements for qualification certification of students, etc. (State Education Quality Service of Ukraine, 2024). These difficulties are related to the processes of decentralization and gradual delegation of powers to regional authorities, which have certain opportunities to choose approaches for ensuring the quality of VET while adhering to centralized external procedures for its assessment. The prospects for expanding the autonomy and independence of VET institutions, which are laid down in the content of current draft laws in the field of vocational education, will facilitate independent management decisions on the formation and effective functioning of the internal quality assurance system in VET institutions, taking into account the peculiarities of the regional labor market and rapid adaptation to the needs of consumers of educational services in the region.

In this context, the regional approach to the formation of an internal quality assurance system in VET institutions involves the analysis of the socio-economic situation in the region, the involvement of local executive authorities, local governments, their structural units on education, heads of VET institutions, and business representatives in the formation of strategies, monitoring of regional development indicators, taking into account innovative approaches to the implementation of educational policy at the national level. The application of the regional approach to ensuring the quality of VET in the context of decentralization and the expansion of the autonomy of VET institutions is based on compliance with the principles of system development and functioning, namely: integrity (changes in system elements lead to changes in other subsystems), identification (specific features of subsystems that contribute to the functioning of the integral system); openness (influence of external and internal factors at the stages of system functioning); flexibility (prompt response to changes), dynamism (continuous innovative development and improvement of the system), etc.

The issues of forming an internal system of quality assurance in VET institutions are specified by the Order of the Ministry of Education and Science of Ukraine «On Approval of Methodological Recommendations on the Formation of an Internal System of Quality Assurance in Vocational Education and Training Institutions», which states that «an internal quality assurance system is a set of conditions, procedures and measures that ensure the effectiveness of educational and management processes that directly affect the quality of the results of the educational process, formation of key and professional competencies of students, contribute to the comprehensive development of their personality» (Ministry of Education and Science of Ukraine, 2021). The heads of vocational education and training institutions are recommended to approve the Regulation on the internal system of quality assurance in vocational education and training institutions, which provides for the development of a Strategy (policy) and procedure for ensuring the quality of education, which: defines the guidelines for the functioning of the internal system of quality assurance; takes into account the interests of participants in the educational process regarding the quality of educational services and the exercise of their other rights; complies with the principles of state policy in the field of education and the principles of educational activity.

To determine the guidelines for the functioning of the internal quality assurance system in VET institutions and to implement the goals of

partnership and responsibility, it is significant to use a partnership approach based on the principles, technologies, and mechanisms of Public-Private Partnership (PPP).

As noted by V. Radkevych, «the general principles of PPP development in the field of VET provide for interaction between state institutions, private companies and public organizations, stipulate mutual benefit and transparency of activities, innovation in the development and implementation of educational programs, social responsibility and ensuring the availability and quality of VET, as well as sustainability and adaptability to changes in society and the economy». Specific principles are also crucial for improving the quality of VET, its relevance to the needs of the labor market and for creating effective beneficial cooperation between government agencies, the private and public sectors, namely: integrity, cooperation and compromise, linking theory to practice and productive activity, decentralization of management, equality of partners, alignment of interests of the parties to the partnership, social responsibility, benchmarking, co-financing, risk sharing between partners (Radkevych et al., 2023).

The choice of guidelines for the activities of the PPP institution involves the use of management decision-making technology, the stages of which are as follows (monitoring the current situation in the internal and external environment (identifying the problem); developing an optimal solution; making a compromise management decision; feedback from all stakeholders). This technology enables the development of constructive interaction between PPP parties at different levels (Kravets et al., 2023) and its result is a defined direction of innovative development of the VET institution and improvement of the quality of the educational process not only to meet the interests of the PPP subjects, but also with their active participation in these processes.

Mechanisms of PPP contribute to the formation of an internal quality assurance policy in VET institutions, providing them with a certain degree of independence in decision-making and do not contradict the main provisions of current legislation. This includes the application of the roadmap for the development of PPPs in VET, the use of cases of cooperation between business and VET institutions (Radkevych et al., 2024); the algorithm of partnership interaction between entities interested in developing modern professional qualifications for the post-war reconstruction of Ukraine (Kravets, 2024); recommendations for the

establishment of sectoral qualification centers for the award, confirmation and recognition of professional qualifications of various categories of the population, including war veterans and internally displaced persons (Onyshchenko, 2024); Strengthening the role of advisory bodies in the field of VET, which implement advisory, expert-analytical, informational, educational and monitoring and evaluation functions in order to establish cooperation between VET institutions, employers and other stakeholders to improve the quality of vocational training of skilled workers, taking into account the needs of post-war reconstruction of Ukraine (Radkevych, 2024). The partnership approach affects the process of developing and quality of the strategy (policy) for ensuring the quality of PA, specifying in the content of the procedure: planning (setting clear and realistic goals), implementation (determining the necessary structure to achieve the goals), evaluation (developing mechanisms for collecting and evaluating information on the achievement of goals) and review (evaluating the results and making necessary amendments or changes) with the participation of stakeholders. Stakeholders on the basis of partnership, influence the improvement of the quality of VET programs. The level of satisfaction with the quality of educational activities/processes necessitates the revision of strategies and relevant procedures. In addition to participants in the educational process (students, pedagogical, research and teaching staff, parents, etc.), consumers of educational services are employers, the community, the state, and society, whose needs are changing and growing in today's conditions.

In this context, the importance of applying a predictive approach to ensuring the quality of VET is becoming more relevant, which implies the ability of the system to update development benchmarks, promptly provide quality educational services following the needs of the economy and regional demands for qualified workers, as well as build flexible procedures and measures for quick access of education seekers, including veterans, demobilized, internally displaced and other people to the market of decent work and civilian life. The predictive approach to ensuring the quality of VET is based on the analysis of the requests of consumers of educational services, the peculiarities of modern reforms of the VET system, trends in the development of the national qualifications system, which are increasingly determining the need for new professions and qualifications; expanding the possibilities of confirmation/assignment, recognition of full and partial professional qualifications, in particular in qualification centers; provision of lifelong professional (vocational) training, in particular in

training centers, industry hubs, enterprises, institutions or organizations; involvement of stakeholders in the development of innovative national education and qualification system that are in line with European quality standards.

Thus, the substantiated modern approaches (transformational, competence, European integration, systemic, regional, partnership-oriented, and prognostic) are comprehensively aimed at developing high-quality national vocational education. These approaches ensure conditions for maximizing individual potential at different stages of life and in changing circumstances, expanding learning opportunities for all social groups in line with labor market needs, and building strong partnerships with businesses to address economic challenges related to Russia's military aggression. Additionally, they contribute to the development and functioning of the national qualifications system, the preservation of human capital, and the fulfillment of Ukraine's European integration commitments.

The implementation of these and other new approaches to the quality assurance system in VET necessitates the revision and updating of its components, the development of effective management technologies, operational measures and procedures, as well as evaluation mechanisms and criteria. Thus, the dynamism of the concept of «VET quality» is confirmed, which continuously evolves in response to modern challenges, covering the set of necessary resources for the organization and provision of quality educational services, taking into account the strategic goals of state policy, innovative approaches to the development of national and regional labor markets, interests and growing needs of students and our society.

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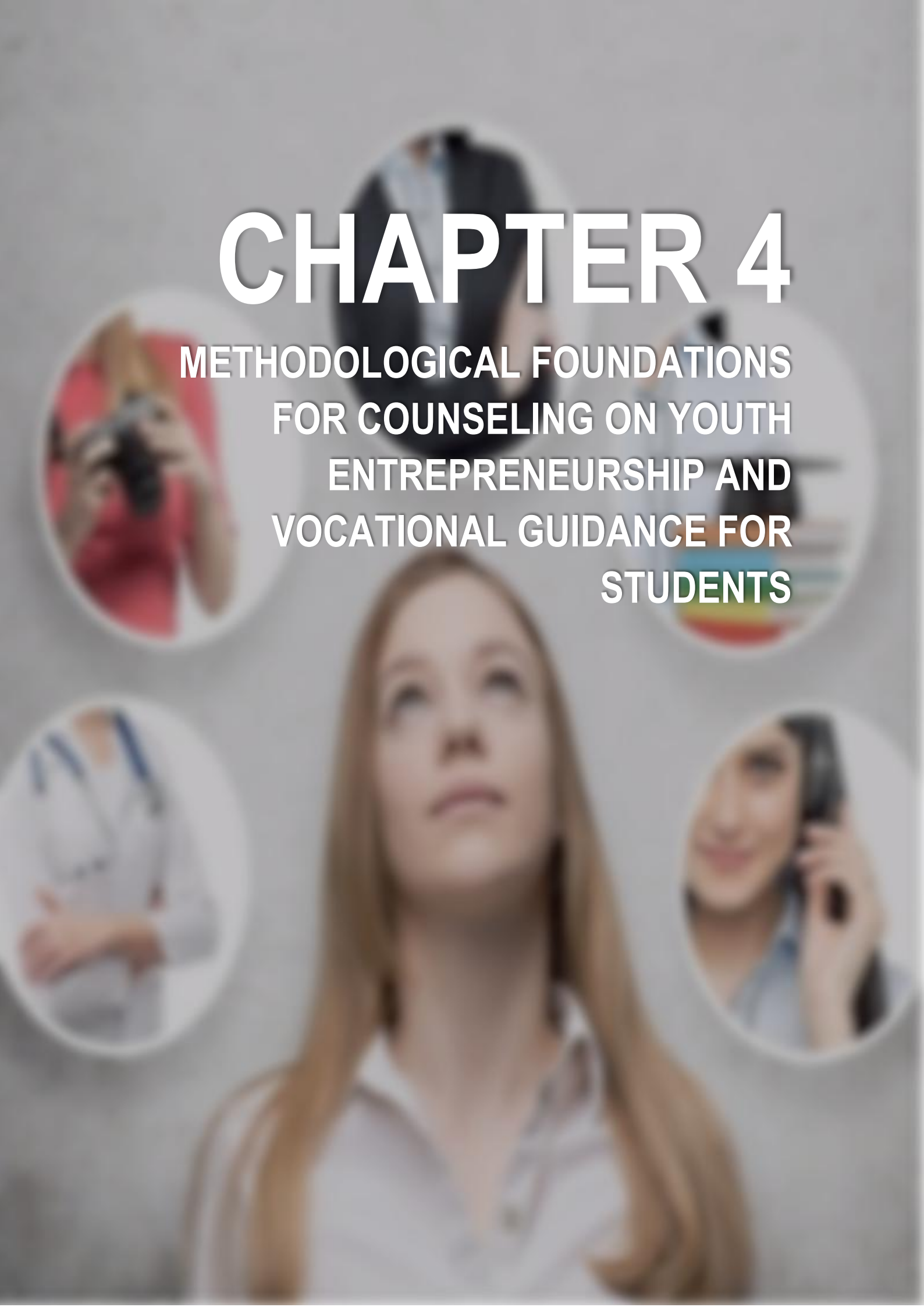

CHAPTER 4

METHODOLOGICAL FOUNDATIONS FOR COUNSELING ON YOUTH ENTREPRENEURSHIP AND VOCATIONAL GUIDANCE FOR STUDENTS

4.1. CAREER ORIENTATION OF FUTURE SKILLED WORKERS: DEVELOPMENT TECHNOLOGY

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The relevance of forming career orientations of future workers is substantiated. Attention is drawn to the fact that in the current socio-economic conditions, solving competitiveness issues and employment problems for vocational school graduates are the most difficult and important. The State no longer guarantees professional development and a "bright future" to every young specialist. The development of career orientations is seen as a complex dynamic system of quantitative and qualitative changes that occur in the minds of vocational school students in one way or another. The article considers the possibilities of creating pedagogical conditions for the formation of career orientations and provides examples of pedagogical technologies, the use of which will direct the formation of students' career orientations towards professional self-development and self-realization in future professional activities.

Keywords: *career orientation, professional development, professional education, professional career, professional independence.*

4.1. КАР'ЄРНІ ОРІЄНТАЦІЇ МАЙБУТНІХ КВАЛІФІКОВАНИХ РОБІТНИКІВ: ТЕХНОЛОГІЯ РОЗВИТКУ

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Обґрунтовується актуальність формування кар'єрних орієнтацій майбутніх робітників. Звертається увага на те, що в сучасних соціально-економічних умовах вирішення питань конкурентоздатності і проблеми працевлаштування для випускників професійної школи є найважчими і найважливішими. Держава вже не гарантує кожному молодому фахівцю професійний розвиток і «світле майбутнє». Розвиток кар'єрних орієнтацій розглядається як складна динамічна система кількісних і якісних змін, що в той чи інший спосіб відбуваються у свідомості учнів професійної школи. Розглядаються можливості створення педагогічних умов формування кар'єрних орієнтацій і наводяться приклади педагогічних технологій, використання яких спрятиме формуванню кар'єрних орієнтацій учнів на професійний саморозвиток, самореалізацію у майбутній професійній діяльності.

Ключові слова: *кар'єрні орієнтації, професійний розвиток, професійна освіта, професійна кар'єра, професійна самостійність.*

Conceptual approaches to the formation of career orientations and relevant pedagogical experience are highlighted in the works of domestic researchers S. Alekseeva, V. Baidulin, V. Biskup, N. Velychko, D. Zakatnyi,

L. Zlochevska, L. Karamushka, L. Kuzminska, O. Kucheryavyi, V. Ovsiannikova, A. Poplavska, as well as foreign authors – S. Covey, D. Super, E. Shane, L. Iacocca. Scientists emphasize that the formation of career orientations and the development of career competence is a complex dynamic system of quantitative and qualitative changes that occur in the minds of vocational school students in one way or another. The changes are related to their age and the enrichment of their life experience, as well as to the social conditions in which they live and their individual mental characteristics.

The concept of "career orientations" is nowadays considered as socially determined motivations for activity, characteristic of a particular person, value preferences, attitudes, interests. The development of career orientations begins in childhood, when parents like to ask their children what they want to be and encourage them to think about it. The answers to such questions are not deeply realized by the child. They are rather emotional responses to random impressions, but they can leave a certain imprint in the mind and turn into stable ideas about the future profession, and remain stable for a long time. Over time, the ideas about their own professional future that arise in children and adolescents spontaneously acquire more realistic features, but an analysis of such ideas and manifestations of career orientations shows that they are not fully or sufficiently realized. Among the typical psychological problems related to career orientations and professional formation of a modern personality are the inconsistency of the ideal and real image of the chosen profession, lack of perception of value orientations for success in professional activities in a market environment, inconsistency of real and ideal motivation for professional self-actualization of a personality in modern working conditions, inadequate self-assessment of one's own abilities and capabilities (Łozowiecka, 2008). D. Zakatnov, Head of the Professional Career Laboratory of the IPE of the NAES of Ukraine, emphasizes the importance of designing educational pedagogical technologies, including technologies for preparing young people to choose and implement a professional career, taking into account the peculiarities of personality development and career orientations at the stage of acquiring professional training (Zakatnov, 2015). Thus, the development of career orientations is an important factor in influencing the choice, planning and implementation of the professional career of each of the future skilled workers in the future.

The development of career orientations is a complex dynamic system of quantitative and qualitative changes that occur in the minds of vocational school students in one way or another. The changes are related to their age and the enrichment of their life experience, as well as to the social conditions in which they live and their individual mental characteristics. Formation of ideas about professional success and career orientations of VET students is not a new issue. After all, students entering an educational institution are necessarily told about the advantages of a particular profession, and at each lesson, teachers and vocational educators, motivating the cognitive activity of a future skilled worker, pay attention to how the knowledge and skills to be learned in this lesson will contribute to their future professional success. In this way, ideas about a possible professional future are formed, but in order for this process to become consistently stable and turn into a dynamic system of career orientation development, we need to master the pedagogical technologies of career orientation development.

From the psychological and pedagogical point of view, the best career is an individual career based on self-knowledge, self-improvement and self-government. Among the various directions of career orientations of specialists, there are eight main ones, which the American psychologist of Swiss origin Edgar Schein called “career anchors”. These are the eight value orientations that are most important for a specialist.

First of all, we are talking about professional competence, i.e. the orientation of people towards professional self-improvement. This attitude is associated with the availability of abilities and opportunities to self-realize in a particular field of professional activity. People with this orientation strive to be masters of their craft, they are especially happy when they succeed in the professional field, but quickly lose interest in work that does not allow them to develop their abilities.

Among our students, we definitely meet those who have certain leadership skills and want to lead other people. E. Shane defined this orientation as “management”. In this case, the personality's orientation to integrate the efforts of other people and the willingness to be responsible for the final result are of paramount importance. The development of this career orientation of a future skilled worker is related to age and work experience. They can develop analytical skills, and their success will be facilitated by interpersonal and group communication skills and emotional balance. It is worth noting that people who are leadership-oriented (“management”) believe that they have not achieved their career goal until they take a position

where they have the opportunity to manage the activities of other people and thus direct the development of production.

A characteristic feature of a significant number of VET students (older adolescents) is their focus on autonomy (independence), their attempts to free themselves from organizational rules, regulations and restrictions. There is a pronounced need to do everything in their own way, to decide when, what and how much to work on. Such a student does not always want to obey the rules established in the educational institution. If this orientation is strongly expressed, the personality does not pay much attention to what is told about the system of his or her professional training and the foresight of his or her professional future. Students with such a career orientation may refuse to follow the instructions of a mentor and rules in order to maintain their independence. In the future, they may work in a field that provides a sufficient degree of freedom, where they will not feel strongly obligated or committed to the organization and will reject any attempts to limit their autonomy.

We must also distinguish between students for whom stability is important. This career orientation ("stability") is driven by the need for security and stability, the desire to make future life events predictable. We are talking about job stability or residential stability. With regard to job stability, we mean the idea of long-term work in a certain organization that has a good reputation, cares about its employees and pays large, decent salaries, and looks reliable in its field. The perceptions of students with this orientation are characterized by a desire to shift responsibility for their career development to the employer. The second characteristic feature of stability orientation is the desire not to change their place of residence. In the future, our stability-oriented students may show their ability to grow in their careers, but, preferring a stable job and life, they are able to refuse high positions if it involves risk and temporary inconvenience, even if they have certain prospects that open up to them.

"Working with people," "serving humanity," "helping people," and "wanting to make the world a better place" are the value orientations of people whose career is about serving people. People with this career orientation most often choose a profession and work in the service sector, environmental protection, product and goods quality control, consumer protection, etc. They are characterized by a need for recognition and respect for themselves for their service to the benefit of people. Service for the benefit of others is motivated by the desire to assert their worldview beliefs.

The development of such an orientation should be concretized in the provision of services and work results that are provided for in the professional training of a future specialist.

Life presents various challenges to a person. E. Shane interprets the concept of “challenges” and a person's reaction to them as one of the types of career orientation. The main values of such a person's career orientation are competitiveness, the desire to win over others, overcoming obstacles, and the ability to solve complex problems that require a person to mobilize his or her strengths and potential. A characteristic feature of a challenge-oriented person is often an assessment of life situations from a win-lose perspective. The processes of struggle and victory are more important to such a person than a specific field of activity and qualifications. For example, a VET student with a similar orientation may consider disputes with fellow students and teachers or in another situation the fulfillment of the teacher's educational tasks as a game to be won. Novelty, variety and challenges are valuable to students and teachers with this orientation, and if things are too easy, they become uninterested.

A vital career orientation is defined as “integration of lifestyles”. A sign that a student is oriented towards the integration of different aspects and lifestyles is that he does not want his life to be dominated by his studies, family or career. He wants his life to be balanced. Such a person values their life as a whole – where they live, what opportunities they have for self-development and self-realization, rather than an educational institution, a specific job or position. In developing the career orientation of students with such an orientation, it is necessary to find positive aspects in the behavior and actions of the student, while motivating the need for cooperation with other people, to identify manifestations of a person's ability to reorient themselves taking into account their own interests and the interests of society.

Over the past decades, the number of people with an entrepreneurial orientation has grown significantly. People with this career orientation strive to create something new, want to overcome obstacles, and are ready to take risks. They do not want to work for others, they are focused on creating a business concept or organization, hoping for financial success, building it so that it becomes their life's work, in which they will find opportunities for self-realization. People with an entrepreneurial career orientation will pursue their business even if they are aware of the reality of serious risks.

The desire to make a career is one of the most important desires of students who have already formed a desire to realize their personal potential and ideas about professional success while studying at VET schools. Therefore, it is important for each of them to realize which career orientations prevail in order to know where success awaits them and what to strive for in their professional development. The diversity of orientations of a future skilled worker in social and professional interaction allows him to enjoy his work, overcome problem situations more easily, and realize himself more actively.

It is an important task of vocational teachers and teachers of VET to help them in this. The results of our research and practical experience show that such activities of youth mentors can be successful if they enrich their own experience by mastering appropriate pedagogical technologies.

The use of innovative pedagogical technologies is one of the dominant trends in the educational process of a vocational school. It is a condition for the development and self-development of students' personalities, activates their creative attitude and initiative socialization, and contributes to their professional development. The concepts of "technology" and "technological approach" are considered quite widely in the modern psychological and pedagogical literature. The concept of "pedagogical technology" as a set of techniques, methods, skills, art (explanatory dictionary), which has many definitions, is firmly established in pedagogical use. Pedagogical technologies are primarily related to ensuring an effective educational process, introducing educational innovations, etc., which are defined in modern psychological and pedagogical literature as: "learning technology", 'educational technology' or 'education technology'. In pedagogical science, the idea of pedagogical technologies as a certain system of organization and management of the pedagogical process is increasingly being affirmed, where pedagogical (educational) technology, built on a scientific basis and programmed in time and space, is defined as a system of functioning of all components of the pedagogical process that leads to the intended results.

