

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
УНІВЕРСИТЕТ ГРИГОРІЯ СКОВОРОДИ В ПЕРЕЯСЛАВІ

ПРОФЕСІЙНА ОСВІТА: МЕТОДОЛОГІЯ, ТЕОРІЯ ТА ТЕХНОЛОГІЇ

Том 11, № 2
2025

Науковий журнал



Переяслав
2025

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
HRYHORII SKOVORODA UNIVERSITY IN PEREIASLAV

PROFESSIONAL EDUCATION: METHODOLOGY, THEORY AND TECHNOLOGIES

Vol. 11, No. 2
2025

Scientific Journal



Pereiaslav
2025

Засновник:

Університет Григорія Сковороди в Переяславі

Рік заснування: 2015

Періодичність випуску: двічі на рік

*Рекомендовано до друку та поширення
через мережу Інтернет Вченою радою
Університету Григорія Сковороди в Переяславі
(протокол № 5 від 24 грудня 2025 року)*

Ідентифікатор медіа: R30-04675

(Рішення Національної ради України з питань телебачення і радіомовлення
№ 1442, протокол № 14 від 25 квітня 2024 року)

Журнал включено до категорії «Б»

Переліку наукових фахових видань України. Спеціальності:

011 – Освітні, педагогічні науки; 012 – Дошкільна освіта; 013 – Початкова освіта;
014 – Середня освіта (за предметними спеціальностями);
015 – Професійна освіта (за спеціалізаціями); 016 – Спеціальна освіта; 231 – Соціальна робота
(Наказ Міністерства освіти і науки України № 409 від 17 березня 2020 року)

**Журнал представлено в таких міжнародних наукометричних базах даних,
репозитаріях та пошукових системах:**

Фахові видання України; Національна бібліотека України імені В.І. Вернадського;
Open Ukrainian Citation Index (OUCI); Google Академія; Crossref;
Dimensions; University of Oslo Library; OpenAlex, Litmaps; Ulrichsweb Global Serials Directory;
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<https://profedu.com.ua/uk>

Founder:

Hryhorii Skovoroda University in Pereiaslav

Year of foundation: 2015

Frequency: semi-annual

*Recommended for printing and distribution
via the Internet by the Academic Council
of Hryhorii Skovoroda University in Pereiaslav
(Minutes No. 5 of December 24, 2025)*

Media identifier: R30-04675

(Decision of the National Council of Television and Radio Broadcasting of Ukraine
No. 1442, Minutes No. 14 of April 25, 2024)

**The journal is included in category “B”
of the List of scientific professional publications of Ukraine. Specialties:**

0111 – Education science; 0112 – Training for pre-school teachers;

0113 – Teacher training without subject specialisation;

0114 – Teacher training with subject specialisation; 0923 – Social work and counselling
(Order of the Ministry of Education and Science of Ukraine No. 409 dated March 17, 2020)

**The journal is presented in the following scientometric databases,
repositories and scientific systems:**

Professional Publications of Ukraine; Vernadsky National Library of Ukraine;

Open Ukrainian Citation Index (OUCI); Google Scholar; Crossref;

Dimensions; University of Oslo Library; OpenAlex, Litmaps; Ulrichsweb Global Serials Directory;
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Modern digital technologies in human resources management: Impact on professional training

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■ **Abstract.** The study aimed to compare the effectiveness of specialists before and after the introduction of digital technologies. The research methodology included experimentation and comparative analysis using learning management systems, cloud-based collaboration platforms, and artificial intelligence in recruitment. The study results demonstrated that digital platforms and automated systems significantly improve the learning process, especially in key areas such as recruitment, onboarding, performance evaluation and development of required competencies. With the use of artificial intelligence and big data, companies can identify training needs with greater accuracy, conduct a more detailed analysis of market trends and predict potential risks, which improves the quality of strategic decision-making. With these technologies, educational institutions can introduce modern teaching methods based on individualised approaches to students and professionals. One of the important advantages of digital solutions is the increased satisfaction of students and employees due to flexible study schedules and distance learning opportunities. This significantly improves internal communication and reduces stress among participants in the learning process. The study determined that such platforms also increase students' loyalty to educational institutions, contribute to their efficiency and allow them to adapt more quickly to the conditions of the modern labour market. The findings create new opportunities for the further development of training programmes in the field of human resources management. In particular, the integration of digital platforms and automated learning systems helps to develop educational strategies that meet the challenges of the digital economy. As a result, specialists become competitive and prepared for the real challenges of their professional activities

■ **Keywords:** automation; innovation; training; competence; transformation

■ Introduction

Modern digital technologies are central in the transformation of human resource (HR) processes and significantly affect the professional training of HR professionals. Automated systems, artificial intelligence (AI), data analytics and cloud services are becoming more widespread, changing the traditional methods of recruiting,

evaluating and developing employees. Such innovations not only optimise the routine operations of HR departments but also provide companies with a competitive advantage by accurately predicting staffing needs and increasing their efficiency. This requires new approaches to training specialists who must be

Suggested Citation:

Nosachenko, V., & Nosachenko, D. (2025). Modern digital technologies in human resources management: Impact on professional training. *Professional Education: Methodology, Theory and Technologies*, 11(2), 10-21. doi: 10.69587/pemtt/2.2025.10.



prepared to work with tools that are significantly different from those used before. In this regard, there is a need to adapt curricula for HR professionals, at universities. In addition to the traditional disciplines related to management theory and human resources, students should acquire practical skills in working with modern HR platforms, and human resource management system (HRIS), as well as data analysis and AI methods to predict employee behaviour and effectively manage their development. This will allow future specialists to easily integrate into the work environment and meet the requirements of the modern labour market. Digital technologies are also central in the development of flexible management approaches, including remote employment, which is becoming increasingly popular. HR professionals need to be able to use tools to organise and monitor employee productivity remotely, which requires new competencies and approaches to HR management. Modern digital technologies have a significant impact on HR management processes, which emphasises the importance of adapting professional training to the new realities of the labour market. This determines the research's relevance.

Modern research is addressing the issue of introducing digital technologies into the field of human resources management, which contributes to improving the efficiency of enterprises. Many scholars study this topic and offer different views on it. For instance, A. Akimov & A. Tikhonov (2023) examined the use of digital technologies in the human resource management system of aerospace enterprises, emphasising their importance for increasing competitiveness. In turn, G. Chen (2021) studied methods of optimising human resources management with the help of information technology, particularly the automation of various procedures. E. Egorov *et al.* (2020) studied the main trends in the use of information technology in the hotel industry, noting the importance of introducing new solutions for human resources management. S. Frkić *et al.* (2020) addressed the importance of digital practical training for students specialising in human resources management, emphasising the relevance of developing these skills. S.S. Gadzali *et al.* (2023) explored human resource management (HRM) strategies in the context of the digital transformation of organisations, emphasising the importance of a strategic approach to change. G.F. Galieva *et al.* (2022) examined anti-crisis technologies for improving the efficiency of HRM, addressing their role in improving the performance of organisations. The importance of IT in HRM processes was studied by N.V. Kozhukhova *et al.* (2021), who emphasised the importance of IT technologies in HR management in the digital age, pointing to their impact on changing approaches to HR management. Y. Li & H. Xiao (2022) presented an automated financial management system based on artificial intelligence technologies, which increases the accuracy and speed of data processing.

The role of the board of directors in improving efficiency is important in reforming the management of enterprises. In this context, H. Liu & G. Hu (2020) investigated the use of artificial intelligence technologies that can significantly improve decision-making and resource management. X. Lu (2020) analysed the use of computer digital technologies for the management of personnel files in universities, demonstrating the benefits of automating processes in higher education, which in turn leads to an increase in the overall productivity of educational institutions. O. Makovoz (2024) analysed the general trends in the use of digital technologies in the field of human resources management, addressing the latest developments and innovative approaches that appear on the market. The design of a personnel information management system for universities, presented by H. Mao & Q. Zhang (2022), improves performance through the introduction of intelligent technologies, which reduces time and resources. H. Nazarova *et al.* (2022) investigated the transformation of HRM principles in modern conditions, emphasising the need to adapt to changes in the labour market. E. Okrushko *et al.* (2023) examined the impact of big data technologies on the digital transformation of HR management in organisations, emphasising the importance of introducing new technologies to improve the efficiency of management processes. The study aimed to compare the activities of specialists before and after the introduction of digital technologies based on standardised methods.

■ Materials and Methods

This study was conducted based on the method of experimentation and comparative analysis during the two months of April-May 2023 and included three stages. The research methodology was conducted using three main technologies, namely LMS, cloud-based collaboration platforms, and AI in recruitment. The company Rozetka (Rozetka, n.d.), which employs 200 specialists, was chosen for the study. Among them, 120 participants are women and 80 are men, aged 25 to 40. The study was conducted in accordance with The guidance note of the European Commission on ethics and data protection (2021).

The first stage of the study involved determining the level of professionalism of the participants without the use of digital technologies, which was used to create a basis for comparison with the results obtained after the introduction of modern digital means. The assessment of professionalism was based on the following criteria: performance (analysis of productivity, teamwork, meeting deadlines and achieving goals); problem-solving ability (determining the level of participants' creativity, data analysis and decision-making in non-standard situations was an important indicator of professional competence); communication skills (participants' ability to interact with colleagues

and management, formulate their thoughts and communicate information effectively was determined); adaptability to change (participants' ability to adapt to workplace changes, address new challenges and learning rate without modern technology); leadership skills and initiative (responsibility for projects and readiness to initiate workplace improvements). Based on these criteria, the initial indicators of each participant's professionalism were formed, and used for further comparison with the results after the introduction of digital technologies.

The second stage was the use of three methods to analyse the effectiveness of digital technologies in training, each of which had its specifics, namely Kirkpatrick's Four-Level Training Evaluation Model (The Kirkpatrick's Model, n.d.) for LMS. This methodology helped to evaluate the effectiveness of training programmes at four levels: participants' response to training, the level of knowledge acquired, changes in the behaviour of specialists after training, and the results of implementing this knowledge in practice. This approach was used not only to study how well the specialists learned new knowledge through the LMS but also how this knowledge affected their productivity in the workplace. Team cohesion assessment (2024) for Cloud Platforms assesses the interaction and cooperation between team members when using cloud technologies. This methodology was used to determine the level of team effectiveness, communication skills, and engagement. It was used to investigate how effectively specialists used platforms such as Microsoft Teams in their professional activities, and the problems and opportunities that arose in the process of cooperation. Quality of Hire (QoH) Assessment for artificial intelligence (AI) in recruitment was used to evaluate the quality of hiring through AI tools (Bika, 2023). The methodology included analysing the compliance of new employees with job requirements, their performance in the first months of employment, and the speed of closing vacancies. This determined how artificial intelligence influenced the improvement of the hiring process, increasing the quality of recruitment and optimising the speed of filling positions. The last stage of the study was a comparative analysis of the professional activities of specialists before and after the introduction of digital technologies.

■ Results

Digital technologies significantly changed human resources management, including professional training. With the rapid development of information technology and growing competition in the labour market, organisations are facing new challenges that require the adaptation of training programmes and methods. The integration of modern technologies, such as LMS, AI and cloud platforms, provides a significant increase in the efficiency of the learning process, allowing access to the latest knowledge and skills. The relevance of

professional training in the context of digitalisation is driven by the need to meet the requirements of a rapidly changing environment. Not only theoretical knowledge is important, but also practical skills, adaptability, critical thinking and effective communication. Modern technologies open new learning opportunities, providing an individualised approach to each specialist. This increases students' motivation and promotes their active participation in the learning process. The introduction of digital technologies in the training of specialists not only improves the quality of education but also creates new teaching methodologies that meet the requirements of the labour market. Such changes create conditions for successful career growth of graduates who are ready to meet the challenges of the modern world. This is especially relevant in the context of globalisation and rapidly changing requirements for professional competencies.

Digital technologies have long been an integral part of human resources management (HRM). They help automate processes, increase workplace efficiency, and improve communication between employees and managers. Modern digital tools for HRM cover a wide range of technologies, such as human resource management systems, artificial intelligence, data analytics, cloud services and mobile platforms. One of the key technologies is a HRIS. They provide centralised storage of employee data, document management, time tracking and processes related to recruitment, remuneration and performance evaluation. HRIS can cut administrative costs and reduce human error by ensuring efficient data management and optimising workflows. Artificial intelligence plays an important role in HR management. AI algorithms can automate recruitment processes, from finding candidates to conducting interviews with chatbots. Artificial intelligence can analyse CVs and provide recommendations on the suitability of candidates for the position. In addition, these technologies can improve the prediction of employee behaviour, and assess employee satisfaction and the risk of attrition, which helps prevent the loss of important personnel. Data analytics technology is used for informed decisions based on the collected information. In HR, this means using data on performance, employee satisfaction, and turnover rates to identify weaknesses and develop strategies to address them. For instance, analytical tools can determine why employees leave, what skills are key to a company's success, and how to better allocate resources for staff training. Cloud technologies have had a significant impact on the field of HR management. Cloud solutions allow companies to access data from anywhere and at any time, which is especially important for organisations with a global workforce. This promotes workplace flexibility and reduces infrastructure maintenance costs. Cloud services can quickly adapt to changes and integrate new features, including remote team management. Mobile platforms allow employees to access HR

systems from their smartphones and tablets, which increases their engagement and efficiency. For instance, employees can view their schedules, request leave, or access internal company information through mobile apps. Mobile platforms also facilitate communication between employees and management, which contributes to better management and teamwork.

In general, modern digital technologies in HR not only optimise processes but also contribute to the development of a more adaptive and efficient workforce. They allow companies to respond quickly to changes, increase employee satisfaction and ensure their professional growth. In the future, the development of artificial intelligence, automation and data analytics can further transform the HR industry, creating new opportunities to increase productivity and efficiency at all levels of the organisation. According to a Gartner study (Gartner for human..., n.d.), 70% of employees believe that the use of digital learning and development platforms significantly enhances their knowledge and skills. These platforms, which can include online courses, webinars, video tutorials and interactive learning modules, provide flexibility in learning, which is especially important. Employees can study at their convenience and in a comfortable environment, which helps to increase their engagement and motivation to learn. During the COVID-19 pandemic, many organisations were forced to switch to distance learning, and the results showed that employees can achieve high results using online tools. This highlights the importance of technology in modern HR and learning, as it opens new opportunities for developing professional skills.

Digital technologies significantly affect the professional training of specialists, changing traditional teaching methods, creating new tools for skill development and contributing to more efficient knowledge acquisition (Onipko & Yaprynets, 2024). The main areas of this impact can be outlined in several key aspects: the introduction of innovative educational platforms, the use of virtual and augmented reality, the personalisation of learning processes, the integration of data analytics and artificial intelligence, and the development of digital competencies. Modern technologies expand access to quality education beyond the physical walls of educational institutions. Online courses, webinars, and educational platforms such as Coursera, edX, and Udemy enable professionals to acquire new knowledge at a time and place convenient for them. This is especially relevant for advanced training and acquiring new professional skills. In addition, virtual classrooms and cloud technologies provide an opportunity for teachers and students to work together on projects regardless of their geographical location, which expands opportunities for international cooperation and experience exchange. Virtual reality (VR) and augmented reality (AR) are creating new horizons in professional

training. With the help of these technologies, specialists can learn in conditions as close to real as possible without leaving the classroom. For instance, healthcare professionals can practice complex surgical procedures in a virtual environment, and engineers can design and test models without the need to create physical prototypes. VR and AR can be used to practice skills without risking health or resources, making the learning process more efficient and safer. Digital technologies can be used to adapt learning materials to the specific needs of each student. Intelligent platforms that use artificial intelligence analyse students' behaviour and performance, providing individualised recommendations for further learning. This contributes to more effective learning, as each specialist can study the material most needed to develop in the profession. Personalisation can also be used to address different learning styles by providing interactive materials, video tutorials, or tasks based on gaming technologies. Data analytics and artificial intelligence are changing the way teachers assess student progress. Data collection and processing technologies can be used to track learning achievements, analyse mistakes and adjust the training process in time. As such, an individual approach to each student and optimisation for the use of time for both teachers and students is possible. AI is also used to automate learning processes, such as grading assignments, organising tests, and adapting materials to the specific needs of the group. With the rapid development of technology, digital literacy is becoming critical for any professional. Educational institutions are increasingly integrating the development of digital skills into their programmes, providing students with knowledge of basic and advanced technologies, from working with computer programs to the basics of programming and cybersecurity. This allows future professionals to be competitive in the labour market and use technology effectively in their professional activities. Innovative platforms, virtual and augmented reality, personalised learning, data analytics, and the development of digital competencies are interconnected to create new opportunities for high-quality training. The use of these technologies helps to increase the efficiency of the educational process, improve the professional skills of specialists and make them better prepared for the challenges of the modern labour market.

The introduction of digital solutions into human resources (HR) curricula significantly improves the effectiveness of HR training. Digital technologies not only improve access to educational materials but also change the learning methods, which is especially relevant for training HR professionals to operate in a modern digital environment. Digital platforms allow students to access materials anytime and from anywhere. This contributes to the flexibility of the learning process and allows professionals to combine their studies with work or other commitments. In addition, digital

solutions, such as interactive simulators, make it possible to practice practical skills in realistic conditions, which significantly improves the quality of training. Modern platforms can analyse the progress of each student and provide individualised recommendations, which improves learning and increases the level of interest in the learning process. For HR professionals who often employ analytical tools for personnel assessment, this opportunity is important because it allows them to master practical skills in a learning environment.

In addition, digital solutions significantly increase the effectiveness of teamwork and communication in the learning process. The use of collaboration platforms, such as Zoom or Microsoft Teams, allows students to develop teamwork skills. Instructors can use these platforms to organise group projects or discussions, which helps students develop critical thinking and leadership skills. HR professionals must constantly monitor new trends in HR management, and digital platforms allow them to access webinars, online courses and conferences, which allows them to stay at the forefront of their profession. The introduction of digital solutions allows for real-time monitoring and evaluation of learning effectiveness. Teachers can receive data on students' performance, progress and level of learning, which allows

them to make prompt adjustments to the learning process. This approach helps improve the quality of training and allows HR professionals to acquire more relevant knowledge and skills. An equally important aspect is the development of the digital skills of the specialists themselves. Modern HR systems, such as HRM platforms, recruitment automation, and HR analytics, are an integral part of a modern HR specialist's work. The introduction of such solutions into the curriculum allows students to gain practical experience with these tools while they are still studying, which significantly improves their competitiveness in the labour market. The introduction of digital solutions into the curriculum for HR professionals significantly increases the effectiveness of their training. They contribute to the development of both practical and theoretical knowledge, improve access to materials, and make the learning process more flexible and personalised. As a result, HR professionals are better prepared to handle the digital environment that is essential in the modern world. The study evaluated the impact of digital tools on the professional skills of Rozetka employees, and the results are presented in Table 1, showing changes in efficiency, problem-solving, communication and other important indicators before and after the introduction of these tools.

Table 1. *The impact of digital tools on the professional skills of Rozetka employees*

Criteria	Before the introduction of digital tools	After the introduction of digital tools	Tools used
Efficiency	65%	85%	Office 365
Problem-solving	60%	82%	Power BI
Communication skills	70%	90%	Zoom
Adaptability to changes	55%	80%	Microsoft Teams
Leadership skills and initiative	50%	78%	Microsoft Planner

Source: *compiled by the authors*

The metrics shown in Table 1 suggest that a significant proportion of employees have demonstrated significant progress in handling workplace tasks and interacting with colleagues. Digital tools simplify the project management process, improve the quality of communication, and increase the speed of response to changes. This is especially relevant in a modern environment when the demands on professionalism are constantly growing and the ability to quickly adapt to new conditions is a key success factor. Improvements have been seen in important skills such as teamwork and leadership. Using digital platforms such as Microsoft Teams and Office 365, specialists have been able to coordinate their work more effectively, set clear priorities, and take on more responsibility for projects. This strengthened team spirit and stimulated initiative among employees, which positively affected overall productivity. Most of the staff showed improvements in the speed of learning new ways of handling workplace tasks and readiness for change. Digital tools have

helped to facilitate this process by reducing stress and increasing confidence in performing work tasks.

Rozetka needs to continuously develop and implement new digital technologies, such as learning management systems, cloud-based collaboration platforms and artificial intelligence in recruitment, as they provide significant benefits for both the company and its employees. Implementation of learning management systems allows a company to maintain a continuous process of training and development of employees. LMS helps to create personalised learning plans, analyse progress and track employee competencies. It provides flexibility in learning, as employees can manage their time and study online, which increases their efficiency. Cloud-based collaboration platforms, such as Microsoft Teams, allow for more efficient communication and collaboration. They simplify access to documents, facilitate real-time information sharing, and provide a secure space for collaboration. Cloud-based solutions also facilitate faster decision-making and optimise workflows, which

is a key factor for success in a globally competitive environment. Artificial intelligence in recruitment is becoming an integral part of the hiring process, as it automates routine tasks such as sorting resumes, finding the best candidates based on skills and qualifications, and analysing interview results. This not only saves time and resources for the HR department but also reduces the risk of subjective hiring decisions, contributing to a more accurate selection of specialists. Continuous development of digital technologies is strategically important for

Rozetka. Implementation of LMS, cloud platforms and AI in recruitment allows companies to remain innovative, increase efficiency, optimise HR management and maintain competitiveness in the global market.

Based on the results of the second stage of the study, where three methodologies were used, including Kirkpatrick's Four-Level Training Evaluation Model, to assess the effectiveness of the implementation of LMS, Table 2 shows the results of Rozetka's employees (200 people) by Kirkpatrick's levels.

Table 2. Evaluation of the effectiveness of the implementation of learning management systems, cloud platforms and artificial intelligence using the Kirkpatrick methodology

Kirkpatrick's Four-Level Training Evaluation Model	Percentage of participants demonstrated a high level of	Percentage of participants demonstrating the average level	Percentage of participants demonstrated a low level of
Reaction (assessment of the usability and satisfaction of the LMS)	85%	10%	5%
Knowledge assimilation (the ability to apply new knowledge)	75%	20%	5%
Behavioural change (application of knowledge in work)	70%	25%	5%
Results (impact on productivity and efficiency)	65%	30%	5%

Source: compiled by the authors

The data in the table demonstrated that most participants positively assessed the reaction to the LMS, which indicates the convenience and usefulness of this tool for training. This indicates the success of the technology implementation itself and its positive impact on the motivation of specialists. A significant number of participants efficiently mastered the new knowledge, which demonstrates the quality of the training material and methods. However, some of the participants showed an average level of learning, which may signal the need to improve the learning process or provide additional support. More than half of the professionals were able to apply the knowledge

gained during employment. This underlines the practicality of the training and its connection with real working conditions. However, not all participants noted an increase in productivity, which suggests that not all professionals have yet fully realised the potential of their new skills.

Team cohesion assessment (2024) methodology was used to assess the impact of cloud platforms on the effectiveness of communication and interaction between specialists. This methodology was used to analyse key indicators. The results of the study are shown in Table 3, which illustrates how cloud technologies contribute to improved collaboration in workgroups.

Table 3. Evaluation of the effectiveness of communication and interaction between specialists when using cloud platforms based on the Team cohesion assessment methodology

Metric	Number of participants	Comment
Teamwork efficiency	150	Most participants reported improved teamwork due to the interactivity of the platforms
Communication	150	A significant number of experts noted that communication has become more open and accessible
Engagement	140	Many participants believe that cloud-based platforms facilitate greater engagement in the workplace
Cooperation	155	Participants reported an increased level of cooperation between team members
Feedback	130	Some professionals noted improvements in receiving feedback from colleagues

Source: compiled by the authors based on Team cohesion assessment (2024)

In particular, the use of cloud-based platforms such as Microsoft Teams positively affected teamwork, communication and engagement. According to the data, most participants rated their work efficiency as significantly improved due to the opportunities provided by these technologies. Many noted that cloud platforms facilitate collaboration by making processes more interactive and

team friendly. This demonstrates the importance and feasibility of implementing such technologies to improve workplace efficiency in a modern environment.

For a detailed analysis of the effectiveness of the implementation of LMS, cloud collaboration platforms and AI, Kirkpatrick's Four-Level Training Evaluation Model was used. This methodology was used to assess the reaction

of participants, knowledge acquisition, behavioural change and the results of technology implementation;

the results of Microsoft specialists' work by levels of this methodology are shown in Table 4.

Table 4. Comparison of professional performance indicators of specialists before and after the introduction of digital technologies based on the Quality of Hire Assessment methodology

Metric	Before implementation	After implementation
Efficiency of workplace tasks handling	65%	85%
Communication skills	60%	80%
Rate of adaptation to changes	55%	75%
Ability to solve problems	70%	90%
The general level of satisfaction	68%	88%

Source: compiled by the authors based on N. Bika (2023)

The last stage of the study confirmed the positive impact of digital technologies on the professional activities of specialists. As the table shows, after the introduction of LMS, cloud-based collaboration platforms and AI in recruitment, the efficiency of task performance increased from 65% to 85%. Participants also demonstrated significant improvements in communication skills (from 60% to 80%) and the speed of adaptation to change (from 55% to 75%). The ability to solve problems has increased from 70% to 90%, indicating an increase in professional competence. Overall employee job satisfaction increased from 68% to 88%. This indicates that the integration of digital technologies has not only improved productivity but also had a positive impact on the team atmosphere. Therefore, the introduction of the latest technology in professional training is crucial to improve efficiency and employee satisfaction.

The results of the study demonstrate the significant impact of digital technologies on the effectiveness of professional activities of specialists in the field of human resources management. This creates new opportunities for the further development of training programmes that meet the needs of the modern labour market. Integration of digital platforms such as LMS, cloud-based collaboration solutions and artificial intelligence in recruitment is an important step in training future professionals. These technologies not only help to improve the efficiency of the learning process but can also be used to adapt curricula to the challenges of the digital economy. Learning management systems provide a personalised approach to learning, allowing professionals to acquire knowledge at the desired pace. This deepens learning and improves professional skills. Cloud-based platforms, such as Microsoft Teams, facilitate communication between participants in the learning process, allowing them to quickly share ideas and resources. This not only improves teamwork but also creates an environment where participants can freely share knowledge and experience, which is especially important in the field of human resources. Artificial intelligence plays an important role in modernising training and recruitment processes. The use of artificial intelligence in recruitment allows for the automation of many routine tasks, which increases the

speed and quality of recruitment. This, in turn, allows HR professionals to focus on strategic aspects of their work, such as talent development and improving corporate culture. The integration of artificial intelligence into training programmes can create new opportunities for developing skills that will become critical in today's economy. The field of human resources management is undergoing significant transformations due to the introduction of new technologies, and educational institutions must respond to these changes. This may include the development of new courses that focus on relevant topics such as data management, artificial intelligence ethics, and digital transformation in organisations. Professionals acquire skills that allow them to effectively use new tools and technologies and adapt to new challenges. This is important not only for the personal development of each specialist but also for increasing the competitiveness of organisations.

The results of the study confirm that the introduction of digital technologies into the curricula for HR professionals creates new horizons for their professional development. The use of such technologies not only improves the efficiency of training but also creates specialists who can adapt to the challenges of the digital economy. In turn, this will have a positive impact on the overall development of organisations and increase their efficiency in the modern-day labour market.

■ Discussion

This study is an important contribution to the determination of the impact of modern digital technologies, including artificial intelligence, on HRM. In the context of rapid digital transformation, HR departments are facing new challenges and opportunities that require a rethinking of traditional approaches to HR. This study has revealed significant significance in the context of current trends in HRM. The main objective of the study was to identify the impact of new technologies, in particular AI, on the efficiency of HR processes. The findings showed that the integration of AI into recruitment, performance management and performance evaluation contribute to the efficiency of organisations. This correlates with the findings of other researchers who have also studied the issue of technological adaptation

in HRM. The findings underlined those organisations that implement AI technologies can significantly reduce recruitment time and improve the accuracy of matching candidates with vacancies. For instance, K. Pryshliak & Y. Semenenko (2024) confirmed that the use of AI in recruitment processes helps to reduce costs and improve the quality of hiring. These results indicate that technological adaptation is critical for the competitiveness of enterprises.

Compared to other studies, the results of the research confirm those by C. Pang (2021), who noted that management reforms in the era of artificial intelligence require new approaches and strategies. In addition, the study by A.B. Shtrikov *et al.* (2022) addressed the application of the Kaizen system in HRM, emphasising that continuous process improvement is an important aspect of ensuring management efficiency. In contrast, Z. Smirnova *et al.* (2021) addressed the role of the digital economy in the management of organisations but did not analyse the direct impact of AI on management processes. This suggests a need for further research on the impact of new technologies on HRM. Y. Tao *et al.* (2023) demonstrated how positioning technologies can be implemented in HRM, but did not address the issue of AI. This created opportunities for future research that could explore the integration of AI with other technologies in HRM in more detail. T. Wang & Y. Cheng (2024) highlighted the importance of intelligent HR systems for ensuring security in enterprises. However, it is necessary to explore how AI can improve these systems in the context of HRM.

A. Vajpayee & K. Ramachandran (2019) emphasised the importance of AI in knowledge management, stating that for the successful implementation of new technologies, it is necessary to increase the level of knowledge of HR managers. K. Veeraiyah *et al.* (2022) also addressed AI, but in the context of financial management, which indicates the diversity of its application in various aspects of management. This emphasises the need for an interdisciplinary approach to the study of AI in HRM. The analysis by Q. Xue (2022) confirmed the practical application of AI and big data in HRM, although the need for a deeper understanding of the impact of these technologies on the cultural and organisational aspects of HRM is present. Y. Yang (2021) addressed the development of computer networks in the context of HRM but does not account for how these technologies can collaborate with AI to improve HR processes. Y. Ye (2020) studied HR information systems but does not address innovative technologies such as AI, which indicates the need for further research.

T. Zbrytska & O. Soroka (2021) emphasised the importance of digital transformation in HRM but do not discuss specific technologies that can be implemented, which opens space for further research in this area. Lastly, J. Zhang & Z. Chen (2024) analysed the digital transformation of HRM in the new environment, which

emphasises the need to adapt to the new challenges and opportunities faced by organisations in the digital age. The findings highlight the importance of continuing research in the field of HRM. It is necessary to conduct a detailed analysis of the impact of specific AI technologies on various aspects of HRM. This could include studying the impact of AI on employee motivation, engagement, and productivity.

Further research should consider the possibility of training HR managers in new technologies, which will allow them to use them more effectively in practice. This is consistent with the findings of A. Vajpayee & K. Ramachandran (2019) on the need to improve the skills of specialists in this area. In conclusion, it is worth noting that in the context of rapid technological development, organisations should be prepared to adapt their HR strategies to new realities. This will not only increase management efficiency but will also contribute to the development of innovative approaches in HRM. Thus, the study emphasises the importance of integrating new technologies into HRM to improve the efficiency of HR management. The findings confirmed the conclusions of other authors, but also point to the need for further research, especially in the context of the introduction of artificial intelligence. In conclusion, it is important to note that in the face of constant change in the world of technology, organisations must be prepared to adapt their HR strategies to remain competitive. These findings are important for the further development of HRM, as they point to the need for continuous improvement of technologies and approaches to HRM, which can be useful not only for the academic community but also for practitioners in the field.

Digital technologies are becoming a fundamental element in modern human resource management, helping to automate processes, increase efficiency, and provide new opportunities for strategic staff development. One of the main drivers of this transformation is AI. The use of AI in the recruitment process allows companies to reduce the time required to find and select candidates by analysing large amounts of data. This approach minimises the human factor, reduces the likelihood of errors and ensures a more objective selection process. In the context of automating routine tasks, artificial intelligence is becoming a powerful tool for creating more efficient HR procedures. Big data also provides significant benefits to HR managers, allowing them to make decisions based on objective indicators and forecasts. Using data on employee productivity, competencies and career development allows for more personalised development and performance strategies. Data analysis helps to identify trends and predict possible problems, such as the risk of staff turnover or reduced productivity. As a result, companies can take proactive measures to retain talent and improve the overall work environment. Cloud-based HR management platforms provide centralised access to data and tools,

facilitating their use regardless of the location of the company or its employees. This increases the flexibility of the organisation, allowing it to quickly adapt to changes in the external environment. Cloud-based solutions can integrate various technologies, including learning management systems, performance tracking and feedback, which helps to create a single information space for human resource management. Automation of routine tasks, such as CV pre-assessment or interview scheduling, is becoming another important component of HR digital transformation. Chatbots and other automated tools help to significantly reduce the workload of HR departments, freeing up time for more complex and strategic tasks. Such innovations not only reduce the time it takes to complete operational processes but also ensure a high level of accuracy and efficiency, which has a positive impact on the efficiency of the entire organisation. The introduction of digital technologies in the field of human resource management creates preconditions for the strategic transformation of HR functions. On the one hand, the automation of routine processes and the use of big data can improve the efficiency and accuracy of decisions. On the other hand, new technologies create opportunities for deeper analysis of staff needs, increased engagement and retention of talent, and the creation of a more flexible and adaptive organisation.

■ Conclusions

Digital technologies have significantly transformed human resource management and professional training. They facilitate process automation, improve workplace efficiency, and simplify communication between employees and management. The implementation of learning management systems, artificial intelligence, and cloud platforms significantly enhances the quality of education by providing access to up-to-date knowledge and skills. This is particularly crucial in a rapidly evolving digital environment, where not only theoretical knowledge but also critical thinking, adaptability, and communication skills are essential. One of the key advantages of modern digital solutions is the personalisation of learning. Intelligent platforms analyse student performance and adapt materials to their specific needs, thereby increasing learning efficiency

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and engagement. Virtual and augmented reality further expand learning opportunities by simulating real-life scenarios without health or resource risks. These technologies are especially beneficial in fields such as medicine and engineering. Digital tools also have a substantial impact on human resource management. AI facilitates the automation of recruitment processes by analysing resumes and predicting candidate suitability. Cloud technologies enhance communication and collaboration within organisations, which is particularly relevant for companies with global teams. Mobile platforms enable employees to interact efficiently with HR systems, review schedules, submit leave requests, and access essential information in real time.

A study conducted among Rozetka employees demonstrated that the introduction of digital tools significantly improved their professional competencies. Specifically, workplace efficiency increased from 65% to 85%, while communication skills improved from 70% to 90%. These findings confirmed that digital solutions streamline project management, enhance communication quality, and increase task execution flexibility. The integration of modern technologies into HR training programs represents a crucial step in preparing professionals capable of operating effectively in a digital environment. The use of LMS, cloud solutions, and AI in education enables workforce training to align with the actual demands of the labour market. This approach fosters the development of professional competencies and enhances organisational competitiveness. Prospects for further research include studying the impact of digital technologies on the educational process in different types of educational institutions and developing new methods that would consider the specifics of teaching in the context of modern challenges.

■ Acknowledgements

None.

■ Funding

None.

■ Conflict of Interest

None.

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Сучасні цифрові технології в управлінні персоналом: вплив на професійну підготовку фахівців

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■ **Анотація.** Метою дослідження був порівняльний аналіз діяльності фахівців до та після впровадження цифрових технологій. Методологія дослідження включала експеримент і порівняльний аналіз із використанням систем управління навчанням, хмарних платформ для співпраці та штучного інтелекту в рекрутингу. Основні результати дослідження засвідчили, що цифрові платформи та автоматизовані системи суттєво покращують навчальний процес, особливо в таких ключових аспектах, як рекрутинг, адаптація нових співробітників, оцінка їхньої продуктивності та розвиток необхідних компетенцій. Завдяки використанню штучного інтелекту та великих даних компанії мають змогу точніше визначати потреби в навчанні, проводити детальніший аналіз ринкових тенденцій і прогнозувати можливі ризики, що в результаті сприяє підвищенню якості прийняття стратегічних рішень. Ці технології дозволяють освітнім установам впроваджувати сучасні методики навчання, які базуються на індивідуалізації підходу до студентів та фахівців. Однією з важливих переваг цифрових рішень є підвищення рівня задоволеності студентів і працівників завдяки гнучким навчальним графікам та можливостям дистанційного навчання. Це значно покращує внутрішню комунікацію та знижує рівень стресу серед учасників навчального процесу. Виявлено, що такі платформи також підвищують лояльність студентів до закладів освіти, сприяють їхній ефективності та дозволяють швидше пристосуватися до умов сучасного ринку праці. Отримані результати відкривають нові можливості для подальшого розвитку навчальних програм у сфері управління персоналом. Зокрема, інтеграція цифрових платформ та автоматизованих систем навчання допомагає розробляти освітні стратегії, що відповідають викликам цифрової економіки. В результаті фахівці стають конкурентоспроможними та підготовленими до реальних викликів професійної діяльності

■ **Ключові слова:** автоматизація; інновації; навчання; компетенції; трансформація



Directions for improvement of the organisation of air traffic controller training in Ukraine in the conditions of the Russian-Ukrainian War

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■ **Abstract.** The research relevance is determined by the need to ensure the continuity and quality of training of air traffic controllers in Ukraine following international standards and requirements in the conditions of the closure of Ukrainian airspace for civil aviation due to Russian aggression and the impact of its consequences. The study aimed to substantiate directions for improvement of the organisation of air traffic controller training in Ukraine during the Russian-Ukrainian War. Analytical, comparative, and generalisation methods were used in the research. The study identified the main problems associated with the high-quality organisation of professional training for air traffic controllers in Ukraine under the conditions of the Russian-Ukrainian War, which have both military and systemic reasons. The features of the organisational system for training air traffic controllers in different countries were outlined. A general overview of the regulatory and legal framework for assessing and monitoring the professionally relevant qualities of air traffic controllers was provided based on the requirements of the International Civil Aviation Organisation. An overview of the four levels of readiness of future air traffic controllers for professional activity was summarised, describing low, sufficient, medium, and high levels, based on the specific nature of their duties. An expanded set of criteria for evaluation of the readiness of aspiring air traffic controllers was proposed. Based on the practical experience of the Ukrainian State Flight Academy, a set of measures was suggested to improve the efficiency of automated testing and assessment of the knowledge of future air traffic controllers. The practical significance of the study is determined by recommendations to improve the training system for air traffic controllers in Ukraine in martial law conditions. Their implementation will help overcome the existing challenges in ensuring the organisation of high-quality training for air traffic controllers in Ukraine. Furthermore, it will create the foundation for the rapid recovery and development of the Ukrainian aviation industry after the war

■ **Keywords:** professional training; civil aviation; levels of readiness for professional activity; methods of assessing professional suitability; professionally relevant qualities

■ Introduction

The foundation for ensuring flight safety in civil aviation is primarily the quality of training organisation for future aviation professionals, especially air traffic controllers.

This is a key element of the aviation incident prevention system. In Ukraine, the effective organisation of professional training for air traffic controllers, especially

Suggested Citation:

Kalashnyk, G., & Kalashnyk-Rybalko, M. (2025). Directions for improvement of the organisation of air traffic controller training in Ukraine in the conditions of the Russian-Ukrainian War. *Professional Education: Methodology, Theory and Technologies*, 11(2), 22-36. doi: 10.69587/pemtt/2.2025.22.



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in conditions of the Russian-Ukrainian conflict, faces numerous significant challenges stemming from both military and systemic issues. Since February 2022, Ukrainian airspace has been closed to civil aviation due to Russian hostility, rendering practical training in real conditions impossible. Simulator training, which is critical for air traffic controllers, is limited due to restricted access to live air traffic data and the inability to practise skills in active airspace. Therefore, cadets are unable to gain comprehensive experience of real air traffic flows, which diminishes the readiness for duty after the end of the war. Training centres for air traffic controllers, such as those at the Ukrainian State Flight Academy, partly mitigate this issue but cannot fully replicate real-world conditions and are equipped with outdated simulators, such as the “Start” system introduced in 1990. Martial law has resulted in reduced state funding for aviation education in Ukraine, as priority shifts to defence needs. The procurement of modern simulators, software updates, and the upkeep of training infrastructure are hampered by limited financial resources. Outdated equipment and restricted access to modern technologies (AI-based simulators) reduce the quality of air traffic controller training compared to international standards.

O. Danylko *et al.* (2023) conducted a comparative analysis of different aspects of professional training in foreign higher education institutions specialising in aviation. The implementation of the concept of collaborative decision-making among air traffic controllers, pilots and airport operators was emphasised in the organisation of training for air traffic controllers. Y. Chen *et al.* (2024) examined methods to optimise aircraft flows. In response to rising workloads for air traffic controllers, the study suggested development of digital twins of airfields to test crisis response scenarios. M. Kaya & S.S. Ateş (2023) investigated the integration of artificial intelligence (AI) into decision-making support systems for controllers in air traffic management. The proposed approach can significantly increase the trust of operators in automated solutions, especially in conditions of high load and uncertainty. M. Jameel *et al.* (2023) presented a virtual pilot for training air traffic controllers, integrating advanced AI tools. This system receives voice commands from student controllers, recognises and interprets them, and then generates a response that imitates the pilot’s speech. The proposed system can significantly accelerate the training process of air traffic controllers, reducing dependence on human simulator pilots and reducing overall training costs. The use of open AI tools can facilitate adaptation of the system to different conditions and scenarios (García *et al.*, 2023). The use of a digital air traffic controller assistant (digital ATCO), which is integrated into the controller’s workplace and performs tasks such as detecting and resolving conflicts, creating commands, and communicating

with pilots (Jameel *et al.*, 2023), is relevant in the training of controllers. M. Kalashnyk-Rybalko & G. Kalashnyk (2025) and G. Kalashnyk *et al.* (2025) addressed improvement of technological solutions for prevention of psychophysiological causes of language errors of air traffic controllers, developing criteria and indicators for diagnosing leadership competence as a professionally substantial quality of controllers. The organisation of professional training of air traffic controllers in different countries prioritise the integration of modern technologies, psychological training methods and compliance with international standards. At the same time, the processes of organisation of the training of air traffic controllers in the conditions of modern hybrid warfare and its consequences are not sufficiently considered in scientific publications.

Among the factors influencing the external environment on the functioning of the organisational system for training air traffic controllers in Ukraine, it is possible to distinguish significant instability of the labour market and crisis phenomena in the economy of Ukraine in the conditions of the Russian-Ukrainian War; instability of the socio-economic system of Ukraine; acceleration of the rate of knowledge obsolescence; rapid development of intellectual information technologies and AI systems in adaptive simulators for training air traffic controllers; transition from the teaching paradigm (transfer of information) to the learning paradigm (transfer of action potential). In the conditions of a competency-based approach (competence-based education), this specificity imposes requirements on the procedures for solving the relevant tasks of organising education, which determines a relevance of a new scientific and methodological concept based on modern information technologies (Kiryanova, 2024). The improvement of the organisation of training of air traffic controllers, which is based on a competency-based approach to training, was emphasised. The study identified ways to enhance the organisation of air traffic controller training in Ukraine under the conditions of the Russian-Ukrainian War.

■ Materials and Methods

The methodology of this study was based on a systemic approach, which ensured a comprehensive consideration of directions for improving the organisation of training for air traffic controllers in Ukraine. The study was conducted through systematic processing of various materials and sources that reflect the features of the organisation of the educational process and the specifics of the organisational system for training air traffic controllers. The subject of an analysis was the main issues related to the proper organisation of professional training for air traffic controllers in Ukraine amid the Russian-Ukrainian War, along with potential solutions. A comparative analysis of the organisation of training for air traffic controllers across different countries was

performed. The United States (US), The United Kingdom (UK), EU countries, and Ukraine were selected for comparative analysis. These countries exhibit different characteristics in the technical training of air traffic controllers and variations in educational infrastructure, facilitating a comprehensive study. This analysis emphasised key aspects such as training duration, costs, technical training features, availability and condition of educational infrastructure, training focus, and adherence to international standards. This approach was applied for a detailed study of the professional training systems for air traffic controllers in various countries, as well as to identify key trends, differences, and opportunities for enhancing the Ukrainian training system.

Data were collected from diverse sources, including scientific articles (Zuluaga-Gomez *et al.*, 2023; Kaya & Ateş, 2023; Chen *et al.*, 2024), regulatory documents of the International Civil Aviation Organisation (ICAO), notably Document 4444 (ICAO, 2016), Annex 1 (ICAO, 2022), Annex 11 (ICAO, 2018), European Aviation Safety Agency (EASA, 2023), Commission Regulation (EU) No. 2015/340 (2015), Eurocontrol Specifications for the ATCO Common Core Content Initial Training (EUROCONTROL, 2015) and Ukraine's Aviation Rules (Order of the State Aviation Service of Ukraine No. 485, 2018). The data was collected to gather extensive information about various aspects of air traffic controller training in the studied countries. The legal framework governing the operation of Ukraine's aviation education system for training air traffic controllers (ATC) was also analysed, which is regulated by several legal acts aligned with international standards, notably those of ICAO and EASA. The analysis utilised regulatory documents from ICAO, EASA, and relevant national legislation such as the Aviation Rules of Ukraine, among others.

In the next phase of the research, the regulatory and legal framework for assessing and monitoring the professionally significant qualities of air traffic controllers was examined in accordance with ICAO regulatory documents (ICAO, 2016; ICAO, 2018; ICAO, 2020; ICAO, 2022a; ICAO, 2022b). This analysis was conducted to summarise the requirements for the organisational system of training air traffic controllers based on ICAO regulations, and to generalise the indicators and criteria for assessing readiness for professional activities. Hence, key criteria, indicators, and methods for evaluating the readiness levels of air traffic controllers were compiled, and the characteristics of four readiness levels for future air traffic controllers – low, sufficient, medium, and high – were established based on the specifics of their professional duties.

In the subsequent stage, sets of criteria and tests used to assess the readiness of air traffic controllers for professional activity were analysed including the ATSA – air traffic skills assessment of the US Federal Aviation Administration (FAA, 2021), and first European

air traffic controller selection test (FEAST) (EUROCONTROL, n.d.). During the analysis of scientific literature, a selective search for sources was conducted in the databases of Scopus, Web of Science, Researchgate, Google Scholar, as well as in regulatory document repositories of ICAO, FAA, EASA and EUROCONTROL. The following criteria for source selection were applied: relevance of publications and relevance to the research topic. This provided a comprehensive overview of modern approaches to training air traffic controllers in accordance with international requirements and within the context of current global challenges.

■ Results and Discussion

Air traffic controllers are a substantial component of air traffic safety. Civil aviation has a developed network of industry-specific higher educational institutions, colleges and training centers. Air traffic controllers are required to undergo a certification and attestation procedure with the issuance of an appropriate document. The isolation of Ukrainian civil aviation from international airspace has hindered integration with EUROCONTROL and ICAO programmes. Limited access to international training centres and exchange schemes diminishes opportunities for updating to modern standards. Regressed European training standards, such as Commission Regulation (EU) No. 2015/340 (2015), may hinder the recognition of Ukrainian air traffic controller certificates after the war. Therefore, improvement of the organisation of air traffic controllers' training in Ukraine during the Russian-Ukrainian War is crucial for the swift recovery of civil aviation once the war concludes.

Features of the organisational system for training air traffic controllers include increased responsibility for the results of professional activities, as controllers are responsible for air transport safety. This determines strict requirements for the quality of professional training and for decision-making processes, as each decision carries high stakes and the risk of catastrophic consequences in case of errors. Air traffic controllers must be able to make the right decisions under strict time constraints, while operating within an environment where the safety criterion imposes stringent demands on all aspects of their professional activities. At the same time, the peculiarities of their training are shaped by the impossibility of practicing skills for actions in extraordinary in-flight situations, the incompleteness or contradictions of information received during aircraft control, and the unpredictability of when and where special situations may arise. These conditions complicate training of controllers regarding emergencies, thus necessitating the development of creative thinking to assess situations, devise and implement optimal solutions under conditions of stress and time pressure. Covering these aspects, the study analysed the organisation of training for air traffic controllers in different countries (Table 1).

Table 1. Features of the organisation of training for air traffic controllers in different countries

Country/Region	Duration of training	Cost of training	Features of technical training	Availability and condition of educational infrastructure	Main focus of training
US	2-5 years (depending on the program: initial training, ~3-5 months at the FAA Academy, further on-the-job training 1-3 years)	Free for candidates accepted to the FAA Academy (government-funded); private programs cost 10,000-30,000 USD per course	Use of simulators (TRACON, En Route), radar and non-critical systems training, emphasis on FAA standards	Highly developed infrastructure: FAA Academy (Oklahoma), simulation centers, partnership with universities (CTI programs)	Flight safety, strict adherence to FAA procedures, and rapid response in high-traffic conditions
UK	1-2 years (initial training, ~12-18 months at NATS or colleges, plus up to 6 months of practical training at the facility)	20,000-50,000 GBP (depending on the program; NATS partially subsidises for selected candidates)	Modern simulators (3D airport models), training in management according to EUROCONTROL standards, and emphasis on automated systems	Well-developed infrastructure: NATS College, simulation centers at airports (Heathrow, Gatwick), cooperation with EUROCONTROL	Coordination with European standards, efficiency at busy airports, and stress resistance
EU countries	1-3 years (depending on the country: initial training ~6-12 months, practical training 1-2 years)	10,000-40,000 EUR (in some countries subsidised by the state or EUROCONTROL)	Use of SESAR simulators, training in European standards (EASA), emphasis on intercultural interaction	Diverse infrastructure: national centers (e.g. DFS in Germany, DSNA in France), coordination through EUROCONTROL	Diverse infrastructure: national centers (e.g. DFS in Germany, DSNA in France), coordination through EUROCONTROL
Ukraine	4 years years (full-time) for a bachelor's degree, an additional 1 year 5 months for a master's degree, and practical training at the facility for up to 6 months	The approximate cost of a bachelor's program is 60,000-120,000 UAH per year (depending on the full-time or part-time form of study)	Using automated systems such as "Start", with emphasis on air traffic safety, at a high level of proficiency in aviation phraseology according to ICAO standards	The Ukrainian State Flight Academy is the main institution for training air traffic controllers. Equipped with an air traffic control training center for practical training	Flight safety, training meets international ICAO standards, harmonisation with European standards

Note: Collegiate Training Initiative (CTI) – USA Federal Aviation Administration (FAA) program, which collaborates with colleges and universities to train future air traffic controllers; SESAR – Single European Sky ATM Research; NATS – National Air Traffic Services; DFS – Deutsche Flugsicherung GmbH; DSNA – Direction des Services de la Navigation Aérienne

Source: compiled by the authors based on NATS (n.d.), Order of the State Aviation Service of Ukraine No. 485 (2018), EASA (2023), OFR & NARA (2025)

In EU countries, ATC training programs are long but provide in-depth theoretical training. The US prioritises practical training and a fast transition to work, which is suitable for a quick introduction of controllers into the profession, but may limit the theoretical basis. European ATC training programs are more universal for international careers, while the US is adapted to local conditions, which may limit the mobility of graduates.

The legal framework for the functioning of the aviation education system of Ukraine for the training of air traffic controllers is regulated by regulatory legal acts that comply with international standards, in particular the requirements of the ICAO and the EASA. These documents establish requirements for the organisation of training, licensing, certification and maintenance of professional qualifications of ATC controllers. The Aviation Rules of Ukraine (Order of the State Aviation Service of Ukraine No. 485, 2018) are a key document in regulating the professional training of ATC controllers. It is based on ICAO standards (Commission Regulation (EU) No. 2015/340, 2015; ICAO, 2016; ICAO, 2022a). Aviation Rules of Ukraine (Order of the State Aviation Service of Ukraine No. 485, 2018) establish requirements for: qualification

standards (education, medical certification, English language proficiency at ICAO Level 4 or higher); training programs that include theoretical training, practical training on simulators and internships; procedures for issuing ATCO Licenses and ratings; determines the mandatory accreditation of educational institutions that provide training and their compliance with EUROCONTROL standards. ICAO has established standards and recommended practices for the training, licensing and maintenance of professional competence of controllers. These requirements are aimed at ensuring flight safety by assessing the professionally relevant qualities of air traffic controllers (Table 2).

The analysis of research data by Y. Chen *et al.* (2024), M. Kaya & S.S. Ateş (2023) supported the need to improve assessment methods, as well as the criteria and indicators of professional readiness. Based on the review of modern approaches to evaluation of information systems and the specifics of air traffic controller training, improved indicators and criteria for assessing readiness were proposed, encompassing psychophysiological, intellectual, theoretical, and practical aspects. Selection of candidates with suitable psychophysiological traits was prioritised due to flight safety heavily relying

on quick decision-making under stress. Assessing the readiness of future air traffic controllers for professional activity is a key element of their training in the context of the high responsibility and specificity of their professional duties (Table 3).

The research summarised the characteristics of four levels of readiness of future air traffic controllers for professional activity – low, sufficient, medium and high – considering the specifics of their professional activity (Table 4).