C. Sysoieva analyzed different approaches to the definition of this phenomenon, emphasizing the multidimensionality of this concept. Determining the theoretical, methodological and methodological foundations of pedagogical technologies, substantiating the signs and criteria of their humanistic orientation, the conditions for their effective functioning in the modern educational space are urgent problems of psychological and pedagogical science and practice, S. Sysoieva believes. – In the real

pedagogical process, the functioning of such technologies has a holistic (teaching, learning, upbringing, development) impact on the student. That is why the term “pedagogical technology” most adequately corresponds to the logic and essence of the deployment of pedagogical interaction between a teacher and students. ... An important problem of pedagogical technologies that expects scientists and practitioners to solve is to ensure a holistic pedagogical impact, focused not on individual qualities of the personality, but on the structure of the personality as a whole, since the effectiveness of pedagogical technology is largely determined by the integration of psychological and pedagogical factors that affect the learning process, with the internal structure of the student's personality, with his or her individual capabilities and general orientation (Sysoieva, 2006, p. 172–173).

Summarizing the various definitions, we tend to consider pedagogical technology as the construction of a teacher's activity, in which all his actions are presented in a certain sequence and integrity, and the implementation involves the achievement of the required result and is predictable. Among the large number of modern technologies, S. Honcharenko singled out the technology of learning, which “in a general sense is defined as a systematic method of creating, applying and defining the entire process of learning and assimilation of knowledge, taking into account technical and human resources and their interaction.” While positively assessing the introduction of learning technologies, the scientist noted that the disadvantage of learning technologies is the focus on reproductive learning, as well as the lack of motivation for learning activities, ignoring the individual and his or her inner world. Taking into account this remark of Academician S. Honcharenko, we propose technologies for the development of career orientations that take into account the personal characteristics of VET students, future skilled workers.

A person who has chosen a profession should form an idea of future success in personal life and professional activity. Such an idea is formed through the realization of one's own desires, psychological characteristics and capabilities, as well as the needs of the labor market. An important step to success for a VET graduate is the correspondence of career orientations, processes of formation of personal characteristics of a specialist to the objective structure of future professional activity.

One of the most important aspects of personal and professional development is one's own adequate assessment of one's capabilities in professional activities. An underdeveloped or distorted self-image that does not correspond to the established career orientations leads to disruption of

life, misunderstanding of one's social roles (“mixing” of roles), disruptions in professional training and activities, increased conflict, and may be accompanied by a decrease in performance and deterioration of health.

If you ask a student how you see your future or what you envision for your career, you are unlikely to get a truthful answer. It is necessary to approach the discussion of such issues gradually. First of all, the teacher must gain the trust of the students. And when such trust is gained, you can start, for example, with the following questions: Do you know someone rich and famous? Is he or she always confident, popular, and always happy? Is he the epitome of success in your life? (It is important not to disrupt the process of reflection here. It is important to listen to the students carefully and to the end, to support their desire to speak out, to share the results of their reflections).

In their reflections, students often rely on the experience of communicating with people who believe that the key to happiness and, therefore, success is having a lot of money, living in a large house, owning the latest cars, etc. Such an orientation is unlikely to be useful in real life. True success is determined by the respect and gratitude of people and comes through honesty and patience, possessing traits that are really hard to achieve. Students themselves must come to the conclusion that material wealth can indeed make life easier, but not necessarily better. For example, money can't make you smarter or more competent in your profession – this comes only through hard work and self-improvement. Money cannot help a person form warm relationships with loved ones – this comes only through love, devotion, and sacrifice. All the money in the world cannot teach respect or loyalty – it comes only with good upbringing and constant care for the feelings of others. Can money give patience, gratitude, courage, friendship, or even generosity? All of these traits – knowledge, wisdom, love, respect, patience – are the most important features of a successful person with a developed career orientation. If these traits depend on money, then it is unlikely that such orientations are genuine and will most likely betray you at the most crucial moment. Money cannot help you achieve any of your vital traits! Money diminishes the desire for success, distracts attention, tempts, and leads to crime and corruption. That is why the illegal claims of clever marketers that money equals success can be easily refuted. This is not a career orientation that really leads to success.

Talking to students about their career orientations will be an important step in shaping their worldview, but an even better incentive for the targeted

development of career orientations and the need for self-improvement can be psychological and pedagogical training. It has been proven in practice to be the most effective form of correcting self-image, professional and life success, developing self-concept, reducing conflict and stimulating the need for achievement. You can get students interested in participating in such training by discussing with them the question of their future and how they envision it.

Training should be used not to refer to teaching methods, but to refer to methods of developing the ability to learn or master any complex activity, including communication. In other words, training is not only a method of developing abilities, but also a method of developing various mental structures and the personality as a whole. Trainings (training games) combine educational and gaming activities that take place in the context of modeling various game situations.

This form of training was developed in psychology primarily for psychological correction through play. We set ourselves a different goal. Pedagogical training, in our understanding, is an element of professional development technology aimed at helping future and current professionals to form their ideas about future professional success, to help them plan their careers, to create conditions for the development of their professional culture and professional self-improvement. The term “correction” means an external, third-party intervention in certain manifestations of a human personality. The purpose of such intervention is to change a person by “correcting” his or her behavior towards compliance with social standards.

Our goal is to help you establish your own professional self, develop your own principles, style and idea of professional success, and develop a desire for creativity that combines your ideas of ideals. The teacher who conducts the training assumes that each student is a unique, valuable personality and has his or her own internal sources of personal transformation and self-development.

We consider training as a single system for changing internal attitudes and behavior, for the effectiveness of which the very atmosphere of the classes is important, where people open up to the maximum, perceive themselves and others differently. The main difference between this form of training and others is that the trainees use all their life experience and potential in the course of training. Trainings help people to acquire the necessary abilities faster, which in ordinary life are formed over many years.

In other words, the goals of training can be very diverse, reflecting the multifaceted nature of the processes taking place. In particular:

– studying students' psychological problems and helping them solve them;

– improving subjective well-being and strengthening mental health;

– studying psychological patterns, mechanisms and effective ways of interpersonal interaction to create the basis for more effective and harmonious communication with people;

– development of self-awareness and self-exploration of future specialists to correct or prevent emotional disorders based on internal and behavioral changes;

– promoting the process of personal development, realization of creative potential, achievement of an optimal level of life and a sense of happiness and success.

The results of our research show the undeniable advantages of group training. These advantages include the following:

1. A student group in VET is a special social environment that counteracts alienation and helps to solve interpersonal problems; in this environment, a student avoids unproductive withdrawal from himself/herself with his/her difficulties, discovers that his/her problems are not unique, that others experience similar feelings – for many students, this discovery in itself is a powerful psychotherapeutic factor;

2. The student group reflects society in miniature, makes obvious such hidden factors as peer pressure, social influence and conformism; in fact, the group models a system of relationships and interconnections typical of the real life of participants, which gives them the opportunity to see and analyze in conditions of psychological safety the psychological patterns of communication and behavior of their classmates and themselves, which are not always obvious in real life situations;

3. The opportunity to receive feedback and support from people with similar problems; in real life, not all people have a chance to receive sincere, non-judgmental feedback that allows you to see your reflection in the eyes of other people who understand the essence of your experiences, since they themselves are experiencing almost the same thing; the ability to “peer” into a whole gallery of “living mirrors” is perhaps the most important advantage of group psychological work, which cannot be achieved in any other way;

4. In a group, a student can learn new skills, experiment with different styles of relationships among equal partners; if in real life such

experimentation is always associated with the risk of misunderstanding, rejection and even punishment, then in group training they act as a kind of "psychological testing ground" where you can try to behave differently than usual, "try on" new models of behavior, learn to treat yourself and people in a new way – and all this in an atmosphere of friendliness, acceptance and support;

5. In a group, students can identify themselves with others, "play" the role of another person to better understand him or herself and to learn new effective ways of behavior used by someone else; the emotional connection, empathy, and empathy that arise in this way contribute to personal growth and the development of self-awareness;

6. Interaction in a student group creates tension, which helps to clarify everyone's psychological problems; this effect does not occur in individual psychological and pedagogical work; while creating additional difficulties for the teacher, psychological tension in the group can (and should) play a constructive role, fueling the energy of group processes; the task of the leader is to prevent tension from getting out of control and destroying productive relationships in the group;

7. The group facilitates the processes of self-disclosure, self-exploration and self-knowledge; otherwise than in a group, otherwise than through other people, these processes are not fully possible; opening oneself to others and opening oneself to oneself allow one to understand oneself, change oneself and increase self-confidence.

Classes can provoke poignant moments that cause shock and shock in students, use such powerful techniques as confession or frank discussion by all students of the actions and deeds of one of them. Good, well-planned trainings build interpersonal relationships that exclude pronounced skeptical remarks from students with impenetrable psychological defenses who make it impossible to concentrate during the training with their comments.

Experienced teacher-trainers include in the training program all the most effective techniques that are currently known in psychology: neuro-linguistic programming, psychodrama and various author's methods.

Most often, training is practiced as a role-playing game and modeled in a specific pedagogical situation, but as a rule, this is all it is. In our opinion, psychological and pedagogical training has much more possibilities – it is a form and method in which a person can reconsider his or her worldview and make a decision to change the way of behavior in general. Then it will no longer be just a game.

A person in training can change their image, change themselves. They develop a new attitude towards their personal and professional self.

The use of game procedures in the educational process has a long history and is so popular that there is no need to dwell on all aspects. Suffice it to say that it is advisable to study and implement the game in pedagogical practice and research from the point of view of improving the effectiveness of the educational process (in the form of trainings) and from the point of view of obtaining prompt feedback (diagnostic function). Such a connection is determined by the fact that it is predictable, predictable more than any other type of human activity, firstly, because students and adults in the game show their emotions and feelings, intellectual and creative forces to the maximum, and secondly, the game itself is a "field of self-expression" in which both students and teachers are most natural, sincere, and open.

For those employees who are interested in the prospects for the development of career orientations of VET students, we suggest that you familiarize yourself in more detail with the content of relevant literary and electronic sources where experienced specialists in the development and implementation of innovative pedagogical technologies share their experience.

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4.2. CAREER COUNSELING IN VOCATIONAL EDUCATION INSTITUTIONS IN MODERN CONDITIONS

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The achievements and controversial aspects of the activities of such structural units in educational institutions are identified. The actual functions of career counseling centers are analyzed, namely: assessment and diagnostic, educational and communicative, integrative and coordination, socialization and advisory, regulatory, information and stimulating. The hypothesis is that the holistic implementation of these functions will help to overcome the contradictions of career counseling for students, in particular, the discrepancies between: the ideal representation and the real profile of a particular profession or specialty, the subjective perception and ignoring of career orientations by young people, and will also make it possible to correct students' self-esteem of individual and personal qualities. The article suggests ways to address issues related to the organization and functioning of career counseling centers in vocational education institutions.

Keywords: *professional career, career development, career counseling centers, vocational education.*

4.2. КОНСУЛЬТУВАННЯ З КАР'ЄРИ У ЗАКЛАДАХ ПРОФЕСІЙНОЇ ОСВІТИ В СУЧАСНИХ УМОВАХ

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Виявлено досягнення та суперечливі моменти діяльності таких структурних підрозділів у закладах освіти. Проаналізовано актуальні функції центрів консультування з професійної кар'єри, а саме: оцінювально-діагностувальну, навчально-комунікативну, інтегративно-координаційну, соціалізаційно-консультативну та регулятивну, інформаційно-стимулювальну. Означено гіпотезу, що цілісна реалізація цих функцій сприятиме подоланню суперечностей кар'єрного консультування учнівської молоді, зокрема, невідповідностей між: ідеальним уявленням і реальним профілем конкретної професії чи спеціальності, суб'єктивним сприйняттям та ігноруванням молоддю кар'єрних орієнтацій, а також уможливить коригування самооцінки учнями індивідуально-особистісних якостей. Пропонуються способи розв'язання питань щодо організації та функціонування центрів консультування з професійної кар'єри в закладах професійної освіти.

Ключові слова: *професійна кар'єра, кар'єрне зростання, центри консультування з професійної кар'єри, професійна освіта.*

At the current stage of civilizational progress, characterized by dynamic transformational changes, special public attention in economically developed countries is paid to matching the demands of the labor market with the proposals of educational institutions in order to ensure the quality of human capital development. Despite the efforts of representatives of different levels of society, the national economic space of many countries faces problems of labor migration, employment, low welfare of citizens, etc. In this regard, there is a need to create the most comfortable conditions for the professional development and further career growth of applicants of different levels of education. One of the effective ways to overcome the problem of outflow of workers abroad, employment and career growth of students is the activity of career counseling centers operating in vocational (vocational-technical), professional pre-university and higher education institutions, as well as in the State and regional employment services (centers), and directly at individual enterprises.

The study of the EU policy documents, in particular, the Maastricht Treaty, the Bruges Communiqué, the Copenhagen Declaration, the European Strategy (EEA-Eionet 2021–2030), the European Commission's White Paper, analytical materials and thematic reports on the state of development of vocational education and training by relevant European specialized institutions (IREIVET, CEDEFOP, ETF, EQUAVET, etc.) shows that the formation of a vocational school is determined by the establishment of a competitive and dynamic economy based on the development of human capital. Therefore, the priority tasks of European policies include ensuring the prestige of vocational education, its focus on the development of professional careers of pupils and students, as well as the functioning of accessible services to provide relevant advice. In Ukraine, the state policy on vocational education is focused on ensuring that its content and quality meet the needs of the labor market, as well as creating conditions for continuous professional development of the individual.

The theoretical analysis of scientific literature and logical generalization of its results allowed us to identify the following conceptual and thematic areas of the issues studied by the authors of the article, namely: human motivation for professional development and further career growth (E. Bern, R. Burns, P. Bourdieu, L. Karamushka, V. Lozovetska, V. Rybalka, E. Sandstrom, I. Yanchenko, D. Winter, et al.); planning and realization of professional career (V. Berg, E. Klimov, S. Covey, O. Kucheriavyi, V. Orlov, L. Peter, D. Supper, J. Holland, B. Schwalbe, etc.); management of

professional career of staff (M. Woodcock, G. Goldstein, M. McMahon, D. Francis L. Iacocca, etc.); forms and methods of career counseling for youth (S. Alekseeva, V. Biskup, L. Yershova, D. Zakatnov, M. Klymenko, L. Kuzminska, etc.) At the same time, the issues of counseling students in career centers of educational institutions are not sufficiently studied, current practices of such units are not analyzed, controversial issues are not identified, and optimal ways to solve them are not proposed.

The purpose of the study is to reveal the problematic issues of counseling pupils and students on professional career issues, identified on the basis of an analysis of the practices of the relevant structural units of educational institutions, and to find optimal ways to resolve such contradictions.

Materials and Methods. Theoretical analysis of regulatory and legislative sources, scientific works, contextual information and logical generalization of its results – to establish the state of development of the problem under study; study of career counseling practices for students – to establish the achievements and controversial aspects of the activities of career counseling centers; pedagogical observation, interviews with teachers, students, representatives of employment centers – to clarify the problematic issues of career centers and identify.

A study of the regulatory and legislative framework shows that the issues of career development of citizens in the Ukrainian state are declared by the current legislation (Law of Ukraine «On Professional Development of Employees» of 12 January 2012, No. 4312-17; Resolution of the Cabinet of Ministers of Ukraine of 11 September 2008 «On Approval of the Concept of the State System of Professional Orientation of the Population» No. 842) and are provided at the state level in the context of career guidance services to the population by employment centres, as well as within the framework of international support (e.g., the EU Programme «EU4Skills: Best Skills for Modern Ukraine», USAID Economic Support to Ukraine Project, etc.).

Initially, career counselling centres for future professionals were created as structural units of higher education institutions (Lviv Polytechnic National University (1993), National University of Kyiv-Mohyla Academy (1994), Kyiv National Economic University (1999). In vocational education institutions, such centres began to be established in 2017 (Volyn region), in 2018 (Khmelnytskyi and Lviv regions) on a large scale in 2020, due to the introduction of the Concept for the Implementation of State Policy in the Field of Vocational Education «Modern Vocational Education» for the

period up to 2027, approved by the Cabinet of Ministers of Ukraine (12.06.2019, No. 419-p). The document emphasises the imperfection of «career counselling for young people and adults, the importance of creating conditions in educational institutions for the formation of a fully developed personality capable of choosing an individual educational trajectory, lifelong learning, professional career development, entrepreneurship and self-employment».

The main motives for establishing such centres in the course of the study were identified as follows:

– the need to promote vocational education and increase the prestige of working professions;

– facilitating the employment of students

– providing pupils and students with the necessary legal, economic and psychological knowledge

– development of professional career and entrepreneurial initiative of future specialists;

– tracking their work experience and career development.

A study of the best practices of such units in Ukraine shows that 85% of them are called «career centre», with the following name invariants as alternatives: professional career centre, career development centre, career development centre, centre for professional career and business development, career and vocational guidance office, etc.

In foreign universities, such units offer different services. In Germany, for example, employees of such units focus on career guidance, employment of university graduates, and monitoring compliance with the requirements of the administration, teachers and employers in the practical (applied) professional training of future specialists. A specific indicator of the successful activity of such career services is the high level of employment of graduates of higher education institutions (http://www.stifterverband.de). The Office of Initiatives and Employment at the University of Alcante (Spain) is aimed at expanding employment opportunities for students and graduates. In this regard, young people are offered various internship programmes, systematic career guidance activities, and advice on self-employment and entrepreneurship (www.gipe.ua.es).

Studying the experience of online resources (Career Hub, My Career platform, rabota.ua online magazine, GURT website, Studway electronic publication, etc.), on the one hand, helps to inform young people about successful self-realisation in Ukraine, and on the other hand, encourages

young people to migrate by vividly promoting international programmes and projects for education and further employment. At the same time, we consider the online testing service «Career Guidance and Development Platform» of the State Employment Service of Ukraine to be relevant. The test is designed to identify value orientations, professional interests, aptitudes, and other individual and personal qualities (inclinations, abilities, talents), and entrepreneurial skills, and is mainly intended for career guidance, which means that it allows each student to choose a future field of activity and profession in accordance with their individual characteristics. A Soft Skills online testing resource has been created for young employees, which allows them to identify competitive advantages, strengths and weaknesses, and additional skills that will facilitate career growth. However, the impact of online testing and online counselling is often negative, as evidenced by the results of conversations with practical psychologists and social educators, as each student is an individually unique person for whom it is desirable to individually select diagnostic methods, formulate clarifying questions, and develop career trajectories.

More than 85% of centres have more than three staff members. As a rule, these are: the head/coordinator of the centre (in most cases, one of the deputy directors of the educational institution) and a group of consultants (professional consultant, career consultant, business consultant, legal advisor). Career counselling is traditionally provided by staff psychologists or social workers at educational institutions. Legal counselling is provided by staff lawyers or law professors. Business counselling is mostly provided by economics teachers, and less often by representatives of partner organisations or employers (by agreement). Professional counselling is often combined with career counselling. If the centre has a separate vocational counsellor, his or her duties are usually assigned to the master of industrial training. In this context, the experience of Higher Vocational School No. 25 in Khmelnytskyi is of research interest. Khmelnytskyi, which opened a Career Counselling and Development Centre in April 2018. Its objectives are to: inform students about the constitutional rights of students; intensify their own efforts to solve employment problems; form an active life position; promote the development of entrepreneurial initiative; expand the range of job search methods and increase the competitiveness of graduates in the labour market, their employment and career growth. The introduction of the innovative variable course «Professional Success and Career» into the educational process contributes to the improvement of professional training

of future skilled workers, their employment and successful self-realisation in the modern labour market. The teaching staff of the institution is aware that an important evaluation and qualitative characteristic of their activities, as well as the functioning of the VET institution, is the construction and successful implementation of the professional career of students and graduates.

As part of the activities of the career counselling centres, students master the content of the disciplines «Man and the World of Professions» and «Building a Career», which aim to provide students with a thorough self-knowledge to make an informed choice of their future professional path, maximise their professional abilities and increase their competitiveness in modern conditions. The objectives of the disciplines are focused on: familiarising pupils and students with the requirements for a specialist in the labour market in modern socio-economic conditions, with career orientations, types and stages of careers; detailed study of pupils' personality traits, professional abilities, inclinations, interests, social expectations, motives that need to be taken into account in building a career; providing information on ways to obtain professions, job search techniques, trends in labour supply and demand in the labour market; organising professional development activities; and

The survey showed a wide range of organisational forms of work of the Centres with vocational education and training students to prepare them for career planning and starting and running their own business. These include activities carried out directly by centre staff and partner organisations outside of school hours, as well as during educational hours and classes.

For psychological counselling, the most popular methods are testing, questionnaires, motivational and remedial training, individual and group conversations, and workshops. For business and career counselling, the most commonly used methods are professional courses, workshops, field trips, vocational tours, project activities, advisory boards, creative meetings with successful graduates, roundtables, coaching sessions, business games, and career lessons. Legal advice usually includes individual and group consultations, lectures, roundtables, meetings with lawyers, etc.

Joint activities with local authorities, state employment services, training and methodological centres (classrooms), employers and business partners of educational institutions that have their own production facilities play an important role in the activities of the Centres. Among such joint activities, survey participants noted: all-Ukrainian vocational education

weeks, trade fairs, occupational festivals, international programmes and projects, open days, career days, monitoring studies, conferences, mentoring and coaching programmes, provision of paid services to the public through production workshops, cafes, hairdressing salons, etc.