Table 2. Regulatory and legal support for the assessment and monitoring of professionally relevant qualities of air traffic controllers

ICAO document	Criteria for professionally relevant qualities	Methods of assessment and monitoring	Application of the requirements of the document during preparation
Annex 1 – Personnel Licensing	Cognitive: memory, attention, spatial thinking. Psycho-emotional: stress tolerance, emotional stability. Communicative: English (ICAO Level 4)	Medical certification (Class 3), psychological tests (attention, memory, stress tolerance tests), periodic competency exams (knowledge of procedures, communication)	Psychological selection before training, regular medical examinations, and language tests
Doc 4444 – PANS-ATM	Spatial awareness, quick decision-making, and communication skills	Simulation assessments, On-the-job training (OJT) observations, and radio communication assessment	Simulation training for developing air traffic control skills
Doc 9868 – Training	Cognitive: information processing, memory. Psycho-emotional: stress tolerance, decision-making. Communicative: ICAO phraseology	Psychological tests, simulation exercises, periodic refresher courses	Stress management training, team interaction, simulation training, and language courses
Doc 10056	Cognitive and psychological qualities, teamwork, and situational awareness	Competency-based assessment, automated systems for monitoring performance, observation and assessment by trainers during practical sessions	Integration of human factors into training
Annex 11 (Air Traffic Services)	Professional competence, communication skills, and operational efficiency	Practical exams, monitoring procedures, certification	Practical exams, monitoring procedures, certification

Source: compiled by the authors based on ICAO (2016), ICAO (2018), ICAO (2020), ICAO (2022a), ICAO (2022b)

Table 3. Generalised criteria, indicators and methods for assessing the levels of readiness of air traffic controllers for professional activity

Assessment criterion	Criterion description	Indicators	Assessment methods	Relationship to professional duties
Cognitive competence	Ability to process information quickly, think spatially, multitask, and predict	Reaction time to tasks. Accuracy of test scenarios; Number of errors in simulations; Ability to predict trajectories	Psychometric tests (e.g., ATSA); Simulation exercises on simulators; Spatial imagination tests	Need for rapid analysis of complex scenarios, real-time coordination of aircraft movements, and avoidance of airspace conflicts
Psycho-emotional resilience	Ability to remain calm, efficient and self-controlled under stressful conditions	Anxiety level; HRV; Recovery time after stressful tasks	Psychometric tests (e.g. ATSA, MMPI); Physiological measurements (HRV, EEG); High-stress simulations; TOVA attention and concentration tests	Working under high pressure, need to make decisions in critical situations
Professional knowledge and skills	Mastery of ICAO standards, ATC procedures and the ability to apply them in practice	Accuracy of procedures; Knowledge of the regulatory framework (assessment through tests); Efficiency in simulation tasks	Written tests on knowledge of standards; Simulation exercises on simulators; Assessment of the implementation of standard procedures	Ensuring the safety and efficiency of air traffic through compliance with international standards
Communicative competence	Clarity, conciseness and correctness of communication, particularly in an English-speaking environment	Quality of communication (clarity, compliance with ICAO standards); Use of standard phraseology; ICAO language proficiency level 4+	Analysis of communication recordings during simulations; English language proficiency tests (ICAO Language Proficiency)	Clear transmission of instructions to pilots, coordination with other controllers in an international environment
Team interaction	Ability to cooperate, lead and adapt to teamwork	Level of cooperation in group tasks; Leadership qualities (assessment through behaviour); Adaptability to a multicultural environment	Observation of behaviour in team simulations; Assessment of intercultural competence	Coordination with other controllers and participants in the aviation system to ensure safety

Note: MMPI – Minnesota Multiphasic Personality Inventory; HRV – Heart rate variability; EEG – ElectroEncephaloGram
Source: compiled by the authors based on ICAO (2016), FAA (2021), ICAO (2022a), ICAO (2022b), J. Zhang et al. (2023), D. Ziakkas et al. (2024), V. Polishchuk et al. (2024)

Table 4. Characteristics of the levels of readiness of air traffic controllers for professional activity

Level	Characteristics of readiness levels
Low	<ul style="list-style-type: none"> ■ Slow response to pilot requests: delays in issue of instructions; ■ Low coordination accuracy: frequent errors in traffic management; ■ Poor multitasking: difficulty handling multiple tasks simultaneously; ■ Low stress tolerance: loss of concentration under pressure; ■ Limited interaction with pilots: unclear or contradictory instructions.
Sufficient	<ul style="list-style-type: none"> ■ Adequate response speed to requests, but possible delays in peak conditions; ■ Moderate coordination accuracy: rare errors in traffic management; ■ Basic multitasking: ability to handle several tasks under standard conditions; ■ Moderate stress tolerance: maintaining concentration in non-critical situations; ■ Clear instructions, but with limited adaptability.
Medium	<ul style="list-style-type: none"> ■ Prompt response to pilot requests in most situations; ■ High coordination accuracy: minimal errors in air traffic control; ■ Efficient multitasking: managing multiple tasks in complex conditions; ■ Good stress resilience: maintaining focus during peak situations; ■ Adaptive instructions: adjusting to changes in air traffic.
High	<ul style="list-style-type: none"> ■ Instant response to pilot requests, even in crisis conditions; ■ Flawless coordination: no errors in complex traffic scenarios; ■ Exceptional multitasking: effectively managing multiple tasks simultaneously; ■ Strong stress resistance: maintaining stable performance under peak loads; ■ Adaptive instructions: predicting changes and optimising traffic; ■ Capable of handling with new technologies.

Source: developed by the authors based on ICAO (2016), ICAO (2022a), ICAO (2022b)

The characteristics of the readiness levels (low, sufficient, medium, high) are based on the ability of candidates to perform professional duties in conditions of multitasking, stress and automation. The professional duties of air traffic controllers include multitasking, rapid response to changes in the airspace, coordination with crews and adaptation to automated systems. Different countries use different sets of criteria and tests to assess the readiness of air traffic controllers for professional activities: ATSA (FAA, 2021), FEAST (EUROCONTROL, n.d.) of the European Air Traffic Management Program (EATMP), which complicates unification. Despite progress, according to researchers by Z. Chen *et al.* (2021), modern simulators do not always reproduce the emotional pressure of real-life working conditions for an air traffic controller. It requires improving assessment methods, as well as improving the criteria and indicators of readiness for professional activity.

An examination of methods used for organising air traffic controller training (Zuluaga-Gomez *et al.*, 2023; Chen *et al.*, 2021) identified common organisational shortcomings, including issues related to the effectiveness of automated testing and the assessment of air traffic knowledge of controllers. To improve the efficiency of automated testing and assessment of air traffic controller knowledge, a set of measures was proposed by expanding the range of simulator scenarios using AI and developing adaptive test systems that use machine learning for the dynamic selection of tasks based on the

controller's level of knowledge and responses to reduce testing duration; using cloud technologies to deploy test and simulation systems.

The indicators used to assess the professional suitability of a future air traffic controller include both objective and subjective indicators. Objective indicators include the results of cognitive ability tests (for example, attention and memory tests), simulator assessments, and error statistics. Subjective indicators include instructor assessments, candidate self-assessment, and psychological stress resistance tests. A comprehensive approach to assessing the professional suitability of air traffic controllers is relevant, with an emphasis on cognitive (attention, memory, spatial orientation, analytical thinking) (de Freitas *et al.*, 2022; Ceken, 2025), psychomotor (reaction speed, coordination, accuracy of task performance), and personal (stress resistance, responsibility, initiative, self-criticism) components. It is necessary to improve automated systems for testing and monitoring of knowledge, skills, and abilities among candidates. The indicators and criteria for evaluation should be comprehensive, covering technical, pedagogical, economic and psychophysiological aspects, and also comply with the principles of systematicity and practical applicability. Based on the analysis of modern approaches to the evaluation of information systems and the specifics of the training of air traffic controllers, the following indicators and criteria were proposed (Table 5).

Table 5. Criteria and indicators of readiness of the air traffic controller for professional activity

Criterion	Indicator	Description
Psychophysiological stability	Level of stress tolerance, reaction speed	Assessment of the dispatcher's ability to work under conditions of high psycho-emotional stress
Intellectual abilities	Accuracy of decision-making, analytical thinking	Ability to analyse complex situations and make quick and accurate decisions

Table 5. Continued

Criterion	Indicator	Description
Theoretical knowledge	Knowledge of regulations, ATC procedures, and radio telephony	Mastery of special disciplines, necessary for air traffic control
Practical skills	Performing management procedures, interacting with crews	Ability to apply knowledge in practice, including use of automated systems
Flight safety	Probability of avoiding emergencies	Assessment of the controller's ability to prevent emergencies and ensure safety
Workstation throughput	Number of aircraft handled per unit of time	Controller efficiency in heavy air traffic conditions
Use of automated systems	Accuracy of work with information systems	Ability to effectively interact with automated control points
Level of professional training	Results of automated and traditional diagnostics	Assessment of readiness for independent work based on testing and simulations
Adaptability to change	Flexibility in responding to non-standard situations	Ability to adapt to changes in airspace or regulations
Level of professional communication	Quality of communication (clarity, compliance with ICAO standards); Use of standard phraseology; ICAO language proficiency level 4+	Clear transmission of instructions to pilots, coordination with other controllers in an international environment

Source: compiled by the authors based on Order of the State Aviation Service of Ukraine No. 485 (2018), EASA (2023)

The study substantiated an expanded set of criteria for evaluating the readiness of future air traffic controllers for professional activity, encompassing psychophysiological, intellectual, theoretical, and practical aspects (Table 5). Particular emphasis was placed on selecting candidates with suitable psychophysiological traits, as flight safety largely relies on their ability to make quick decisions under stressful conditions. Under normal flight conditions, operations of air traffic controller are strictly governed by regulatory documents, which facilitate the algorithmic organisation of their tasks. Modern methods of organising training for air traffic controllers do not fully meet modern standards for development of their knowledge, skills, and abilities, nor do they ensure the reliability and promptness of decisions in critical situations. The most notable shortcomings in the organisation of training for air traffic controllers include (Kaya & Ateş, 2023): inadequate consideration of individual training characteristics, insufficient effectiveness of knowledge acquisition, limited success of independent training, ineffective control and ongoing assessment of trainees' knowledge, skills, and abilities, limited capabilities of specialised technical tools, low efficiency of simulator training, which does not account for individual differences, limited visibility, accessibility, and duration of knowledge acquisition. Additionally, in conditions of martial law, aviation educational institutions in Ukraine are compelled to adapt to distance learning formats, which are not always effective for the practical training of air traffic controllers.

Problem-based learning is a vital method in training air traffic controllers, as it encourages the development of critical thinking, independence, and the ability to solve complex professional tasks under conditions of uncertainty. This approach fosters crucial qualities, such as attention, memory, observation, initiative, caution, and determination; it also aids in developing skills for analysing complex situations that occur during air traffic control; and it stimulates the cognitive activity of cadets through the modelling of real work scenarios.

During theoretical training, problem-type tasks are utilised to simulate real air traffic control situations to educate on how to make quick decisions under stress and while multitasking. Since air traffic controllers operate under high psychological pressure, the training process emphasises fostering psychological resilience and cognitive capabilities. The psychological foundations of problem-based learning consider the factors of task complexity that influence the development of swift response and decision-making skills. Qualities such as criticality, self-criticism, unconventional thinking, and responsibility are cultivated, which are essential for the role of a air traffic controller.

In EU countries, problem-based learning is used in training air traffic controllers, fostering critical thinking and decision-making skills in stressful situations, along with intensive use of simulators that imitate real scenarios, such as conflict and emergencies (Efthymiou, 2023). The USA prioritises practical training through simulators and OJT (On-the-Job Training). Theoretical training in the USA is kept to a minimum for earlier progression to practical skills. Case methods are commonly employed to analyse real air traffic incidents. Despite advancements in training air traffic controllers, certain issues remain. These include the insufficient adaptation of problem-based learning methods to the specific requirements of training controllers as operators of complex system, the need for continuous updates to training programmes correlating with the latest technologies and standards of the ICAO, and limited access to modern training facilities at some aviation educational institutions. To enhance the effectiveness of air traffic controller training, it was essential to address the challenges of adapting methods, updating training programmes, and providing modern training facilities. Training of air traffic controllers as a problem area, which includes pedagogical and psychological knowledge, is poorly formalised. To solve this problem, it is necessary to use modern information technologies and AI methods (Değas *et al.*, 2022; Abu Talib *et al.*, 2025).

In the process of planning air traffic controller training, three typical elements can be distinguished: theoretical training, practical training, and control. Theoretical (pre-training) education includes studying the basics of air navigation systems, concepts of air traffic organisation, air traffic service procedures, and principles of capacity management. Professional disciplines that form the foundational knowledge for a dispatcher are prioritised. The greatest opportunities for adaptation to professional activity are offered by practical training. It is designed to determine and reinforce the educational material in declarative systems, to develop professionally relevant skills and abilities, and to foster intuition in procedural systems (simulators). During simulator training, four main steps are identified presenting the trainee with exercises on a specific training element or a set of elements that the cadet has become familiar with during the initial review of the theory, executing these exercises by the trainee, computer evaluation of each exercise's results, providing the necessary assistance throughout each exercise.

Simulation systems and simulators are employed to assess practical skills in simulated conditions, such as air traffic control or emergency response, for example, using a Full-Flight Simulator (FFS) or ATC simulators (Ziakkas *et al.*, 2024). The Ukrainian State Flight Academy operates a certified air traffic control training centre. Advantages of simulation systems and simulators for training air traffic controllers include realistic reproduction of the working environment, assessment of reactions to stressful situations and multitasking, and collection of real-time data on decision-making. Disadvantages of these systems for training include high development and operational costs, limited scenario variety compared to real-life conditions and difficulty in assessing "soft" skills such as communication and leadership.

Systems such as EUROCONTROL FEAST (EUROCONTROL, n.d.) are adapted for use in aviation training centres. The Ukrainian State Flight Academy hosts a certified training centre for administering the EUROCONTROL FEAST. CBT systems are used to evaluate theoretical knowledge, covering air traffic rules, phraseology, meteorology, and more through multiple-choice questions, matching tasks, or direct answers. These systems offer several advantages: rapid result processing, the ability to generate large question databases with random selection, and objective assessment (free from subjective influence by instructors). However, limitations include restricted evaluation of practical skills, the potential for rote memorisation of answers, and the absence of assessment of the cadet's psychophysiological state. A substantial element in assessing the readiness for professional activity of future air traffic controllers are systems of analysis of behaviour and psychophysiological state. They use biometric data (heart rate, stress level, reaction speed) (Lambay *et*

al., 2024) to assess the readiness for high load conditions. Among their advantages are the ability to evaluate psychophysiological stability and identify overload risks (Zhang *et al.*, 2023). However, they also have disadvantages, such as limited integration with other assessment systems and the high cost of equipment (for instance, sensors for monitoring). Automated adaptive testing systems dynamically adjust the complexity of questions or scenarios based on the controller's level of training. They can be used for personalised assessment and reduce testing time by removing tasks that are too easy or too difficult. Among the challenges are the complexity of developing adaptation algorithms and the need for a large task database.

Automating the system for assessing a future air traffic controller's readiness significantly reduces subjectivity in evaluation. Simulation systems can be used for practical skills assessment in conditions close to real life, while adaptive systems enhance engagement and training effectiveness. However, their use during training faces challenges such as high development and implementation costs, and a limited number of scenarios in simulators, which do not always reflect real air traffic controller conditions. Based on the results of the research, the following set of measures was proposed to increase the efficiency of automated testing and assessment of knowledge of air traffic controllers: a comprehensive evaluation covering knowledge, skills, and stress tolerance, expansion of the scenario database using AI to generate dynamic situations that emulate rare or extreme events (e.g., equipment failures, adverse weather), developing adaptive testing systems that employ machine learning to tailor tasks based on the controller's knowledge and reactions, thereby reducing test duration and increasing accuracy; utilising cloud technologies to deploy testing and simulation systems, which lowers hardware costs. Collaboration with organisations such as EUROCONTROL and ICAO is essential to standardise new methods of automated testing and ATC controller assessment. However, the ongoing Russian-Ukrainian War has limited cooperation with EUROCONTROL, EASA. Restricted access to global training centres and exchange programmes hampers adaptation to contemporary standards.

The approach to optimisation of the activities of air traffic controllers from the perspective of training is based on the concept that the effectiveness of their work is dependent on their level of competence. From this standpoint, practical tasks related to professional selection and training are addressed, forming the organisational system of air traffic controller training. This system encompasses two types of logically interconnected tasks: design and development of internal work tools, which include creating training programmes, developing the ontology of educational disciplines, and establishing optimal (rational) schedule, planning and predicting the results of air traffic controller training,

which include evaluating the preparedness of each air traffic controller at a specific training period, forecasting the duration of training, developing a model for an air traffic controller, selecting effective means and methods for training air traffic controllers and enhancing the, establishing quantitative criteria to assess the level of readiness of air traffic controllers, determining suitable periods for training (including re-training) and verifying the level of competence of air traffic controllers.

The main institution for training air traffic controllers in Ukraine is the Ukrainian State Flight Academy (Kropyvnytskyi). It is accredited to train air traffic controllers based on ICAO and EASA standards. The academy's training programmes for air traffic controllers include basic training to acquire initial knowledge, simulator training, rating training for specific sectors such as aerodrome, area, or approach control, and OJT. The Ukrainian State Flight Academy employs a simulator that replicates real working conditions for air traffic controllers. However, the simulator and many training tools at the academy are outdated, which hampers training for modern automated air traffic control systems. Martial law, in effect since 2022, restricts access to equipment upgrades due to financial constraints. The closure of airspace during the war further complicates practical training and internships for future air traffic controllers. Modernising air traffic controller training simulators and introducing simulators supporting systems such as SESAR (n.d.) will help align with European standards, which is vital for Ukraine's future integration into the single European aviation space. Candidates applying to the Ukrainian State Flight Academy must undergo a strict medical examination following ICAO Class 3 standards. Regular medical checks are mandatory throughout cadet training and for maintaining an air traffic controller certificate. Proficiency in English at ICAO Level 4+ is compulsory for all air traffic controllers operating in international airspace. The training programmes include specialised aviation English courses designed for air traffic controllers.

Military operations restrict access to training centres, especially near combat zones. Online training maintains the continuity of theoretical education, reducing risks for cadets and instructors. Meanwhile, practical classes can be held in secure locations or in collaboration with training centres in EU countries, where Ukrainian cadets can participate in simulator training for air traffic controllers. The Ukrainian State Flight Academy organises such training for future pilots at centres in the Czech Republic, Slovakia, and Latvia. However, training for air traffic controllers in EU training centres is absent. Establishment of such programmes will help retain Ukraine's human resource potential and decrease cadet outflow abroad. Therefore, improving air traffic controller training can be achieved through such interconnected approaches as refining methods to optimise training processes and

develop the necessary knowledge, skills, and abilities in air traffic management, enhancing criteria for evaluating the competence of air traffic controllers, upgrading automated testing and assessment systems and further improving simulator training through advanced information technologies.

Recommendations for enhancing Ukrainian air traffic controller training system amid martial law include several measures. The outdated training infrastructure for air traffic controllers in Ukraine should be modernised through international cooperation and technical assistance from organisations such as ICAO, EASA, or EUROCONTROL to upgrade training equipment and implement simulators that support modern air traffic management systems such as SESAR (SESAR, n.d.). This could be achieved via the ICAO (n.d.) initiative, which provides capacity-building support for modernising ATM infrastructure in war-affected regions, and through technical assistance grants or donations, such as those offered by the EUROCONTROL European ATM Voluntary Solidarity Fund for Ukrainian aviation sector (EUROCONTROL, 2024), Fund IFATCA "Support Ukrainian Controllers" (IFATCA, n.d.). The introduction of high-fidelity simulators compatible with the SESAR (n.d.) programme, which emphasises digitalisation, automation, and performance-based navigation (PBN), could involve the purchase or lease of SESAR-compatible tools through EASA technical cooperation programmes. These simulators should accurately reproduce real-time scenarios such as trajectory-based operations and remote tower control systems. During martial law, mobile or cloud-based simulators should be prioritised to reduce risks from potential attacks and ensure training continuity. Such an approach can be used not only for upgrades to controller training equipment but also promotion of long-term sustainability, positioning Ukraine as a vital participant in the European ATM network.

Hybrid educational programmes should be developed and implemented in the training of future ATC controllers, combining online theoretical courses with offline practice on simulators in safe regions of Ukraine or abroad. Theoretical modules can be provided in a hybrid (online and offline) format based on an aviation training institution in Ukraine. For offline practice, it is necessary to organise simulator sessions in potentially safe regions of Ukraine (e.g., Lviv region) or abroad, in cooperation with institutions in EU countries such as the Czech Republic or Romania. Additionally, it is necessary to integrate assessment tools, such as the Competency-based training and assessment (CBTA) system (IATA, 2024), for remote tracking of progress through digital portfolios and periodic assessments. This hybrid model aligns with global trends in digital education by ICAO e-learning initiatives and supports the training of aviation professionals for Ukraine's post-war aviation recovery.

It is necessary to improve the psychological training of cadets and their stress resilience development by mandating courses focused on vital professional qualities, such as stress management, critical thinking, and decision-making in crises situations, using high-fidelity simulators. This requires the integration into existing curricula by mid-2026 of annual courses covering key competencies: stress management (mindfulness and feedback techniques), critical thinking (scenario-based problem solving), and crisis decision-making (e.g., emergency response such as aircraft diversion). This can be achieved through cooperation with organisations such as EUROCONTROL, utilising the “Yellow-Blue Roadmap” for Ukraine program (EUROCONTROL, 2023), which includes specialised seminars, competency training, peer support programmes, and psychological assessments of aviation professionals.

It is necessary to accelerate the harmonisation of educational programmes for Ukraine’s aviation institutions with EASA and EUROCONTROL Specifications for the ATCO Common Core Content Initial Training (EUROCONTROL, 2015) to ensure international recognition of Ukrainian air traffic controller certificates and support further harmonisation within Ukrainian integration into European Union, as well as the swift restoration of civil aviation after the Russian-Ukrainian War. This requires the alignment of Ukrainian air traffic controller training programmes with the EASA requirements for air traffic controller licensing under Commission Regulation (EU) No. 2015/340 (2015), including basic training in subjects such as aviation law, meteorology and human factors, as well as specialised training in operational procedures and emergencies for specific air traffic control units. It is also necessary to adopt the EUROCONTROL’s CBTA (competency-based training and assessment) principles, which ICAO endorses as the most effective method for training air traffic controllers, focusing on performance standards rather than rote memorisation. This includes the introduction of proficiency testing of future air traffic controllers by instructors through on-the-job training.

These recommendations contribute to the debate on improving the current training system for air traffic controllers in Ukraine in conditions of the Russian-Ukrainian war, offering practical advice on developing and integrating hybrid educational programmes in accordance with ICAO and the European Aviation Safety Agency standards, using the Ukrainian State Flight Academy as an example. Presented proposal aims to improve the psychological training and stress resilience of air traffic controllers by introducing mandatory courses on development of key professional qualities, such as stress tolerance, critical thinking, and decision-making during crisis situations, utilising high-complexity simulators that address modern challenges in the aviation industry.

The study results highlighted the need to maintain the continuity and quality of air traffic controller training

in Ukraine in line with international standards and requirements, especially amid the closure of Ukrainian airspace due to Russian aggression. Improvement of the training system is essential during the Russian-Ukrainian war through adaptation of training to the closed airspace conditions and addressing the decline in practical skills caused by the lack of real flights. This presents a critical problem, as without regular practice, the certification and competence of air traffic controllers gradually diminish, risking the safety of civil aviation recovery in Ukraine after the war. The study also concluded that the training organisation should modernise Ukraine’s outdated air traffic control training facilities through international cooperation. This involves attraction of technical assistance from organisations such as ICAO, EASA, or EUROCONTROL to upgrade simulators and introduce the latest systems compatible with modern air traffic control frameworks such as SESAR, while enhancing virtual and simulation methods to sustain skills without physical access to airspace. Other studies supports this approach, demonstrating that virtual training can reduce costs and ensure remote training, prioritising interoperability of air traffic control systems.

For example, F. Pérez Moreno *et al.* (2022) demonstrated that machine learning can dynamically adjust key parameters of air traffic complexity within simulators. Without such improvements, Ukraine risks losing qualified personnel, which could delay aviation’s post-war recovery by months. G. De Rooij *et al.* (2022) investigated a model of collaborative ATC where automation handled individual flights while maintaining human involvement to prevent skill degradation. This was the first detailed task model with the potential to modernise ATC training with simulators for mixed conflicts, qualification analysis of delegation impacts, proposals for “smart” distribution of basic flights, and compatibility with SESAR. In Ukraine, during the period of martial law, similar hybrid programmes with automation for safe regions are needed for controller training, with the approval of EASA/EUROCONTROL, to support the restoration of Ukrainian aviation. Investment is also needed in digital platforms that incorporate AI for personalised training, as described in the model developed by A. Degas *et al.* (2022), where the Descriptive, Predictive, Prescriptive model with explanatory AI achieved a 7.7% accuracy in predicting controller reactions. Development of simulated environments with explanatory AI improves awareness of system decisions among controllers, reduce errors, and build trust. A. Degas *et al.* (2022) emphasised the significance of user-oriented AI that considers controllers’ cognitive states and provides integration for predicting aircraft trajectories and potential conflict situations, enabling more personalised and flexible training. M. Kaya & S.S. Ateş (2023) proposed AI-driven radio communication analysis to reduce errors, while R. García *et al.* (2023) suggested AI-based automatic recognition of flight call signs to

increase recognition accuracy, lessen workload, and improve situational awareness. M. Jameel *et al.* (2023) recommended digital assistants for ATC training, focusing on enhancing teamwork between human controllers and autonomous systems. J. Zuluaga-Gomez *et al.* (2023) developed an innovative AI-based system for training air traffic controllers using a virtual pilot simulator, which is an automated alternative to traditional training. This system has significant potential for modernising air traffic control training, particularly in resource-constrained environments such as Ukraine during martial law. Automation of the pilot role supports hybrid programs with online simulations, reducing dependence on instructors and ensuring training in safe regions. Compliance with ICAO standards (e.g. CBTA through error simulation) facilitates international certification, and open source facilitates implementation through partnerships with EASA or EUROCONTROL. These findings support the overall conclusion of this study: hybrid educational programmes combining air traffic controllers' training with online simulations and using AI to simulate realistic ATC scenarios improve training effectiveness.

Improvement of the organisation of training involves analysing modern foreign practices to update existing methods and develop hybrid educational programmes for training controllers in Ukraine. These findings align with those presented by O. Danylko *et al.* (2023) in an analysis of the training of aviation specialists in the USA, Europe, and Asia, and recommended the exchange of experience and adaptation of available courses for positive changes in Ukraine's domestic aviation training system. This study reaffirmed these findings, highlighting the importance of integrating technologies into updated educational programmes for training air traffic controllers in Ukraine. The study also emphasised that improvement of simulator training with AI optimises programmes and adapts them to military conditions. Another key finding of presented study was the need to develop and implement hybrid educational programs for training controllers that combine online theoretical courses with offline practice on simulators in safe regions of Ukraine or abroad. The war has isolated Ukraine's aviation sector, making the need for partnerships with foreign ANSPs (Air Navigation Service Providers) evident. These include internships, funding, and exchange programmes, which help compensate for the lack of domestic resources. International cooperation is vital for enhancing the competencies of Ukrainian air traffic controllers in the context of restricted airspace caused by the Russian-Ukrainian conflict. EUROCONTROL, via the European Special Solidarity Fund, already funds training and skills retention, covering personnel costs. Without such international support, the post-war recovery of Ukrainian civil aviation could take years and risk significant economic losses.

Another substantial conclusion was made regarding the need to strengthen psychological training and develop stress resilience through mandatory courses on developing professionally relevant qualities, such as stress management, critical thinking, and decision-making under pressure. These courses should utilise high-fidelity simulators that reflect current aviation challenges. The relevance of these findings was supported by other experts who have investigated fatigue as a critical risk factor in air traffic management (Wu & Sun, 2022; Polishchuk *et al.*, 2024). V. Polishchuk *et al.* (2024) proposed a three-stage approach to identifying fatigue to ensure safety: technical assessment, expert assessment, and uncertainty modelling combined with logical inference. N. Wu & J. Sun (2022) suggested the mandatory detection of controller fatigue through radio communication, while J. Zhang *et al.* (2023) emphasised the role using biosensors for fatigue diagnosis and automatic alerting when fatigue thresholds are reached. C. Ye *et al.* (2022) addressed recognition of levels of mental fatigue, particularly through language comprehension assessments. The use of machine learning to detect, monitor, and recover from physical fatigue as a primary safety measure during air traffic control was proposed by A. Lambay *et al.* (2024). However, some aspects of this study differ from previous findings. It highlights that controller fatigue is higher in real operational conditions compared to training centres, increased traffic boosts cognitive load, yet fatigue is not the primary cause of incidents. Therefore, according to the study's results, it was recommended to adopt a systematic approach to enhancing the training of air traffic controllers, focusing on the implementation of innovative technologies that support complex competency models by combining technical knowledge with skills such as stress management and decision-making under pressure.