In almost 39% of VET institutions, the goals and activities envisaged by the Centres correspond to the content of a number of subjects («Fundamentals of Sectoral Economics and Entrepreneurship», «Fundamentals of Market Economics and Entrepreneurship», «Fundamentals of Sectoral Economics», «Fundamentals of Entrepreneurship», «Fundamentals of Entrepreneurship, Fundamentals of Advertising Marketing and Design, Fundamentals of Marketing and Management, Fundamentals of Labour Law, Fundamentals of Legal Knowledge, Occupational Health and Safety, Occupational Health and Safety and the Environment, Job Search Techniques, Fundamentals of Entrepreneurial Success, «Financial Literacy, Commercial Activity, E-Commerce, Skills for a Successful Career, Ukrainian Business Speech, Professional Ethics, Professional Ethics and Basics of Psychology, Business Activity, Business Management, Basics of Consumer Knowledge, «Fundamentals of Professional Mobility, Fundamentals of Small Business, Economics of Different Types of Enterprises, Foreign Economic Activity, Crisis Management, Market Research, Commodity Market Infrastructure, Fundamentals of Taxation, Technology, Civic Education, etc.).

In many VET institutions, issues related to preparing young people for self-employment by starting and running their own business are considered in classes on various subjects as separate modules («Job Search Techniques», «Creating a Business Plan», «Self-Presentation», «Features of Real Business Activities», «Entrepreneurial Competence», «Essence and Methodological Foundations of Entrepreneurial Activity», «Forms of Entrepreneurship», «Features of Employment in Modern Conditions», «Paperwork for Hiring»),

In VET institutions, educational hours are also used to develop career and entrepreneurial competence, where information hours, conversations, quizzes, round tables, discussions, literary mixes, creative meetings and other forms of group work are held for this purpose.

Despite the fact that most of the Centres have been operating for an average of 2-3 years, they have already had events that have been recognised as the most successful. These include: the quest game «Successful Merchant» held at the Epicentre Khmelnytskyi shopping centre; training

«Sources of Funding for Youth Startups»; the All-Ukrainian competition of business ideas and innovative projects «Business Aviators» (Higher Vocational School No. 11 in Khmelnytskyi); a roundtable discussion with employers. Khmelnytskyi); a roundtable discussion with employers on «Current Trends in the Youth Labour Market in the Region» (Vocational School No. 29 in Volodymyrets); a joint project of the Kalush City Employment Centre and Vocational School No. 7 in Kalush. Kalush «Building a Professional Future Today»; trainings «Building a Career and Professional Development», «Business from Scratch», «Business Promotion» (Separate Structural Subdivision «Liubeshiv Technical Vocational College of Lutsk National Technical University»); literary mix «We are talented in vocational education» (Berdychiv Higher Vocational School in cooperation with Berdychiv City Employment Centre); conversations with graduate students on the topics «One Step to Success», «Employment Strategy and Tactics», «My Profession is My Future», «Working profession – a step to a great career», "Your career starts today", "Turn your dreams into a goal", "A thousand professions – yours is one", "Human happiness in work", "Strategy of choosing a profession", "Variety of working professions", "Image of VET graduates" (Reshetylivka Professional Agricultural Lyceum named after I. G. Borovensky); "Career guidance in the style of coaching", psychological training «Successful career!», defence of entrepreneurship projects (Vinnytsia Interregional Higher Vocational School); online counselling «Job Search Technology» and development of a business plan «How to start your own business» (Kryvyi Rih Vocational Mining and Electromechanical Lyceum in cooperation with the City Employment Service); the project «Snail in Ukrainian Cuisine» (Lebedynske Higher Vocational School of Forestry in cooperation with Farm Eco) and many others.

The implementation of many successful activities became possible due to the organised cooperation of the Centres with potential employers, which is envisaged in the work plans of educational institutions, directly in the work plans of the Centres, and is carried out by teachers as part of their disciplines and by masters of industrial training during the students' internships.

The establishment of career centres and other structural units designed to prepare young people to start and run their own business has significantly intensified in 2020–2022, but has not become a widespread phenomenon in the VET system. The opening of career centres was facilitated by the

adoption of the Concept for the Implementation of State Policy in the Field of Vocational Education and Training «Modern Vocational Education and Training» for the period up to 2027 and the participation of educational institutions in innovative educational activities at the regional and national levels. Therefore, there is a need to promote this Concept and detail its provisions through an operational implementation plan and specification of performance indicators (KPIs) and encouragement of educational institutions to participate in innovative educational activities.

All the Centres have a certain legal framework. However, not all of them have separate premises and sufficient material and technical equipment, operate on a voluntary basis, and have certain problems with financing their activities and motivating their staff. The lack of stable funding and clear localisation of the Centre makes it difficult for staff to communicate with each other, with students and with partner organisations, reduces the status and prestige of the unit, and reflects the attitude of the educational process as a somewhat marginal entity. In the context of the post-war economic recovery in Ukraine, high-quality training of young people for self-employment and starting their own business is an important task for VET institutions, which will have both an obvious social effect (reduction of unemployment) and an economic one (increase in state budget revenues). This necessitates addressing the issue of funding career centres at the state level. Funding for such structural units should be viewed not as a cost of vocational education, but as a profitable investment in it.

An important aspect of the activities of Career and Entrepreneurship Competence Centres is the coverage of information about their work, achievements and plans on their own websites, pages of official websites of VET institutions, through printed materials, publications in the media, etc. At the same time, many Centres have just started their activities and therefore their websites or webpages do not always have a logical architecture, meaningful and conveniently arranged content, a photo gallery or an archive of events. Publishing products do not always meet the standards of electronic and/or printed publications. This necessitates raising the level of digital competence of the Centres' staff, developing recommendations for website administration, creating web pages, building their structure, etc.

In the Statutes of 47% of the Centres that took part in the survey, «promoting the development of entrepreneurial initiative» is declared. In many VET institutions, the work of the Centres to develop career and entrepreneurial competences of future specialists not only involves

conducting their own events, but also extends to all activities of the educational institution, both in class and extracurricular. In 62% of educational institutions, the development of career and entrepreneurial competences is carried out through the teaching of individual subjects («Fundamentals of Business Activity», «Fundamentals of Sectoral Economics and Entrepreneurship», «Fundamentals of Entrepreneurship», «Business Economics», etc.), in 29% – in the process of studying individual modules, 72% – when solving relevant theoretical and practical tasks in the classroom. Therefore, there is an obvious need for educational and methodological support for the development of entrepreneurial competence of VET students (in particular through: preparation of curricula, textbooks and manuals for them, taking into account the sectoral specifics of educational institutions and specialties in which future specialists are trained; development and dissemination of lesson notes, extracurricular activities, business projects, etc. to develop the entrepreneurial competence of future specialists).

The centres help to strengthen ties between educational institutions and local authorities, state employment services, and potential employers, who are mostly small and medium-sized businesses. This is evidenced by the mass events held jointly with partners (all-Ukrainian vocational education weeks, fairs and festivals of professions, open days, career days, international projects, conferences, etc.) and recognised by representatives of VET institutions as the most successful. Therefore, it is advisable to create an all-Ukrainian communication platform for the Centres to share information and disseminate best practices in preparing young people for entrepreneurship.

Thanks to the activities of the Centres, VET institutions have begun systematic work on tracking the career paths of graduates, including those in small business. This data can become one of the criteria for the effectiveness of the centre and educational institution in preparing young people for entrepreneurship. This leads to the need to develop methodological recommendations for organising and monitoring the employment of graduates of VET institutions that train specialists for various sectors of the Ukrainian economy, including small businesses.

Thus, we consider a career counselling centre to be a social project that functions as a structural unit of an educational institution (institution or enterprise) to provide ongoing psychological and pedagogical support for the career development of pupils (students) or employees of a particular

institution (enterprise) in accordance with the individual and personal characteristics of each person. In most cases, such centres operate on a voluntary basis, as their key characteristics should be flexibility and freedom. In view of this, the main tasks of career counselling centres are as follows:

– on the basis of activation of individual and personal resources of pupils (students) or employees of a particular institution (enterprise) to provide support for the career development of each person;

– to form an active worldview position on life creativity;

– to identify and analyse individual abilities, career orientations, value priorities of future professionals;

– to stimulate positive internal motivation of pupils (students), employees for professional success and educational achievements;

– to plan possible options for future professional careers in Ukraine or in foreign countries in accordance with the defined career orientations.

The main task of the career centre is to determine the individual characteristics of an individual's career orientations in order to design and model a professional trajectory and further develop his or her career. In this case, career orientations are understood as socially conditioned and psychologically motivated motivations of an individual to develop a career, which significantly depend on the priorities in the system of values, socio-psychological attitudes, and needs of future professionals. Career orientations are relatively stable formations that determine a person's professional path, are determined by value orientations and relevant worldview priorities. Their formation is one of the substantive features of the activity.

The need to open and operate career counselling centres in Ukraine is stipulated in the current legislation and regulations, but the Ministry of Education and Science of Ukraine has not yet adopted the Model Regulations and Conceptual Framework for the operation of career counselling centres in educational institutions.

The professional career centres established on the basis of educational institutions should provide, first of all, assistance to the professional development of future specialists, which is possible through the use of effective methods of developing communication skills, forming skills of active job search, providing effective employment counselling based on the maximum consideration of individual abilities, establishing productive interaction with employers; conducting trainings, master classes, competitions of innovative ideas, start-up projects.

When studying the peculiarities of the activities of career counseling centers in VET institutions, we identified the following problematic issues: predominance of fragmentation in counseling students on professional careers; lack of regulatory and legal support for the functioning of centers; partial consideration of regional peculiarities of the labor market; duplication of functions and tasks of career centers in educational institutions and employment centers; students' mental stereotypes, narrow and one-sided perceptions of the labor market, institutions, and enterprises; low motivation of young people to work, achieve professional success, and grow in their careers; imbalance between the realities of the regional labor market and the number of graduates of specific professions; insufficient number of qualified career center staff, etc.

It is important for career counseling centers to fulfill the following functions: evaluation and diagnostic, which involves determining the motives for choosing the type and methods of professional career, diagnosing career orientations; educational and communicative, which is focused on teaching technologies for planning a professional career through individual and personal interaction, information exchange, identifying, consolidating and reproducing connections and relations that form a system of values, norms, individual actions, ways of activity, consolidate and standardize the behavior of young people in the labor market at the appropriate stages of civilization; integrative and coordination, which determines the cross-cutting vectors of activities of the Center's employees and employees of educational institutions to train competitive specialists capable of designing a professional career, self-realization within the framework of professional activities, professional growth through the intensification of team building processes, creating a team with common interests and value orientations, and forming a sense of mutual responsibility among representatives of professional communities; socialization, counseling and regulatory, which involve the conscious assimilation of professional (corporate) culture norms, social roles, reference (typical) patterns (stereotypes) of behavior and mechanisms for their implementation, the formation of value orientations, and the provision of advisory assistance in career planning; information and stimulating, which consists in providing young people with up-to-date information on career development, the latest state of the labor market, professions in demand, employers' requirements, as well as timely identification of achievements and shortcomings in building and implementing a professional career, applying measures aimed at

consolidating, strengthening and developing positive changes and blocking and eliminating negative features.

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4.3. DEVELOPMENT OF ENTREPRENEURIAL COMPETENCE OF FUTURE SPECIALISTS IN THE ENERGY SECTOR OF UKRAINE

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The article addresses the issue of forming entrepreneurial competence among future specialists in the energy sector of Ukraine's economy, with a particular focus on renewable energy sources, in the context of strategic transformations within the national energy industry and the urgent needs of the labor market. It analyzes the regulatory, legal, and methodological framework, as well as innovative educational initiatives aimed at training qualified professionals. Special attention is given to examining the structural components of entrepreneurial competence of future renewable energy specialists through the lens of professional and educational standards. The article proposes scientifically grounded methodological recommendations for enhancing the preparation of specialists in alternative energy sources for entrepreneurial activities.

4.3. РОЗВИТОК ПІДПРИЄМНИЦЬКОЇ КОМПЕТЕНТНОСТІ МАЙБУТНІХ ФАХІВЦІВ ЕНЕРГЕТИЧНОГО СЕКТОРУ ЕКОНОМІКИ УКРАЇНИ

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У статті в контексті стратегічних трансформацій вітчизняної енергетичної галузі й нагальних потреб ринку праці розкрито проблему формування підприємницької компетентності майбутніх фахівців енергетичного сектору економіки України, зокрема, у сфері відновлювальних джерел енергії. Проаналізовано нормативно-правове й методологічне забезпечення, інноваційні освітні ініціативи з підготовки кваліфікованих робітників. Особливу увагу приділено вивченню структурних компонентів підприємницької компетентності майбутніх фахівців з відновлювальної енергетики крізь призму професійних та освітніх стандартів. Запропоновано науково-методичні рекомендації щодо вдосконалення підготовки фахівців з альтернативних джерел енергії до підприємницької діяльності.

Keywords: *entrepreneurial competence, renewable energy, alternative energy sources, professional education, educational process, structure of entrepreneurial competence.*

Ключові слова: *підприємницька компетентність, відновлювальна енергетика, альтернативні джерела енергії, професійна освіта, освітній процес, структура підприємницької компетентності.*

Energy security is a key component of national security for every state, particularly when a country has limited domestic energy resources and relies on imported energy carriers. In this context, energy policy transcends being merely a sectoral strategy and becomes a fundamental condition for the sovereign existence and development of the state. Leading global powers identify renewable energy as a top priority in their energy strategies. This approach enables the simultaneous resolution of a wide range of strategic issues: enhancing energy independence, reducing the environmental impact of energy production, preserving fossil fuel reserves for future generations, and utilizing these resources more rationally in non-energy industrial sectors. The multifaceted nature of renewable energy development demands a comprehensive approach to addressing these challenges (Kudria, 2024).

The European Union exemplifies the most systematic and innovative approach to shaping energy policy. This policy rests on three core principles: ensuring reliable energy supply, maintaining affordable prices for consumers, and mitigating environmental harm through the advancement of renewable energy. The experience of European countries demonstrates that transitioning to renewable energy sources is not solely a matter of implementing energy-efficient technologies. "Green energy" is gradually evolving into a robust economic sector that successfully competes with traditional forms of power generation, such as coal, oil and gas, and nuclear power plants.

Ukraine’s energy sector is undergoing a period of profound transformation. On one hand, the industry is experiencing technological modernization, the adoption of cutting-edge energy technologies, and integration into the European energy framework. On the other hand, it faces significant challenges: ensuring energy security, restoring infrastructure damaged by military actions or shelling, improving energy efficiency, and pursuing decarbonization in line with global sustainable development trends.

According to the Office for Investment Attraction and Support, UkraineInvest (2024), prior to the full-scale invasion, the total capacity of renewable energy sources (RES) in Ukraine reached 9.9 GW. By early 2024,

despite ongoing hostilities, RES capacity stood at 8.7 GW. Notwithstanding the challenging wartime conditions, the sector continues to grow: in 2023 alone, over 1,400 new renewable energy facilities were connected to the national grid. During this period, 182.3 MW of wind power plants and approximately 500 MW of solar power plants were commissioned. Investment activity also remains significant – Ukrainian businesses invested around USD 150 million in solar energy development in 2023. Additionally, since 2009, the "Green Tariff" has been in place, incentivizing private owners to install their own electricity-generating capacities and sell surplus power to the state. Private companies are able to deploy alternative energy sources such as solar panels, wind turbines, and small hydropower plants, thereby contributing to the sustainable development of Ukraine's energy sector.

The current development of renewable energy is guided by strategic priorities outlined in the "Concept of Ukraine's 'Green' Energy Transition to 2050," which aims to increase the share of RES to 70% of the country's energy mix by 2050, aligning with European climate goals. The concept encompasses phasing out coal-based generation, transitioning to a circular economy, limiting the share of nuclear energy, and integrating into the European energy space (Vseukrayinska enerhetychna Asambleya, 2020).

Meanwhile, as noted in a Forbes Ukraine study (2024), following the destruction of all major thermal power plants (TPPs) and hydroelectric power plants (HPPs) due to war crimes committed by the Russian Federation, renewable energy has shifted from a promising prospect to a strategic priority for energy security. Ukraine's national system operator, Ukrenergo, is developing a model for the future energy system based predominantly on renewable energy sources. This strategy sets ambitious targets: a fivefold increase in wind power capacity, a fourfold expansion of biofuel-based TPPs, a 60% boost in solar generation, and the establishment of 0.8 GW of energy storage systems within the next 2–3 years.

The rapid development of renewable energy in Ukraine, accompanied by an increase in production capacities and the introduction of related technologies (such as energy storage systems and balancing capacities), has created an urgent need for qualified personnel. The country requires a comprehensive system for training specialists across various fields and professions: from engineering and technical staff to skilled technicians in installation and maintenance, equipped with knowledge of energy management principles. Studies indicate that between 2016 and 2021, there

was a significant rise in job opportunities for non-traditional "green" professions: sustainable development managers (+30%), wind turbine technicians (+24%), solar energy consultants (+23%), and ecologists (+22%). These shifts reflect a fundamental transformation of the labor market within the energy sector (Semyhina & Markevych, 2022). Experts particularly value entrepreneurial skills in future professionals in this field, driven by the unique nature of renewable energy, which offers distinct opportunities for innovation and startups. The modern energy sector demands specialists capable not only of addressing technical challenges but also of identifying market opportunities, developing business models, and efficiently managing resources.

An analysis of the source base concerning the formation of entrepreneurial competence among future energy sector specialists related to alternative energy sources reveals considerable interest in this topic within the scientific community. The issue of preparing young people for entrepreneurial activities is increasingly addressed in the works of domestic and international researchers, regularly discussed at scientific events of various levels, and reflected in regulatory and legal documents governing the education sector. The theoretical and methodological foundations for developing entrepreneurial competence have been elaborated in studies by S. Alekseieva (2020), L. Bazyl (2021), V. Baydulin (2022), I. Hrytsenok (2024), L. Yershova (2024), D. Zakatnov (2024), V. Orlov (2022), and N. Vanina (2024). These researchers have substantiated the essence of entrepreneurial competence, defined its structure, and proposed approaches to its development within the professional education system.

Of particular significance to this study are scientific investigations into the didactic and methodological foundations of integrating an entrepreneurial component into the educational process (Alekseeva & Yershova, 2020; Bazyl & Orlov, 2023). The importance of these contributions lies in their combination of a theoretical justification for the need to foster entrepreneurial competence with the development of practical mechanisms for its implementation within vocational (technical-vocational) education institutions. Scholars have substantiated a set of pedagogical technologies and methods that facilitate the development of entrepreneurial thinking within the context of professional training. The methodological approaches proposed by these authors, which include diagnostic tools, techniques for developing business skills, and criteria for evaluating outcomes, are particularly valuable and can be adapted to the specifics of the

energy sector to create a comprehensive model for fostering entrepreneurial competence among future specialists in the field.

An analysis of the energy segment of the national economy as an environment for the professional activities of future specialists in alternative energy sources confirms that its transformation (market liberalization, decentralization of energy systems, and the growth of renewable energy sources) significantly alters the requirements for professional training. Industry experts emphasize the increasing demand for professionals who can not only effectively address technical tasks but also demonstrate entrepreneurial initiative, assess the economic feasibility of technological solutions, and develop and implement innovative projects in the energy sector (Ukrainian Clean Generation, 2023).

At the same time, an analysis of scientific sources reveals a significant gap in the study of the specifics of entrepreneurial skills among graduates of vocational (technical-vocational) education institutions whose professional activities will be directly linked to renewable energy sources. This issue gains particular importance in the context of the demonopolization of Ukraine's energy market, which creates new opportunities for small and medium-sized enterprises in the sector. The rapid development of technologies that enable consumers to simultaneously act as electricity producers – a hallmark of "green" energy – fundamentally alters the structure of the energy sector and fosters the emergence of innovative business models. An additional factor highlighting the urgency of this issue is the growing international funding for energy efficiency and renewable energy projects, tied to the restoration processes of the country's energy system, which was devastated by russian aggression. This demands specialists capable of developing investment proposals and effectively managing such projects. Another key trend is the servitization of the energy sector, which requires professionals to possess advanced customer-oriented skills and marketing acumen. Consequently, there is a need to refine the structure of entrepreneurial competence for energy specialists, taking into account the sector's specific characteristics. The methods for integrating an entrepreneurial component into the professional training of energy specialists, aligned with industry trends and labor market demands, remain insufficiently explored. There is also a lack of comprehensive pedagogical technologies aimed at fostering entrepreneurial competence that consider the profile of professional activities related to alternative energy sources.

The purpose of this study is to conduct a detailed analysis of the current state and development trends of renewable energy in Ukraine, identify professional and qualification challenges within the energy sector associated with alternative energy sources, provide a theoretical and methodological substantiation of the process of forming entrepreneurial competence in future skilled workers, taking into account strategic transformations in the domestic energy industry and current labor market needs, and address the development of its structural components in line with modern regulatory and methodological frameworks.

To achieve this objective, a range of methods were employed, including: theoretical analysis, which involves a critical review of regulatory and legal documents and a systematic study of scientific sources to identify conceptual approaches to the professional training of future energy sector specialists and the formation of their entrepreneurial competence; praximetric methods, aimed at diagnosing progressive pedagogical practices through a thorough analysis of educational and training programs for specialists, as well as innovative methodological strategies and approaches to developing entrepreneurial competence; and methods of generalization and forecasting, applied to systematize positive experiences, diagnose problematic aspects of training, and develop strategic recommendations for improving educational practices and initiatives in the field of vocational education for specialists in alternative energy sources.

The current state of business education in Ukraine reveals a structural mismatch between the theoretical content of educational programs and the practical competencies demanded by the energy market, particularly in the context of renewable energy sources. The depth of this issue is substantiated by statistical data and expert assessments of the training of specialists for the energy sector. Today, Ukraine has a unique opportunity to build a more efficient, environmentally friendly, reliable, and competitive energy system, to implement European regulations and policies, and to create conditions for significantly improving energy efficiency. However, achieving this goal is hindered by a shortage of qualified personnel. According to expert studies (UN Global Compact Network in Ukraine, 2022), 97% of energy companies acknowledge the existence of a "specialty crisis" in the energy sector. Demand is particularly growing for specialists in electrical engineering, electrotechnics, electromechanics, thermal energy, and renewable energy sources. The transformation of the energy market amid sector decentralization and the development of small-scale generation has created

a new segment where technical competencies are inseparable from entrepreneurial thinking. Yet, an assessment of the educational level of training reveals an alarming trend: only 10% of graduates demonstrate a high level of proficiency, 31% possess a sufficient level, and 59% exhibit a low level.

An analysis of the reasons behind this state of professional training identifies systemic issues in the interaction between education and business. Energy companies note that the primary obstacles to collaboration with educational institutions include the inflexibility of these institutions (29%), a lack of financial autonomy that diminishes their interest in genuine cooperation with companies (20%), and inadequate communication between education and business – education "does not hear" the voice of business (15%). This institutional gap between education and the energy sector prevents graduates from developing an entrepreneurial vision of industry processes. At the same time, representatives of energy companies acknowledge their own responsibility in this situation, pointing to insufficient state support for collaboration processes between businesses and educational institutions, as well as the business sector’s low willingness to bear the financial and organizational costs of training future employees.

The development of "green" entrepreneurship is a strategically important direction of Ukraine’s economic policy. However, the existing approaches to fostering entrepreneurial competence among future energy professionals require improvement to adequately prepare them for such activities. The potential of young students, their ambitions, and their readiness to implement innovations could become a vital resource for transforming the energy sector, enhancing its competitiveness, and addressing pressing energy supply challenges.

The formation of entrepreneurial competence among future energy sector specialists holds strategic importance at the state level, as evidenced by several regulatory and legal documents. Notably, the Cabinet of Ministers of Ukraine’s Resolution No. 761-r of August 13, 2024, "On the Approval of the National Action Plan for Renewable Energy until 2030 and the Implementation Plan," emphasizes the importance of creating conditions for the training and retraining of Ukrainian professionals in the field of renewable energy sources and alternative fuels. State support for the professional training of energy specialists is driven by objective market needs, as significant growth is projected in renewable energy production volumes, the installed capacity of renewable energy facilities, energy storage

systems, and balancing capacities. This presents new challenges for the education system, which must reorient itself toward developing competencies relevant to Ukraine's modernized energy sector.

The practical implementation of state initiatives requires a transformation of the entire educational vertical, including institutions of vocational (technical-vocational) education. The effectiveness of this process depends, among other factors, on establishing productive collaboration between the educational and business environments. Such interaction lays the foundation for systemic transformations in Ukraine's energy sector, aligning it with contemporary global trends and sustainable development requirements. Only through the combined efforts of the educational community, research institutions, and energy enterprises can a workforce be developed capable of implementing energy-efficient technologies and enhancing the competitiveness of the domestic energy sector based on principles of environmental responsibility.

A vivid example of the educational system responding to labor market demands in the energy sector is the training of skilled workers in state vocational (technical-vocational) education institutions for the profession of "Technician for the Installation and Maintenance of Renewable Energy Systems." This relatively new profession is gaining particular relevance amid the rapid development of alternative energy sources. The functional responsibilities of such specialists encompass a broad range of knowledge and skills: from the installation and maintenance of renewable energy systems, assessment of the quality of installed equipment, and monitoring of energy device operations to the ability to establish their own businesses, thereby ensuring self-employment and self-reliance. The professional activities of a technician in this field involve setting up structures to secure system components in designated locations, laying cables and pipelines, and assembling individual installation units. Key competencies of the specialist include the ability to work with technical documentation and equipment operation manuals, utilize assembly drawings and diagrams, and select the necessary tools and devices. An essential aspect of the job also involves identifying failures and malfunctions in renewable energy systems, monitoring the external condition of equipment, and conducting preventive maintenance to ensure the reliable operation of energy systems (Svit profesiy, 2025).

Defining the functional responsibilities of technicians for the installation and maintenance of renewable energy systems highlights the

wide range of professional competencies required for effective performance. For a systematic understanding of qualification requirements, it is advisable to refer to the regulatory framework governing vocational training in the context of modern labor market demands. The foundational tool for regulating professional qualifications within Ukraine's educational landscape is professional standards, which, pursuant to Article 39 of the Law of Ukraine "On Education" (Verkhovna Rada Ukrayiny, 2017), are defined as officially approved requirements for workers' competencies. These documents serve as the fundamental basis for shaping professional qualifications and the subsequent development of educational programs. Methodologically significant is the fact that the development of professional standards involves various stakeholders in the educational and professional environment, including employers, their organizations and associations, government bodies, research institutions, industry councils, public associations, and other interested parties. This ensures a multi-stakeholder approach and comprehensive representation of requirements. Emphasis is placed on the fact that professional standards are developed for the most promising and in-demand types of labor activities, professions, and qualifications on the labor market. The process of developing a professional standard involves thorough research and analysis of effective labor practices, with the mandatory involvement of experts – experienced professionals in the relevant field – ensuring the document's alignment with current industry needs.

Within the educational system, professional standards are utilized for three key processes: first, the development of educational programs, standards, and teaching materials for all forms and types of education, including on-the-job training for workers and the preparation of pedagogical staff; second, the establishment of standards for evaluating learning outcomes and awarding professional qualifications, ensuring objectivity and uniformity in certification processes; third, the creation of unified criteria for assessing the competencies of individuals seeking professional qualifications, regardless of the pathways through which they were obtained. This aligns with the principles of lifelong learning and the recognition of outcomes from non-formal and informal education.

A thorough study of the regulatory framework for the professional training of energy sector specialists requires an analytical consideration of the professional standard that governs the qualification requirements for future industry professionals. To identify the potential for developing

entrepreneurial competence among prospective specialists in alternative energy sources, a systemic analysis will be conducted of the structural and substantive characteristics of the professional standard "Master of Installation and Maintenance of Renewable Energy Systems," approved by Order No. 106-22 of the Ministry of Economy of Ukraine on January 13, 2022. This standard serves as a normative and methodological document reflecting a consolidated approach to defining qualification requirements, structured according to labor functions, professional competencies, and the necessary knowledge and skills. Analysis of the document enables the identification of competence units that correlate with the entrepreneurial component of professional activity.

Methodologically significant is the section "Professional Qualifications," which establishes a hierarchical structure of qualification levels – from Category III to Category I – with a corresponding expansion of labor functions. For instance, a Category III master must possess the labor functions of "Performing preparatory and auxiliary works," "Installing supporting structures and system fasteners," "Installing system equipment," and "Maintaining and repairing systems" (with professional competencies such as "Ability to perform instrument repair work," "Ability to monitor the operation of relevant devices and equipment," and "Ability to oversee system functionality"). A Category II master encompasses the functions of the first level, with the added competence of "Setting up, adjusting, testing, inspecting, and commissioning systems." A Category I master includes all the aforementioned functions, supplemented by "Organizational support for installation and maintenance works." It is this final labor function that integrates a set of competencies directly linked to entrepreneurial activity.

A detailed analysis of the substantive content of the labor function "Organizational support for works" reveals a structured system of professional competencies, knowledge, and skills that shape the entrepreneurial dimension of a specialist. The competence "Ability to develop simple projects and schemes for the installation of renewable energy systems" presupposes proficiency in methods of economic efficiency, as well as fundamentals of economics and production organization. These knowledge components foster the development of economic thinking as a foundational element of entrepreneurial competence. The skills of "Developing modifications and determining general operating parameters of renewable energy systems" and "Developing and/or selecting schemes and procedures for installing modules and blocks of renewable energy systems"

integrate technical and economic aspects of professional activity, which are essential characteristics of entrepreneurial thinking.

The competencies "Ability to prepare technical documentation related to the maintenance of renewable energy systems" and "Ability to manage the preparation of planned and reporting documentation of the relevant focus" form the procedural and operational component of entrepreneurial competence. Of particular importance is the skill of "Preparing specifications, diagrams, tables, and charts necessary for the maintenance of renewable energy systems," which underpins the analytical dimension of entrepreneurial activity. The knowledge of "Methods for calculating the economic efficiency of implementing new equipment, advanced technology, and inventions of the relevant focus" acquires a system-forming significance for the development of entrepreneurial competence. This knowledge enables the ability to evaluate innovative technological solutions from the perspective of their economic feasibility – an imperative of entrepreneurial thinking–alongside "Fundamentals of economics, production organization, labor, and management." This latter competence unit is integrative in nature, as it combines knowledge components from four interrelated domains that form the cognitive foundation of entrepreneurial activity: understanding the economic mechanisms of the energy services market, the ability to optimally structure production processes, competence in the rational organization of labor, and managerial skills necessary for establishing one’s own business.

The analysis of the "General Competencies" section of the professional standard reveals the presence of components that are integral characteristics of entrepreneurial activity: the ability to make decisions within the scope of professional competence and bear personal responsibility for the outcomes; adaptability and stress resilience; and the capacity for professional mobility and adaptation. These competencies form the personal component of entrepreneurial competence, ensuring readiness to act under conditions of uncertainty and risk. Particularly significant are the competencies "Ability to apply digital technologies and tools, and evaluate information" and "Ability to rationally use energy resources and materials in professional activities," which reflect contemporary trends in the digitalization of business processes and resource efficiency as foundational elements of competitiveness in the energy sector.

The analysis of the section "Regulatory and Legal Framework Governing the Relevant Professional Activity" demonstrates the complexity of legal regulation within the industry and the necessity of integrating

knowledge from various normative legal acts that govern activities in the field of renewable energy. Specifically, the Laws of Ukraine "On Alternative Energy Sources" (Verkhovna Rada Ukrayiny, 2003), "On Environmental Protection" (Verkhovna Rada Ukrayiny, 1991b), and "On Consumer Rights Protection" (Verkhovna Rada Ukrayiny, 1991a) constitute the legal component of entrepreneurial competence.

The professional standard for the occupation "Technician for the Installation and Maintenance of Renewable Energy Systems" identifies competency units that facilitate the development of entrepreneurial competence across the domains of knowledge, skills, and personal qualities. At the same time, the standard reflects the integrated nature of professional activity, where entrepreneurial competence is not a standalone component but is organically embedded within the system of professional competencies of an energy sector specialist. The identified structure of entrepreneurial competence within the professional standard provides a methodological foundation for the development of innovative pedagogical technologies aimed at fostering this competence in future renewable energy specialists within the system of vocational (technical-vocational) education. These technologies are tailored to the specifics of the industry and the current needs of Ukraine’s energy market, while also serving as a basis for the development of a national educational standard.

The National Educational Standard for the occupation "Technician for the Installation and Maintenance of Renewable Energy Systems," approved by Order No. 535 of the Ministry of Education and Science of Ukraine on April 18, 2024, serves as the regulatory foundation for training qualified workers, underscoring its strategic importance in building the human resource capacity of the renewable energy sector. Developed based on the professional standard, it constitutes an integrated normative-methodological document that regulates the content of education, its structure, and learning outcomes. The conceptual foundation of the standard is a competency-based approach, as outlined in the introductory section of the document, which emphasizes the formation and development of key, general, and professional competencies. The structural design of the standard reflects a hierarchical logic for developing professional qualifications, progressing from foundational to advanced levels. It establishes three qualification levels for technicians in the installation and maintenance of renewable energy systems: Category III as the entry level, Category II as the baseline level, and Category

I as the highest level, aligning with the principle of continuity in vocational education.

An analysis of the list of key competencies reveals the systemic integration of entrepreneurial competence into the educational process, particularly through its designation as a core component, described via a structured system of knowledge and skills. A substantive analysis of this competence highlights its cognitive components: economic-theoretical knowledge of market economics and its operational principles; organizational-legal knowledge regarding forms of entrepreneurship in Ukraine and relevant regulatory documents; procedural knowledge related to starting a business, types of wages, and labor incentives; and strategic-managerial knowledge concerning the transformation of ideas into actionable outcomes, the economic and social prerequisites of entrepreneurship, project planning and management, and the development of business plans.

Entrepreneurial competence is defined as a recommended outcome to be developed at the final stage of an educational program, emphasizing its integrative nature and the necessity of being grounded in other competencies. Its significance is particularly evident in its development within the structure of learning outcomes for Category I masters, specifically through the learning outcome "Provide organizational support for the installation and maintenance of renewable energy systems." This is achieved via the professional competence "Ability to prepare technical documentation related to the maintenance of renewable energy systems," encompassing knowledge of methods for calculating economic efficiency, as well as fundamentals of economics and production organization. The activity component of entrepreneurial competence is structured through regulatory and legal skills in utilizing relevant acts, analytical skills for critical analysis of creative processes in project planning, financial and managerial skills for independent financial decision-making and negotiation, communicative and motivational skills to inspire appreciation of ideas, and project-related skills in developing business plans.

A structural-functional analysis of the standard reveals the systemic integration of entrepreneurial competence components into various learning outcomes and professional competencies, particularly in documentation and analytical competencies. A methodological feature of the standard is the systemic integration of entrepreneurial competence with other key competencies, notably digital competence, which creates a synergistic effect

in the context of readiness for entrepreneurial activity in a modern digitalized environment. The state educational standard for the profession establishes a comprehensive regulatory and methodological framework for developing the entrepreneurial competence of future energy sector specialists. It ensures the systemic integration of entrepreneurial knowledge, skills, and abilities into the educational process structure, aligning with current industry trends and labor market demands. Its implementation in the educational process of vocational (technical-vocational) education institutions provides a methodological foundation for training a new type of specialist capable not only of effectively performing technical tasks but also of demonstrating entrepreneurial initiative and developing and implementing innovative projects in the field of renewable energy.

A significant component in fulfilling the objectives outlined by the state educational standard is the availability of appropriately oriented curricula. In this context, it is expedient to analyze the curriculum of the academic discipline "Fundamentals of Innovative Entrepreneurship," developed by researchers from the Institute of Vocational Education of the National Academy of Pedagogical Sciences of Ukraine (Alekseieva et al., 2019). The structure and content of the program allow for the identification of its key features and potential for adaptation to the training of energy sector specialists. The program has a clear modular structure, comprising seven thematic blocks and a culminating project. The total volume of 20 instructional hours is distributed based on the significance of various aspects of entrepreneurial training. The largest allocation (4 hours) is devoted to the module "Economic and Legal Conditions of Innovative Entrepreneurship," underscoring the importance of a regulatory and legal framework for successful business operations. At the same time, considerable attention is given to "Theoretical Foundations of Innovative Entrepreneurship" and "Personal Self-Management" (3 hours each), forming the basis for theoretical knowledge and personal qualities.

The program’s content is logically structured, progressing from an understanding of the fundamentals of innovative entrepreneurship to practical skills in planning, communication, and ethical aspects of business conduct. Notably, the program integrates not only economic and legal issues but also personal development components, such as "Personal Self-Management," which includes time management, personal development, and career planning. This approach aligns with the contemporary understanding of entrepreneurial competence as a comprehensive combination of

knowledge, skills, and personal attributes. The teaching methods recommended by the program – such as targeted discussions, brainstorming, Gordon's method, and heuristic methods – are aimed at fostering creative thinking and innovative exploration, which are critical for developing an entrepreneurial mindset. The practical orientation of the program is realized through the educational project "Creating a Business Plan," which serves as a final assessment task, ensuring the application of acquired knowledge in a specific development project.

The "Fundamentals of Innovative Entrepreneurship" program can serve as a methodological foundation for developing the entrepreneurial competence of future specialists. However, it requires targeted adaptation and modernization to account for the specifics of applying alternative energy sources and current trends in the development of the energy component of the national economy. To align the program with the needs of training specialists in renewable energy, it is advisable to supplement it with thematic modules reflecting the sector's particularities. These may include innovative business models in the energy sector; digital technologies related to renewable energy sources and their application in entrepreneurial activities; environmentally oriented entrepreneurship in the energy sector; the development of innovative projects in renewable energy; and the establishment of businesses focused on the installation and maintenance of renewable energy systems, among others.

Research into the modern educational environment demonstrates that the implementation of entrepreneurial training tasks for specialists in the renewable energy sector involves significant methodological updates to educational programs in vocational (technical-vocational) education institutions. An analysis of their practices reveals the transformation of courses such as "Fundamentals of Sectoral Economics and Entrepreneurship," "Fundamentals of Innovative Entrepreneurship," and "Fundamentals of Entrepreneurial Activity" into a comprehensive educational component. This component integrates fundamental economic concepts with the sectoral specifics of alternative energy. Such integration is characterized by the interpenetration of entrepreneurial and professional competencies, creating a reinforced, mutually complementary effect in training qualified workers. The methodological rethinking of educational programs occurs through systematic interaction between educational institutions and stakeholders, ensuring that the educational process aligns with current industry requirements. This approach fosters the development

of institutional collaboration models by involving representatives of energy companies in educational-methodological councils, contributing to the content development of programs, and providing expert evaluation of learning outcomes. This enables the integration of progressive industry experience into the educational process, reflecting broader trends in the development of green energy in Ukraine.

A structural-content analysis of adapted educational programs reveals that traditional entrepreneurial components undergo substantive transformation. Specifically, the theoretical foundation of entrepreneurship is enriched with an analysis of the renewable energy market's peculiarities ("Entrepreneurial Potential of Renewable Energy"); the development of an entrepreneur's personal qualities is examined through the lens of the sector's specific demands ("Professional Profile of an Entrepreneur in the Renewable Energy Sector"); and the legal aspects of entrepreneurial activity are contextualized within the regulatory framework governing alternative energy. A noticeable transformation is also evident in other program components: traditional business planning methodology gains subject-specific focus through an emphasis on renewable energy projects, while formal procedures for starting a business are highlighted with attention to the organizational and legal specifics of green energy enterprises; production management shifts its focus to technological innovations and operational processes characteristic of the alternative energy sector; general economic principles of pricing policy are adapted to account for specific tariff-setting mechanisms, while financial and economic tools are considered through the prism of investment features of energy projects; and the ethical-value component of entrepreneurial activity is enriched with issues of environmental responsibility and sustainable development, which are defining for the renewable energy sector.

It is important to emphasize that the development of such adapted programs considers not only current but also prospective industry needs, enhancing the relevance of training specialists with well-developed entrepreneurial competencies. The involvement of employers in designing educational programs ensures that both the current state of the energy sector and its projected transformation directions are taken into account.

The methodological framework for fostering entrepreneurial competence in future renewable energy specialists is achieved through the organic integration of innovative digital ecosystems and the implementation of international cooperation projects. This creates conditions for aligning

national educational practices with global standards of entrepreneurial education. Contemporary educational practice faces the need to develop comprehensive digital environments capable of providing high-quality professional training for "digital natives" – a generation shaped by a technologically saturated environment. For instance, the "Professional Education Online" platform, introduced by the Ministry of Education and Science of Ukraine in 2022, serves as a comprehensive didactic environment, including for the development of entrepreneurial competence. This educational ecosystem is characterized by the integration of interactive tests with adaptive algorithms, the availability of virtual simulators, and production process simulations, ensuring a high level of immersion for learners in professional realities. The multimedia content format enables the modeling of professional scenarios in a virtual environment, the individualization of educational trajectories, and an increase in learners' cognitive engagement. The platform's functional capabilities lay the groundwork for developing strategic thinking and communication skills through virtual presentations and collaborative projects.

In the context of international collaboration, the online course "BIZ-UP: Entrepreneurial Skills for Youth," developed by the International Labour Organization, stands out. The course features a clear structure comprising six concise modules, each lasting approximately 45 minutes, which progressively cover key aspects of entrepreneurial activity – from business idea development to financial planning and personnel management. A distinctive feature of the course is its practical orientation: through real-world examples, participants can observe the progress of three young entrepreneurs and assist them in addressing business challenges. While the course can be completed independently, its effectiveness is enhanced with the involvement of a mentor who can evaluate completed tasks and provide recommendations for further entrepreneurial development (Mizhnarodna orhanizatsiya pratsi, 2023).

European Union programs and GIZ initiatives in Ukraine are exemplified by a project implemented by the Volyn Resource Center titled "Strengthening the Capacity of Vocational Education Institutions to Enhance Youth Adaptability to Labor Market Needs During Wartime Through the Development of Entrepreneurial Skills" (Volynskyi resursnyi tsentr, 2023). This project was carried out within the "EU4Skills: Better Skills for Modern Ukraine" program. The outcome was the online course "Own Business: Methods for Teaching Students Entrepreneurship," distinguished by the

accessibility of didactic materials, interactivity, modular structure, and an integrated approach to building entrepreneurial competencies. Additionally, under the initiative "Business Skills for Economic Growth: Training Courses for Students, Vocational Education Teachers, and Aspiring Entrepreneurs," implemented as part of the "Professional Education in Ukraine/Skills4Recovery" program by the German Society for International Cooperation (GIZ) with financial support from the German Ministry for Economic Cooperation, two key educational directions were realized: youth entrepreneurship development and adult entrepreneurship training (Vyshcha osvita v Ukrayini, 2024).