This study underlined a different and vital approach: in the context of the psychological trauma of war, fatigue, and personnel losses, the improvement of operational efficiency and stress adaptation for future controllers should be prioritised. Therefore, improved training amid wartime should primarily involve developing cognitive skills enabling controllers to better cope with stress and multitasking in high-pressure environments. Furthermore, automatic fatigue notification systems could be integrated into training scenarios to simulate real air traffic management and enhance safety. This conclusion was reinforced by S. Ceken (2025), determining a positive correlation between cognitive flexibility and psychological resilience among 217 controllers surveyed. Another substantial conclusion of the study was the need to accelerate the harmonisation of educational programmes with the requirements of EASA and EUROCONTROL to ensure the recognition of

Ukrainian air traffic controllers' certificates abroad and further harmonisation in the context of Ukraine's European integration and the prospects for a rapid restoration of civil aviation after the end of the Russian-Ukrainian war. The results of proposed study confirmed this approach, offering practical advice on the development and integration of hybrid educational programmes harmonised with the standards of the European Aviation Safety Agency using the example of the Ukrainian State Flight Academy. Early planning for the restoration of Ukrainian civil aviation and replenishment of human resources is critical.

The study demonstrated that enhancing the training of air traffic controllers in Ukraine requires a comprehensive approach, combining technology, international aid, and psychological support. The war has transformed challenges into opportunities for modernisation of Ukrainian civil aviation sector, notably improving the training effectiveness of aviation specialists, especially air traffic controllers. Recommendations and measures to improve the organisation of air traffic controller training in Ukraine, based on research findings, will ensure continuity and lay the groundwork for the country's aviation industry's recovery after the war. However, without swift implementation, the risks will remain high. Investment and international assistance are essential. This approach will not only secure the safety of Ukraine's civil and transport aviation in the post-war period but also contribute to the rapid economic recovery through aviation activities.

■ Conclusions

The study aimed to identify ways to improve the training system for air traffic controllers in Ukraine during the Russian-Ukrainian War, and this goal was successfully achieved. Therefore, the following tasks were completed: the main issues in organising high-quality professional training for air traffic controllers in Ukraine during the war were analysed, and their causes identified; the features of organising educational processes in different countries were examined, the specifics of the organisational system for training air traffic controllers were determined, the utilisation of modern information technologies in training was evaluated; modern methods for developing operators' competencies in complex systems and organising training were analysed, indicators and criteria for air traffic controller readiness for professional activity were improved, and directions for enhancing the training of air traffic controllers in Ukraine during wartime were proposed. Based on the study's findings, the main challenges for effective training of air traffic controllers in Ukraine during wartime include limited access to practical classes, financial constraints, personnel losses, psychological stress, security risks, and non-compliance with

international standards. To address these issues, it is necessary to expand international cooperation for access to training centres and programme, secure funding for equipment upgrades, adapt training curricula to modern challenges by incorporating problem-based learning, AI, and virtual reality technologies; and develop realistic, practical simulations. Modern educational approaches in air traffic control training primarily rely on automated systems such as simulators, knowledge assessment tools, and educational process organisation technologies that often utilise mathematical models of controllers' activities.

An analysis of modern technologies revealed promising prospects for integrating AI, particularly digital controllers and AI-based simulators. Key indicators of air traffic controllers' readiness include stress resilience, decision accuracy, knowledge of regulatory frameworks, and proficiency with automated systems. Meanwhile, methods for assessing readiness for professional duties require refinement, especially regarding the integration of modern air traffic control systems and the adaptation of future controllers to new technologies. An analysis and synthesis of the regulatory framework for evaluating and monitoring essential professional qualities of air traffic controllers was conducted following International Civil Aviation Organisation standards. The results highlighted the need to improve indicators and criteria for assessing the preparedness of future ATC controllers. An expanded set of assessment criteria was proposed, encompassing psychophysiological, intellectual, theoretical, and practical aspects. Considering the specifics of ATC controllers' professional duties, four levels of readiness – low, sufficient, medium, and high – were identified and refined. Drawing on experiences from the Ukrainian State Flight Academy, measures were proposed to improve training, including modernising simulators, introducing hybrid training models, enhancing psychological training, and aligning training programmes with European standards. These measures aim to ensure continuity and high quality in air traffic controller training, creating prerequisites for Ukraine's aviation industry to recover swiftly after the war. Further research should address development of standardised methods for real-time assessment of the professionally relevant qualities of air traffic controllers.

■ Acknowledgements

None.

■ Funding

None.

■ Conflict of Interest

None.

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Напрямки удосконалення організації підготовки диспетчерів управління повітряним рухом в Україні в умовах російсько-української війни

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■ **Анотація.** Актуальність теми дослідження зумовлена необхідністю забезпечення безперервності та якості підготовки диспетчерів управління повітряним рухом в Україні відповідно до міжнародних стандартів та вимог в умовах закриття повітряного простору України для цивільної авіації через російську агресію та її наслідки. Метою дослідження було обґрунтування напрямків удосконалення організації підготовки диспетчерів управління повітряним рухом в Україні в умовах російсько-української війни. Для дослідження було використано методи аналізу, порівняння, узагальнення. В ході дослідження було визначено основні проблеми якісної організації професійної підготовки диспетчерів в Україні в умовах російсько-української війни, які мають як воєнні так і системні причини. Було окреслено особливості організаційної системи підготовки диспетчерів управління повітряним рухом в різних країнах. Виконано узагальнення нормативно-правового забезпечення оцінки та моніторингу професійно-важливих якостей диспетчерів управління повітряним рухом відповідно до вимог Міжнародної організації цивільної авіації. Було виконано узагальнення характеристик чотирьох рівнів готовності майбутніх диспетчерів до професійної діяльності – низького, достатнього, середнього та високого з урахуванням специфіки професійних обов'язків. Запропоновано розширений комплекс критеріїв для оцінки готовності майбутнього диспетчера управління повітряним рухом до професійної діяльності. З урахуванням практичного досвіду роботи Української державної льотної академії було запропоновано комплекс заходів для підвищення ефективності автоматизованого тестування та оцінювання знань майбутніх диспетчерів управління повітряним рухом. Практична цінність даного дослідження полягає в обґрунтуванні рекомендацій щодо вдосконалення існуючої системи підготовки диспетчерів управління повітряним рухом в Україні, які враховують реалії воєнного стану. Їх реалізація допоможе подолати поточні виклики забезпечення організації якісної підготовки диспетчерів управління повітряним рухом в Україні. В подальшому це створить основу для швидкого відновлення та розвитку української авіаційної галузі після закінчення війни

■ **Ключові слова:** професійна підготовка; цивільна авіація; рівні готовності до професійної діяльності; методи оцінки професійної придатності; професійно-важливі якості



English for Specific Purposes in creative disciplines: Bridging theory and labour market needs

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■ **Abstract.** This study investigated how English for Specific Purposes instruction can be aligned with employability goals in creative disciplines – specifically Digital Art and Design – through the integration of authentic workplace scenarios and micro-credentialing systems. Drawing on a qualitative case study design, data were collected from higher education institutions known for innovation in English for Specific Purposes via document analysis, semi-structured interviews with instructors of English for Specific Purposes and curriculum designers, and surveys from 28 students enrolled in courses incorporating these pedagogical approaches. The study revealed that authentic tasks in English for Specific Purposes – such as client briefings, visual presentations, and project critiques – significantly enhanced student motivation (71.43%) and improved awareness of learning objectives. Additionally, 78.57% of participants stated that earning digital badges for communicative performance helped them better recognise the practical value of their skills. Micro-credentials aligned with Common European Framework of Reference for Languages descriptors and embedded in formal assessment frameworks ensured transparent and modular verification of learning outcomes. Despite these benefits, instructors reported challenges such as increased workload and the absence of centralised platforms for issuing credentials. Based on these findings, the study contributes to scientific literature through the introduction of the transferable integration model, which combines authentic communication tasks, skill-specific badges, portfolio development, and industry feedback to support professional readiness in creative disciplines. The transferable integration model offers a replicable structure for English for Specific Purposes curricula that not only fosters but also certifies field-specific communicative competence and is tailored to the needs of the labour market. The effectiveness of this model depends on its careful implementation, verification mechanisms, and ongoing institutional support

■ **Keywords:** English language training; professional communication; micro-credentials; design education; career pathways; educational innovations; employability

■ Introduction

The modern global economy places increasing demands on graduates to demonstrate not only linguistic accuracy but also effective communication skills tailored to real-world professional settings. In the field of English for Specific Purposes (ESP), this shift requires a pedagogical evolution: away from abstract grammar instruction and toward practical, context-based language use. Many university-level ESP programmes continue

to prioritise traditional academic tasks that bear little resemblance to workplace communication, leading to a disconnect between what is taught in classrooms and what is expected in jobs. As a result, graduates often struggle with professional integration, especially in creative industries where collaboration, pitching, and visual communication are central. To address this, educators and curriculum designers are exploring alternative

Suggested Citation:

Shykhnenko, K. (2025). English for Specific Purposes in creative disciplines: Bridging theory and labour market needs. *Professional Education: Methodology, Theory and Technologies*, 11(2), 37-46. doi: 10.69587/pemtt/2.2025.37.



approaches that embed industry-relevant communication scenarios and assessment strategies into ESP learning environments.

Researchers J.G. Laborda & U.K. Serrouk (2021) explored the evolving role of ESP in both classroom and workplace contexts. They concluded that integrating authentic tasks into ESP instruction significantly enhances learners' meta discursive awareness and engagement with real-world communication practices. Their study emphasised the value of contextually relevant materials in fostering pragmatic competence. T. Golub *et al.* (2024) focused on critical thinking development in ESP through speaking and listening tasks. The authors found that scenario-based speaking activities not only improve language fluency but also promote students' ability to formulate arguments and critique ideas – skills particularly relevant in creative disciplines such as design and digital art. K. Falkner & E.E. Stålbrandt (2023) examined how authentic learning scenarios influence employability perceptions among higher education graduates. According to their findings, students who engaged in workplace simulations and collaborative projects reported stronger confidence in their professional communication skills and a clearer sense of how academic learning connects to job market expectations. Researcher N. Epaphras (2025) analysed the potential of micro-credentials to bridge the skills gap in higher education. The study highlighted that when micro-credentials are tied to specific competencies and integrated into course structures, they not only validate learning outcomes but also enhance motivation and provide tangible evidence of employability-related skills. Scientists H. Pirkkalainen *et al.* (2022) conducted a review on micro-credentials in higher education, concluding that while institutional interest is high, many programmes lack a clear framework for implementation. Their findings pointed to the need for more robust design models that connect credentialing to meaningful learning outcomes and curriculum coherence. According to A. Stamatakis *et al.* (2025), the integration of micro-credentials within digital education offered new opportunities for personalised learning and skill recognition. They also noted that effective implementation requires coordinated infrastructure and clear alignment with instructional goals – challenges that remain unresolved in many ESP programmes.

Despite these promising findings, several aspects remain insufficiently addressed in the literature. First, most studies explore either scenario-based instruction or micro-credentialing in isolation, without examining how the two approaches might complement each other. Second, there is limited evidence on how these practices can be adapted specifically for creative disciplines, where visual storytelling, persuasive communication, and critique-based dialogue are central. Finally, little attention has been given to designing transferable pedagogical models that embed both authenticity

and credentialing into ESP curricula in a cohesive way. This study aimed to fill these gaps by investigating how authentic workplace scenarios and micro-credentialing systems can be jointly used to align ESP instruction with employability goals in creative fields, particularly Digital Art and Design. The objectives were: to describe existing practices of implementing these innovations in ESP programmes; to analyse the synergies and challenges involved in combining them; and to propose a transferable curricular model. The novelty of this research lies in its dual focus on authenticity and modular certification as mutually reinforcing strategies for professional readiness. In doing so, the study contributes a replicable framework for aligning ESP pedagogy with the evolving communicative demands of the creative industries.

■ Materials and Methods

To guide this inquiry and structure the comparative case analysis, the following research questions were formulated:

RQ1: How are authentic workplace scenarios implemented in ESP curricula across different case sites?

RQ2: In what ways are micro-credentials designed and integrated within these programmes?

RQ3: What synergies and challenges emerge when combining scenario-based learning with micro-credentialing toward enhancing employability, and how can these insights be applied to creative education contexts such as Digital Art and Design?

The development of these questions was essential for ensuring conceptual clarity and methodological coherence across diverse case contexts. Given the study's aim it was crucial to define specific priority areas that would enable the systematic data collection, coding, and comparison of different cases. By dividing the study into three main areas (scenario implementation, micro-credential design, and their combined impact), the research questions provided a clear analytical framework that aligned the qualitative tools (interviews, surveys, and document analysis) with the broader objective of identifying transferable pedagogical strategies. This structure also enhanced the study's internal validity by allowing for triangulation of insights across different data sources and participant groups. Ultimately, the research questions served not only as thematic guides but also as a basis for interpreting pedagogical practices in a way that informs both theory and application. This study employed a multiple-case qualitative design (Hunziker & Blankenagel, 2021) to explore how ESP programmes integrate authentic workplace scenarios and micro-credentialing, with an emphasis on their applicability to Digital Art and Design education. The case study methodology was selected due to its strength in providing in-depth, context-rich insights into complex educational phenomena and its suitability for comparative, exploratory research across diverse institutions.

Two institutions offering ESP instruction were purposively selected as case sites. The selection criteria required the presence of one or both of the following curricular innovations: authentic workplace scenarios (e.g., simulations, project-based tasks), and micro-credentials or digital badges awarded for demonstrated skill mastery. Although the institutions represented varied academic domains, the analysis was guided by a specific interest in evaluating the relevance and transferability of these practices to creative disciplines, particularly Digital Art and Design. Participants included six ESP instructors and curriculum designers with doctoral degrees from the State University of Trade and Economics, Kyiv National University of Technologies and Design, and Kyiv National University of Culture and Arts. In addition, students enrolled in relevant ESP programmes were drawn from the latter two institutions. Instructor and designer participants were selected based on their direct involvement in the planning or delivery of ESP content. Student participants were recruited through convenience sampling, specifically via voluntary response, from classes where these curricular innovations were implemented.

Data were collected through a triangulated approach involving three key methods. First, document analysis relying on qualitative data was conducted on ESP syllabi, lesson plans, assessment tools, and micro-credential structures to examine how curricular intentions align with workplace communication and employability goals. This included analysis of materials from two international institutions known for their ESP innovation. Tampere University of Applied Sciences (Finland) offers a course titled Languages for Specific Purposes and Professional Communication, which is aligned with both academic and professional ESP objectives (Tampere University student's guide, 2024). The second institution, the School of Hotel and Tourism Management at The Hong Kong Polytechnic University (PolyU), provides evidence of similar alignment in its subject syllabi, including English Communication for Hospitality and Tourism Management (ELC3721) among undergraduate courses, and also offers a MicroMasters in International Hospitality Management, which provides verified certificates and credit pathways for its modular credentialled courses (The Hong Kong Polytechnic University..., n.d.; MicroMasters in International..., n.d.).

Second, semi-structured interviews were conducted with six ESP instructors and curriculum developers from the State University of Trade and Economics, Kyiv National University of Technologies and Design, and Kyiv National University of Culture and Arts to gather qualitative data on their experiences with implementing authentic workplace scenarios and micro-credentials. The interviews were conducted online via Zoom in the Ukrainian language, each lasting approximately 45-60 minutes. Ethical standards were observed throughout the study: participants were informed about the

purpose of the research, gave voluntary consent, and were assured of confidentiality and the right to withdraw at any stage (Ethics and data protection, 2021). The interview guide focused on questions such as:

1. What types of authentic tasks are integrated into your ESP curriculum?
2. How do students typically respond to these scenario-based tasks?
3. Have you observed any impact on student engagement or skill development?
4. In your experience, what are the benefits of incorporating micro-credentials?
5. What challenges have you encountered in implementing micro-credentialing?
6. How do you assess the effectiveness of these innovations in improving employability?
7. Are the credentials formally recognised by your institution or employers?
8. How do you align task design with industry-specific language demands?
9. What institutional support or limitations affect your use of these practices?
10. How transferable do you think these practices are to other disciplines?

These guiding questions allowed for probing and clarification, ensuring rich, context-sensitive responses from participants. Third, a survey was administered to 28 students from the State University of Trade and Economics, Kyiv National University of Technologies and Design, and Kyiv National University of Culture and Arts and enrolled in ESP courses that included these innovations. Students were asked to provide answers to the questions about the appropriateness of introducing the proposed practices, their usefulness in acquiring the skills necessary for future careers, the practicality of the proposed innovations, etc. The survey collected both quantitative and qualitative data, combining Likert-scale items on perceived authenticity, motivation, and employability relevance with open-ended questions to capture student reflections and experiences in greater depth. All instruments were designed to elicit both descriptive and evaluative responses and were reviewed for clarity and alignment with the study's objectives. Prior to their participation, students were informed about the purpose of the study and their role in it, and ethical principles were fully observed, including voluntary participation, anonymity, and the confidentiality of all collected data.

Data analysis followed a thematic coding approach. Interview transcripts and open-ended survey responses were coded inductively using NVivo qualitative software. Codes were grouped into categories such as instructional strategies, learner engagement, skill assessment, and employability perceptions. These categories informed the development of broader themes reflecting effective practices and implementation challenges. A cross-case comparative analysis was then

conducted to identify patterns, divergences, and emerging models across the two case sites. Where appropriate, narrative vignettes were constructed to illustrate context-specific practices, and curricular models were developed to summarise effective integration of authentic tasks and micro-credentials. This rigorous, multi-phase process ensured validity through triangulation, while offering rich insights into practices with potential transferability to creative education. The study's limitations include the use of non-random sampling and a small case set, which may constrain the generalisability of findings; furthermore, the model's scalability in resource-constrained or non-English-speaking contexts remains to be explored, and future longitudinal or employer-validated studies are needed to verify actual professional transfer.

■ Results and Discussion

This section presented the findings of the study in alignment with the three research questions, addressing each sequentially. The results are drawn from a thematic analysis of data collected through document review, semi-structured interviews with ESP instructors and curriculum designers, and student surveys. Each subsection synthesises the perspectives of participants and evidence from curricular documents, offering a comparative view across the selected case sites. The discussion integrates these findings with relevant literature to highlight patterns, contextual variations, and implications for ESP instruction – particularly in relation to its applicability within creative disciplines such as Digital Art and Design.

RQ1: Authentic scenario implementation

During the document analysis of the selected institutions, authentic task-based instruction emerged as a prominent feature across the syllabi. The most common practices identified were case studies that simulated real business or design briefs, role-plays and simulations replicating professional communication, and collaborative projects grounded in real-world scenarios.

Thematic analysis of interviews conducted with six ESP instructors and curriculum designers from three Ukrainian institutions revealed three key themes related to the implementation of authentic workplace scenarios in ESP instruction.

First, task realism emerged as a significant source of student motivation. Participants consistently reported that learners showed higher engagement when tasks closely resembled real-world professional activities. One instructor noted that students are “more invested in the learning process when the assignments resemble what they’ll actually do at work,” suggesting that authenticity in task design enhances both motivation and perceived relevance. Second, the interviews highlighted the importance of discipline-specific language demands. Instructors emphasised the need to tailor vocabulary and communicative practices to the specific requirements of each professional field. Within creative disciplines, this meant not only ensuring linguistic accuracy but also enabling students to persuasively articulate concepts, describe visual elements, and explain their design rationale. As one participant remarked, “In art and design, it’s not just about English. It’s about how to describe concepts, mood, and visuals persuasively”.

Third, participants identified several institutional constraints that limited the implementation of authentic scenarios. These included restricted contact hours, rigid curricular structures, and standardised assessment protocols, which collectively hindered the consistent use of immersive workplace simulations. As a result, some instructors were compelled to use simplified or informal scenario-based tasks instead of fully integrated, discipline-specific simulations. The comparative analysis of the two institutional case sites revealed both common strategies and contextual variations in the implementation of authentic workplace scenarios in ESP curricula (Table 1). The institutions incorporated task-based activities aimed at simulating professional communication; however, the type of task, disciplinary alignment, and depth of integration varied considerably.

Table 1. Comparison of authentic task integration across three ESP programmes

Institution	Task type	Field focus	Integration depth
Tampere (Finland)	Proposals, team briefings	Engineering	Moderate
PolyU (China)	Role-plays, written reports	Business, hospitality	High

Source: designed by the author based on *The Hong Kong Polytechnic University: Subject description form (n.d.)*, *Micro-Masters in International Hospitality Management (Online programme) (n.d.)*, *Tampere University student’s guide (2024)*

As can be seen in Table 1, Tampere University integrated authentic writing tasks, such as technical proposals and team briefings, within engineering contexts but lacked substantial oral communication components or discipline-specific performance criteria. Hong Kong Polytechnic University, while operating in business and hospitality domains, featured robust scenario-based role-plays and workplace writing assignments, demonstrating high task realism and strong alignment with professional communication standards. These

findings suggest that while authentic task design is broadly adopted, its depth and disciplinary specificity vary by institutional context.

The data drawn from 28 students’ survey responses enrolled in ESP courses at Kyiv National University of Technologies and Design and Kyiv National University of Culture and Arts offered valuable insights into learner perceptions of scenario-based instruction. Using a Likert-scale questionnaire, students evaluated the authenticity, engagement, and professional relevance

of ESP tasks. The findings indicated that 23 students (82.14%) agreed the instructional activities reflected real-life communication situations, while 21 students (75%) found scenario-based tasks more engaging than traditional grammar-focused exercises. Additionally, 20 students (71.43%) reported that these tasks increased their confidence in professional communication, suggesting a meaningful link between task authenticity and communicative self-efficacy. Open-ended survey responses provided further qualitative context. Students highlighted their appreciation for group critiques, mock client meetings, and design justification presentations, emphasising the relevance of these tasks to their anticipated professional environments. These results reinforce the pedagogical value of authentic scenario-based instruction in ESP, particularly for enhancing student engagement and perceived workplace preparedness in creative disciplines.

In summary, the integration of authentic workplace scenarios across the case institutions demonstrated variation in depth and disciplinary alignment. Programmes that effectively merged real-world task authenticity, field-specific communicative demands, and interactive, performance-based activities emerged as the most pedagogically robust. These findings underscored not only the pedagogical value but also the practical feasibility of adopting such approaches within ESP curricula tailored to creative disciplines. In these creative disciplines, where communication frequently involves visual explanation, client-oriented dialogue, and collaborative critique, scenario-based instruction offers a meaningful pathway to bridge language learning with professional preparedness.

RQ2. Integration and design of micro-credentials in ESP programmes

An analysis of micro-credential structures and assessment design at the two selected institutions – Tampere University and the PolyU – revealed contrasting approaches to modular certification systems. While both institutions demonstrated an interest in integrating micro-credentials, the degree of formal recognition and structural embedding varied considerably. At Tampere University, micro-credentials were systematically embedded within the Professional Communication in Engineering course. Students earned digital badges upon completing workplace simulations, such as technical writing portfolios and collaborative team briefings. Each badge was aligned with specific

Common European Framework of Reference for Languages (CEFR) descriptors and was supported by instructor feedback. Moreover, badge metadata clearly specified the skill criteria, evidence of achievement, and relevance to real-world applications, making the system transparent and outcome-oriented. In contrast, PolyU adopted a more informal and decentralised approach. Although there was no institutional framework standardising the use of micro-credentials, some instructors independently issued certificates or LinkedIn-compatible badges upon completion of ESP projects. These credentials typically focused on professional writing tasks – such as service emails and workplace reports – and were designed to increase visibility for employers rather than to reflect detailed skill mapping or competency alignment. Interview data from instructors and curriculum developers reflected a range of perspectives on micro-credentialing. Several participants praised the system’s modular flexibility and its ability to clearly communicate learning outcomes to students and external stakeholders. In their view, badges offered learners a sense of progression and clarity, as students could identify exactly which competencies they had demonstrated. However, other interviewees expressed concerns about the lack of institutional support, fragmentation across platforms, and the time-intensive nature of designing rigorous, evidence-based badge criteria. Despite these concerns, there was general consensus that micro-credentials serve as effective motivational tools and hold significant potential for enhancing employability, particularly when integrated with scenario-based tasks that mirror professional communication contexts. The comparative analysis of the two case institutions illustrated distinct models of implementation, each shaped by different levels of policy support, pedagogical coherence, and technological infrastructure (Table 2). Tampere University followed a curriculum-embedded model in which micro-credentials were formally tied to course outcomes, supported by CEFR alignment and guided instructor evaluation. In contrast, PolyU employed a more informal, instructor-led model, where badges were awarded at the discretion of individual faculty members and often lacked unified design standards or institutional endorsement. These differences reflect broader tensions between standardisation and flexibility in the integration of micro-credentials within higher education, particularly in ESP contexts.

Table 2. Comparative models of micro-credential integration in ESP programmes

Institution	Integration model	Credential design features	Challenges identified
Tampere (Finland)	Curriculum-embedded	CEFR-aligned, linked to performance tasks, instructor feedback	Platform setup, alignment with formal credits
PolyU (China)	Informal, instructor-led	Badges for task completion (e.g., reports, emails), employer-facing	Fragmentation, lack of standardisation

Note: the data presented in Table 2 were synthesised from document analysis and interviews with ESP curriculum developers of the selected institutions. These categories are interpretive and reflect recurring structural and pedagogical features observed in each setting

Source: designed by the author based on *The Hong Kong Polytechnic University: Subject description form (n.d.)*, *Micro-Masters in International Hospitality Management (Online programme) (n.d.)*, *Tampere University student's guide (2024)*

RQ3. Synergies and challenges in combining scenario-based learning with micro-credentials for employability in creative education

Survey findings revealed a strong synergy between scenario-based instruction and the use of micro-credentials, particularly in terms of fostering student engagement, clarifying learning outcomes, and enhancing perceptions of career readiness. Among the 28 student respondents, 71.43% reported that the opportunity to earn digital badges for completing professional tasks made the learning experience more goal-oriented and closely aligned with their future employment aspirations. Furthermore, 78.57% of students indicated that earning micro-credentials helped them better understand the value of specific communication competencies, such as presenting creative concepts, participating in critiques, and writing proposals. Qualitative feedback reinforced these sentiments; students remarked that the badges “broke the course into visible milestones” and “provided something tangible to add to a curriculum vitae (CV) or portfolio”. This perception was particularly notable among students in creative disciplines, who saw scenario-based projects and credentialed presentations as directly applicable to real-world contexts such as client consultations and creative pitching. Despite these benefits, the dual implementation of scenario-based instruction and micro-credentialing also introduced several challenges. Interviewed instructors noted an increase in instructional workload, particularly related to the design and alignment of tasks with badge criteria, the development of detailed rubrics, and the documentation of student performance. Another key issue was

the lack of institutional infrastructure to support credentialing systems. In the absence of centralised platforms or official recognition mechanisms, instructors reported inconsistencies in badge quality, uncertainty regarding their value, and confusion among students about their purpose and relevance. Cross-case analysis further underscored the importance of aligning authentic assessment tasks with skill-specific, transparent credentials. Programmes that achieved this integration – by linking tasks such as client presentations, design critiques, and collaborative projects with targeted badges – tended to produce higher levels of learner motivation and stronger signals of employability. These models showed considerable promise for creative disciplines, where success depends not only on technical proficiency but also on the ability to communicate design rationale, collaborate effectively, and engage in persuasive, reflective dialogue with clients and peers. Drawing on these findings, the study developed the transferable integration model for ESP instruction in creative fields. The model illustrates how scenario-based instruction can be systematically structured to promote professional readiness in disciplines such as Digital Art and Design. It incorporates key components including authentic communication tasks, skill-specific micro-credentials, portfolio-based assessment, and optional feedback from industry professionals. These elements are arranged in a modular format with reciprocal and sequential relationships, enabling flexible curricular alignment while facilitating the transfer of communicative competence from the classroom to workplace settings. The complete model is presented in Figure 1.