The "Recovery through Social Entrepreneurship" program (2023–2025), implemented by the European Union in collaboration with the Ministry of Foreign Affairs of Lithuania, merits particular attention. This initiative aims to cultivate a cohort of social entrepreneurs among the youth of Ukraine, Georgia, and Moldova. Its methodological framework incorporates components of the Startup Pre-Accelerator, including grant support (2,000 EUR) for prototyping and presenting business models to investors (Proiekt EU4Youth, 2025).

The aforementioned international projects and digital educational platforms in the field of vocational education demonstrate a positive impact on the development of foundational entrepreneurial competencies among future skilled workers. These educational resources effectively facilitate the mastery of general aspects of entrepreneurial activity through the integration of interactive methodological tools, virtual simulators, and practice-oriented approaches. However, for the comprehensive training of specialists in renewable energy, it is essential to significantly expand their methodological toolkit, taking into account sector-specific requirements. The development of entrepreneurial competence in the domain of alternative energy sources should involve the integration of educational and methodological modules into these initiatives. Such modules should focus on fostering skills in technical analysis of project energy efficiency, energy balance calculations, and grid integration of renewable sources. It is also advisable to incorporate components addressing tariff policy, licensing specifics in the "green" energy sector, mechanisms of energy auctions, and the intricacies of contract formulation. A promising direction for the methodological support of such projects lies in integrating components for modeling sector-specific business structures for startups in bioenergy, solar, and wind energy sectors, with the involvement of industry experts and potential investors. This targeted

approach will ensure the development of specialized competencies necessary for effective entrepreneurial activity within the unique context of the renewable energy market.

The results of the study on the development of entrepreneurial competence among future specialists in Ukraine's energy sector economy indicate that transformational processes in the energy industry – particularly in the renewable energy segment – demand a fundamentally new approach to professional training. The rapid increase in the share of alternative energy in the country's energy balance, as outlined in strategic documents, underscores the need for specialists capable of operating effectively amid the demonopolization of the energy market and the development of decentralized energy systems.

The content of regulatory documents concerning the professional training of specialists, as reflected in the professional standard and the state educational standard for the occupation "Technician for the Installation and Maintenance of Renewable Energy Systems," ensures the structural integration of entrepreneurial competencies across various qualification levels. These range from organizational task execution, the development of simple projects and installation schemes, to knowledge of methods for calculating economic efficiency, as well as fundamentals of economics, production organization, labor, and management. Nevertheless, the demands of the energy market are outpacing the current state of the educational system, as evidenced by the findings of expert studies.

The vast majority of entrepreneurial training programs demonstrate potential for developing basic entrepreneurial competencies but require significant industry-specific adaptation. To effectively train specialists in renewable energy, these programs should be supplemented with thematic modules reflecting the specifics of economic activities related to alternative energy sources: innovative business models in the energy sector, digital technologies and their application in entrepreneurial activities, environmentally oriented enterprises, the development of innovative projects in the field of renewable energy, and the peculiarities of launching a business focused on the installation and maintenance of relevant systems. At the same time, transformative processes are already underway in the educational practices of vocational (technical-vocational) institutions – educational components of entrepreneurship are undergoing substantive modification through the contextualization of theoretical material to the specifics of alternative energy. Thematic modules on its entrepreneurial potential are

being developed, the features of organizational and legal forms of green energy enterprises are being explored, and business planning methodologies are focusing on renewable energy projects. A positive trend is the involvement of energy company representatives in shaping the content of educational programs and evaluating learning outcomes, which helps bridge the institutional gap between education and business.

Significant potential for enhancing entrepreneurial competence lies in innovative educational initiatives and digital platforms introduced through mechanisms of international cooperation. Interactive tests, virtual simulators, and production process emulators create conditions for modeling professional scenarios and increasing learners' cognitive engagement. Educational services resulting from international collaboration provide structured learning of key aspects of entrepreneurial activity using real-world examples, characterized by accessible didactic materials and an integrated approach to fostering entrepreneurial competence, while also enabling the practical implementation of business ideas. However, these educational resources require substantial industry-specific contextualization to effectively train specialists in alternative energy systems.

To address the identified challenges, we consider it necessary to implement systemic changes in the methodological support for training specialists in the energy sector. In our view, the priorities today include the development of specialized educational materials on the technical and economic feasibility of energy projects, tariff policies, and licensing in the field of green energy, as well as mechanisms for energy auctions and the specifics of contract negotiation; the introduction of dual education with direct involvement of energy enterprises; the development of industry-specific business incubators and startup support programs in the fields of bioenergy, solar, and wind energy; and the establishment of institutional partnerships between educational institutions, research organizations, and energy companies.

A promising direction for further research is the development of a comprehensive model for fostering entrepreneurial competence that accounts for the specifics of various renewable energy segments, as well as the study of integration mechanisms combining traditional vocational (technical-vocational) education with innovative approaches to developing entrepreneurial skills. The issue of exploring pedagogical conditions for enhancing entrepreneurial competence within the dual training system remains relevant, as does the analysis of global experiences in integrating

digital technologies into entrepreneurial education, with particular attention to the specifics of restoring Ukraine's war-damaged energy infrastructure.

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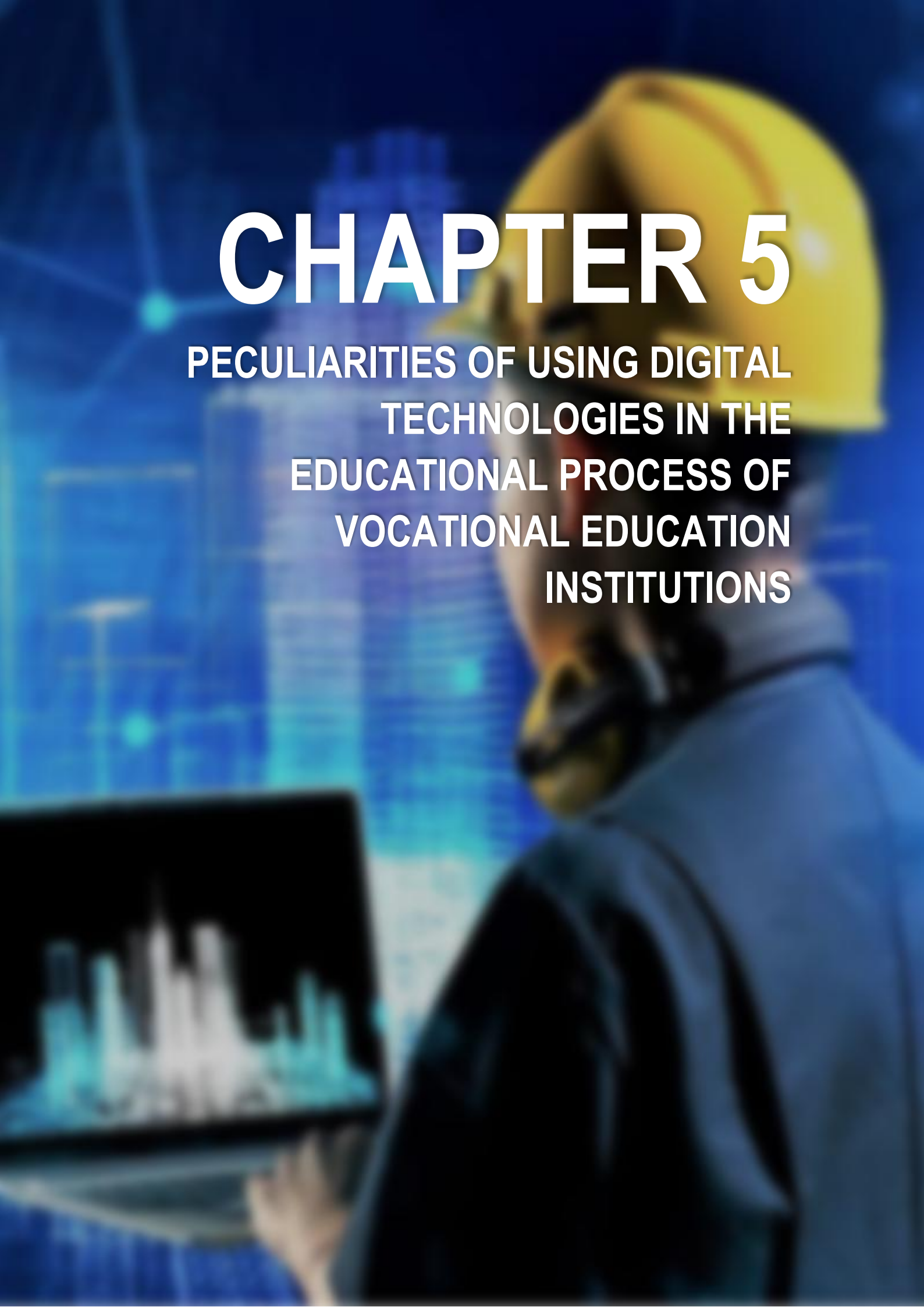

CHAPTER 5

PECULIARITIES OF USING DIGITAL TECHNOLOGIES IN THE EDUCATIONAL PROCESS OF VOCATIONAL EDUCATION INSTITUTIONS

5.1. ANALYSIS OF BIG DATA IN THE PEDAGOGICAL SPHERE USING ARTIFICIAL INTELLIGENCE

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The role of big data as a strategic resource in education is explored, transforming traditional approaches to teaching and management through the processing of vast amounts of information based on the 5V model and artificial intelligence technologies. The potential for personalizing education is highlighted, enabled by the integration of diverse student data, which allows artificial intelligence algorithms to create adaptive learning pathways, thereby enhancing knowledge acquisition efficiency. The significance of big data in predicting academic performance and early identification of challenges is analyzed. The study examines how big data analysis optimizes educational processes, from curriculum development to policy planning, while increasing student motivation through innovative methods such as gamification. Ethical and technical challenges related to data privacy and algorithmic bias are addressed, underscoring the need for developing standards and protective technologies to ensure the fair use of big data in education.

Keywords: *big data; artificial intelligence; personalized learning; academic performance prediction; adaptive learning.*

5.1. АНАЛІЗ ВЕЛИКИХ ДАНИХ У ПЕДАГОГІЧНИЙ СФЕРІ ЗА ДОПОМОГОЮ ШТУЧНОГО ІНТЕЛЕКТУ

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Розкрито роль великих даних як стратегічного ресурсу в освіті, що трансформує традиційні підходи до навчання та управління завдяки обробці великих обсягів інформації за моделлю 5V і технологіями штучного інтелекту. Висвітлено можливості персоналізації навчання через інтеграцію різноманітних даних про учнів, що дає змогу алгоритмам штучного інтелекту створювати адаптивні навчальні траєкторії, підвищуючи ефективність засвоєння знань. Проаналізовано значення великих даних у прогнозуванні успішності та ранньому виявленні проблем. Досліджено, як аналіз великих даних оптимізує освітні процеси, від розроблення навчальних планів до планування політики, підвищуючи мотивацію учнів на основі інноваційних методів, такі як гейміфікація. Висвітлено етичні та технічні виклики, пов'язані з конфіденційністю даних і упередженістю алгоритмів, що вимагають розроблення стандартів і технологій захисту для справедливого використання великих даних в освіті.

Ключові слова: *великі дані; штучний інтелект; персоналізація навчання; прогнозування успішності; адаптивне навчання.*

In the modern world, the concept of Big Data has gained extraordinary relevance. This is driven by the rapid development of digital technologies,

the globalization of information flows, and the need for efficient management of various resources. Organizations, governments, and researchers increasingly turn to Big Data to understand complex social, economic, educational, and environmental processes. In this context, Big Data transcends its role as a mere tool, becoming a strategic asset that determines competitiveness and progress across diverse fields. The sources of Big Data encompass both technological and human dimensions. Social networks, such as X or Facebook, generate billions of posts daily, reflecting users' opinions, emotions, and behaviors. Sensors in smart cities, industrial systems, or medical devices continuously collect data on temperature, movement, or health conditions. Mobile devices, in turn, record geolocation, search queries, and transactions, creating detailed profiles of human activity (Chen et al., 2014). These data can be structured, such as tables in databases, or unstructured, such as text posts or multimedia content, which complicates their processing using conventional methods.

In this regard, Big Data in education serves as a catalyst for change, promoting personalized learning, efficiency, and the adoption of innovations. Its primary value lies in its ability to transform information into practical solutions that enhance the educational process and prepare learners for future challenges. As data volumes grow and processing methods improve, the role of Big Data in education will only intensify, opening new horizons for science, pedagogy, and management (Johnson et al., 2016). Specifically, BigA Data refers to vast arrays of information characterized by five key attributes, known as the 5V model: Volume, Velocity, Variety, Veracity, and Value. Volume denotes the immense quantity of data, which can reach petabytes or even exabytes, exceeding the capacity of traditional databases. Velocity reflects the rate at which information is generated, received, and requires processing, often in real time (Olafsson & Wu, 2008). Variety highlights the wide range of data formats – from text and numbers to images, videos, and audio. Veracity underscores the challenge of accuracy and reliability, as Big Data often contains noise or incomplete records. Finally, Value defines the ability of this data to yield benefits after analysis. A distinctive feature of Big Data is that traditional technologies, such as relational databases or basic analytical tools, are inadequate to handle its complexity and scale. Specialized solutions, such as distributed data storage systems (Hadoop), real-time processing platforms (Apache Spark), or machine learning techniques (Gandomi & Haider, 2015), are employed for this purpose. These technologies not only enable the storage of vast data

volumes but also facilitate rapid analysis, uncovering hidden patterns. Such an approach demands significant computational resources and highly skilled specialists, making Big Data a domain primarily accessible to large organizations or research groups.

The role of Big Data in contemporary education is becoming increasingly significant, as it enables the transformation of traditional approaches to teaching, forecasting, and managing educational processes. In the educational context, Big Data is utilized to analyze learners' academic performance, personalize curricula, and predict resource needs, such as teaching staff or educational infrastructure. For instance, data analysis can identify patterns in students' knowledge gaps or predict the likelihood of dropout, enabling timely preventive measures (Kolomiiets & Kushnir, 2023). In higher education institutions, Big Data supports the optimization of course allocation and the development of adaptive learning systems tailored to the individual characteristics of each learner (Baker et al., 2016). Consequently, Big Data forms the foundation for innovation and quality improvement in education during the digital era. Its value in education lies not only in its volume but also in its capacity to convert raw information into knowledge that supports informed decision-making. Leveraging artificial intelligence technologies, such as predictive models or time-series analysis, Big Data enables the identification of external factors affecting academic success and the adaptation of teaching strategies to meet the needs of students and educators (Hodets'ka, 2024).

The application of big data in educational institutions enables the creation of dynamic assessment models that account not only for final outcomes but also for the learning process in real time. For instance, the analysis of streaming data from educational platforms such as Moodle or Google Classroom allows instructors to monitor students' progress and adjust instructional materials according to their level of mastery (Johnson et al., 2016). This is particularly relevant in the context of distance learning, where rapid adaptation is critical. Furthermore, big data can assist in predicting the professional development needs of teachers by analyzing data on their effectiveness and student feedback (Radkevych, 2024). In a broader context, big data in education supports effective managerial decision-making at the state level, such as planning educational policies or allocating funding. The analysis of demographic data, test results, and socioeconomic factors enables forecasting of regions that may require additional schools or specialized programs (Berdo et al., 2023). This facilitates resource

optimization and enhances educational accessibility, particularly for vulnerable population groups. The above underscores the transformative role of big data in establishing a fair and efficient educational system. The prospects for utilizing big data in education are closely tied to advancements in artificial intelligence technologies, which enable the processing of complex datasets and the refinement of predictive methods. For example, machine learning models can predict students' career trajectories based on their academic performance and preferences, aiding in the development of recommendation systems for career choices (Baker et al., 2016). In the future, the integration of big data with real-time technologies, such as the analysis of student behavior during classes, could lead to the emergence of fully adaptive learning ecosystems tailored to each individual's needs.

To unlock the potential of big data, it is useful to consider its application across various domains. For instance, in business, big data analysis is widely employed to study market trends and consumer behavior. Companies like Amazon analyze purchase histories, search queries, and customer reviews to predict demand and optimize product offerings (LaValle et al., 2011). In medicine, big data enhances diagnostics by processing information on symptoms, genetic data, and medical histories, enabling the creation of personalized treatment plans and early disease detection. In the financial sector, real-time transaction analysis helps banks identify fraudulent activities, thereby improving customer security. These examples illustrate how big data supports evidence-based decision-making rather than intuition, a principle directly applicable to its role in education. In pedagogy, big data opens new horizons by analyzing information on student performance, attendance, class participation, and interactions with online platforms. For example, data on grades and time spent on assignments can reveal topics that pose difficulties for most students, allowing instructors to adjust teaching methods accordingly (Daniel, 2015). Additionally, big data facilitates personalized learning: platforms like Coursera or Khan Academy use algorithms to generate instructional materials tailored to an individual student's knowledge level and learning style. Thus, education becomes more flexible and oriented toward personalized developmental trajectories.

One of the key areas of big data application in education is the evaluation of learning outcomes and the identification of problem areas. The analysis of statistical data on test results, attendance, and student behavior enables teachers and educational administrators to respond promptly to challenges. For instance, if a system detects a decline in a student's activity

on an online course or frequent absences, it may indicate a drop in motivation or other issues requiring pedagogical intervention (Picciano, 2012). Such approaches allow for real-time progress monitoring and the prediction of potential risks, such as student dropout. On a broader scale, this contributes to the development of support strategies for students and the improvement of overall academic success rates. Another significant advantage of big data is its capacity to analyze educational trends and develop innovative teaching methodologies. The collection and processing of data from diverse sources – ranging from national exams to student feedback – enable the identification of systemic patterns affecting educational quality. For example, data analysis may indicate that interactive teaching methods, such as gamification, significantly increase student engagement compared to traditional lectures (Siemens, 2013).

The analysis of data collected on students' behavior during task performance, their interactions with digital platforms, and their testing outcomes enables the development of personalized learning trajectories (Rosenzweig et al, 2021). For instance, algorithms can identify specific topics that pose difficulties for an individual learner and suggest additional learning materials or exercises tailored to their knowledge level and learning style. This approach not only enhances the effectiveness of material comprehension but also fosters a positive attitude toward learning, as students feel that their needs are being addressed by the instructor. Another significant advantage of leveraging big data is the early identification of students who require additional support or those ready for accelerated learning. By analyzing large datasets, such as grades, attendance, time spent on tasks, and even behavioral patterns, systems can predict potential challenges before they become critical (Siemens & Baker, 2012). For example, if data indicates a consistent decline in a student's activity on an online platform, this could serve as a signal for the teacher to intervene – ranging from individual consultations to adjusting teaching methods. Meanwhile, talented students demonstrating rapid progress can be assigned more challenging tasks to stimulate their development, rather than remaining within the confines of a standard curriculum.

Big data also plays a crucial role in optimizing curricula and schedules. By analyzing the learning effectiveness of different groups, session durations, and students' responses to specific teaching methodologies, educational institutions can refine the structure of the educational process (Daniel, 2016). For instance, if data reveals that students

grasp mathematics more effectively in the morning and literature in the afternoon, schedules can be adjusted accordingly. Furthermore, analyzing student engagement – such as their frequency of participation in discussions or views of educational videos – enables teachers to adapt lesson content, making it more engaging and interactive. This approach not only improves learning outcomes but also encourages students to adopt a proactive stance toward their education.

Research findings on big data in education highlight the relevance of applying Learning Analytics to predict student performance. For example, the study by Sharma et al. (2023) demonstrates how big data analysis from Learning Management Systems (LMS) can predict the risk of student dropout based on their activity, such as login frequency or time spent on tasks. The authors employed machine learning algorithms, including regression analysis and neural networks, to develop predictive models with up to 85% accuracy. These models allow instructors to intervene promptly, offering additional support to students at risk. Such studies underscore the potential of big data in creating proactive educational management strategies. Another key research focus is the development of adaptive learning systems that utilize big data to personalize the learning experience. Research by Huda et al. (2021) showed that adaptive platforms, which analyze individual learning styles, knowledge levels, and student progress, can increase material comprehension efficiency by 20–30% compared to traditional methods. These systems rely on real-time processing of large datasets, enabling automatic adjustments to lesson content, task difficulty, or learning pace to meet the needs of individual students. Such approaches not only enhance outcomes but also boost student motivation through personalized experiences.

However, despite these advantages, researchers face several challenges, particularly ethical concerns and data privacy issues. As noted by Regan & Jesse, (2019), collecting vast amounts of student data – including behavior and personal characteristics – raises concerns about potential misuse or data breaches. For instance, in many countries, legislation such as GDPR limits the use of personal data, complicating the scaling of research efforts. Additionally, questions arise regarding algorithmic bias, which may unfairly classify students due to unrepresentative data. These challenges necessitate the development of clear ethical standards and data protection technologies. The significance of this research for educational advancement is difficult to overstate, as it lays the

groundwork for innovative pedagogical practices and enhances teaching effectiveness. Big data enables the identification of hidden patterns in the educational process, optimizes institutional resources, and even forecasts future labor market needs by analyzing trends in student training. For example, according to O. Fakunle & H. Higson (2021), the use of big data in higher education institutions reduced administrative course costs by 15% while simultaneously increasing student engagement. Thus, these studies serve as a catalyst for systemic changes within the global educational ecosystem.

The primary approach to analyzing big data in education is machine learning, which enables the prediction of learning outcomes and the identification of potential issues. For instance, classification or regression algorithms can predict the likelihood of a student failing an exam by analyzing their previous grades, activity on the platform, and time spent on tasks. Such predictions allow teachers to intervene promptly and provide support to learners. Machine learning is also employed in developing adaptive learning systems that tailor educational material to a student's knowledge level, thereby facilitating personalized education (Radkevych, 2023). This approach relies on the ability of algorithms to learn from large datasets, uncovering complex relationships that are difficult to detect manually (Siemens, 2013). Statistical analysis is another key method used to identify patterns in student behavior and the effectiveness of educational programs. Through correlation analysis or factor modeling, researchers can, for example, determine which aspects of a subject – such as lesson duration, the number of practical tasks, or frequency of interaction with the teacher – most significantly impact learners' performance. In pedagogy, this approach is frequently applied to assess the influence of various teaching strategies on student outcomes. For instance, statistical models may reveal that regular testing correlates with better grades, providing a basis for adjusting curricula. Such analysis underpins evidence-based decision-making in educational institutions (Baker et al., 2016). Data mining plays a crucial role in uncovering hidden patterns within large educational datasets. This method enables the detection of non-trivial relationships, such as those between class attendance, social factors, and academic performance. In the context of pedagogy, data mining is often used to cluster students based on their learning styles or to identify at-risk groups requiring additional attention. For example, analysis of logs from learning management systems (LMS) may indicate that students who rarely access supplementary materials are more

likely to demonstrate unsatisfactory knowledge. These insights assist educators in developing targeted support strategies based on specific behavioral patterns (Romero & Ventura, 2020).

Data visualization is an equally important tool that simplifies the interpretation of complex datasets for educators and administrators. Interactive dashboards, charts, and heatmaps allow for a quick assessment of key indicators, such as student progress, teacher effectiveness, or resource utilization. For example, real-time data visualization can highlight which topics within a subject pose the greatest difficulties for learners, enabling timely adjustments to teaching methods. This approach is particularly valuable in large educational systems, where the volume of data complicates analysis without graphical representation. Visualization transforms abstract numbers into actionable insights, supporting decision-making (Few, 2004). Among the technologies applied to big data analysis in pedagogy, Hadoop and Spark stand out as powerful tools for processing vast amounts of information. Hadoop, with its distributed file system, enables the storage and processing of terabytes of data, such as activity logs from platforms like Moodle. Spark, in turn, facilitates rapid real-time processing, which is beneficial for analyzing streaming data, such as student interactions during online lessons. Visualization tools like Tableau integrate with these systems, providing a user-friendly interface for report generation. Specialized platforms, such as Moodle Analytics, are utilized in educational institutions to predict performance and optimize courses, demonstrating how technology can enhance learning in practice (Romero & Ventura, 2020).

Big data enables personalized learning by integrating diverse information streams that reflect students' individual characteristics. These include demographic data (age, gender, socioeconomic status), cognitive profiles (speed of material comprehension, memory type), learning styles (visual, auditory, kinesthetic), and personal preferences (interests, motivation). Such data is collected through interactive platforms, tests, sensors, and even social media, forming multilayered student profiles. Computational big data processing technologies, such as Hadoop or Apache Spark, allow for the systematization of these heterogeneous datasets and their transfer to machine learning systems for further analysis. This approach not only identifies students' current knowledge levels but also predicts their future needs, creating flexible learning pathways (Pryshlyak et al., 2020; Siemens, 2013). Machine learning algorithms play a pivotal role in personalization by analyzing collected data and identifying specific student

needs. For example, clustering algorithms can group students by similar characteristics, while regression models predict performance based on prior results. Deep learning algorithms, such as neural networks, can detect complex behavioral patterns, such as when students lose interest in material or require additional explanations. These technologies enable real-time adaptation of educational content – adjusting task difficulty, offering alternative formats (video, text, interactive exercises), or modifying the pace of instruction. As a result, students receive an education tailored to their individual capabilities and goals (Yurchenko, 2018; Russell & Norvig, 2016).

The most pressing topic in the field of pedagogical research is the prediction of student success in modern educational institutions, as it not only enhances the quality of education but also reduces dropout rates, which remain a significant challenge. The increasing volume of available data, the digitalization of educational processes, and the advancement of big data analytics technologies have opened new opportunities for predicting learning outcomes and risks associated with discontinuation of studies. Such approaches are particularly crucial amid the dynamic changes in educational systems, where traditional assessment methods – such as grade point averages or subjective teacher evaluations – are no longer always sufficient to provide a comprehensive picture of students' potential difficulties (Berdo et al., 2023). At the same time, predictive analytics promises a personalized approach to each learner, enabling timely identification of those in need of support and optimizing the resources of educational institutions. The relevance of this direction is further underscored by global challenges, such as the COVID-19 pandemic, which exposed the vulnerabilities of traditional performance monitoring systems and heightened the need for automated and precise forecasting tools (de Oliveira et al., 2021).

The application of predictive analytics in pedagogical systems relies on the integration of big data, encompassing a wide range of indicators of student activity. These data include quantitative variables – such as attendance, test scores, and time spent on tasks in distance learning systems – as well as qualitative aspects, such as participation in discussions or engagement with learning materials. Statistical models, such as logistic regression or survival analysis, enable the identification of correlations between these predictors and the likelihood of academic success or failure (Rudenko, 2024). For instance, regular absences from classes or a decline in average grades over a semester often serve as early indicators of dropout risk.

Moreover, these models can account for complex interrelationships between variables, making them effective for forecasting in real-world conditions where student behavior may be nonlinear.

The development of artificial intelligence, particularly neural networks, has significantly expanded the capabilities of predictive analytics in education. Neural networks, such as deep recurrent networks or convolutional models, can analyze temporal data sequences – for example, the dynamics of grades or activity in online systems throughout a semester – uncovering hidden patterns that are difficult to detect using traditional methods (Doleck et al., 2020). Such approaches are especially valuable in the context of massive online learning, where data volumes grow exponentially, and standard statistical tools may lack sufficient flexibility. For example, neural networks can predict the likelihood of student dropout with an accuracy of 85–90% when input data include a comprehensive set of predictors, such as login frequency, study duration, and even the tone of comments in discussions (Yurchenko, 2018).

A key component of predicting academic success is the identification and integration of predictors into early warning systems, which enable educators and administrators to address potential issues before they become critical. Among the most commonly cited predictors, researchers highlight attendance (with a correlation coefficient to success often exceeding 0.7), average grades from previous academic periods, and behavioral indicators, such as activity on forums or timely submission of assignments (Bañeres et al., 2020). These data are aggregated into a unified system that generates alerts for instructors, such as notifications about students at high risk of dropping out. In some cases, early warning systems are integrated with adaptive learning platforms that automatically offer students additional resources or consultations, increasing the likelihood of their retention in the educational institution. The practical significance of predictive analytics lies in its ability to facilitate timely interventions, reducing dropout risks and improving overall learning outcomes for students. The success of such initiatives depends on data quality and model accuracy – inaccurate predictions can lead to erroneous conclusions and inefficient resource allocation. Therefore, continuous refinement of algorithms and consideration of contextual factors, such as socioeconomic status or curriculum specifics, are critically important. Evaluating the accuracy of predictive models in dynamic educational contexts remains a complex task, as the educational

environment is constantly evolving under the influence of external and internal factors.

The increasing volume of data generated through students' interactions with educational information systems opens new opportunities for understanding how their actions influence learning outcomes. Digital footprints, such as time spent reviewing materials, participation in discussions, or accessing supplementary resources, serve as a valuable source of information for educators and researchers. Analyzing these patterns not only enables the evaluation of the effectiveness of existing educational programs but also facilitates their adaptation to the needs of diverse student groups, thereby enhancing the quality of education (Berdo et al., 2023). In this context, the relevance of behavioral analysis lies in its potential to transform traditional approaches to education, making them more personalized and data-driven. Consequently, associative analysis, which involves identifying correlations between students' actions and their academic performance, becomes particularly significant. This method allows for the establishment of connections, such as between the frequency of accessing additional resources and exam success rates. Such insights help determine which actions contribute to better knowledge retention and which may be less effective. According to Yurchenko (2020), associative analysis can also uncover hidden dependencies, such as the impact of group collaboration on student motivation. Combining this approach with clustering provides a comprehensive picture of behavioral patterns, serving as a foundation for subsequent pedagogical decisions.

Data derived from digital footprints enable the adaptation of course content and structure to the needs of specific groups of learners. For instance, if data indicate that students from a particular class assimilate material more effectively through interactive tasks, educators can increase the proportion of such elements in the curriculum (Doleck et al., 2020). This enhances the relevance of educational content and its alignment with the actual needs of learners. Furthermore, behavioral analysis aids in optimizing the temporal frameworks of courses by identifying periods when students most actively engage with the system. Another critical aspect is the optimization of pedagogical strategies based on the obtained data. Different student groups exhibit distinct learning approaches, and understanding these differences allows instructors to select the most effective teaching methods. For example, for students who rarely utilize additional resources, introducing mandatory consultations or guidance may be beneficial (Zadorina et al.,

2025). Conversely, for those who actively collaborate with peers, expanding opportunities for group work could be advantageous. This approach not only increases student engagement but also fosters a more inclusive educational environment. The application of clustering techniques and associative analysis enables the identification of key behavioral patterns and the tailoring of educational programs to students' real needs. These methods enhance learning effectiveness by optimizing pedagogical strategies and making education more personalized.

Based on the above, the following conclusions can be drawn: Firstly, big data in education is regarded as a strategic resource that transforms traditional approaches to teaching and managing educational systems. Its value lies in the ability to process vast amounts of information, characterized by the 5V model (volume, velocity, variety, veracity, value), and convert it into practical solutions. Through artificial intelligence technologies such as machine learning, time series analysis, and predictive modeling, big data enables the identification of hidden patterns, the adaptation of curricula to individual student needs, and the forecasting of academic success or dropout risks. For instance, analyzing data from remote learning platforms (Moodle, Google Classroom) allows real-time tracking of student progress, adjustment of educational materials, and timely support for those in need.

Secondly, the personalization of education, as one of the key applications of big data, relies on the integration of diverse information sources – from grades and attendance to behavioral patterns and socio-economic factors – enabling the creation of detailed student profiles. Artificial intelligence algorithms, such as clustering, regression, and neural networks, analyze this data to propose adaptive learning pathways that account for individual learning styles, knowledge levels, and motivation. For example, platforms like Coursera or Khan Academy leverage big data to automatically select educational materials tailored to the specific needs of learners, increasing knowledge retention efficiency by 20–30%. This approach not only improves learning outcomes but also fosters a positive attitude toward education, as students feel their individual needs are being addressed.

Thirdly, big data plays a crucial role in predicting academic performance and early identification of issues. Early warning systems, based on the analysis of predictors (attendance, grades, platform activity), enable educators and administrators to respond promptly to potential challenges, such as declining motivation or dropout risks. Studies show that predictive

models built on machine learning achieve accuracy rates of up to 85%, making them a powerful tool for proactive educational management.

Fourthly, big data analysis contributes to the optimization of educational processes at various levels – from curriculum development to national policy planning. For example, analyzing demographic data and test results allows for forecasting resource needs (teachers, infrastructure) and allocating them more efficiently. At the classroom level, big data helps tailor schedules, teaching methods, and lesson content to make them more relevant to students. Innovations such as gamification or interactive tasks, driven by data on student engagement, enhance motivation and productivity.

Fifthly, the ethical and technical challenges associated with using big data in education relate to privacy and the potential misuse of personal data, particularly in the context of legislative frameworks like GDPR. Additionally, algorithmic bias due to unrepresentative data may lead to unfair conclusions about students. These issues necessitate the development of clear ethical standards and data protection technologies to ensure the safe and equitable use of big data.

In conclusion, big data, supported by artificial intelligence, opens new horizons for pedagogy, making education more personalized, effective, and data-driven. It enables not only responses to current challenges but also the anticipation of future needs, laying the groundwork for innovative teaching approaches. However, realizing this potential requires overcoming ethical and technical barriers and continuously refining analytical methods to ensure education remains fair and accessible to all.

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5.2. PECULIARITIES OF USING DIGITAL PLATFORMS FOR PROFESSIONAL TRAINING OF SKILLED WORKERS IN THE ENGINEERING INDUSTRY

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The benefits of digitalisation, including personalised learning, integration of SMART technologies and adaptive educational solutions, are analysed. The key challenges are identified, including industry-specific adaptation of platforms, lack of specialised learning resources, and the need for virtual simulators. The prospects for introducing artificial intelligence, gamification and the Internet of Things into the educational process are considered. Possibilities for improving the training of specialists through cooperation between educational institutions and industrial enterprises are outlined.

Keywords: *digital platforms, vocational education, mechanical engineering, adaptive learning, digital technologies.*

5.2. ОСОБЛИВОСТІ ВИКОРИСТАННЯ ЦИФРОВИХ ПЛАТФОРМ ПРОФЕСІЙНОЇ ПІДГОТОВКИ КВАЛІФІКОВАНИХ РОБІТНИКІВ МАШИНОБУДІВНОЇ ГАЛУЗІ

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Проаналізовано переваги цифровізації, включаючи персоналізоване навчання, інтеграцію SMART-технологій та адаптивні освітні рішення. Визначено ключові виклики, зокрема галузеву адаптацію платформ, недостатність спеціалізованих навчальних ресурсів та потребу у віртуальних симуляторах. Розглянуто перспективи впровадження штучного інтелекту, гейміфікації та Інтернету речей у навчальний процес. Окреслено можливості покращення підготовки фахівців через співпрацю освітніх закладів із промисловими підприємствами.

Ключові слова: *цифрові платформи, професійна освіта, машинобудування, адаптивне навчання, цифрові технології.*

Since the 20s of the 21st century, digital technologies have become the basis for the transformation of most areas of human life around the world. As digitalisation covers all areas of human activity, it has inevitably affected educational institutions, including the vocational training system. The introduction of digital platforms in education provides access to quality training that meets the requirements of the times. In the context of current global changes (economic, political, technological), the vocational education system should respond to these challenges by adapting and introducing new teaching methods, including through the use of digital platforms (Pryhodii, 2024b).

In the context of the digital transformation of the engineering industry, there is a need to work with big data, artificial intelligence, automation of production processes, and the use of the latest technologies for the development and maintenance of machinery. In order to train specialists capable of working with such technologies, the education system should actively integrate digital platforms to create conditions for the development of new competencies and ensure a high level of qualification (Hurzhii & Pryhodii, 2024).

The future of digital platforms for skilled worker training looks promising. Every year, the number of tools that allow creating interactive, adaptive courses, using artificial intelligence to personalise learning, and conducting real-time knowledge assessment is growing (Radkevych et al., 2025). Given the rapid development of technology and the needs of the engineering industry, digital platforms are becoming an essential tool for improving training.

Traditional approaches to worker training, especially in the engineering industry, often do not meet the requirements of the modern labour market. This is due to a lack of flexibility in the educational process, limited opportunities for personalised learning, and a lack of quick access to new knowledge. At the same time, digital platforms are able to provide continuous updating of educational materials, interactivity, and individualised approaches to each vocational education student, which allows for effective training of skilled workers (Pryhodii, 2025).

There are a number of advantages to using digital platforms for skilled worker training. One of the main ones is access to training materials in any convenient way, which allows you to study at your own pace and time. Digital platforms also provide ample opportunities for integration with other information systems, including production systems, which allows training to

be organised on-site or off-site. The use of virtual laboratories, simulators and training simulators allows students to practice in real-world conditions without risking safety. From this perspective, digital platforms can significantly improve the quality of skilled worker training (Pryhodii et al., 2023).

The introduction of digital platforms in vocational education is actively developing in many countries around the world. For example, countries in the European Union (CEDEFOP, n.d.), the United States (Neendoor, 2024), and Japan (Slashdot, 2025) have long been implementing such technologies, which not only improve the effectiveness of training but also ensure the mobility of workers in the international labour market. Studying the experience of these countries can help adapt their achievements to Ukrainian realities. At the same time, Ukraine is also making powerful steps in introducing digital platforms in vocational education, but the process requires further research and adaptation to the specifics of the Ukrainian education system and industry (Ministerstvo osvity i nauky Ukrayiny, n.d.).

In the scientific and pedagogical literature, there is a variety of approaches to defining the concepts of ‘digital educational platforms’, ‘digital learning platforms’ and ‘digital vocational training platforms’ (Ministry of Education and Science of Ukraine, n.d.). The absence of a single established terminology can complicate the research, practical implementation and effective use of these platforms in the vocational education system. A clear distinction and analysis of different variations of definitions contributes to a deeper understanding of their functionality, scope and potential impact on the training of future professionals. Therefore, it is important to study the specifics of each of these concepts, their interrelationships and differences, which will allow for more effective strategies for the digitalisation of vocational training.

Digital learning platforms are integrated environments that provide access to learning content, facilitate interaction between teachers and learners, and offer learning management tools (Josué et al., 2023).

These platforms typically support a variety of learning methodologies, including blended learning, self-paced learning, and interactive content delivery. Key features of digital learning platforms include (Pryhodii, 2025):

– Learning management system (LMS) capabilities that provide structured course management and tracking of learners' progress;

– integration of multimedia content, including video lectures, interactive simulations and virtual laboratories;

– collaboration tools such as discussion forums, chat functions and virtual classrooms for communication between students and teachers;

– assessment and analytics, including automated testing, progress monitoring and personalised feedback.

The main focus of digital learning platforms is on the transfer of theoretical knowledge and broad subject coverage. Although they are used for vocational training, their universal nature may require additional customisation to meet the specific training needs of skilled workers in the engineering industry.

Digital learning platforms share many similarities with digital education platforms, but emphasise flexibility, adaptive learning, and personalised learning experiences (Blyzniuk, 2021). These platforms typically use artificial intelligence and machine learning algorithms to adapt content based on learners' progress and preferences. The distinctive features of digital learning platforms are:

– adaptive learning paths that dynamically adjust the curriculum to the individual skills and knowledge levels of learners;

– gamification elements such as badges, leaderboards and interactive tasks that increase motivation to learn;

– support for mobile learning, which provides access to learning content from any device;

– cloud accessibility, which ensures seamless integration with various third-party tools and resources.

Digital learning platforms are particularly effective for organising self-directed learning based on competence development. In vocational training, they can complement practical classes with digital resources, bridging the gap between theory and practical application.

In contrast to digital education and training platforms, digital vocational training platforms are specifically designed to support the acquisition of practical skills in professional fields. These platforms integrate advanced technologies such as augmented reality (AR), virtual reality (VR) and digital twins to simulate real industrial processes. The key characteristics of digital vocational training platforms are aimed at (Hurzhii & Pryhodii, 2024):

– task-based learning, where learners engage in interactive practical exercises directly related to industry needs;

– simulation tools that allow users to practice equipment handling, assembly processes and troubleshooting in a virtual environment;

– competency-based assessment, which ensures that users are qualified to industry standard through skills testing and certification;

– integration with Industry 4.0 technologies, enabling real-time data exchange, remote monitoring and training using the Internet of Things.

These platforms are closely aligned with the needs of the engineering industry, providing immersive, hands-on learning experiences. They facilitate the acquisition of skills in a controlled and cost-effective manner, reducing the need for physical resources and minimising the risks associated with on-the-job training.

All three types of digital platforms serve educational purposes and share common features: online access to educational resources; tools for interaction and collaboration; assessment and tracking of learners' progress; and integration with external content and tools. However, their main functions and applications differ:

– digital learning platforms focus on structured, theoretical learning with a broad curriculum;

– digital learning platforms emphasise flexibility, personalised learning and gamification;

– digital vocational training platforms provide practical skill development through simulations and problem-based learning.

The development of digital platforms has transformed vocational training in various industries, including engineering. These platforms offer innovative solutions that improve the acquisition of skills, increase the efficiency of learning, and meet the current requirements of the industry. The following analyses the features of digital platforms in the professional training of skilled workers in the engineering industry (Pryhodii, 2024b).

Digital platforms developed for the engineering industry include industry-specific tools, simulations, and real-world applications that enhance learning. They integrate computer-aided design (CAD) and computer-aided manufacturing (CAM) software, allowing students to design, test, and optimise machine components before production. In addition, computer numerical control (CNC) programming simulators allow students to gain experience with automated manufacturing processes without the risks and costs associated with actually operating machines (Pryhodii, 2024a).

Moreover, these platforms often include digital twins that create virtual representations of real machines and systems. Learners can interact with these models to simulate work scenarios and troubleshoot in a controlled environment. This *industry-specific adaptation* ensures that the

training materials and simulations are in line with the latest developments and trends in the engineering sector, preparing workers for real-world challenges (Profosvita, n.d.).

Blended learning combines online learning with hands-on training to optimise skill development. Digital platforms offer e-learning modules, training videos and interactive exercises that facilitate the learning and testing of theoretical concepts. This self-paced learning allows trainees to acquire fundamental knowledge before embarking on an apprenticeship (European Commission, n.d.).

In addition, virtual and augmented reality (VR/AR) technologies are integrated into training programmes, providing an immersive experience where employees can interact with machinery in a virtual space. VR-based training reduces the risk of accidents and improves understanding by allowing learners to perform complex tasks in a simulated environment before operating real equipment.