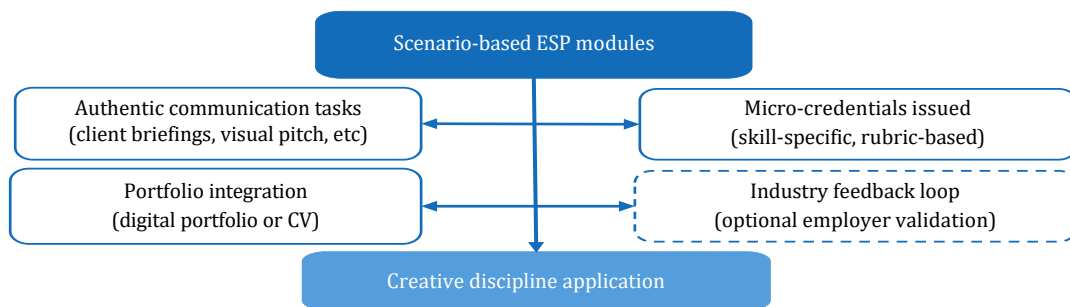


Figure 1. Transferable integration model for ESP in creative disciplines

Source: designed by the author

As can be seen in Figure 1, the visual framework emphasises both instructional flow and pedagogical reciprocity, which are particularly relevant in creative fields, where communication tasks are both applied and discipline-specific. One of the model’s primary strengths lies in its emphasis on instructional flow and reciprocal pedagogy, reflecting how authentic communicative practices both inform and are shaped by ESP modules. This bidirectional relationship encourages contextual relevance, with tasks such as client briefings

and visual presentations functioning not only as learning tools but also as realistic simulations of professional discourse. The inclusion of micro-credentials represents another benefit, offering modular, skill-specific validation of student performance. This adds a layer of transparency and motivation, particularly valuable in flexible, portfolio-driven fields. The model also supports evidence-based progression, as learners compile scenario outputs into portfolios – an especially meaningful form of assessment in disciplines where creative

communication and design rationale must be explicitly demonstrated. Importantly, the Industry Feedback Loop introduces the potential for external validation, providing a feedback mechanism that can inform curricular revision and strengthen alignment with evolving workplace standards. This positions the model as both adaptive and scalable. However, several limitations should be acknowledged. First, the model assumes institutional readiness to implement micro-credentialing, which may be constrained by policy, infrastructure, or faculty workload. Second, while the modular design offers flexibility, it risks fragmentation without unified assessment frameworks. Finally, the model is conceptually transferable, but its operationalisation in specific creative contexts – such as digital media, animation, or game design – requires further contextual tailoring. In summary, the model offers a promising blueprint for bridging language instruction with creative employability, but its effectiveness depends on thoughtful implementation, validation mechanisms, and sustained institutional support. This study advanced the discourse on ESP by comparing pedagogical practices, assessing their transferability to creative education contexts, and anchoring findings within relevant theoretical frameworks and recent empirical research. The comparative case analysis revealed complementary but distinct approaches to ESP implementation across the two institutions. At Tampere University, scenario-based learning and micro-credentialing were integrated into formal curriculum structures, whereas at PolyU, these innovations were adopted more informally by individual instructors.

Research from the OECD (2023) and scientist Y. Ozarslan (2025) have similarly noted that micro-credentials support modular, lifelong learning pathways and can bolster employability if thoughtfully embedded within instructional design. The findings also resonate with M. Chan (2023), who emphasised the pedagogical value of authentic, context-driven ESP tasks for the development of meta-discursive competence in professional settings. In M. Chan's (2023) study, learners engaged with domain-specific scenarios and reported increased confidence in navigating workplace discourse. Similarly, T. Le Van & H. Hai Tien (2021) argued that collaborative ESP tasks grounded in real workplace contexts fostered communicative competence extending beyond textbook genres. The present research built on these findings by demonstrating that when micro-credentials are aligned with CEFR descriptors and embedded into assessment systems – as observed at Tampere – they promote curricular coherence and clearer articulation of learning outcomes. K. Ahsan *et al.* (2023) confirmed that modular micro-credentials significantly contribute to learner motivation and accountability, offering structured validation of skill acquisition. Their systematic review underscored the need for institutional frameworks that support the design and deployment of micro-credentials, an issue mirrored in this study where instructors

cited the lack of centralised platforms as a key implementation challenge. A. Stamatakis *et al.* (2025) likewise emphasised that the integration of micro-credentials within digital education expands opportunities for skill recognition, particularly when aligned with AI-powered and open education ecosystems. Applying these insights to the creative disciplines, the research highlighted how ESP learners in digital art and design must articulate visual reasoning, respond to critiques, and pitch design concepts – skills identified by F. Zhao (2024) as critical yet often missing in traditional ESP syllabi. F. Mao & J. Zhou (2024) also identified this misalignment in their needs analysis, finding that students in art and design colleges often lacked training in field-specific communication genres.

The results suggested that task realism and communication-oriented credentialing can address this gap effectively. Furthermore, the transferable integration model proposed in this study is grounded in constructivist and task-based learning principles, which resonates with the conclusions highlighted by W. Guariento & J. Morley (2001). The authors noted that authentic tasks are genuinely effective only when learners actively construct knowledge in conditions closely replicating real communicative scenarios, as such authenticity supports the transfer of acquired skills into actual language-use situations. Moreover, the model aligns with cyclic curriculum design frameworks, as emphasised in the work of R. Dazeley *et al.* (2025). The authors argued that such cyclicity enables a more organic implementation of models oriented towards transferability, since the curriculum must adapt through repeated iterations in response to learners' needs and learning objectives. Within this structure, authentic communicative tasks build progressively towards professional readiness, supported by skill-specific digital badges and feedback loops involving industry stakeholders.

The present qualitative and quantitative findings reinforce stakeholder perceptions documented in contemporary literature. J. Goulding *et al.* (2024) found that digital badges served not only as motivational tools for students but also as clear signals of achievement for employers. S. Athey & E. Palikot (2024) reported that non-traditional credentials were increasingly valued in labour markets, especially when tied to demonstrable workplace competencies. In this context, students confirmed that micro-credentials offered tangible milestones and made their learning outcomes more visible and professionally relevant. Nevertheless, barriers persist. L. Wheelahan & G. Moodie (2022) warned that micro-credentialing systems risk fragmenting qualifications if not integrated into coherent curricular structures. This study found that such risks materialised in the absence of institutional infrastructure. R.M. Selvaratnam & M. Sankey (2025) proposed incremental piloting of credentialing schemes as a solution – an approach this study supports, particularly in

creative disciplines where curriculum flexibility is essential. Finally, W. Alamri (2025) emphasised that the use of authentic materials in English as a Foreign Language listening instruction notably enhanced learner engagement and comprehension. This aligns with the observation that scenario-based ESP tasks – like client briefings and visual presentations – not only improved motivation but also provided scaffolding for real-world communication tasks. A. Gumartifa *et al.* (2025) further demonstrated that digital tools and culturally relevant ESP materials empower linguistically diverse learners, reinforcing the need for contextually embedded instruction. Taken together, these sources enrich the theoretical grounding and empirical justification for the present model. Programmes targeting creative disciplines should adopt industry-informed badge rubrics that evaluate both linguistic and domain-specific communicative tasks. Modular sequencing should facilitate progression from task execution to portfolio development and include feedback opportunities from creative professionals. While limitations related to sample size and generalisability remain, the model presented here offers a replicable, research-based framework for advancing integrated ESP design in the era of modular and competency-based education.

■ Conclusions

The findings of this study offered evidence-based insights into the alignment of ESP instruction with employability outcomes in creative education. By analysing two institutional cases, the research demonstrated that authentic workplace scenarios – such as client simulations and collaborative projects – substantially enhanced student engagement, motivation, and perceived relevance of language learning. Among surveyed students, over 70% indicated that scenario-based tasks increased the realism and applicability of ESP coursework and reported that such activities improved their understanding of workplace communication. Instructors similarly emphasised the value of task realism in fostering professional readiness, particularly in disciplines like Digital Art and Design, where language use is closely tied to describing visuals, narratives, and concepts. Document analysis further confirmed that authentic tasks were integrated into course syllabi through structured activities such as role-plays, design briefs, and industry-style presentations. These strategies helped simulate workplace demands and supported the development of field-specific communicative competencies.

Regarding micro-credentialing, the study confirmed its potential as a mechanism for making skill development transparent and modular. At Tampere University,

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micro-credentials were aligned with CEFR descriptors and embedded into formal assessment frameworks, leading to increased clarity of learning outcomes. In contrast, PolyU implemented badges more informally, which still motivated learners but lacked standardised recognition. Interviewees noted that badges offered students visible milestones and contributed to goal-oriented learning. However, challenges included increased instructional workload and the need for institutional platforms to support badge issuance. The proposed transferable integration model synthesises these practices into a replicable structure applicable to creative disciplines. It highlights the pedagogical synergy between scenario-based instruction and micro-credentialing while acknowledging implementation barriers such as limited contact hours and resource constraints. In conclusion, the study affirms that when ESP modules incorporate discipline-specific authentic tasks and credentialed assessments, they can significantly enhance the transfer of communicative competence to workplace contexts. For creative education, this model represents a viable template for developing instructional designs that not only foster language skills but also validate them through evidence-based, recognisable formats.

■ Acknowledgements

The author would like to express their sincere gratitude to the faculty and staff of the State University of Trade and Economics, Kyiv National University of Technologies and Design, and Kyiv National University of Culture and Arts for their support in facilitating this research. Special thanks are extended to the ESP instructors, curriculum designers, and student participants whose valuable insights and feedback made this study possible. The author also acknowledges the academic guidance and peer feedback received during the conceptualisation and refinement of this study, which significantly contributed to the clarity and depth of the research. Lastly, appreciation is due to the international institutions whose publicly available ESP materials enabled meaningful comparative analysis.

■ Funding

This research was conducted as an independent, self-funded study. No external financial support was received from institutions, grants, or funding agencies. The author assumes full responsibility for all aspects of the research process and dissemination.

■ Conflict of Interest

The author declares no conflict of interest related to the conduct, analysis, or publication of this research.

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Фахова англійська мова для творчих спеціальностей: поєднання теорії та потреб ринку праці

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■ **Анотація.** У даному дослідженні ставилося за мету з'ясувати, яким чином навчання англійської мови за професійним спрямуванням може бути узгоджене з цілями працевлаштування у креативних галузях – зокрема у сфері цифрового мистецтва та дизайну – шляхом інтеграції автентичних професійних сценаріїв і систем мікрокваліфікацій. В межах дослідження було зібрано дані від закладів, що впроваджують інноваційні програми англійської мови за професійним спрямуванням для спеціальних цілей, проаналізовано наявні документи, результати напівструктурованих інтерв'ю з викладачами та розробниками навчальних програм в українських закладах вищої освіти, а також опитування 28 студентів. Результати дослідження свідчать, що автентичні завдання з англійської мови за професійним спрямуванням (брифінги, презентації, рецензії) суттєво підвищують мотивацію студентів (71,43 %) і сприяють розумінню професійної доцільності навчання. Цифрові бейджі за комунікативні досягнення допомогли 78,57 % учасників усвідомити прикладну цінність здобутих навичок. Мікрокваліфікації, узгоджені з дескрипторами Загальноєвропейської системи компетенцій володіння іноземною мовою та включені до систем оцінювання, забезпечили прозору модульну верифікацію результатів навчання. Незважаючи на позитивний вплив, викладачі повідомили про труднощі з їх реалізацією: збільшене навантаження та відсутність єдиної платформи для сертифікації. Дослідження робить внесок у наукову літературу, пропонуючи «модель трансферної інтеграції», що поєднує сценарії, бейджі, портфоліо й галузевий фідбек для розвитку професійної комунікативної компетентності студентів творчих спеціальностей. «Модель трансферної інтеграції» є відтворюваною структурою для програм англійської мови за професійним спрямуванням, що не лише формують, а й верифікують професійно орієнтовані комунікативні компетентності та є спрямованими на потреби ринку праці. Ефективність зазначеної моделі залежить від її виваженого впровадження, механізмів перевірки та постійної інституційної підтримки

■ **Ключові слова:** англійська мова; підготовка; професійна комунікація; мікрокваліфікації; дизайн-освіта; кар'єрні траєкторії; освітні інновації; працевлаштування



Integration of safety and occupational health and safety competencies into the system of patriotic education of students

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■ **Abstract.** The purpose of the study was to assess the role of educational and extracurricular activities in shaping students' patriotic consciousness and active civic position within the context of educational and professional training and the development of civic and social competencies. The research methodology was based on documentary, analytical, and comparative approaches and included a systematic analysis of university curricula and programmes, modelling scenarios for the formation of patriotic values, as well as evaluating the effectiveness of integrating innovative methods, digital platforms, and projects aimed at developing students' civic consciousness. It was established that patriotic education of youth in Ukraine is implemented as a purposeful pedagogical process that combines moral, ethical, cultural, social, and legal components, contributing to the formation of civic consciousness, patriotic identity, state-oriented attitudes, and social activity among students. At the preschool and school levels, the main forms of implementation include Ukrainian language celebrations, Vyshyvanka Day, the creation of collages, school-based projects, and participation in patriotic song competitions, which enhance emotional attachment to national culture. At the university level, patriotic education is carried out through the integration of national values into students' professional training, participation in student self-governance, and involvement in scientific and patriotic projects, thereby fostering civic identity and an active social position. Disciplines related to occupational health and safety contribute to the acquisition of knowledge about the history of civil protection, national defence, and moral and ethical principles, while practical classes, simulations, and role-playing activities develop critical thinking, responsibility, and readiness for volunteer engagement. It was

Suggested Citation:

Polukarov, Yu., Prakhovnik, N., Polukarov, O., & Kachynska, N. (2025). Integration of safety and occupational health and safety competencies into the system of patriotic education of students. *Professional Education: Methodology, Theory and Technologies*, 11(2), 47-60. doi: 10.69587/pemtt/2.2025.47.



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found that within the educational process, humanitarian and IT specialisations included 68 hours of instruction, technical specialisations included 72 hours, and for first-year students, 36 hours of integrated training were organised, aimed at fostering an active civic position and a sense of national belonging. The study also determined that the integration of innovative teaching methods, digital platforms, project-based activities, case studies, and mentoring enhances the effectiveness of forming patriotic values and civic consciousness by ensuring a balanced combination of students' intellectual, emotional, and practical development

■ **Keywords:** civic consciousness; digital technologies; interdisciplinary approach; strategic thinking; social discipline

■ Introduction

The study of the integration of safety and occupational health and safety competencies into the student training system is relevant due to the increasing demands placed on young people who must be able to act effectively under conditions of socio-political instability and dynamic production processes. Within the educational environment, it is essential to cultivate in students a conscious attitude towards their own safety and the safety of others, adherence to labour regulations, and the development of responsibility, discipline, and civic engagement. Patriotic education thus acquires a practical orientation, as it contributes to the formation of competencies required to protect national interests and strengthen collective security. The combination of theoretical knowledge with practical skills enables students to apply the principles of safety and occupational health and safety effectively in everyday life, professional training, and public activity, thereby underlining the importance of studying this topic.

In academic research, the integration of patriotic education with the development of safety and occupational health and safety competencies has been comprehensively examined in the context of educational reforms, military challenges, and social responsibility. Researchers from various countries have analysed educational models that ensure the interconnection of professional, moral, and civic training of students. Similar conclusions were reached by V. Myroshnychenko *et al.* (2024), who demonstrated that the implementation of the Defence of Ukraine programme for future teachers contributed to an increased level of professional responsibility in the field of national security. This programme combined elements of military-patriotic training, labour protection, civil defence, and pedagogical skills, thereby fostering readiness for action in emergency situations. A key component in integrating safety and labour protection competencies was the formation of a safety culture, which, according to O. Nahaichuk (2024), constitutes a systemic element of the educational process. The development of a safety culture within the Ukrainian educational environment included practices of risk prevention, compliance with labour discipline, and the cultivation of psychological readiness to act in crisis situations. The researcher emphasised that the effectiveness of this process increased when safety training was

combined with the cultivation of a patriotic position and civic responsibility.

The issue of educational system resilience to wartime challenges was addressed by D. Pustovoichenko *et al.* (2024). Their study emphasised that, under conditions of armed aggression, Ukrainian education fulfils not only an educational but also a socio-psychological function, contributing to the development of resilience, adaptability, and moral stability among students and educators. The authors' findings indicated that the integration of value-oriented educational practices aimed at supporting psychological security and patriotic education strengthens social cohesion and civic responsibility among young people. Such approaches are directly linked to the professional development of future specialists, as they foster the ability to act under conditions of risk, make informed decisions, cooperate in crisis situations, and maintain ethical standards in professional practice. Consequently, the stability of the educational environment, combined with patriotic and humanistic values, represents a key factor in the formation of a competent, morally mature, and socially responsible specialist.

The scholarly positions of M. Vaintraub (2024) demonstrated that, under conditions of martial law in Ukraine, the preparation of teachers to work in hazardous environments required the development of professional competencies related to risk management, psychological resilience, and pedagogical ethics. This confirmed the interrelationship between professional competence, safe behaviour, and patriotic consciousness. In particular, N. Yevtushenko & N. Tverdokhliebova (2024) examined the integration of personal safety into the education of students specialising in "civil safety" at technical higher education institutions. Their findings showed that the combination of theoretical knowledge with practical training in civil protection fosters students' critical thinking, readiness to make decisions in emergency situations, and a responsible attitude towards professional duties. I. Bazhenkov *et al.* (2024) investigated teaching technologies in lycées with a national-patriotic and security orientation, using educational institutions of the Ministry of Internal Affairs of Ukraine as an example. They found that the application of interactive methods, simulations, and project-based activities promotes teamwork, risk management skills, and social engagement among students,

forming a foundation for the development of professional competencies in the future. In a separate study, Z. Petrochko (2021) analysed social partnership as a key factor in the national-patriotic education of youth. The author demonstrated that cooperation between educational institutions, public organisations, and volunteer initiatives ensures the practical implementation of patriotic values and supports the development of responsibility, leadership qualities, and readiness for civic engagement.

Despite the contributions of the aforementioned authors, several gaps remain. In particular, insufficient attention has been paid to practical mechanisms for implementing safety and occupational health and safety competencies within the educational process of higher education institutions. Furthermore, existing studies do not adequately address the systematic nature and long-term effects of such programmes, their adaptation to different fields of study, or their integration into the contemporary educational process. This leaves unresolved questions regarding the effectiveness of specific methods and projects in real educational settings. The purpose of this study was to assess how educational and cultural initiatives contribute to the formation of students' patriotic values and civic consciousness while simultaneously developing their professional, social, and communicative competencies within an educational and professional context. The objectives of the study were to analyse the process of forming national and patriotic consciousness among young people in Ukraine; to evaluate the role of occupational health and safety disciplines in the development of patriotic values and civic consciousness among students; and to formulate recommendations for the implementation of patriotic education in higher education institutions.

■ Materials and Methods

Based on the source analysis approach proposed by J. Cao (2021), D. Pustovoichenko *et al.* (2024), and O. Nahaichuk (2024), key concepts of patriotic education in Ukraine were analysed, including patriotic education, civic consciousness, patriotic identity, state position, values of national culture, as well as social activity and volunteering. These concepts were examined to clarify their content and approaches to patriotic education, to define target orientations, and to identify competencies that contribute to responsible citizenship and the professional socialisation of students.

A consistent documentary and analytical method were applied, aimed at identifying the potential of occupational health and safety disciplines to support the development of patriotic values and civic consciousness among students, which was defined as a priority research area. The analysis was conducted on the basis of curricula and educational programmes of the National Technical University of Ukraine "Kyiv Polytechnic Institute" for 2023 and 2025, specifically the

disciplines Life Safety and Civil Protection (Levchenko *et al.*, 2019) for humanitarian and IT specialisations, Occupational Safety and Civil Protection (2023) for technical specialisations, and the newly introduced discipline Civil Protection, Defence and Patriotic Education (2025) for first-year students (female students and non-military male students). The content of these curricula and programmes was examined to determine their contribution to the formation of students' professional competencies. The curricula were analysed to identify elements that contribute to the development of patriotic values, responsibility, and civic engagement among students. Within the content analysis, thematic blocks were identified that integrate knowledge of civil defence, labour protection, the history of national defence, and moral and ethical principles. On the basis of this analysis, scenarios for the process of forming patriotic values and civic consciousness among students were modelled.

As part of the study, a comparative analysis of innovative approaches to the development of patriotic education was conducted. These approaches combine the practical acquisition of knowledge with the formation of value orientations, civic responsibility, and an active social position. The analysed tools included interactive simulations and modelling of emergency situations, game-based learning and gamification, project-based activities, the case method, the use of multimedia and digital technologies, interdisciplinary approaches, mentoring, and the involvement of role models. Particular attention was paid to Ukrainian educational and digital programmes that contribute to the formation of national identity and the strengthening of the patriotic component within the educational process. The analysed initiatives included the projects Youth is changing Ukraine (n.d.), Zrozumilo (2025), National memory (Committee on Humanitarian and Information Policy, 2025), Youth for Ukraine (Denisyuk, 2023), Digital patriots (Public organisation "Historical Platform", n.d.), and the United Ukraine platform (Volyn Regional State Administration, 2025). These programmes were selected because they encompass a wide range of activities, from military-patriotic training and online courses to virtual tours of historical sites in Ukraine, patriotic education laboratories, and digital services designed to integrate national content into the educational environment.

The analysis was carried out using a comparative method, which made it possible to assess the effectiveness of each approach and programme, determine the level of their integration into academic disciplines, and correlate the results with criteria of educational effectiveness, student accessibility, interactivity, use of digital resources, and potential for fostering patriotic consciousness. This approach provided a systematic understanding of which innovative methods and Ukrainian educational initiatives are most effective for

implementing patriotic education as a priority area in higher education institutions. Based on the findings, recommendations were formulated to enhance the effectiveness of national-patriotic education of youth, ensure the systematic development of students' patriotic self-awareness, and strengthen the integration of patriotic values into the educational and social environment of universities.

■ Results

Analysis of the formation of national-patriotic consciousness of youth in Ukraine

Patriotic education represents a purposeful pedagogical process that fosters love for the Motherland, awareness of historical heritage, assimilation of national values, and readiness to act in the interests of the state. It integrates moral and ethical, cultural, social, and legal components, thereby shaping students' responsibility, respect for traditions, and sense of belonging to the national community (Cao, 2021). Civic consciousness, in particular, reflects an individual's awareness of their role in public life, responsibility for the future of the country, and willingness to adhere to democratic principles and protect the rights of others. It develops through active participation in social processes, self-organisation, reflection, and the cultivation of critical thinking skills. This component serves as the cognitive foundation of patriotic education, as it enables conscious and responsible action aligned with national interests. Patriotic identity is expressed through a sense of belonging to the Ukrainian people and the perception of oneself as part of their history, culture, and contemporary society. It is formed through knowledge of historical events, national symbols, traditions, and language, as well as through personal involvement in the preservation of cultural heritage. This process is accompanied by emotional experiences of community, pride in the state, an understanding of the value of freedom, and a sense of responsibility for the country's future. The state position reflects a conscious attitude

towards the state as the principal institution ensuring societal stability, security, and development. It manifests itself in compliance with laws, support for public initiatives, participation in social reforms, and readiness for self-sacrifice in the interest of preserving statehood. The formation of such a position occurs through educational, informational, and upbringing influences that create conditions for understanding the role of each citizen in national development.

The values of national culture constitute the spiritual and moral foundation of patriotic education. Their assimilation through art, folklore, history, language, and customs contributes to strengthening cultural identity and forming aesthetic sensitivity and moral resilience. Through the education system, artistic initiatives, and public activities, intergenerational values are transmitted, ensuring cultural continuity and internal unity of society (Pustovoichenko *et al.*, 2024). Social activity represents the practical manifestation of an established civic position. It is expressed through volunteering, participation in youth associations, environmental and charitable projects, and a willingness to cooperate and support others. Volunteering plays a central role in strengthening patriotic feelings, as it transforms patriotism from a declarative concept into a way of life, integrating moral, civic, and labour values. These concepts are deeply interconnected: civic consciousness forms the intellectual basis of patriotism, patriotic identity provides emotional depth, the state position defines value orientation, and social activity and volunteering ensure the practical realisation of patriotic principles. Together, they constitute an integrated system in which educational, cultural, and social influences contribute to the formation of a mature personality capable of combining love for the Motherland with active civic participation (Nahaichuk, 2024). Table 1 illustrates the characteristics of patriotic education formation at different levels of personality development, reflecting the sequential development of value orientations, civic consciousness, and students' active life positions.

Table 1. Formation of patriotic education at different levels of personality development

Environment level	Main goal of patriotic education	Forms and methods of implementation	Examples of practical activities	Expected results
Preschool	Formation of elementary ideas about the Motherland, family, native language, folk traditions	Games, listening to fairy tales, folk songs, participation in thematic mornings	Ukrainian Language Day, Vyshyvanka Day, creation of the collage "My Ukraine"	The emergence of a feeling of love for one's native land, respect for national symbols
Elementary school	Development of emotional and value-based attitude towards the native land, the state, and working people	Conversations, integrated lessons, project work, school holidays	Project "Ukraine – my Home", participation in patriotic song competitions, creation of a class emblem	Awareness of belonging to the Ukrainian people, formation of an initial civic position
Secondary school	Deepening knowledge about history, culture, and statehood; fostering civic responsibility	Educational hours, historical reconstructions, volunteer initiatives, local history tours	School volunteer groups, meetings with veterans, participation in all-Ukrainian remembrance events	Formation of a sense of pride for the people, active civic position, readiness to serve society
Higher education institution	Integration of patriotic values into professional training, development of civic identity	Educational courses, student self-government, scientific and patriotic projects	Forum "Students for Ukraine", charity events, participation in student military-patriotic clubs	Awareness of responsibility for the future of the state, active participation in public life

Table 1. Continued

Environment level	Main goal of patriotic education	Forms and methods of implementation	Examples of practical activities	Expected results
Social environment (society, media, cultural space)	Supporting sustainable patriotic orientations, engaging in public service	Public initiatives, cultural events, participation in volunteer movements, media projects	“City of Heroes” programs, volunteer platforms, art festivals, information campaigns	Strengthening social unity, developing active citizenship, integrating patriotic values into everyday life

Source: compiled by the authors

Patriotic education should be understood not merely as a system of knowledge and educational influences, but as a dynamic process of value formation that integrates the intellectual, emotional, and behavioural development of young people, directing it towards strengthening statehood, social cohesion, and the cultural continuity of Ukrainian society. The level of national-patriotic education among Ukrainian youth demonstrated a noticeable increase during the period 2022-2024, which is associated with heightened civic engagement, the expansion of youth initiatives, and increased support for state programmes with a patriotic orientation. Taken together, the above findings indicate that patriotic education in Ukraine is developing towards the active integration of educational and public components, where the formation of patriotic identity is based not only on emotional and value-based awareness, but also on real practices of civic participation.

The role of occupational health and safety disciplines in the development of patriotic values and civic consciousness of students

In Ukraine, occupational health and safety disciplines began to be incorporated into university curricula in the early 2000s, driven by the need for the systematic development of students’ competencies in ensuring occupational safety and health, protecting life and health, and fostering civic consciousness and responsibility. Initially, these disciplines were predominantly regulatory and technical in nature, focusing on occupational safety rules, emergency response algorithms, and fundamental aspects of civil protection. In the context of the Ukrainian-Russian War, the content of these disciplines has been expanded and deepened through the integration of patriotic education, the history of national defence, moral and ethical aspects of state protection, and the development of practical skills related to volunteering and civic engagement. These changes have affected both content and instructional formats: traditional lectures are now combined with interactive training sessions, role-playing activities, field exercises, and social projects. This approach enables students not only to acquire theoretical knowledge but also to develop patriotic values through practical activities aimed at protecting society and actively participating in the life of the state.

The discipline Life Safety and Civil Protection (Levchenko *et al.*, 2019), taught for humanitarian and IT specialisations, comprises 68 hours of instruction, including 36 hours of theoretical lectures and 32 hours

of practical classes. The thematic modules cover the history of civil protection, contemporary labour protection standards, citizens’ rights and obligations in emergency situations, as well as elements of volunteering and civic activity. Lectures are delivered in multimedia-equipped classrooms, allowing for the presentation of regulatory documents, evacuation schemes, and video materials based on practical cases. Practical classes include the modelling of emergency situations, practising actions according to evacuation plans, simulation-based teamwork exercises, and first-aid training. These activities contribute to the development of responsibility, independence, and students’ readiness to contribute to the defence of the state.

For technical specialisations, the discipline Occupational Safety and Civil Protection (2023) includes 72 hours of instruction, of which 40 hours are allocated to practical laboratory and training sessions. The curriculum addresses topics such as risk assessment in industrial environments, safe equipment handling procedures, labour protection standards in Ukraine, emergency preparedness in production settings, and the development of teamwork under extreme conditions. Lectures integrate historical aspects of national defence and elements of patriotic education through the analysis of significant defence-related events and examples of civic heroism. Practical training is conducted in specialised laboratories and training workshops, using equipment for emergency scenario modelling and simulators for practising actions in critical situations.

The new discipline Civil Protection, Defence and Patriotic Education (2025), introduced for first-year students, comprises 36 hours per semester and is aimed at integrating knowledge of civil protection, the history of statehood, and elements of civic activism. The thematic modules include the history of national defence, the legislative foundations of civil protection, moral and ethical aspects of defending the Motherland, rules of conduct in emergency situations, and practical volunteering skills. Lectures combine multimedia presentations, discussions of real-life cases, narratives about national defence heroes, and the demonstration of regulatory documents. Practical classes involve first-aid training, evacuation exercises, role-playing scenarios for emergency response, volunteer activities, and socially oriented projects implemented on campus. The delivery of the course requires appropriately equipped classrooms, training areas for practising practical skills, and interactive platforms for case discussion and analysis.

Scenarios for the development of students' patriotic values and civic consciousness are based on the principles of consistency, integration, and adaptability. They provide for a clear definition of educational objectives, the combination of theoretical knowledge with practical tasks, the use of active teaching and assessment methods, and the provision of systematic feedback with subsequent adjustment of educational

activities. This approach contributes to the formation of value-based, social, and cognitive competencies, as well as an active civic position. Table 2 presents scenarios for the formation of patriotic values and civic consciousness through the integration of occupational health and safety discipline content, combining theoretical instruction, practical tasks, and socially oriented activities.

Table 2. Scenarios for the formation of patriotic values and civic consciousness of students through occupational health and safety disciplines

Level/discipline	Main topics	Number of hours	Forms of conduct	Practical scenarios and tasks
Humanitarian and IT specialties – "Life Safety and Civil Protection"	History of civil defence, rights and obligations of citizens, volunteering, social activism	68 (36 theory/32 practice)	Lectures, multimedia presentations, discussions	Emergency simulations, evacuation simulations, team games, volunteer projects
Technical specialties – "Occupational Safety and Civil Protection"	Occupational risk assessment, safety regulations, legislation, history of national defence	72 (32 theory/40 practice)	Lectures, labs, simulators, case studies	Emergency situation training, team interaction, analysis of historical cases of heroism, production trainings
First-year students – "Civil defence, defence and patriotic education"	Legislative framework, history of defence, moral and ethical aspects, volunteering, emergencies	36 (18 theory/18 practice)	Lectures, interactive trainings, role-playing games	First aid, evacuation, case discussions, volunteer exercises, social projects on campus

Source: compiled by the authors

The disciplines Life Safety and Civil Protection, Occupational Safety and Civil Protection, and Civil Protection, Defence and Patriotic Education influence the professional development of future specialists by combining theoretical instruction with the practical development of skills related to safe and responsible behaviour. The study of safety and occupational health and safety competencies fosters discipline, responsibility, and professional ethics among students, while teaching them to assess risks and make effective decisions in crisis situations, and emphasising their social role in protecting the lives and safety of others. Interactive training sessions, emergency simulations, and volunteer practices contribute to the development of teamwork abilities, rapid response skills, and critical thinking, which are key professional competencies of a modern specialist. In addition, the awareness of civic responsibility cultivated through patriotic education motivates students to act not only within the professional sphere but also in public life, thereby strengthening the integration of ethical, professional, and social dimensions of specialist training.

Comparative analysis of innovative practices of patriotic education in higher education

In addition to formal academic disciplines such as Life Safety and Civil Protection, Occupational Safety and Civil Protection, and Civil Protection, Defence and Patriotic Education, the above-mentioned programmes are aimed not only at fostering patriotic values but also at developing key professional competencies among

future specialists. Interactive simulations and the modelling of emergency situations enhance students' ability to make decisions under conditions of uncertainty, foster responsibility for the consequences of their actions, and develop the capacity to assess risks rapidly and coordinate teamwork. Game-based learning and gamification contribute to the development of communication skills, creativity, and strategic thinking, supporting effective collaboration, collective decision-making, and the ability to cope with stressful situations.

Project-based activities and the case method develop competencies in risk management, planning, and analysis, teaching students to evaluate the impact of decisions on social and professional processes while fostering initiative and leadership qualities. The use of multimedia and digital technologies enhances digital literacy, the ability to work with information resources, analyse data, and present results in a professional manner, which is an essential component of contemporary professional competence. An interdisciplinary approach promotes the integration of knowledge from different fields, forming systems thinking and the ability to identify relationships between historical, legal, social, and technological aspects of activity. Mentoring and the use of role models support the development of teamwork skills, ethical leadership, and a responsible attitude towards professional decision-making, demonstrating how patriotic values can be integrated into professional ethics and behavioural culture in future professional practice.

A distinct group of initiatives includes Ukrainian programmes and projects aimed at developing the

professional and civic competencies of future specialists, including Youth is changing Ukraine (n.d.), course Zrozumilo (2025), National Memory (Committee on Humanitarian and Information Policy, 2025), Youth for Ukraine (Denisyuk, 2023), Digital patriots (Public organisation “Historical Platform”, n.d.), and the United Ukraine platform (Volyn Regional State Administration, 2025). These initiatives employ specific competency-building tools, such as project activities, digital simulations, crowdsourcing, interactive educational platforms, team-based hackathons, virtual debates, volunteer practices, online courses, and inter-university internships (Table 3). These tools contribute to the development of key professional skills, including critical thinking, communicative culture, analytical and managerial competence, digital literacy, and responsible leadership. Their effectiveness is largely explained by the fact that the programmes and initiatives are grounded in a competency-based approach and integrate educational, practical, and value-oriented components. They not only transmit knowledge but also shape behavioural models, practical skills, and the

social responsibility of future specialists. In particular, the projects Youth is changing Ukraine (n.d.) and Youth for Ukraine (Denisyuk, 2023) promote the development of leadership, analytical, and managerial competencies through teamwork and the implementation of socially significant initiatives. The Digital Defence and Digital Patriots programmes integrate digital technologies into civic education, supporting the formation of digital literacy, information security awareness, and responsible citizenship. Interactive learning formats – including simulations, debates, and crowdsourcing platforms – stimulate the development of critical thinking, creativity, and communicative culture. The National Memory initiatives and the United Ukraine platform combine educational objectives with the cultivation of ethical positions, patriotism, and civic consciousness. All these initiatives are implemented through partnerships between educational institutions, public organisations, and state bodies, creating an intersectoral environment of cooperation that provides real conditions for the development of key competencies and the professional growth of students.

Table 3. Characteristics of innovative approaches and projects for the development of patriotic education of students

Innovative approach/project	Description and features	Implementation format	Potential for the formation of patriotic values	Digital/multimedia elements
Interactive simulations and modelling of emergency situations	Practicing actions in crisis and extreme situations, developing responsibility and team interaction	Laboratory classes, trainings, role-playing games	Formation of civic responsibility, critical thinking, patriotic consciousness	Use of training equipment, simulators, VR platforms
Game-based learning and gamification	Using game elements to motivate students and acquire knowledge about history and statehood	Board and digital games, quests, competitions	Consolidation of knowledge about national history, development of patriotic identity	Applications, online platforms, interactive tasks
Project activities and case method	Real or simulated situations requiring decision-making	Project work, research groups, case analysis	Activation of social position, development of critical thinking, awareness of the role of a citizen	Using online libraries, collaboration platforms
Multimedia and digital technologies	Using videos, presentations, online courses, virtual tours	Lectures, interactive classes, distance learning	Deepening knowledge about historical heritage, national identity	VR tours, online platforms, digital resources
Interdisciplinary approach	A combination of knowledge from history, law, sociology, and civil defence	Integrated courses, interdisciplinary seminars	Formation of a comprehensive vision of the state and society, development of patriotic consciousness	Presentations, digital cases, interactive exercises
Mentoring and role models	Mentoring from experienced educators and community activists	Trainings, lectures, personal consultations	Awareness of the value of civic activity, an example of patriotic behavior	Video lectures, online consultations
Military-patriotic training	Training on the basics of defence and civil protection	Practical classes, field trainings	Formation of readiness to defend the state, patriotic identity	Video tutorials, interactive platforms
Programs “Youth is changing Ukraine”, “National memory”, “Digital defence”	Targeted projects to engage students in volunteer and community activities	Volunteer events, interactive lectures, social campaigns	Reinforcing patriotic values through practical activities	Social networks, digital platforms, online courses
Online courses and virtual tours	Studying historical and cultural sites through digital resources	Virtual tours, online lectures	Development of national identity, knowledge about cultural heritage	VR tours, interactive maps, multimedia presentations
Platform “United Ukraine”, “Digital Patriots”	Comprehensive resources for integrating patriotic content into learning	Online courses, educational modules, social activities	Systematic formation of civic position and patriotism	Remote platforms, interactive tasks, digital services

Source: compiled by the authors

Such programmes are integrated into the educational process through their modular structure, allowing them to be implemented as elective courses, components of practical classes, or elements of interdisciplinary modules. This flexibility enables students to combine academic learning with real cases of social relevance. In some universities, these initiatives are already embedded in curricula through civic education modules, courses in project management, media literacy, digital security, and sustainable development. They complement traditional disciplines by providing students with opportunities to apply knowledge in practical contexts, collaborate with partners beyond the university, and participate in national and international competitions, social initiatives, or digital projects.

Unlike lecture-based and laboratory classes, which predominantly involve the reproductive acquisition of knowledge and the completion of predefined tasks, these programmes are grounded in the principles of active learning, partnership, and reflection. They offer students autonomy in selecting topics and formats of work, stimulate creativity, and foster the development of emotional intelligence, ethical responsibility, and digital mobility. As a result, students not only master theoretical material but also develop sustainable professional and civic competencies, including decision-making skills, teamwork, systems thinking, and responsibility for social change, which clearly distinguishes these programmes from traditional forms of education.

The integration of safety and occupational health and safety competencies into student training further contributes to the development of professional skills, particularly responsibility, discipline, teamwork, and the ability to act under conditions of risk. In humanitarian and IT specialisations, the discipline Life Safety and Civil Protection integrates historical, legal, and technological contexts, enabling students to understand the importance of risk management, digital security, and the personal role of a specialist in maintaining system stability. Practical classes – including emergency and evacuation simulations, work with digital simulators, and participation in volunteer projects – develop communication and analytical skills, decision-making capacity, teamwork abilities, and professional responsibility.

In technical specialisations, the discipline Occupational Safety and Civil Protection (2023) is focused on developing competencies in industrial safety, risk assessment, technical thinking, and preventive management. Through laboratory work, the use of modern simulation technologies, and case-based learning, students acquire skills in identifying hazardous situations, planning safe technological processes, and making collective decisions in crisis conditions. This contributes to the formation of a professional and ethical position, as well as a sense of responsibility towards both the team and society. For first-year students, the course Civil Protection, Defence and Patriotic Education serves as

a foundation for the development of basic professional and social competencies related to self-organisation, critical thinking, stress resilience, and readiness to act in non-standard situations. Role-playing activities, interactive training sessions, first-aid exercises, and participation in joint projects foster communication skills, leadership qualities, and social responsibility, thereby enhancing students' professional maturity.

The implementation of innovative educational projects within the university involves the integration of educational, practical, and digital components. In this context, modules of the disciplines Civil Protection, Defence and Patriotic Education and Life Safety and Civil Protection incorporate student participation in virtual courses, simulations, volunteer initiatives, and project-based activities. Teachers and mentors assume a guiding role, supporting the decision-making process and contributing to the development of analytical and critical thinking. At the same time, training sessions, laboratory classes, and role-playing exercises are conducted to practise professional actions under realistic conditions, ranging from providing assistance to managing crisis situations. Digital platforms ensure interactivity, accessibility of learning materials, and opportunities for teamwork, while public presentations, competitions, and participation in social projects enhance motivation for professional self-development. This approach enables students not only to acquire knowledge in occupational safety and health, but also to develop a comprehensive set of professional competencies – analytical, communicative, managerial, and civic – that determine their readiness for effective activity in a modern educational and professional environment.

Recommendations for the implementation of patriotic education of students in higher education institutions

For the effective implementation of professionally oriented student training in higher education institutions, it is recommended to adopt a comprehensive integration of academic disciplines, innovative teaching methods, and digital resources, combining theoretical instruction with the development of practical skills and professional competencies. In particular, within the disciplines Civil Protection, Defence and Patriotic Education, Life Safety and Civil Protection, and Occupational Safety and Civil Protection, it is advisable to allocate dedicated modules aimed at developing competencies such as critical thinking, teamwork, responsibility, the ability to act under conditions of uncertainty, and effective decision-making. Practical classes should be organised in the form of interactive emergency simulations, role-playing activities, and training sessions that develop communication, cooperation, leadership, and risk management skills, while also fostering awareness of the social significance of professional activity. To enhance students' professional

engagement, the implementation of project-based methodologies and case studies is recommended, in which teams address real or simulated industrial, social, or security-related problems, propose solutions, and present outcomes in the form of practical recommendations, reports, or digital presentations.

Innovative digital tools and multimedia platforms enable the creation of interactive learning environments, the delivery of virtual training sessions, simulations of professional situations, and online courses focused on the development of professional competencies, thereby making education flexible, accessible, and aligned with contemporary labour market requirements. For example, students may complete digital courses in risk management, information security, or crisis communication, participate in virtual laboratories, or develop digital products that integrate knowledge from different fields. The use of gamification through educational quests, simulation scenarios, and online simulators supports the development of skills related to independent information retrieval, data analysis, and professional decision-making.

It is also important to involve mentors, including experienced professionals, academic staff, and industry representatives, who can demonstrate examples of professional ethics, effective communication, and teamwork. This approach helps students to orient themselves towards real standards of professional conduct, recognise the value of their individual contribution to collective outcomes, and develop leadership qualities.

To ensure the systematic implementation of these measures, educational and extracurricular activities should be planned according to a calendar-based framework that integrates lectures, practical classes, internships, and project work. Clear criteria for assessing the development of professional competencies should be defined, with ongoing monitoring of outcomes and the provision of feedback to students. The comprehensive application of these recommendations not only enhances the level of professional training but also supports the development of critical thinking, communicative culture, civic responsibility, and readiness for innovation, which are essential attributes of a modern, competitive specialist.

■ Discussion

The effective integration of safety and occupational health and safety competencies into the system of patriotic education ensured not only the formation of a responsible civic position, but also the development of professional resilience, social activity, and a culture of work. The interconnected development of safety, labour, and patriotic values created a holistic system for preparing students to act in complex socio-political and professional conditions. The obtained results are consistent with the conclusions of A.E. Abylkassymova (2020), who emphasised that the modernisation of

education in Kazakhstan involved the harmonisation of students' moral, value-based, and professional orientations. According to the findings of the present study, the integration of safety and patriotic components facilitated a transition from a knowledge-oriented to an activity-based educational model, which corresponds to the Kazakhstani concept of educating citizens who are prepared to act for the benefit of society. The use of interactive simulations and role-playing activities contributed to students' readiness for rapid response in crisis situations and fostered a responsible attitude towards professional tasks, while simultaneously promoting communication and leadership skills essential for effective teamwork.

The present findings also align with those of X. Eryong & J. Li (2021), who demonstrated that patriotic education in China is regarded as a central objective of educational policy aimed at the moral development of the individual. In the Ukrainian educational context, comparable approaches were implemented through the cultivation of students' readiness for responsible behaviour in situations involving risk, which is consistent with the concept of moral development described by the Chinese researchers. The results further correspond to the study by N. Ahmad *et al.* (2021), which showed that the formation of communities educated in the field of cybersecurity contributed to the development of a culture of responsibility and critical thinking. Similarly, the inclusion of occupational safety and digital security components in the educational process stimulated students' conscious attitudes towards risk and increased their readiness to protect public interests. In addition, the integration of digital technologies and multimedia resources into education enhanced digital literacy and the ability to apply modern tools in professional activities.

The development of students' safety awareness within the framework of patriotic education contributed not only to the acquisition of practical self-protection skills, but also to the formation of a value-motivational basis for social engagement. This conclusion is consistent with the findings of R. Fortuna & A. Khadir (2022), who demonstrated that civic education in Indonesia played an integrative role in strengthening national identity. In a similar manner, under Ukrainian conditions, patriotic education incorporating safety-related components fostered a sense of belonging to the state through awareness of the obligation to act safely and responsibly.

The results also aligned with the conclusions of A.Y. Aránega *et al.* (2021), who emphasised that the formation of key competencies, particularly labour-related and social competencies, promoted young people's engagement in socially useful activities and reduced the risk of social isolation. The present study demonstrated that the inclusion of occupational safety knowledge within patriotic education produced a similar effect,

activating students' participation in public initiatives aimed at enhancing the safety of the educational environment. A comparison with the findings of K. Dancs & M. Fülöp (2020) revealed parallels in the interpretation of social and humanitarian education as a means of developing critical thinking and civic maturity. At the same time, the results partially diverged from the conclusions of Q. Chen *et al.* (2023), who examined the incorporation of engineering education accreditation concepts into natural science curricula. Those authors emphasised a technocratic approach to competency formation, whereas the Ukrainian study highlighted the advantages of a humanistic orientation, in which safety and labour are interpreted through the values of patriotism, humanity, and mutual support.

The conducted study also confirmed the position of O.T. Amie-Ogan & S. Harry-Ngei (2023), who demonstrated that effective management of safety and occupational health resources in educational institutions strengthens an organisational culture of responsibility. The findings showed that the study of relevant disciplines contributes to the formation of a conscious civic position, patriotic identity, and practical professional competencies among students. These results are consistent with the conclusions of L. Ling (2024), who noted that the synthesis of professional competencies with strategic educational approaches enables students to develop critical thinking and readiness for socio-economic challenges more effectively. Students who participated in programmes integrating safety and occupational health and safety competencies demonstrated a higher level of awareness of personal responsibility in this field compared with control groups.

This observation corresponds to the findings of G. Ngwacho (2024), who emphasised that the incorporation of value-oriented education into competency-based programmes contributes to the formation of socially responsible and professionally prepared citizens. In the work of J. Cao (2021), it was shown that the formation of patriotic values among university students occurred through the integration of ideological and political courses into the education system during the COVID-19 pandemic. The author demonstrated that patriotism developed more effectively when theoretical knowledge was combined with practical actions aimed at ensuring public safety, thereby creating a foundation for competencies related to the protection of life, health, and a responsible attitude towards work. A similar interdependence between educational and value components was examined by Y. Guan (2023), who found that the inclusion of ideological and political content in physical education contributed not only to the development of patriotic attitudes, but also to the formation of discipline, collectivism, and readiness to act under conditions of risk. This approach was interpreted as an integration mechanism linking physical culture, work ethics, and the fundamentals of safety. The issue of

military-patriotic training of upper secondary school pupils and university students as a basis for security competence was addressed by M.S. Turdibae-vich (2022). The author demonstrated that civic-oriented schools combining general education with preparation for military service create favourable conditions for developing young people's readiness to defend the state and for fostering an understanding of labour discipline as a component of national security.

The acquisition of security competencies is not limited to theoretical instruction. An analysis of practical tasks and training activities showed that students developed skills in critical risk assessment and the ability to act effectively in emergency situations. This finding is consistent with the concepts presented by A.I. Ryskulbekov *et al.* (2020), who emphasised the importance of practical training of reserve personnel in educational institutions to ensure societal safety and sustainable development. It was established that the practical consolidation of knowledge increased awareness of the necessity of occupational health and safety and contributed to the formation of patriotic responsibility. The study demonstrated that the integration of patriotic education with security competencies fostered value orientations that stimulated an active civic position. X. Sun (2023) noted that the incorporation of the ideas of the founding spirit of the party into political and ideological education contributed to the formation of a holistic understanding of students' duties towards the state and society. The present results are consistent with this approach, demonstrating that patriotic education not only shapes moral and ethical principles but also provides socially significant competencies in the fields of safety and labour. In particular, the findings showed that the inclusion of security competencies in the educational process increased students' motivation to learn.

T. Scott & F.N. Husain (2021) observed that reliance on traditional textbooks and formal curricula limited students' capacity for independent critical thinking and the formation of value orientations. The introduction of integrative approaches made it possible to overcome these limitations by fostering an active stance and the ability to make decisions in complex situations, which is supported by the data obtained in this study. The combination of safety and occupational health competencies also contributed to the development of digital competence and readiness to address globalised challenges. The conclusions of G. Yang *et al.* (2023) are consistent with these results, as the authors demonstrated that the integration of digital technologies with ideological education stimulated a responsible attitude towards personal health and collective security, confirming the importance of including digital components in patriotic education. Analysis of international experience further supports the findings. The work of T.B. Van & V.V. Hong (2025) aligns with the conclusions of this study, noting that patriotism in Vietnam, as a component

of comprehensive education, includes the development of social responsibility and civic engagement. This corresponds to the effects identified in the Ukrainian context, namely the formation of civic responsibility and readiness for professional activity. In addition, the results reported by H. Tran *et al.* (2023) are consistent with the present findings, as the organisation of educational activities centred on cultural values in Vietnamese schools promoted positive civic orientations and social activity among pupils, similar to the effects observed when integrating security competencies into the patriotic education of students.

The work of M.T. Yani *et al.* (2023) is also conceptually consistent with the results of this study. The authors demonstrated that the integration of moderate religious education and national defence content into higher education contributes to the development of civic responsibility, moral stability, and students' ability to make conscious decisions in matters of personal and collective security. It was found that the inclusion of security competencies in the educational process activates interdisciplinary thinking and strengthens the links between ethical, social, and professional components of student training. These conclusions allow the proposed approach to be considered an effective model for the professional development of future specialists, oriented towards the integration of spiritual and moral, civic, and professional qualities required for responsible behaviour under contemporary social challenges. The conclusions of P. Zhang *et al.* (2023) are likewise consistent with the obtained results, emphasising the importance of a systemic approach to the formation of engineering competencies, which corresponds to the effects of incorporating safety and occupational health knowledge into patriotic education to foster students' systems thinking.

P. Wei (2024) demonstrated that, in Chinese educational materials, the interrelationship between patriotic and socio-emotional skills supported the development of value-based attitudes towards work, collective interaction, and civic responsibility. This combination enhanced students' ability to recognise occupational safety as an integral component of moral and national education. The political and regulatory foundations of educational safety were analysed by E. Xue *et al.* (2021), who found that, during the pandemic, China implemented reforms aimed at integrating safety principles into both general and higher education programmes. This experience confirmed the effectiveness of state support combined with the cultivation of collective responsibility for community well-being. Approaches to creating an ideologically enriched learning environment were examined by W. Zheng & L. Wu (2024), who substantiated the concept of integrating vocational training with patriotic education within the context of higher education modernisation in China. Their analysis showed that the combination of ideological, professional, and security-related components contributed to the formation

of competencies essential for social stability and the development of labour responsibility among young people.

■ Conclusions

The study found that patriotic education of youth in Ukraine is implemented as a purposeful pedagogical process that integrates moral and ethical, cultural, social, and legal components, fostering civic consciousness, patriotic identity, a state-oriented position, and social activity among students. The findings demonstrated that the formation of patriotic consciousness occurs through a combination of intellectual, emotional, and practical development, which ensures an active civic position and a conscious commitment to the Motherland.

An analysis of formal academic disciplines, including Life Safety and Civil Protection, Occupational Safety and Civil Protection, and Civil Protection, Defence and Patriotic Education, as well as Ukrainian programmes and initiatives such as Youth is changing Ukraine. National Memory, Digital Defence, Youth for Ukraine, Digital Patriots, and the United Ukraine platform, showed that these initiatives are aimed not only at fostering patriotic values but also at systematically developing key professional competencies of future specialists. Interactive simulations, emergency scenario modelling, project-based activities, and game-based learning contribute to the development of decision-making skills under conditions of uncertainty, risk assessment abilities, teamwork, effective communication, strategic thinking, and leadership qualities. The use of digital and multimedia tools enhances information literacy, analytical skills, and the ability to present results in a professional manner, while an interdisciplinary approach integrates knowledge from historical, legal, social, and technological domains, thereby promoting systems thinking. Mentoring and the involvement of role models further support the development of ethical leadership, responsible professional conduct, and social responsibility.

These programmes are organically embedded within the educational process as elective courses, practical modules, or interdisciplinary subjects, enabling students to apply theoretical knowledge in practice, collaborate beyond the university environment, and participate in national and international initiatives. In contrast to traditional lectures and laboratory classes, which primarily involve the reproductive acquisition of knowledge, such initiatives are based on active learning, learner autonomy, reflection, and creativity. This approach ensures the formation of sustainable professional and civic competencies, including the ability to work collaboratively, critically analyse information, make responsible decisions, and contribute to social change.

The recommendations emphasise the need for a comprehensive integration of academic disciplines, practical training, project-based methodologies, case studies, and digital resources. This includes the organisation of role-playing activities, emergency simulations,

volunteer initiatives, and the involvement of experienced mentors to foster patriotic awareness, civic responsibility, practical decision-making skills, critical thinking, and an active social position among students. Prospects for further research may focus on examining the effectiveness of combining volunteer projects with academic disciplines in developing practical skills and strengthening students' social responsibility.

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■ Acknowledgements

None.

■ Funding

None.

■ Conflict of Interest

None.