The blended approach also includes remote access to laboratories where vocational trainees can control physical machines through cloud-based systems, bridging the gap between theoretical learning and practical application. This hybrid model ensures that workers develop both the cognitive and technical competencies required by the engineering industry.

The emergence of Industry 4.0 has brought new technologies to the manufacturing sector, requiring corresponding changes in vocational training to *integrate learning with SMART manufacturing technologies* (Pryhodii et al., 2022).

Digital platforms integrate Internet of Things (IoT) sensors, artificial intelligence (AI) and big data analytics to expose vocational learners to the modern manufacturing environment.

Through IoT integration, students can analyse machine data in real time, monitor performance and predict maintenance needs. AI-based tools support decision-making by identifying patterns and recommending process optimisation. These features prepare skilled workers for smart factories, where automation and data analytics play a crucial role in increasing productivity and efficiency.

In addition, the robotics modules allow vocational students to program and operate robotic systems used in processing and assembly lines. The integration of SMART technologies into the curriculum ensures that employees acquire the competencies necessary for career development in the modern manufacturing environment.

Digital platforms enable *remote access and flexibility*, making vocational training more accessible to learners regardless of their location. Online courses, webinars, and virtual laboratories allow learners to participate in skill development without the need to be physically present at educational institutions (Josué et al., 2023).

Flexibility is particularly useful for learners in remote areas, people with busy work schedules, and those seeking to upgrade their skills while maintaining their jobs. Mobile-compatible learning platforms further increase accessibility by allowing learners to access content on smartphones and tablets.

In addition, cloud-based learning solutions facilitate collaborative learning, where vocational learners can interact with teachers and colleagues through discussion forums, video conferencing, and real-time project collaboration. This flexibility ensures that learners can study at their own pace while maintaining a work-life balance.

Modern digital platforms include *adaptive learning technologies based on artificial intelligence* that personalise the educational process. Artificial intelligence algorithms analyse the user's progress, identify their strengths and weaknesses, and adapt the educational process accordingly (Radkevych et al., 2025).

Intelligent learning systems provide instant feedback, offer additional resources, and adjust the complexity of exercises according to the level of training of students. Gamification elements, such as quizzes, tasks and achievement badges, increase engagement and motivation.

Additionally, AI-powered virtual assistants and chatbots support learners by answering questions, guiding them through complex procedures, and offering real-time help to resolve complications. Adaptive learning ensures that each vocational trainee receives an individualised learning experience, optimising knowledge retention and skill acquisition.

Effective vocational training requires cooperation between educational institutions, training centres and leading companies in the machine building industry. Digital platforms facilitate partnerships by enabling direct interaction between students and industry professionals.

Cooperation with industry partners provides access to real-life cases, expert lectures and mentoring programmes, helping vocational students gain insight into current trends and challenges. Companies can offer virtual internships where students work on real industrial projects under the supervision of experts (Evans et al., 2023).

In addition, corporate learning portals allow companies to customise training modules to meet their specific workforce needs. Such collaboration ensures that the curricula remain relevant, in line with industry needs and technological advances in the engineering sector.

Digital platforms support competency-based learning, where vocational learners progress based on the acquisition of skills rather than time spent studying. *Competency-based certification and assessment* ensures that each learner meets professional standards before progressing to the next level (Europass, n.d.).

Automated assessments, including simulation-based assessments, measure practical skills by requiring vocational learners to complete tasks in a virtual environment. Artificial intelligence-based assessment systems provide objective assessments, highlighting areas for improvement.

Upon successful completion of the training, vocational learners receive digital certificates that serve as verifiable proof of their competencies. These digital certificates increase the chances of employment and career development as they meet industry-recognised standards.

One of the important advantages of digital learning platforms is *cost-effectiveness and resource optimisation*. Traditional teaching methods require significant investment in physical infrastructure, equipment and learning materials. Digital solutions reduce these costs (per student by 25-30%) through virtual simulations and cloud-based learning environments (Shah, 2024).

In addition, distance learning eliminates the need for travel costs and minimises equipment downtime, as employees can practice in a simulated environment before using real equipment. Digital platforms also enable the reuse of training materials, reducing the cost of developing new training programmes.

By optimising resource allocation and reducing operational costs, digital platforms make high-quality training more accessible and sustainable. Companies benefit from a well-trained workforce without the burden of excessive training costs.

Thus, the peculiarities of using digital platforms for professional training of skilled workers in the mechanical engineering industry include: industry adaptation; blended learning; integration of learning with SMART production technologies; remote access and flexibility; adaptive learning technologies based on artificial intelligence; cooperation with industry

partners; competency-based certification and assessment; cost-effectiveness and resource optimisation.

To identify the current state of use of digital platforms for the professional training of skilled workers in the mechanical engineering industry, a survey of 76 teachers of vocational education and training institutions in the mechanical engineering sector was conducted. The respondents evaluated various aspects of the use of digital platforms on a four-level scale ('sufficient', 'medium', 'low', 'insufficient').

In general, the survey was conducted in a mixed format - both in the form of an online survey and through individual interviews with teachers. The survey participants represented different regions of Ukraine and had different levels of experience in using digital technologies in the educational process. This made it possible to obtain a variety of opinions on the effectiveness of digital platforms and their relevance to the needs of modern vocational education in the engineering industry.

The survey revealed significant differences in the levels of sectoral adaptation of digital platforms (Figure 5.1).

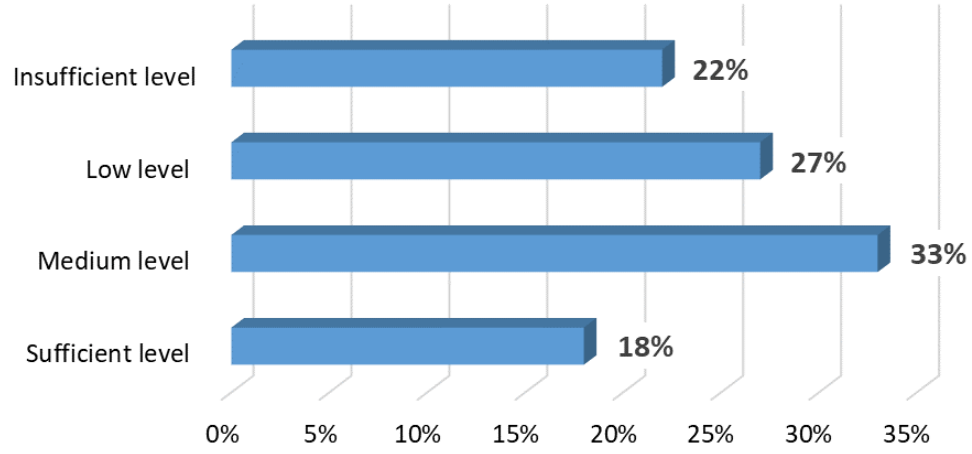

Figure 5.1
Level of industry-specific adaptation of digital platforms.
Note. Created by the author.

The analysis of the responses showed that the effectiveness of platforms largely depends on their compliance with the specifics of machine building production. The main challenges identified are the lack of

specialised training resources and the difficulty in setting up platforms for integration with production processes.

A detailed analysis also showed that most learning platforms contain general educational materials that do not take into account the specifics of mechanical engineering. This complicates learning, as teachers are forced to adapt the content manually, which takes a lot of time. In addition, the study identified the need to develop specialised modules for automated production control systems and material handling, which would significantly increase the level of adaptation of the educational process to the real conditions of the industry.

Evaluation of the implementation of blended learning based on digital platforms has demonstrated good results (Figure 5.2).

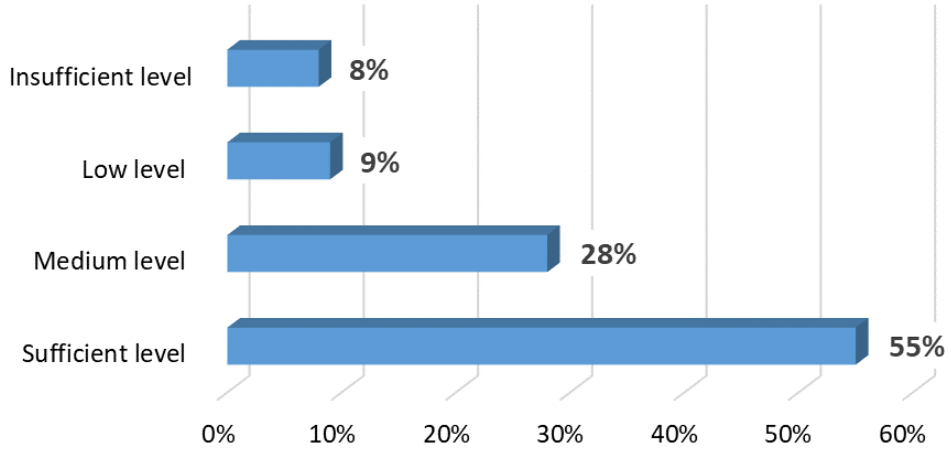

Figure 5.2.
Level of implementation of blended learning based on digital platforms.
Note. Created by the author.

On the positive side, most teachers use digital platforms to prepare theoretical materials and conduct tests. However, respondents point to difficulties in organising practical classes due to the lack of virtual laboratories and simulators.

The analysis of the responses showed that teachers often use blended learning for theoretical training, but face difficulties in delivering practical classes. The majority of respondents noted that it is necessary to expand the capabilities of digital platforms in terms of interactive simulations, which will allow vocational students to acquire practical skills in a virtual

environment. In addition, some teachers stressed the need to introduce cloud-based solutions for modelling production processes.

The survey results show that the level of integration of digital platforms with SMART technologies in production is insufficient (Figure 5.3).

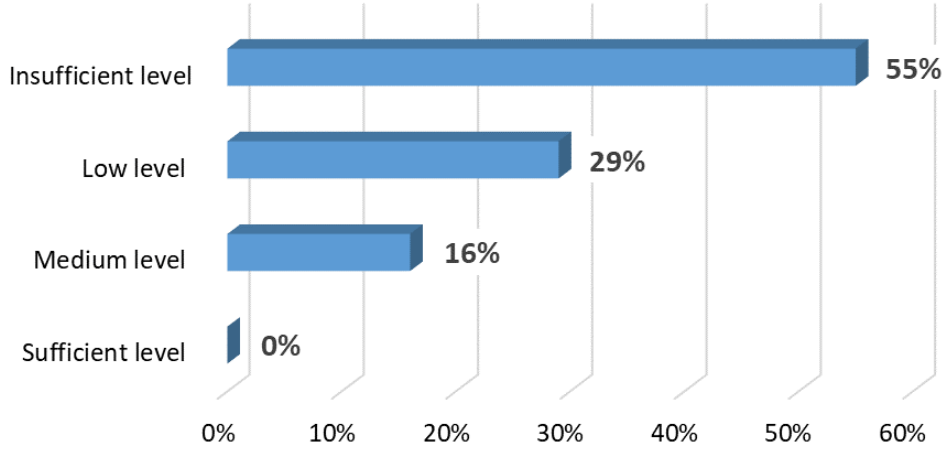

Figure 5.3
Level of integration of digital platforms with SMART technologies in production.
Note. Created by the author.

It is noted that the key barriers are the lack of appropriate software packages and insufficient qualifications of teachers to use them. At the same time, institutions that actively cooperate with businesses demonstrate a higher level of integration of such technologies into the educational process.

The survey also showed that the best results are demonstrated by educational institutions that have established partnerships with industrial enterprises, which allows them to provide students with access to modern SMART technologies. At the same time, there is a need to expand the number of training courses focused on the use of automated production systems and digital twins, which will allow future professionals to better adapt to the conditions of modern production.

A significant number of respondents noted the convenience of digital platforms in providing remote access (Figure 5.4).

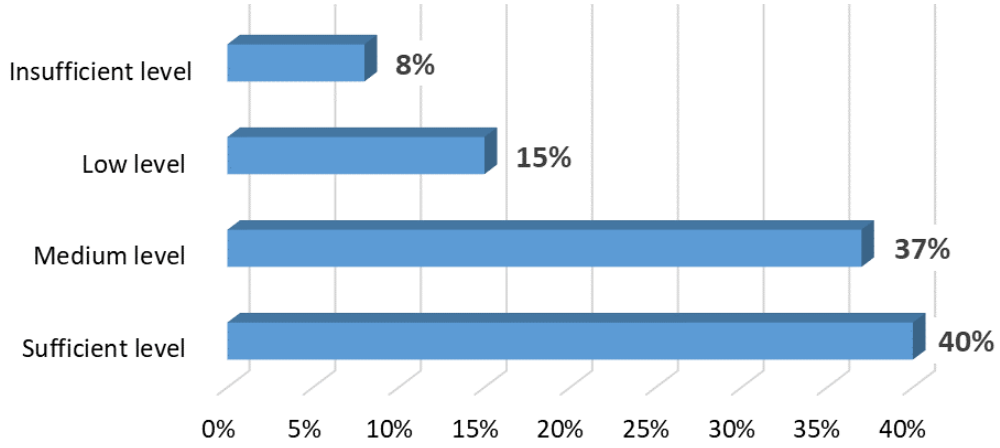

Figure 5.4
Level of provision of remote access.
Note. Created by the author.

The main advantage is the ability to access learning materials at any time and place, which contributes to the individualisation of the educational process. At the same time, challenges are associated with the quality of the Internet connection and the need for more effective methods of monitoring the learning activities of vocational education students. Some teachers also note the need to improve mechanisms for monitoring academic integrity in distance learning.

The level of use of adaptive learning technologies based on artificial intelligence is relatively low (Figure 5.5).

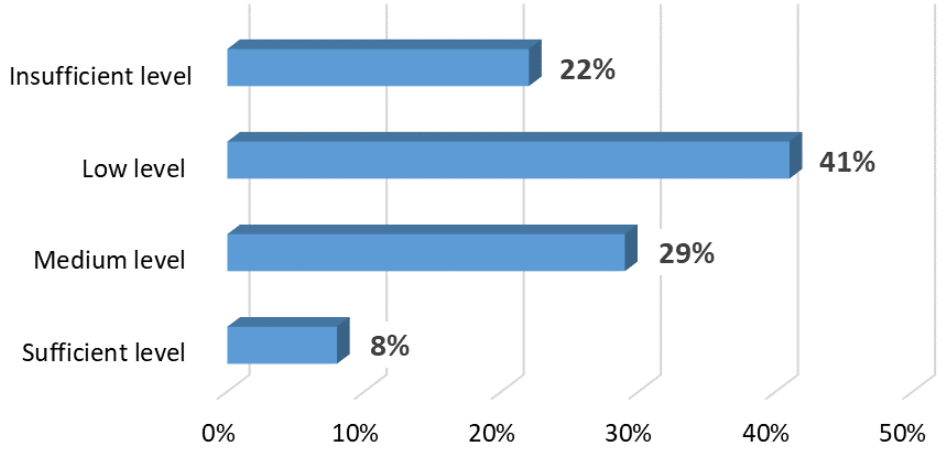

Figure 5.5
Level of use of adaptive learning technologies.
Note. Created by the author.

The main obstacles are the high cost of developing and implementing such solutions, as well as the limited availability of ready-made adaptive platforms focused on the machine-building industry. Nevertheless, respondents noted the prospects of introducing such technologies, in particular for automated knowledge assessment and personalised learning paths. Some educational institutions are already beginning to use elements of artificial intelligence to adapt curricula to the individual needs of vocational students.

The survey results show that cooperation with businesses in using digital platforms in education is uneven (Figure 5.6).

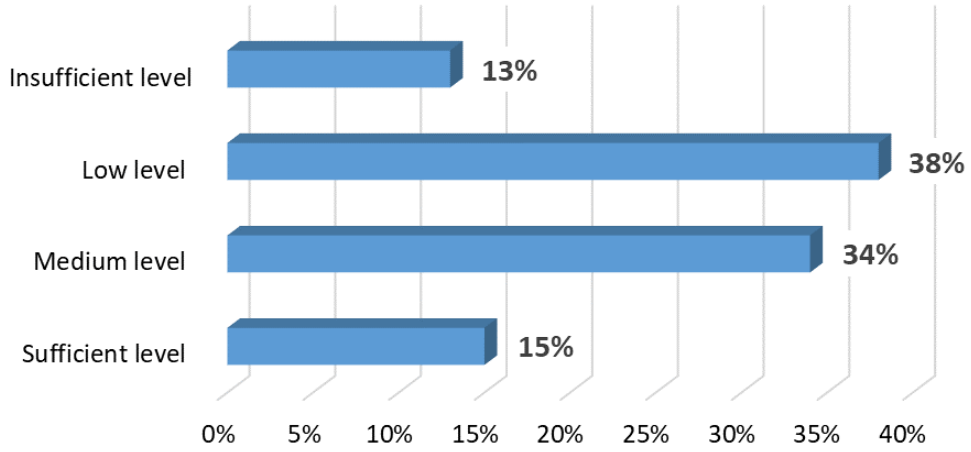

Figure 5.6.
Level of collaboration with enterprises within the digital platform.
Note. Created by the author.

The main difficulty is the lack of integrated programmes that would allow educational and production institutions to be connected in a single digital environment. At the same time, successful examples of such cooperation point to the effectiveness of dual education and the improvement of graduates' skills. A significant number of respondents emphasise the importance of expanding such partnerships through the joint creation of digital educational resources.

The assessment of digital platforms by the criterion of competence certification and assessment showed an average distribution (Figure 5.7).

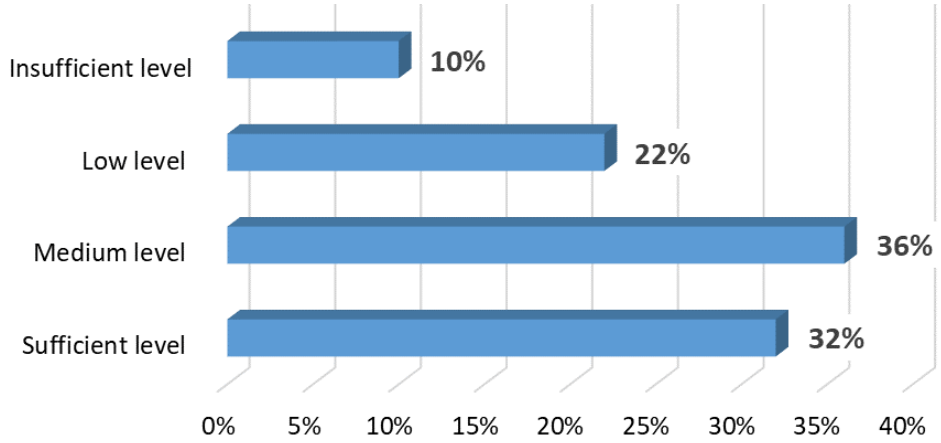

Figure 5.7
Level of certification and assessment based on competencies.
Note. Created by the author.

The respondents believe that digital platforms contribute to the objectivity of assessment through automated tests, but note the need to expand the forms of assessment, including integration with production projects. Another important aspect is the possibility of using digital platforms to certify specialists in accordance with international standards.

The study of the level of cost-effectiveness of digital platforms revealed the following results (Figure 5.8).

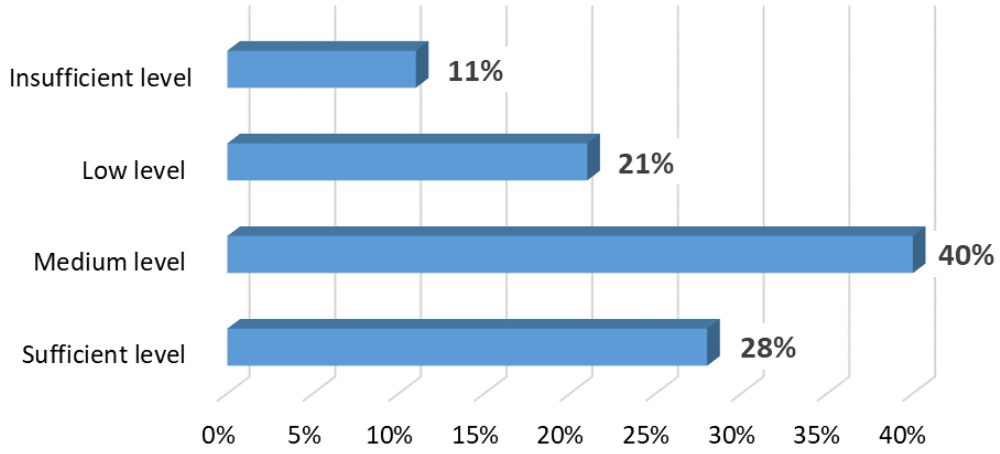

Figure 5.8
Level of economic efficiency of digital platforms.
Note. Created by the author.

A significant part of the respondents noted a reduction in the cost of printed materials and an increase in the efficiency of the educational process in its theoretical aspect, while in terms of professional and practical training, one third of the respondents noted the inadequacy of platforms to address this issue. Teachers also note that the cost of licences and technical support can be significant, requiring additional budgetary resources or grant programmes.

The survey results indicate that digital platforms are being actively introduced into the professional activities of mechanical engineering teachers, but the level of use of various aspects varies considerably. The main challenges remain industry-specific adaptation of platforms, integration with production technologies, expanding the possibilities of competency-based assessment, and the use of adaptive learning technologies. At the same time, the growing level of remote access, cooperation with enterprises and gradual optimisation of resources are positive trends.

As the machine building sector continues to evolve, digital learning solutions will play a crucial role in shaping the future workforce, driving innovation and increasing industrial efficiency.

The key features of an effective digital training platform for skilled workers in the mechanical engineering industry are task-based learning, simulation tools, competency-based assessment and integration with advanced industrial technologies. These features ensure that workers acquire practical skills in a safe and controlled digital environment before moving on to real-world applications in a production environment.

The integration of AI, augmented and virtual reality, and the Internet of Things into training platforms enhances the learning experience by making it more engaging and aligned with industry requirements. To maximise the benefits of digital vocational training, vocational education and training institutions and businesses should cooperate to ensure that the training content remains relevant and in line with technological advances in the engineering industry. This approach will help to prepare a workforce that is well equipped to meet the changing needs of modern manufacturing.

Thus, effective use of these features ensures the modernisation of the vocational education system, focused on the needs of the industry. The industry environment adapts learning to real-world conditions, and the blended learning approach increases flexibility and engagement. Integration with intelligent manufacturing technologies prepares students for digital transformation, and remote access ensures continuity of learning. Adaptive

learning with artificial intelligence personalises learning, improving results. Collaboration with industry partners enhances workforce readiness, and competency-based certification provides proof of skills. Finally, cost-effectiveness and resource optimisation increase accessibility and sustainability, making vocational education more efficient and effective.

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5.3. CURRENT STATE AND PROSPECTS OF INTEGRATING DIGITAL PLATFORMS INTO THE PROFESSIONAL TRAINING OF SKILLED WORKERS

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The article deals with the practical cases of using digital platforms in the educational process for the vocational training of future skilled workers. It has been established that they can be used to organize online learning, build a digital architecture for the management of vocational training (VET), overcome the gender gap, in the employment process, professional self-determination, inclusive employment, etc. It is recommended that social networks, immersive technologies (AR|VR), artificial intelligence, etc., be integrated into digital platforms to increase the efficiency and effectiveness of the educational process. The analysis of scientific sources shows that digital platforms are an indispensable tool in the training of future skilled workers, helping them to acquire knowledge faster, more efficiently, and with maximum practical results.

Keywords: *digital platforms, vocational education, skilled workers.*

5.3. СУЧАСНИЙ СТАН ТА ПЕРСПЕКТИВИ ІНТЕГРАЦІЇ ЦИФРОВИХ ПЛАТФОРМ У ПРОФЕСІЙНУ ПІДГОТОВКУ КВАЛІФІКОВАНИХ РОБІТНИКІВ

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У статті розглянуто практичні кейси використання цифрових платформ в освітньому процесі для професійної підготовки майбутніх кваліфікованих робітників. Встановлено, що вони можуть бути використані для організації онлайн-навчання, побудови цифрової архітектури управління професійним навчанням (ПОН), подолання гендерного розриву, у процесі працевлаштування, професійного самовизначення, інклюзивного працевлаштування тощо. Рекомендується інтегрувати в цифрові платформи соціальні мережі, імерсивні технології (AR|VR), штучний інтелект тощо для підвищення ефективності та результативності освітнього процесу. Аналіз наукових джерел свідчить, що цифрові платформи є незамінним інструментом у підготовці майбутніх кваліфікованих робітників, допомагаючи їм здобувати знання швидше, ефективніше та з максимальним практичним результатом.

Ключові слова: *цифрові платформи, професійна освіта, кваліфіковані працівники.*

The rapid development of industry changes priorities in the economy and updates the requirements for vocational education. The educational

process as a dynamic, holistic pedagogical system is subject to constant transformation, a change in the educational paradigm, and the introduction of new means and technologies of learning. The digitalization of vocational education responds to global information challenges and is accompanied by a "synergistic" update of educational content, its content, and the results of graduate training.

Digital educational platforms in practical application. Digital transformation has led to the restructuring of all industrial structures, which required the development of educational platforms for vocational education and careers. The model of such a resource (Lee et al., 2023) should consider the needs of the instructor, employer, and student, consist of data about the student, data about the content of training, information about work, a community of practitioners, a learning control mechanism, and a mechanism for recommendations on work.

The transfer of learning tasks and support for the educational process of VET to a shared virtual educational space has become an immediate challenge and has been accompanied by a qualitative analysis of the use of digital approaches and tools. The work (Görl-Rottstädt et al., 2022) proposes the online platform ILIAS (TM) and the web conferencing software Adobe Connect (TM) to analyze critical learning situations and develop virtual learning scenarios in terms of didactics adapted to different learning groups and needs in and outside the classroom.

The publication of digital textbooks for vocational education is challenged by digital technologies. Most educational publishers have increased their investments in the development of digital products, organically combining existing content, and human and technological resources (Shi, 2011). There is a shift in teaching and learning from traditional approaches to digital ones, by integrating digital learning materials into online platforms with content support, clear organization and structure, and effective methods for providing personalized services for mobile learning.

The development and implementation of digital systems can help students: a) become familiar with computer assembly and maintenance through virtual operations; b) reduce equipment losses caused by incorrect operation in the real course; c) demonstrate scenarios and project-based learning methods; d) increase student interest and initiative. A vivid confirmation is a course on computer assembly and maintenance using 3D

Max for modeling and building a virtual modeling system based on the Unity 3D platform in a vocational education institution (Lu et al., 2023).

The authors (Schober et al., 2014) proposed a web-based educational platform "Third Place of Learning" (TPL) – "Dritter Lernort" to support distance learning in the vocational education system in Germany. The goal of this project is to combine the vocational education system with digital media. The web-based platform allows students to be taught using interactive examples and exercises, to form the content of the training, the training material, and the technical structure following the didactic concept.

An analysis of the integration of the Blackboard digital platform as a learning resource into the educational process of the School of Accounting and Administration confirmed that the inclusion of digital technologies in professional training opens up new possibilities for the space and time of learning, creates conditions for better planning and teaching practices, and also provides students with tools for conducting learning, more autonomy and responsibility (Beatriz et al., 2013).

The digital development of innovation and entrepreneurship in colleges forms a comprehensive digital ecosystem in which digital platforms play an important role. The comprehensive educational digital platform for innovation and entrepreneurship education (Wang & He, 2024) in vocational education institutions based on large language models (LLM) allows the processing of large amounts of text data using ChatGPT 4o.

Interaction with digital technologies involves a process based on three axes: teach to use, teach to defend, and teach to create technologies (Rueda-Rueda et al., 2019). Digital platforms are not only a pedagogical tool. Modern conditions require them to become learning areas for training qualified IT workers, create spaces to inform students about the caution to be exercised on social networks and the Internet, and support strategies to encourage the study of IT, systems engineering, and related areas.

Experimental installations of a learning environment using an e-learning platform based on SCORM 2004 were carried out for students taking a computer-aided drafting course at the Faculty of Mechanical Engineering in a vocational school (Lin & Pan, 2006).

The impact of digital educational platforms on learning, development, professional growth, and satisfaction of employees in enterprises was investigated through a survey and was designed to test the aspects of interactivity, personalization, engagement, and effectiveness of learning (Nikolova, 2024). The results indicate that digital platforms improve

professional skills and productivity, but are correlated with lower satisfaction with course quality, require better adaptation of content and teaching methods to individual needs, and emphasize the importance of social learning and collaboration through interactive features, which significantly increase engagement and learning outcomes.

Social media. Mobility, multi-screening and multitasking in youth culture allow us to equate new media practices in the era of convergence of digital platforms and cross-media consumption. An empirical study of a sample of 1,814 students in basic, secondary, and vocational education in Portugal was conducted to analyze digital media consumption practices and network connections because of the use of technological resources (Amaral et al., 2017). The results showed high levels of online activity among Portuguese youth in the digital environment, especially social networks.

A survey of 209 students on the role of social media in vocational and technical education aimed to find out whether it is possible to use them as a platform for learning. The first aspect of the study was to measure the participants' social interaction through digital technologies, and the second aspect was to assess students' attitudes toward social media as a means of learning in the VET environment. Most participants agreed that social media can be chosen for professional learning and are conceptually ready to use it as a digital platform (Wahyudin et al., 2018).

Gamification. The article (Kotsifakos et al., 2018) proposed a game-based online learning platform for professional education that included polymorphic online games. The educational content of the platform covers topics related to web algorithms, techniques and data flow methods (Bellman-Ford, Dijkstra, Floyd, and Johnson algorithms). Completing each scenario introduces the student to the process of a particular algorithm and how each algorithm is implemented in a network environment.

Immersive technologies (AR|VR). The concept of a metaverse, a virtual world that offers immersive experiences, has recently gained widespread interest. Designed as a simulation of the physical world, the metaverse encompasses all areas of human activity and provides a platform for researchers from all disciplines. A study (Magetos et al., 2023) demonstrated the development of an educational virtual world for teaching the course "Art History" in the vocational education system using the spatial.io web environment, educational resources from digital repositories (Sketcfab and Photodentro), and the ADDIE educational design model. Such

online virtual world platforms are provided free of charge for educational purposes with free digital repositories of 2D and 3D educational resources.

Augmented reality and virtual reality, which have been developed over many years, have become the main environment for providing educational services due to digital transformation and the transition to remote content delivery. Positive dynamics are demonstrated by research (Shim & Lee, 2022) on the development of a vocational education learning model using AR/VR and realistic XR content Metaverse.

The potential of using mobile augmented reality (AR) and virtual reality (VR) technologies to support experiential learning in vocational education is to overcome the scarcity of resources in learning environments by allowing students to access many resources on digital platforms. AR and VR can play an important role in enhancing experiential learning and providing students with hands-on simulation experiences in various fields of knowledge (Jantjies et al., 2018).

Virtual simulation technology has changed the educational process in vocational education institutions. Thanks to it, it is possible to reduce the level of investment, losses, risks and difficulties in the implementation, monitoring and reproduction of training projects of the vocational course of vocational education based on virtual simulation technology. The authors (Liu et al., 2024) created the VR Smart Education training platform, which allowed to combine of high-quality training resources, practical training, individual intelligent training equipment equipped with a virtual operating platform and comprehensive innovative improvement of teaching methods.

Conducting experimental training using the virtual simulation platform of computer assembly is a new direction, as it contributes to a revolution in the forms, methods, and concepts of training, improving its quality (Liu, 2028).

Virtual internship allows students, especially engineering majors, to gain real experience and skills remotely online. The authors (Stefanovic et al., 2021) proposed a life cycle model and methodology for virtual internships on a digital platform. This complex connects students, vocational education institutions, company profiles, internship databases, lectures, assignments, and assessments, in a secure and shared digital environment. It allows the development of adapted and flexible internship programs, configuring them for specific scenarios or integrating them with other specialized e-learning platforms. This complements the user experience and provides practical workflows and recommendations. The complex contains

effective, personalized, inexpensive, and adaptive solutions, digital resources, and recommendations that ensure a higher level of collaboration, and better communication, increasing the level of professional knowledge and acquired skills.

A positive effect was shown by testing a digital educational application based on augmented reality for people with cognitive disabilities during vocational training in the field of housekeeping (Wuttke et al., 2022). For this purpose, an online learning platform with built-in AR learning stations was developed and evaluated by the target group.

Artificial Intelligence. Lifelong learning and continuous education have become the main pillars for enhancing personal growth in the professional world. Artificial Intelligence (AI) has transformed traditional educational models to provide personalized learning experiences. The revolutionary impact of artificial intelligence (AI) on professional education, learning processes, and preparing students for the changing demands of the labor market requires consideration of its diverse applications, including virtual reality (VR), augmented reality (AR), machine learning (ML), and the Internet of Things (IoT), as well as their role in enhancing personalized learning, skill development, and job readiness (Çela et al., 2024). Among the challenges of integrating AI into vocational education, such as algorithmic bias, digital divide, and data privacy issues, are also proposed mitigation strategies to ensure fair and effective implementation, ethical considerations, emphasizing the balance between using AI innovations and preserving essential human interaction and ethical integrity.

In vocational education, AI plays an important role in improving the efficiency and effectiveness of learning. Applications include a) developing adaptive curricula that can adjust the curriculum according to the abilities and needs of students, b) assessing student performance and providing automatic feedback, c) assessing and monitoring student performance (Suparyati et al., 2024).

For example, with funding from the German Federal Ministry of Education and Research, the cross-platform AI-based companion program cOmpanion (platform-independent) for optimizing lifelong learning (acronym: APOLLO) has been developed (Boesl et al., 2023).

Educational Institution Management. In the era of Society 5.0, characterized by the seamless integration of cyber systems and physical environments, educational institution leaders can cultivate a culture of innovation, collaboration, and excellence to meet the changing needs of VET

institutions, provide high-quality education, and prepare students for success in a rapidly changing world. Using digital platforms and resources, it is possible to develop curricula, support the process of pedagogical practice, implement diverse assessment strategies, and improve communication, collaboration, and administrative efficiency of educational institutions (Hadi et al., 2024). By focusing on a technological approach to learning management, leaders can promote effective data-based decision-making, ensure transparency, and accountability adapted to the demands of the digital era.

The development of technology provides an impetus for changing the digital architecture of L(VET)E. The development and application of education management information systems allow for more open and flexible platforms that include student management, curriculum management, course planning, exam management, assessment management, course selection management, teaching quality management, etc. (Zheng, 2010).

Gender equality. Online learning has become a transformative force that has contributed to the advancement of gender equality and the empowerment of women. Online vocational education and training for women can contribute to their inclusion in the labor market, expand economic opportunities, and improve financial independence (Lashgari, 2024). Digital platforms help to form the knowledge and skills necessary for success in the digital age, create unprecedented opportunities for women's personal and professional development, and bridge the gender gap.

Employment. Mobile applications designed on the principles of gamification provide the opportunity to use game techniques in professional self-determination based on personal preferences and choices with feedback. Such a diagnostic program allows students to form an idea of the predisposition to one of the types of professions (human-human, human-nature, human-technology, human-symbolic system, or human-artistic image). The application can be a tool for the work of a teacher-psychologist, career counselor, or parents. On the other hand, children can use this program themselves when choosing their learning trajectory.

Information technologies have proven themselves positive in the process of inclusive employment of people with neurological and intellectual disabilities, including Down syndrome, Asperger syndrome, autism spectrum disorder and mental retardation. The digital job search platform "Workability": a) organizes cooperation with such individuals, corporate

employers and vocational training centers; b) provides a digital interface with accessible customizable functions, such as speech-to-text conversion and image recognition capabilities (Madan et al., 2024). Such a digital product creates an inclusive environment, contributes to improving employment according to abilities and preferences, changes the scope of employment, social activity and involvement of this demographic group.

On the other hand, a randomized control trial conducted to assess whether digital platforms improve employment outcomes and job search among vocational education graduates found evidence of voluntary unemployment: graduates responded to access to the platform by increasing their expected wages and showing less interest in working. On the other hand, some graduates did lower their expectations (Kelley et al., 2024).

Survey on attitudes and use of digital platforms. A study of pedagogical and digital practices in vocational education in the Spanish region of Catalonia involved a survey of 158 teachers and 309 students in secondary and higher vocational education programs. The results of the quantitative analysis show that while most vocational education teachers use a combination of active and lecture methods, less than a third use online tools, giving priority to institutional platforms (Noguera et al., 2024). The results highlight the need for vocational education programs to improve the integration of digital tools and address various issues with learning effectiveness to better meet the expectations and needs of students.

In a thematic interview of Finnish vocational education institutions on the well-being of students in online learning environments, 20 teachers answered questions on positive emotions, engagement, relationships, the meaning of achievement and students' enjoyment of learning. The results showed that good digital skills helped students navigate the online collaborative learning platform they used. Students experienced the joy of learning when online tasks included variety, activity, work-life orientation, and when they received individual control and when the teacher also guided group activities (Kiikeri et al., 2024).

The prospects for integrating digital platforms into the vocational training of skilled workers can be seen in the context of patent proposals in the Derwent Innovations Index. Among the latest developments in vocational education:

1. A digital learning content creation system that supports the learning process and creates a training course on a digital virtual reality platform (Yu et al., 2022). It effectively reduces repeated investment in training and

development, as well as shortens the period of production of educational content and provides convenient and flexible applications for teachers and students. The system reduces the degree of dependence on the teacher and continuously optimizes and reproduces qualified learning content with different requirements and specifications.

2. An intelligent experimental platform with numerical control for use in secondary vocational education (Su & Guan, 2024). The platform has a mechanical robot arm, which is connected to the router through a network camera, a server, a remote network controller, a body measurement device, an experimental box, and a simulation board. Various actions required for the experiment are accurately performed through the final performer. The platform improves flexibility, and conveniently performs customized services according to professional characteristics and experimental requirements. The student's experimental enthusiasm and interest are improved.

3. Cloud service platform provision system in vehicle virtual simulation training based on the combination of virtual and real modes (Wu, 2021). The virtual disassembly and maintenance training sub-module uses a three-dimensional (3D) digital model, virtual display technology, and is equipped with a vehicle fault collection box and a data collection terminal. This module is connected with the traditional learning sub-module through the cloud to send and receive data. The described intelligent learning cloud platform realizes networked practical training for automotive vocational education.

4. A method for building a digital platform for intelligent vocational education in enterprise development, which involves building subject libraries of resources to support corporate learning (Qi, 2023). The method allows for the implementation of accurate training for enterprise personnel and improves training efficiency.

5. An artificial intelligence-based training method for professional skills development involves the collection and analysis of training data and student feedback information, as well as providing training quality assessment and improvement suggestions for teachers (Duan et al., 2023). The method includes the integration of natural language processing technology, online collaborative learning technology, web page rendering technology, search, functional modules of recommendation technology, and data management and analysis technology into the AI training system. The course content, training resources, and other necessary training resources are

viewed by the student. Multi-person video conferencing, file sharing, instant messaging, and other functions are performed to support online learning and communication. The learning data and student feedback information are collected and analyzed by the AI learning system based on search and recommendation technology. The teaching quality evaluation and improvement suggestions are provided for the teacher, and personalized support and suggestions are provided for the student. The described method improves the efficiency and quality of learning, promotes online collaborative learning and communication, reduces the cost of learning, improves efficiency, and provides a more scientific, efficient, and more humanized digital learning and educational solution for students and teachers.

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AFTERWORD

This monograph marks an important stage in the scientific and methodological support for the modernization of vocational education in Ukraine. The studies presented herein reflect not only the current state of the system but also identify strategic directions for its further development in the context of post-war recovery, digitalization, and European integration.

The research results open broad prospects for continuing scientific inquiry, particularly in several key areas that are critical to the development of a modern and competitive system of vocational education and training. Among them is the deepening of methodological principles for the professional training of skilled workers in the road transport industry, with a focus on integrating artificial intelligence technologies into educational processes. The implementation of such technologies enables the personalization of learning trajectories, optimization of practical training, and enhancement of the predictive capacities of educational analytics.

Another promising area of further research lies in the development of a methodological system for ensuring the quality of professional training of junior bachelors in agricultural colleges. Given the strategic importance of Ukraine's agricultural sector and the need to rebuild rural communities, improving the training of specialists in this field is essential for ensuring food security, sustainability, and innovation in agrarian production.

Equally relevant is the continued search for innovative methods of professional and practical training of future specialists in the construction industry, particularly under the conditions of Ukraine's post-war reconstruction. The sector requires not only highly qualified workers but also modern training approaches that integrate energy efficiency, green building technologies, and Industry 5.0 principles.

The issue of training future skilled workers in general remains a priority, as it encompasses not only the acquisition of professional competencies but also the formation of flexible, adaptive, and entrepreneurial personalities capable of responding to the dynamic demands of the labor market.

The authors believe that future research in these directions will contribute to the development of a new quality of vocational education—one that is responsive to national challenges, integrated into the European educational space, and aligned with global technological trends.

MONOGRAPH

SCIENTIFIC AND METHODOLOGICAL SUPPORT FOR THE DEVELOPMENT OF VOCATIONAL EDUCATION

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The monograph 'Scientific and Methodological Support for the Development of Vocational Education' is the result of in-depth research and practical developments by leading scientists of the Institute of Vocational Education of the National Academy of Pedagogical Sciences of Ukraine. It presents modern scientific and methodological principles of modernisation of vocational education in Ukraine in the context of post-war reconstruction, global technological transformations and implementation of European integration priorities. The publication covers the issues of innovative training of skilled workers, digitalisation of education, development of entrepreneurial competences of young people, quality assurance of vocational training and professional development of teachers.

The publication is intended for scientists, teachers, managers, methodologists, students and representatives of public authorities involved in the development of the vocational education system. It will be useful for anyone looking for effective science-based solutions for training competitive professionals capable of ensuring the recovery and sustainable development of Ukraine's economy.

Монографія «Науково-методичне забезпечення розвитку професійної освіти» є результатом ґрунтовних наукових досліджень і практичних розробок провідних учених Інституту професійної освіти НАПН України. У ній представлено сучасні науково-методичні засади модернізації професійної освіти України в умовах післявоєнного відновлення, глобальних технологічних трансформацій та реалізації євроінтеграційних пріоритетів. Видання охоплює питання інноваційної підготовки кваліфікованих робітників, цифровізації освіти, розвитку підприємницьких компетентностей молоді, забезпечення якості професійної підготовки та професійного розвитку педагогічних працівників.

Видання призначене для науковців, педагогів, управлінців, методистів, здобувачів освіти та представників органів державної влади, які займаються розвитком системи професійної освіти. Вона буде корисною для всіх, хто шукає ефективні науково обґрунтовані рішення для підготовки конкурентоспроможних фахівців, здатних забезпечити відновлення й сталий розвиток економіки України.

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