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■ **Анотація.** Метою дослідження було оцінити роль навчальних та позанавчальних заходів у формуванні патріотичної свідомості та активної громадянської позиції студентів у контексті освітньо-професійної підготовки й розвитку громадянських та соціальних компетентностей. Методологія дослідження ґрунтувалася на застосуванні документально-аналітичного та порівняльного підходів, включала систематичний аналіз навчальних планів і програм університетів, моделювання сценаріїв формування патріотичних цінностей, а також оцінку ефективності інтеграції інноваційних методів, цифрових платформ і проєктів для розвитку громадянської свідомості студентів. Встановлено, що патріотичне виховання молоді в Україні здійснюється як цілеспрямований педагогічний процес, який об'єднує морально-етичні, культурні, соціальні та правові складники, формуючи громадянську свідомість, патріотичну ідентичність, державницьку позицію та соціальну активність студентів. На дошкільному та шкільному рівнях основні форми реалізації включають свята української мови, День вишиванки, створення колажів, шкільні проєкти та участь у конкурсах патріотичної пісні, що сприяє підвищенню емоційної прив'язаності до національної культури. Визначено, що на рівні університету патріотичне виховання здійснюється через інтеграцію національних цінностей у професійну підготовку студентів, участь у студентському самоврядуванні та науково-патріотичних проєктах, що забезпечує формування громадянської ідентичності та активної соціальної позиції. Дисципліни з охорони праці та безпеки життєдіяльності сприяють засвоєнню знань з історії цивільного захисту, національної оборони та морально-етичних принципів, а практичні заняття, симуляції та рольові ігри розвивають критичне мислення, відповідальність і готовність до волонтерської діяльності. Було з'ясовано, що під час навчального процесу гуманітарні та IT-спеціальності охоплювали 68 годин, технічні 72 години, а для першокурсників було організовано 36 годин інтегрованого навчання, спрямованого на формування активної громадянської позиції та почуття національної приналежності. Визначено, що інтеграція інноваційних методів, цифрових платформ, проєктної діяльності, кейс-стаді та менторства підвищує ефективність формування патріотичних цінностей і громадянської свідомості, забезпечуючи поєднання інтелектуального, емоційного та практичного розвитку студентів

■ **Ключові слова:** громадянська свідомість; цифрові технології; міждисциплінарний підхід; стратегічне мислення; соціальна дисципліна



Analysis of demand for legal education in higher education institutions and prospects for subsequent employment in Ukraine

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■ **Abstract.** The relevance of the study is determined by the need to modernise Ukraine's system of legal education in the context of increasing competition in the labour market and the necessity to align the professional training of lawyers with contemporary international standards. The purpose of the study was to identify the specific features of legal training in Ukraine and to assess its compliance with the requirements of the legal labour market. The methodological framework comprised analysis, synthesis, comparison, deduction, as well as formal-legal and comparative methods. On the basis of reports by the Ministry of Education and Science of Ukraine, the National Agency for Higher Education Quality Assurance, and the Association of Legal Clinics of Ukraine, it was established that the practical component of training accounts for only 15-20% of the curriculum, whereas in the United States its share reaches 30-35%. The comparative analysis of educational models demonstrated the higher effectiveness of clinical education, paid internships, and formative assessment of competences, which provide graduates with a broader range of professional skills. An additional analysis of employment trends showed that the proportion of young lawyers who obtain employment in their field within the first year remains below 50%, which correlates with the limited volume of practical modules and underdeveloped mechanisms for assessing professional skills. A conceptual three-level model for evaluating the effectiveness of training future lawyers (content-structural, competence-based, and market-analytical levels) was developed, enabling educational outcomes to be correlated with employment indicators and the structure of demand for legal services. The proposed recommendations may be used to update standards of legal education, develop dual programmes, and strengthen practice-oriented training in Ukrainian law schools

■ **Keywords:** competence-based approach; graduate employment; legal education; quality assurance in education; legal labour market

■ Introduction

The relevance of the study is determined by the need to create an effective model of higher legal education in Ukraine that would meet the contemporary requirements of the country's socio-economic and legal

development. Despite the introduction of new mechanisms of quality assurance in education over the past decade, a coherent model for regulating the market for legal education provision has yet to be formed. The

Suggested Citation:

Lytvynov, O., & Lytvynov, V. (2025). Analysis of demand for legal education in higher education institutions and prospects for subsequent employment in Ukraine. *Professional Education: Methodology, Theory and Technologies*, 11(2), 61-74. doi: 10.69587/pemtt/2.2025.61.



reform of higher education has stimulated the development of educational programmes, including those in legal disciplines, their alignment with the standards of the Bologna Process, and the introduction of a competence-based approach. However, the effectiveness of these changes in the context of training competitive legal professionals and their subsequent employment remains an open question.

Problems of legal education and graduate employment are actively examined in academic doctrine. As noted by O.A. Bilichak (2019), there is an urgent need to overcome the gap between the theoretical knowledge provided to students and its practical application. The researcher found that the majority of higher education institutions do not include, within compulsory course blocks, practical tasks such as drafting procedural documents, analysing real court cases, or participating in moot court hearings. V. Ternavska (2022) analysed trends in the development of legal education in Ukraine and proposed ways to improve it, concluding that there is a need to strengthen the practical component of training and introduce interactive teaching methods. N. Milovska (2021) examined the problems of adapting graduates of law faculties to labour market requirements, emphasising the lack of practical experience in working with procedural documents and participating in court proceedings. N. Spasibukhov (2024) highlighted the effectiveness of involving practising lawyers in teaching and organising internships as a tool for developing practical skills. A.V. Ivantsova (2020), comparing American and Ukrainian models of legal training, concluded that clinical legal education, widespread in the United States, is one of the most effective ways of forming practical competences, and that its elements should be integrated into the educational process of Ukrainian higher education institutions.

Current trends in the global development of legal education indicate a gradual shift from an academic-theoretical to a practice-oriented approach. F. Bartlett *et al.* (2022) demonstrated that student participation in pro bono clinics not only develops professional skills but also increases employability. A comparative study conducted in Australia, South Africa, and Chile showed that students who participated in clinical programmes display more developed legal reflection, stronger client-handling skills, an enhanced ability to analyse legal risks, and greater flexibility in adapting to employer requirements. This research is relevant for the Ukrainian context, as it confirms the advantages of learning-through-practice models in legal training, which correspond to European approaches to competence-based educational design.

Further development of this idea was presented by J. Alexander (2023), who proposed a model for shaping professional identity and confidence in future lawyers through clinical education. The author argued that clinical courses are a powerful instrument not only for

developing practical skills but also for cultivating professional values such as responsibility, ethical sensitivity, communication skills, and the capacity for self-reflection. Successful professional training of lawyers presupposes a combination of academic theory with experiential learning that facilitates the transfer of legal knowledge into practice. Such programmes enable future professionals to recognise the social role of the profession and to prepare for cooperation with various sectors of society.

Digital competence of lawyers is gaining additional importance and is now regarded as an integral component of professional readiness. K. Martzoukou *et al.* (2022) found that a significant proportion of law students assess their own digital skills as insufficient for the contemporary labour market. The development of information-analytical abilities, skills in using legal databases, electronic court platforms, and artificial intelligence tools is becoming a crucial condition for successful professional realisation of graduates. Consequently, educational programmes should integrate elements of digital literacy at all stages of the learning process and provide students with practical tools for working in the electronic legal environment. In the European context, M. Mazzetti (2024) drew attention to the comparative-law approach in professional legal education, emphasising the importance of methodological analysis in teaching law and forming competences of future professionals. The researcher demonstrated that the comparative-law method contributes to the development of analytical thinking and a deeper understanding of legal processes in an international context. Integrating such methods into the curricula of law faculties promotes the formation of global legal awareness and the ability to adapt to a changing international environment.

Despite a substantial body of research devoted to the modernisation of legal education, a number of important aspects remain insufficiently explored. Academic studies tend to focus on individual structural elements of educational programmes, while a comprehensive comparison of the content-structural, competence-based, and market components of legal training in Ukraine has not yet been presented in a systematic manner. The relationship between theoretical modules and practice-oriented components, the misalignment between learning outcomes and labour market requirements, as well as the real impact of clinical training, digital tools, and interdisciplinary specialisations on graduates' professional capacity remain under-researched. There is also a lack of studies in which the Ukrainian model of legal education is directly compared with the American one in terms of practical training, professional identity, and employment indicators.

The purpose of the study was to identify the specific characteristics of legal training in Ukraine and to assess its compliance with labour market requirements in the legal sphere. The objectives of the study were to

identify key problems in the training of Ukrainian lawyers, analyse employer requirements for young professionals, and, drawing on the experience of the United States, develop recommendations to enhance the effectiveness of professional legal education.

■ Materials and Methods

The methodological framework of the study constituted an integrated system of analytical tools aimed at a comprehensive analysis of legal training in Ukraine and its comparison with the American model of professional legal education. The study covered the period from 2020 to 2025, selected as a representative timeframe for assessing structural changes in legal education, updates in state policy, and dynamics of graduate employment, which were most pronounced during this period. The first stage involved a systematic examination of statistical reports of the Ministry of Education and Science of Ukraine (2025), containing data on enrolment dynamics in the specialty 081 “Law”, admission volumes to higher education institutions, and graduate employment indicators. These materials made it possible to conduct a structural-dynamic analysis of changes in state policy regarding legal education, correlate employment trends with the overall number of graduates, and clarify the proportion of individuals who successfully integrate into the labour market. Additionally, regulatory and analytical reports of the National Agency for Higher Education Quality Assurance of Ukraine (2024a; 2024b), an analytical review by the Ministry of Justice of Ukraine (2018), and materials from the International Labour Organization (2021) were analysed. Content analysis of these sources enabled the identification of institutional parameters of state regulation, accreditation requirements, assessment mechanisms, and socio-economic factors shaping demand for legal professions.

Within the study, an in-depth analysis of the structure of Ukrainian educational programmes for training lawyers was conducted. For this purpose, reports of the National Agency for Higher Education Quality Assurance of Ukraine (2024a; 2024b) concerning the composition of typical curricula, the ratio of theoretical and practical disciplines, quantitative indicators of practical training, as well as the requirements of state standards (Ministry of Education and Science of Ukraine, 2025) were examined. The method of analysis allowed the identification of key structural elements of programmes, while the comparative method made it possible to determine the average proportion of practical components in Ukrainian higher education institutions.

The comparative analysis of the American model of legal education was based on official reports of the American Bar Association (n.d.) for 2022-2024, in particular the Employment Summary Reports (Standard 509), which constitute the primary source of standardised information on the structure of Juris Doctor programmes, the scope of clinical courses, formative assessment

mechanisms, and graduate employment outcomes. The choice of these documents was justified by their evidential value, as they provide the most representative data for accurate comparison with the Ukrainian context. For an in-depth analysis of the practice-oriented component, contemporary empirical studies on clinical education and the formation of professional competences of future lawyers were used (Bartlett *et al.*, 2022; Donnelly, 2022; Alexander, 2023). The use of these sources made it possible to combine structural data from the American Bar Association with empirical evidence on the effectiveness of clinical learning, ensuring a methodologically robust basis for model comparison. Content analysis of programme and analytical materials enabled the generalisation of key parameters of American programmes: the share of practical modules, the structure of clinical training, the use of simulation-based courses, systems of admission to the profession, and the logic of professional accreditation. This made it possible to correlate them with the Ukrainian model, in particular by identifying differences in the share of practical training, the use of formative assessment, the level of institutional autonomy, and the degree of student integration into the professional environment.

The method of synthesis was applied to integrate the results of analysing Ukrainian and American educational models and to construct a generalised logic of the functioning of the contemporary legal education system. Attention was focused on identifying common and distinctive features of the models that determine graduates' competitiveness in the labour market. The application of the comparative method made it possible to juxtapose different models of professional legal training, generalise structural characteristics, levels of practice-oriented preparation, and the logic of competence assessment. In this context, external studies describing alternative models of legal education were examined (Kakhnych, 2021; Weber *et al.*, 2025; Karttunen *et al.*, 2025), enabling the identification of universal parameters of an effective system of professional training and their correlation with the state of Ukrainian programmes.

The final stage involved the development of a conceptual model for evaluating the effectiveness of professional legal training, integrating three interrelated levels – content-structural, competence-based, and market-analytical. Its construction was based on the analysis of statistical reports on enrolment and employment by the Ministry of Education and Science of Ukraine (2025), accreditation requirements of the National Agency for Higher Education Quality Assurance of Ukraine (2024a), and comparison with external international models. This approach made it possible to systematically assess the interconnection between the normatively defined structure of education, the actual level of competence formation among students, and employment factors, thereby ensuring the comprehensive nature of the study.

■ Results

The study of the professional training of future lawyers in Ukraine in 2020-2025 made it possible to identify a set of systemic problems and development trends within the education sector. Analysis of the Ministry of Education and Science of Ukraine (2025) report showed that demand for the specialty 081 "Law" remains consistently high, although the graduate labour market over the period in question was characterised by oversupply. Despite a reduction in the number of state-funded places and an increase in the competitive entry threshold, legal education continues to hold its position among the most popular fields. A structural-dynamic analysis of statistical data made it possible to trace changes in the profile of applicants and the relationship between demand for legal education and actual employment outcomes, revealing uneven trends at different stages of 2020-2025. According to the Ministry of Education and Science of Ukraine report, the share of law graduates employed in their field within the first year after obtaining a diploma is only 42-47%, depending on the graduation year and region. This figure was confirmed by comparing the share of graduates employed in-field with the total number of individuals who completed studies in the relevant year, in accordance with the statistical data of the Ministry of Education and Science of Ukraine report.

Among the key reasons for this situation is a mismatch between students' academic achievements and the practical competences required for work in the legal environment. According to the analytical review by the Ministry of Justice of Ukraine (2018), employers noted an insufficient level of practical skills among law graduates: 42% of applicants experienced difficulties in drafting procedural documents, 37% in performing basic representation procedures, and 46% in applying legal analysis algorithms. This indicates the absence of an effective mechanism for assessing professional competences within master's programmes. Traditional formats – defence of a qualification thesis or a state examination – do not always reflect the real level of students' practical preparation. Overall, demand for legal education among prospective graduates remains steady despite the progressive oversaturation of labour supply in the market. Applicants do not always base their choice on the "prestige" of a particular institution; factors influencing their decision also include geographical proximity to their place of residence, the organisational support offered to students, and tuition fees (Lauder & Mayhew, 2020). Based on data from the Ministry of Education and Science of Ukraine (2025) report, it was established that, notwithstanding high and stable demand for legal education, the proportion of graduates who secure in-field employment within the first year after receiving a diploma remains below 50%. The main causes of this phenomenon remain both a mismatch between jobseekers' expectations and available

vacancies on the labour market (in particular, the level of remuneration offered to junior specialists) and a mismatch between jobseekers' qualifications and employers' requirements.

An analysis of current educational programmes in law faculties of Ukrainian higher education institutions confirmed the dominance of a theoretical-dogmatic approach over practical training, which substantially reduces graduates' competitiveness in the labour market. According to the National Agency for Higher Education Quality Assurance (2024) and the Ministry of Justice of Ukraine (2018), on average more than 70% of subjects belong to the theoretical block – constitutional, administrative, civil, criminal, commercial, and international law – whereas practical modules – legal clinics, internships, court simulations, and applied disciplines – account for, on average, 15-20% of the curriculum. This imbalance produces a predominantly academic type of specialist who possesses deep knowledge of legal norms but does not always have the skills to draft procedural documents, conduct negotiations, use legal IT tools, and comply with professional ethics in a real working environment. A comparison of typical curricula of Ukrainian universities with those of leading American institutions, as presented in the Employment Summary Reports (Standard 509), shows that in the United States the share of practical courses, clinical work, and paid internships amounts to 30-35% of total training volume (American Bar Association, n.d.). As a result, students in Ukrainian higher education institutions acquire predominantly theoretical knowledge without the opportunity for systematic application, which explains the low in-field employment rates recorded in the Ministry of Education and Science of Ukraine (2025) report. Content analysis of materials from the Ministry of Education and Science of Ukraine and the National Agency for Higher Education Quality Assurance of Ukraine (2024a; 2024b) confirmed that the key problem areas remain legal writing, analysis of case law, and application of representation procedures. The Association of Legal Clinics of Ukraine report (2024) notes that students in legal clinics prepared 8,960 procedural-legal documents and carried out 326 instances of representation of interests in courts and other bodies. The performance indicators of educational programmes and the activities of legal clinics recorded in the Association of Legal Clinics of Ukraine report demonstrate that the practice-oriented component of training directly affects graduates' level of professional readiness. The International Labour Organization (2021) programme identifies the need to combine professional educational outcomes with the principles of decent work, digitalisation, and labour-market mobility, which may serve as a benchmark for modernising Ukrainian law programmes. Employers in the legal sector, according to analytical data from the National Agency for Higher Education Quality Assurance (2024)

and the International Labour Organization, set a clear requirement to combine deep knowledge in core substantive and procedural fields with practical skills of applying it. This concerns not only knowledge of normative acts, but also the ability to draft procedural documents correctly, analyse case law, negotiate, conduct legal risk analysis, and provide legal support for projects in the business environment. A graduate of a higher law school who has not been able to gain practical experience during study or has not completed internships typically does not meet these requirements. This creates a gap between employers' expectations and the actual level of preparation of young specialists, which is particularly visible in the private sector, where a lawyer is expected not only to be legally literate but also capable of making operational decisions in a dynamic legal environment (Li, 2023).

A comparative analysis based on the Employment Summary Reports (Standard 509) – the official reporting form of US law schools published by the American Bar Association (n.d.) – confirmed that in the United States the emphasis in legal training is shifted towards building professional competences through clinical practice, simulated court proceedings, and extended paid internships. Students have the opportunity to apply knowledge in real or near-real conditions already during their studies. In Ukrainian universities, such a model has not yet become systemic: practical training is often reduced to short-term work placements without a clear mechanism for assessing outcomes. A difference is also evident in approaches to quality assurance: in the United States, key benchmarks include the bar passage rate and employment in the JD Advantage category, whereas in Ukraine employment outcomes do not directly influence curriculum updates. According to the National Agency for Higher Education Quality Assurance (2024), Ukrainian legal education partially corresponds to the principles of “employability-oriented education”, but lacks systemic implementation of the competence-based approach. Unlike Ukraine, legal education in the United States is postgraduate in nature. To enter law school, students first obtain a bachelor's degree (four years) in any field, and then study for a three-year Juris Doctor programme. It is accredited by the American Bar Association and includes compulsory modules in legal writing, advocacy, mediation, legal research, and clinical practice. The share of practical training within the programme reaches 30-35%, and students' participation in clinics, internships, and educational moot court proceedings is a necessary condition for obtaining the degree. The final stage of

professional training is the Bar Exam – a comprehensive examination in substantive and procedural law, characterised by a high level of difficulty and serving as a marker of graduates' professional readiness.

Legal training in the United States has a distinct system that differs substantially from the Ukrainian one. Unlike Ukraine, where students may enter a law faculty directly after school, in the United States legal education is postgraduate. Future lawyers must first obtain a bachelor's degree (typically four years of study) in any field. Popular subjects include political science, history, and English, but any discipline may be chosen. After earning a bachelor's degree, candidates apply to law schools. They must take the standardised Law School Admission Test, which assesses analytical and logical skills. The admissions process also includes submitting letters of recommendation, writing a personal statement, and undertaking an interview. The programme of study at law school usually lasts three years and leads to the Juris Doctor degree. The first year typically covers foundational areas of law: civil law, criminal law, constitutional law, contract law, and so forth. In the second and third years students may choose specialised courses aligned with their interests. Considerable attention is paid to the development of practical skills. Students participate in moot courts (simulated hearings) and clinical programmes where they work with real clients under the supervision of academic staff. Many students undertake summer internships in law firms, which often serve as a route into future employment. After graduating from law school, graduates must pass the licensing examination in the state where they intend to practise. This examination is difficult and comprehensive, testing knowledge of both federal law and the law of the specific state. Preparation for the Bar Exam often takes several months of intensive study.

After obtaining a licence to practise, lawyers are required to engage in continuous professional development. Most states require lawyers to complete a certain number of hours of further training each year to maintain their licence. Many lawyers pursue additional specialisation through Master of Laws (LLM) programmes, which usually last one year. Some also obtain a doctoral degree (S.J.D. or J.S.D.) for an academic career. The American Bar Association plays a key role in setting standards for legal education and accrediting law schools. Membership in professional associations is important for networking and professional development. Table 1 presents a generalised comparison of the key structural differences between the Ukrainian and American models of legal education.

Table 1. Structural differences between the Ukrainian and American models of legal education

Criterion	Ukraine	US
Type of educational model	Bachelor's + Master's (5.5-6 years)	Postgraduate J.D. programme (3 years after a Bachelor's)
Share of practical subjects	15-20%	30-35%

Table 1. Continued

Criterion	Ukraine	US
Availability of legal clinics	In 38% of universities; irregular	A compulsory component of the J.D. programme
Internships	Irregular; mostly short-term	Paid internships and clerkships are standard
Assessment of readiness for the profession	State examination / qualification thesis	Bar Exam, a condition of entry to the profession
Links with employers	Episodic; informal	Institutional; embedded in accreditation
Level of digitalisation in education	Moderate; fragmented implementation	High; digital justice is part of training
Graduate employment	42-47% in the first year	80-90% in Bar Passage Required + JD Advantage categories

Source: compiled by the authors on the basis of F. Bartlett et al. (2022), L. Donnelly (2022), J. Alexander (2023), National Agency for Higher Education Quality Assurance of Ukraine (2024a; 2024b), the Ministry of Education and Science of Ukraine (2025), the American Bar Association (n.d.)

The Ukrainian system of legal education is characterised by earlier entry of students into professional training (from the bachelor's level), but has a substantially lower share of practice-oriented components – 15-20% versus 30-35% in leading international models – and a weaker institutional link with the legal labour market, as reflected in the limited role of paid internships, clinical education, and partnerships with legal employers. The American model demonstrates a higher level of integration between theory and practice, clear accreditation standards, and direct participation of professional associations in regulating educational quality. In the longer

term, it is advisable for Ukraine to introduce structural elements characteristic of the US system, in particular a unified qualification examination for lawyers, an increased share of clinical education, expanded partnerships with law firms and international organisations, and a focus of curricula on developing practical and interdisciplinary competences that determine the competitiveness of the modern legal professional. On the basis of the findings, a conceptual model for evaluating the effectiveness of training future lawyers was developed, encompassing three interrelated levels: content-structural, competence-based, and market-analytical (Fig. 1).

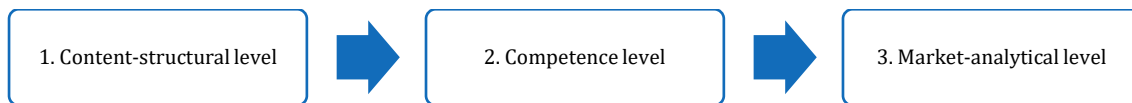


Figure 1. Conceptual model for evaluating the effectiveness of training future lawyers

Source: compiled by the authors

The first level, presented in Figure 1, defines the logic of curriculum design, the ratio of theoretical and practical subjects, and the presence of clinics, internships, and interdisciplinary modules. The second level provides for assessing the formation of professional skills (drafting procedural documents, legal analysis, client communication). The third, market-analytical level assesses the correlation between educational training and in-field employment indicators, and also takes into account trends in the legal services market. It is this level that ensures the transition from internal parameters of programme quality to external indicators of graduate success and makes it possible to interpret educational outcomes through the prism of labour-market supply and demand. Accordingly, further analysis of enrolment dynamics, applicants' motivations, and actual employment trajectories is viewed as an empirical test of the hypotheses embedded in the model: the extent to which the current structure of programmes and the real level of competences formed correspond to employers' expectations and macro-trends in the legal market.

Within the study, employer requirements in the legal sector regarding professional and general competences

of future lawyers were also systematised. Analysis of the legal services market shows that the modern legal professional must possess not only solid theoretical knowledge but also practical skills in applying legal rules, the ability to negotiate, analyse risks, draft procedural and contractual documents, provide legal support for commercial activity, and work with digital platforms of a legal focus. This is also confirmed by surveys of law firms and recruitment agencies, which note that candidates for junior lawyer positions should demonstrate the ability to work with large volumes of information, build legal argumentation, analyse case law, and apply problem-solving algorithms to legal issues. Labour-market indicators in the legal field clearly point to the growing role of practical competences, which become decisive in hiring decisions. Studies by the International Labour Organization (2021) and the National Agency for Higher Education Quality Assurance of Ukraine (2024a; 2024b) emphasise that graduates are expected not only to possess academic knowledge, but also to be able to apply it in practical situations, work with cases, payment documents, contractual structures, procedural motions, and other

documents forming the basis of a lawyer's day-to-day work. In this context, the problem of insufficiently developed soft skills is highlighted: communication, critical thinking, time management, and teamwork. Particular attention was drawn to interdisciplinarity as one of the defining criteria of modern legal education. According to the National Agency for Higher Education Quality Assurance of Ukraine (2024a; 2024b), employers expect young lawyers to be able to operate at the intersection of law, economics, finance, management, and information technology. At the same time, in most Ukrainian programmes interdisciplinary preparation is fragmented, largely through elective courses or individual study loads. As a result, graduates are often insufficiently prepared for work in areas where legal issues are closely intertwined with business analytics, financial audit, IT compliance, communications, and project management. A further aspect concerned assessing students' readiness for professional activity, including psychological and communicative components. According to survey results reported by the National Agency for Higher Education Quality Assurance (2024) and the International Labour Organization, a significant proportion of students face fear of responsibility, insufficient independence in decision-making, difficulties in negotiating with clients, and lack of confidence in their professional skills. These problems are exacerbated by the absence of adequate preparation for work in a real legal environment, where high requirements for accuracy and responsibility are combined with the need to respond quickly to changing circumstances. The conclusions confirm that young lawyers often have inflated expectations regarding working conditions and pay, linked to insufficient awareness of the real state of the legal services market. A significant proportion of graduates are not ready for high workloads, intensive schedules, complex negotiations, and diverse tasks, which creates an imbalance between their expectations and the realities of professional activity. This is evident both in the public sector, where competition for posts is high, and in the private sector, where employers require flexibility, adaptability, and an understanding of business processes from junior specialists.

A separate strand of the research examined the impact of digitalisation on the quality of legal education. The introduction of electronic platforms for analysing case law, training simulators, and digital justice tools is gradually transforming approaches to teaching legal disciplines. In Ukraine during 2020-2025 there was a gradual expansion of digital services such as court-decision analysis systems, counterparty checkers, automated legal document builders, and other digital solutions for legal practice. This contributes to increased digital literacy and skills in using legal-tech tools. One of the key instruments of digitalisation in Ukrainian legal education has been platforms providing online access to court decisions and legal databases. The use

of such resources allows students to work through real cases, analyse precedents, and prepare legal positions on the basis of up-to-date practice. Big-data processing technologies, artificial intelligence in legal analytics, and modelling of legal situations are becoming part of the educational process, although integration of these tools into curricula remains fragmented. Digitalisation also encompasses the use of specialised legal analytics systems such as LIGA360, YouControl, and Contractum, as well as access to international legal platforms. An important role in developing practical skills is played by court-process simulators, enabling students to practise action algorithms during courtroom debates, preparation of procedural documents, determination of legal positions, and analysis of case law. Modern simulation tools help to build future lawyers' professional readiness to work in adversarial proceedings and to respond rapidly to changing circumstances. Experience of using online platforms to organise legal clinics shows that digitalisation makes it possible to expand students' access to real practice. Online client offices, remote consultations, virtual citizen-reception rooms, and systems for documenting requests simplify the provision of primary legal assistance and ensure flexible interaction between students, mentors, and real clients. Digital tools also allow more effective case statistics, workload assessment, and the design of individual pathways for developing students' practical skills. A high level of informatization in legal practice requires modern lawyers to be able to work with legal-process automation tools, electronic document management platforms, legal data management systems, and digital communication services. Students who possess skills in working with digital tools demonstrate better preparation for professional activity, particularly in compliance, IT law, personal data protection, and case-law analytics. However, the level of students' digital competence significantly depends on the quality of universities' technical provision and the degree to which relevant tools are integrated into curricula.

The employment problems faced by graduates of law faculties in Ukraine are systemic in nature and are determined not only by the state of the labour market, but also by shortcomings within the professional education system itself. As the analysis of reports by the Ministry of Education and Science of Ukraine (2025) and the National Agency for Higher Education Quality Assurance of Ukraine (2024a; 2024b) shows, one of the key factors is the low level of students' practical training, which does not ensure sufficient professional readiness to perform the tasks expected of junior lawyers in the workplace. Most curricula in law programmes are oriented towards a lecture-based, theoretical model and do not provide an adequate volume of practical classes, internships, or simulated court proceedings. At the same time, funding for legal education remains limited: only 8–10% of institutions have the capacity

to introduce modern digital laboratories, use licensed legal software, or maintain legal clinics on a permanent basis (Association of Legal Clinics of Ukraine, 2024). A further substantial barrier is the weak digitalisation of the educational process. Although a number of online resources for lawyers have been created in Ukraine – such as the Liga:Zakon Education, PravoSud, and Online Law School platforms – their integration into curricula is fragmented. Most universities limit themselves to using electronic lectures or providing remote access to databases, whereas at leading US institutions accredited by the American Bar Association (n.d.) digital tools constitute an integral part of training: courtroom simulators, virtual legal clinics, interactive case platforms, and electronic environments for collaborative editing of procedural documents. Another problem is the absence of effective mechanisms linking educational and professional environments. Graduates often lack an adequate level of legal analytics, business writing, or client-handling skills, as confirmed by employers: 37.2% of them indicate an insufficient level of practical preparation among junior specialists (Ministry of Justice of Ukraine, 2018). This problem is compounded by weak decentralisation of regional legal services markets, which limits opportunities for internships and first jobs for graduates in smaller communities (Telestakova *et al.*, 2020). Thus, comprehensive renewal of professional legal education should include increased funding for educational institutions, expansion of the digital infrastructure of the learning process, integration of clinical and simulation-based forms of training, and the creation of sustainable partnerships between universities, law firms, and public institutions. Only such a strategy will ensure that legal training meets contemporary challenges and guarantees graduates' competitiveness in the labour market.

One factor that complicates the professional realisation of law graduates is the psychological unpreparedness of young specialists for the realities of the modern labour market. As A. Kharkivska & A. Prokopenko (2023) note, a typical graduate of a Ukrainian higher education institution is characterised by ambition, initiative, and goal orientation; however, these qualities are often accompanied by inflated expectations regarding working conditions and the speed of career progression. This combination leads to a gap between graduates' self-assessment and the real requirements of employers, which in turn negatively affects their ability to adapt to the professional environment. In legal education this tendency is particularly visible, as legal practice requires the gradual accumulation of professional experience, resilience, and a high level of responsibility. To minimise this gap, professional education should be directed towards developing in students an adequate professional self-concept, internal motivation, and the capacity for reflection on their own capabilities. Practice at leading US universities accredited

by the American Bar Association (n.d.) indicates that these qualities are developed through systematic implementation of individual learning pathways, mentoring, and coaching programmes. Within such initiatives, students receive guidance on building a career strategy, participating in public-law projects, and managing their personal professional brand.

A similar model could be implemented in Ukrainian law schools through the establishment of career offices and the introduction of courses such as “The Legal Profession and Career Development”, focused on combining educational, psychological, and practical components. An important direction for modernising professional education should be the introduction of specialisation from the second year of study, enabling students to choose practice-oriented courses in line with their interests and potential career trajectories (Balzer, 2020). This would support the development not only of specialised but also of interdisciplinary competences required for work in the modern legal market – particularly in fields such as IT law, international business, mediation, or intellectual property law. In parallel, it would be appropriate to introduce simulation classes, business games, and educational court proceedings, which allow students to master practical aspects of the future profession in a safe, controlled environment. In addition, professional education should be based on continuous dialogue between universities, employers, and professional communities. Organising academic-practical seminars, round tables, and joint training sessions involving lecturers, students, practising lawyers, and business representatives would ensure that curricula correspond to the real requirements of the legal market. The introduction of such a system, aligned with the principles of lifelong learning, would gradually eliminate the contradiction between academic training and the practical challenges of the profession, promote students' academic mobility, and enhance the international prestige of Ukrainian legal education (Kharkivska & Prokopenko, 2023).

In the longer term, professional legal education should focus on training narrowly specialised lawyers who combine thorough knowledge in a chosen field of law with an understanding of related areas – economics, management, information technology, and international relations. A modern lawyer must think not only as a legal scholar, but as an analyst and strategist capable of assessing legal processes through the prism of economic, technological, and social factors (Li, 2023). For this reason, the need to modernise professional training lies not in simply expanding curricula, but in their structural renewal aimed at integrating interdisciplinary modules and developing practical skills and critical thinking. Drawing on US experience, where the Juris Doctor system is a model of deeply practice-oriented training, it is appropriate to implement a number of steps. First, the practical component of the

educational process should be strengthened by increasing the share of clinical classes and internships in cooperation with public authorities, judicial institutions, and private law firms. In leading American schools, including Harvard Law School and Yale Law School, students are required to participate in legal clinics and moot court competitions, enabling them to develop analytical, communicative, and ethical competences. Similar practice could be introduced in Ukrainian universities through the creation of dual education programmes in cooperation with practising lawyers, bar associations, and professional bodies (Association of Legal Clinics of Ukraine, 2024). Second, it is important to establish a system of specialisations within master's programmes, allowing students to choose narrow training tracks – IT law, medical law, environmental law, intellectual property, alternative dispute resolution, and others (National Agency for Higher Education Quality Assurance of Ukraine, 2024a; 2024b). In the United States, such a model ensures graduates' competitiveness and career flexibility, as narrowly profiled legal professionals have consistently higher employment levels (American Bar Association, n.d.). For Ukraine, it is also advisable to develop a national specialisation framework with clear descriptions of competences aligned with employers' needs. Third, it is important to strengthen the digital component of professional education. Educational programmes should include work with modern legal-tech platforms, court-process simulators, electronic case-law databases, as well as training in digital security and working with big data (Spasibukhov, 2024). US experience demonstrates that integrating such tools into the learning process develops not only professional but also technological competence among lawyers, making them ready for the challenges of digital justice.

Therefore, reform of professional legal education in Ukraine should be based on combining theoretical depth with practical orientation. This entails: transition to a competence-based learning model, expansion of practical modules, development of narrow specialisations, digitalisation of the educational environment, and strengthening partnerships between universities and employers. Adopting the best elements of the American system – clinical education, individualised programmes, and mandatory practical placements – will create conditions for forming a new generation of Ukrainian legal professionals capable of acting effectively within a globalised, technologically complex legal space.

■ Discussion

The issue of the effectiveness of legal education and its alignment with labour market needs has attracted considerable scholarly attention. In the work of V. Kakhnych (2021), emphasis was placed on a comparative analysis of legal training in the United States, Canada, and Ukraine, where the author concluded that Western universities provide a higher level of practical preparation

due to the active use of clinical forms of learning. This approach confirms the importance of increasing the share of applied modules, fully consistent with the findings obtained, which demonstrate an insufficient balance between theory and practice in Ukrainian programmes. In the study by S. McConnell (2023), the process of forming commercial awareness among future lawyers was analysed. The author noted that legal professionals must understand the business contexts of their activity and be conversant with managerial and financial issues. In this regard, she substantiated the need for an interdisciplinary approach to legal education. This conclusion resonates with the findings obtained, which likewise emphasised the importance of combining legal and economic knowledge to enhance graduates' competitiveness. The work of L. Donnelly (2022) contributed to the scholarly discussion by providing empirical evidence that participation in legal clinics increases professional readiness. The author found that graduates with clinical experience demonstrated better analytical thinking and ethical judgement. These findings align with the conclusions of this study, which also highlighted the role of clinical learning as an effective mechanism for developing professional competences.

The study by A. Shevchenko & V. Antoshkina (2023) identified a systemic problem of the predominance of theoretical disciplines in the curricula of Ukrainian universities. The authors argued that graduates often have a high level of academic knowledge but lack practical skills in legal writing, communication, and client work. Analysis of the results obtained confirms their position: practical training in Ukrainian educational institutions still accounts for only about one fifth of study time, whereas in leading law schools worldwide this indicator is at least one third. E. Gonzalez Ehlinger & F. Stephany (2024) addressed a broader context – the transformation of the labour market in connection with the spread of the concept of skill-based hiring. They argued that for successful employment, legal professionals must possess not only knowledge of law, but also digital, analytical, and communication skills. This approach echoes the results of the study, which likewise evidenced the growing role of interdisciplinary competences in the contemporary legal environment. D. Jackson & C. Cameron (2025) analysed how extra-academic activity affects graduates' employment success. They found that student participation in volunteering and debating programmes increased the likelihood of obtaining employment. This conclusion is consistent with the identified patterns whereby students' practical activity during study contributes to the development of professional identity and soft skills that are important for effective integration into the legal profession.

The combination of legal education with analytical practice is of particular significance under current conditions of educational reform. In this context, S. McConnell *et al.* (2024) emphasised the effectiveness of the

policy clinic model, which enables students to participate in developing real legal initiatives and solutions. Such an approach, based on practical experience and analysis of socially significant problems, contributes to the development of critical thinking, ethical sensitivity, and responsibility among future lawyers. These observations fully accord with the results of the present study, which likewise established that involving students in practical analytical activity increases their professional maturity and readiness to work in real law-enforcement conditions. Developing this idea further, the results of V. Magesh *et al.* (2025) demonstrated that technological innovations, in particular the use of artificial intelligence tools, contribute not only to modernising the learning process but also to shaping new types of legal thinking. The authors emphasised that digitalisation of education enables students to work with large volumes of legal data, improves the accuracy of analytical conclusions, and develops strategic forecasting capacity. The results of the present study fully accord with this position: digital court-process simulators, online platforms for drafting procedural documents, and interactive collaborative environments proved to be effective tools for improving the quality of professional legal training.

Further reflection on the role of universities in shaping lawyers' professional culture was presented in the study by A. le Roux-Kemp (2024). The scholar stressed that the system of legal education in the United Kingdom should serve not only as an institutional foundation for acquiring legal knowledge, but also as an environment for fostering ethical standards, social responsibility, and professional dignity. This view is closely aligned with the findings of the present study, which likewise emphasised that in the Ukrainian context the development of professional values and ethical awareness among future lawyers is no less important than technical or legal competence. Accordingly, the need for systematic cooperation between universities, professional associations, and public authorities becomes evident, enabling the learning process to be harmonised with the requirements of the contemporary legal environment.

Formative feedback in hybrid intelligence environments, as shown by F. Weber *et al.* (2025), not only improves the quality of legal writing but also accelerates the development of structured skills of legal argumentation. Students working within mixed-intelligence models demonstrate a greater capacity to construct logically coherent texts, correct stylistic errors, and select more precise legal formulations. This pattern is consistent with the findings obtained, which confirmed the need to expand training formats for written tasks and introduce systematic mechanisms of formative assessment in Ukrainian training programmes. In the field of digital simulations, M. Wang (2025) demonstrated that electronic courses built on hybrid algorithms provide adaptive customisation of learning content to students'

individual needs, increasing interactivity and the accuracy of modelling legal situations. The advantages of such technologies fully coincide with the role of digital platforms and simulators identified in the study in strengthening the practice-oriented component of legal education, confirming the appropriateness of their wider use. The problem-based learning model examined by E. Karttunen *et al.* (2025) demonstrated significant potential in developing the ability to work with complex multi-level legal cases. The use of PBL approaches contributes to a deeper understanding of evidential materials, analysis of legal norms, and the development of well-founded decisions. This logically correlates with the findings obtained, which indicated a growing need to develop analytical, research, and interdisciplinary competences in the training of modern legal professionals. Aspects of professional identity formation were supplemented by J. Craft (2025), who argued that developing self-compassion increases law students' psychological resilience, reduces the risk of professional burnout, and improves the quality of ethical judgement. The alignment of these conclusions with the results of the present study, which highlighted the importance of ethical sensitivity, stress-resilience, and internal motivation, confirms the need to strengthen values-oriented components in law education programmes. The combination of these elements outlines a structural tendency towards balancing technical, analytical, and personal-professional aspects of training future lawyers.

In summary, research demonstrated a shared transformation of legal education – from a predominantly academic-theoretical model to a system oriented towards competences, practical training, and flexible educational trajectories. Across the works analysed in this section, there is a consistent increase in attention to the development of soft skills, digital and information literacy, analytical thinking, legal writing skills, and professional ethics as integral components of the professional readiness of future lawyers. At the same time, current trends envisage the integration of technological solutions – simulations, hybrid intelligence platforms, adaptive e-courses – that enable students to work with realistic legal scenarios and master complex procedures in a more applied format. Comparison with international models of legal education further confirms the relevance of expanding clinical training, internships, and formats of problem-based learning. The results obtained are consistent with these scholarly positions, recording the need to review the structure of Ukrainian educational programmes, increase the share of practical modules and implement digital simulators, and harmonise the content of training with the requirements of the contemporary legal services market. In view of the patterns identified, an important future direction is the development of a comprehensive training model combining legal, analytical, digital, and ethical competences, ensuring graduates' competitiveness on the global legal market.

■ Conclusions

The analysis confirmed the existence of a structural imbalance between the theoretical and practical components of legal training in Ukraine, which is reflected both in the content of educational programmes and in graduate employment outcomes. The data obtained confirmed that, on average, practical training accounts for no more than 15-20% of the curriculum, whereas in the United States the share of practice-oriented elements reaches 30-35% and includes compulsory legal clinics, long-term paid internships, mock-trial formats, and standardised assessment of applied skills on the basis of bar passage rates. Within the Ukrainian system, state final certification is oriented predominantly towards theoretical knowledge, which produces a gap between learning outcomes and the practical skills demanded by employers. This gap is confirmed by statistical materials: students who undertook clinical training and worked with digital courtroom simulators demonstrated a significantly higher level of professional competence formation, reflected in improved analytical, communication, and procedural skills. Comparative analysis of Ukrainian and American educational models identified differences in curriculum structure: in the United States practice is integrated at all stages of training, whereas in Ukraine practical modules often have an optional or fragmented character. Examination of employment reports confirmed that higher education institutions in which the share of clinical training exceeds the average provide a higher percentage of in-field employment within the first year after graduation. This study established that the average employment level of Ukrainian law graduates remains lower than in countries with a high degree of practical integration, making it possible to trace a direct relationship between programme structure and labour-market outcomes.

Statistical data obtained from the analysis of Ukrainian regulatory and analytical reports confirmed that the level of applied competence formation is uneven and depends on the presence of a legal clinic, formative assessment methods, and the digital learning infrastructure. Students who participated in clinical programmes more often demonstrated the ability

to draft procedural documents correctly, perform legal writing, and work with evidence, as well as faster adaptation to real professional situations. The comparison showed that systems in which practical learning constitutes the structural core of the programme ensure more stable employment outcomes and greater alignment of competences with real market requirements. The three-level model proposed in this study for assessing training effectiveness – content-structural, competence-based, and market-analytical – proved effective as a tool for comprehensive measurement of learning outcomes. At the content-structural level, the model made it possible to establish a critical insufficiency of practical modules in most Ukrainian programmes; at the competence-based level, to identify a gap between declared learning outcomes and the real level of skills; and at the market-analytical level, to show limited alignment of graduates with employer requirements, reflected in lower early employment indicators. Taken together, these factors indicate a systemic need to move towards a model oriented towards practical outcomes, integrated formative assessment, development of clinical infrastructure, and broader implementation of legal-tech digital tools. Generalisation of all results obtained supports the conclusion that improving the effectiveness of professional legal education in Ukraine requires increasing the proportion of practical training, institutionally embedding clinical education, involving employers in curriculum design, updating assessment methods through real cases, and expanding digital-analytical platforms. Such changes will contribute to the formation of competitive graduates capable of meeting the requirements of the modern legal market and integrating into global professional standards.

■ Acknowledgements

None.

■ Funding

None.

■ Conflict of Interest

None.

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Аналіз попиту на юридичну освіту у вищих навчальних закладах та перспективи подальшого працевлаштування в Україні

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■ **Анотація.** Актуальність дослідження визначається потребою модернізації системи юридичної освіти України в умовах зростаючої конкуренції на ринку праці та необхідності узгодження професійної підготовки юристів із сучасними міжнародними стандартами. Метою дослідження було визначення особливостей підготовки правників в Україні та оцінка її відповідності вимогам ринку юридичної праці. Методологічну основу становили аналіз, синтез, порівняння, дедукція, формально-юридичний і компаративістський методи. На основі звітів Міністерства освіти і науки України, Національного агентства із забезпечення якості вищої освіти та Асоціації юридичних клінік України встановлено, що практична складова підготовки охоплює лише 15-20 % освітньої програми, тоді як у США її частка сягає 30-35 %. Проведений порівняльний аналіз освітніх моделей засвідчив вищу результативність клінічної освіти, оплачуваних стажувань і формативного оцінювання компетентностей, що забезпечує випусникам ширший спектр професійних навичок. Додатковий аналіз тенденцій працевлаштування показав, що частка молодих юристів, які отримують роботу за фахом протягом першого року, залишається нижчою за 50 %, що корелює з обмеженим обсягом практичних модулів та нерозвиненими механізмами оцінювання професійних умінь. Розроблено концептуальну трирівневу модель оцінювання ефективності підготовки майбутніх юристів (змістово-структурний, компетентнісний і ринково-аналітичний рівні), яка дозволяє співвіднести освітні результати з показниками працевлаштування та структурою попиту на юридичні послуги. Запропоновані рекомендації можуть бути використані для оновлення стандартів юридичної освіти, розвитку дуальних програм і посилення практикоорієнтованої підготовки в українських правничих школах

■ **Ключові слова:** компетентнісний підхід; працевлаштування випусників; правнича освіта; контроль якості освіти; ринок юридичної праці



Theoretical and methodological approaches to modernisation of IT specialist training in the context of sustainable development and digitalisation of education

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■ **Abstract.** The study aimed to analyse the effectiveness of educational programmes in the fields of F2 Software Engineering, F3 Computer Science, and 126 Information Systems and Technologies, and to identify ways to improve them based on the needs of the industry. The research methodology included questionnaires, quantitative analysis, comparative analysis of educational programmes, and expert evaluation of teaching materials. During the study, conducted in September 2024, the study determined that educational programmes for training specialists in computer science, software engineering, and information systems need to be updated following labour market requirements. An analysis of teaching materials revealed that most educational programmes do not update the technologies and tools used in the professional sphere, nor do they consider the development of digital skills and principles of sustainable development. Moodle was the most popular learning platform, used by 40% of respondents. According to teachers' assessments, students' digital literacy is mostly at an average level (56.6%). Only 31.6% of respondents noted a high level, which indicated a need for professional competence development. The student survey revealed that a blended form of educational organisation dominates (over 60% support) in combination with a high level of digital autonomy among students (79% study materials independently). The analysis of training revealed that although there are isolated attempts to integrate innovative technologies, in particular artificial intelligence, their implementation is insufficient for the full development of specialists. There is a need to improve teaching methods through the integration of online courses and project activities. The results can be used by teachers and administrators of higher education institutions to improve training methods, to update educational programmes in line with the requirements of the modern labour market

■ **Keywords:** digital technologies; technological changes; information security; critical thinking; self-learning

■ Introduction

Training specialists in information technology (IT) has become relevant in the context of the transition to a sustainable development model and the active introduction of digital technologies in all spheres of public life, particularly in education. Sustainable development requires the formation of professional competence that combines knowledge in the field of information

technology with awareness of environmental, social and economic challenges. The transformation of the education system involves rethinking educational approaches, the content of educational programmes, teaching methods, and the development of students' critical thinking, self-learning, interdisciplinary interaction and innovative activities. There is a growing demand

Suggested Citation:

Kotenko, N. (2025). Theoretical and methodological approaches to modernisation of IT specialist training in the context of sustainable development and digitalisation of education. *Professional Education: Methodology, Theory and Technologies*, 11(2), 75-88. doi: 10.69587/pemtt/2.2025.75.



for specialists who are not only capable of developing IT solutions, but also address the principles of ethical use of technology, digital security, energy efficiency and environmental impact. There is a problem of adapting the IT training system to the new conditions of digitalisation and the challenges of sustainable development, which requires updating the conceptual foundations of professional training, introducing innovative educational practices, strengthening the interdisciplinary nature of learning and developing digital culture among students. The need for such an update is determined not only by rapid technological changes, but also by the need to ensure a balance between technical competence, social responsibility and environmental awareness among future IT professionals.

Several studies addressed various aspects of IT specialist training in the context of digitalisation and transformation of the educational space. In particular, Y. Tryus & I.V. Herasymenko (2021) emphasised the introduction of elements of dual education into the training process for future IT specialists. The study proposed effective models, methods, and means of training that combine academic education with practical experience in enterprises. The results show an improvement in the quality of student training thanks to the systematic integration of the educational process with real production conditions. B. Zulauf & N. Knipprath (2020) investigated the specifics of training IT specialists in university computer centres. The study emphasised the need for practice-oriented training, which includes the implementation of real projects, work with infrastructure tasks and participation in the technical support of IT systems of institutions. This format contributes to the formation of professional skills and readiness for practical activities. O. Yezhova (2024) revealed the possibilities of using digital technologies in the professional training of specialists in the field of technology and design. The study showed that the use of digital tools increases students' interest in learning, promotes the development of creativity, interdisciplinary thinking, and independence in the learning process.

Theoretical and methodological approaches to developing the educational potential of students in higher education institutions (HEIs) were proposed by V. Leleka *et al.* (2023). The study emphasised personality-oriented education, self-realisation of students, and the development of their professional autonomy, which are key factors in the high-quality training of IT specialists. M.A. Alzahrani (2025) addressed the significance of assistive technologies in teaching students with disabilities in an inclusive education environment. Although the study does not exclusively concentrate on IT specialists, it emphasises the significance of adapting digital solutions to the needs of different categories of learners, which is also relevant for the training of future IT specialists. L.I. Bilousova *et al.* (2024) presented their experience of implementing interdisciplinary

projects in the training of future IT specialists. The study demonstrated that cross-sector integration promotes the development of systematic thinking, communication skills, and the ability to solve complex problems in the IT field. The researchers emphasise the importance of teamwork in such projects, as it develops cooperation skills in a real professional environment. In addition, the integration of several disciplines improves mastery of the practical context of the IT industry.

I. Hevko *et al.* (2020) emphasised the development of practical skills in modelling and printing three-dimensional objects during professional training. The use of 3D technologies not only improved mastery of modern tools among students but also contributed to the development of spatial thinking, design skills and engineering competence. Such technologies ensure interactivity and clarity of the learning process, which increases student motivation. The above-mentioned studies mostly focused on individual aspects of IT specialist training, namely dual education, digital technologies, interdisciplinarity or technical skills, but did not sufficiently cover a comprehensive model of professional training in the context of sustainable development. The study aimed to analyse educational programmes in Ukrainian higher education institutions. The objectives of the study were to analyse curricula and teaching materials to identify benefits and issues; to determine the relevance of teaching materials to the modern requirements of the IT industry and the needs of the labour market based on a survey of study participants; to develop recommendations for improving educational programmes, incorporating the requirements of IT companies and trends in the IT sector.

■ Materials and Methods

The study analysed the curricula and educational programmes at bachelor's level at three leading higher education institutions in Ukraine: the Interregional Academy of Personnel Management (IAPM), the National Technical University "Kharkiv Polytechnic Institute" (NTU KhPI) and Vinnytsia National Technical University (VNTU). These universities were selected due to their representativeness in the field of IT education, different forms of ownership (public and private institutions), and the availability of accredited educational programmes. The analysis covered the curricula and methodological materials of bachelor's degree programmes in the specialties F2 Software Engineering, F3 Computer Science and 126 Information Systems and Technologies. Identification of the advantages and disadvantages of training and the level of integration of sustainable development principles into the content of training were emphasised.

The study also used methodological materials, in particular: textbooks (Dovgalets & Masliy, 2009; Butenko & Syry, 2020) to analyse traditional approaches to teaching basic IT disciplines in Ukrainian higher education

institutions; online courses on the Udacity and Coursera platforms to compare the content of modern international training. The course “CS50: Introduction to Computer Science” on edX was used as an example of a comprehensive general introduction to computer science with an emphasis on practical skills. The presentations [RE-183] Machine learning theory and algorithms (n.d.) were selected as a representative example of methodological support for Ukrainian technical programmes.

The study, conducted in September 2024, included a survey of 240 IT students (80 from each university). The sample of students included students aged 17 to 22 (132 males and 108 females) studying technical subjects. The criteria for inclusion in the study were: studying IT disciplines at the specified higher education institutions and voluntary consent to participate in the survey. The criteria for exclusion were the absence of informed consent or withdrawal from the survey process. Sixty IT teachers were also surveyed, 20 from each university. A separate questionnaire consisting of closed questions was used for each category of respondents (students and teachers). Responses were recorded in a multiple-choice format, which facilitated quantitative analysis. Responses were scaled using nominal and ordinal scales, depending on the nature of each question. The survey was conducted in person using paper questionnaires, which respondents filled out directly in the classrooms. After the questionnaires were collected, the data were processed and analysed using quantitative statistical methods. Questionnaire for students of technical specialities:

1. Which learning format do you consider to be the most effective? (Face-to-face/Distance learning/Blended learning)
2. Are you familiar with the concept of “sustainable development” in the context of IT? (Yes, very familiar/Heard of it, but know little about it/No)
3. Which digital platforms do you use most often during studies? (Moodle/Google Classroom/Zoom or Teams/Other)
4. What proportion of the learning material is studied independently using online resources? (More than 50%/20-50%/Less than 20%/I do not use online resources)
5. Do you have sufficient practical training for your future profession? (Yes/Partially/No)
6. What skills should be prioritised in IT education, in your opinion? (Teamwork/Critical thinking/Working with big data/Other)
7. How would you rate the level of digitalisation at your educational institution? (High/Medium/Low)
8. Would you like to participate in international educational IT projects? (Yes/Maybe/No)

The questionnaire for IT teachers consisted of the following questions:

1. Is the concept of sustainable development included in your educational programmes? (Yes/Partially/No)

2. Which digital educational platforms do you use most often in teaching? (Moodle/Google Classroom/Microsoft Teams/Other)

3. How would you rate the level of digital literacy among students? (High/Medium/Low)

4. What forms of educational process organisation do you practise most often? (Face-to-face/Distance learning/Blended learning)

5. Have you taken any advanced training courses in digital pedagogy? (Yes, regularly/Yes, once/No)

6. What topics should be covered more extensively in IT specialist training? (Ethical aspects of technology/Green IT/Cybersecurity/Other)

7. What difficulties do you most often encounter when introducing innovations in teaching? (Insufficient technical support/Resistance to change/Lack of time/Other).

The collected data were statistically processed using descriptive statistics methods, which determined the average values, frequencies, and trends in respondents’ assessments. The analysis of the obtained data identified key aspects that influence the effectiveness of learning and teaching technical disciplines in conditions of constant change. The results obtained contributed to the formulation of recommendations based on the requirements of IT companies. The study was conducted following the American Sociological Association’s Code of Ethics (1997) on ethical principles for research involving human subjects. All participants provided written consent to voluntarily participate in the study.

■ Results

Analysis of curricula and teaching materials

The training of specialists in the field of information technology largely depends on the content of educational programmes, the structure of curricula, the relevance of teaching materials, and the alignment of the educational process with the current challenges of digital transformation and sustainable development. An analysis of the curricula of three bachelor’s programmes: F2 “Software Engineering” (n.d.) at the Inter-regional Academy of Personnel Management, Computer science. Modelling, design and computer graphics (n.d.) at the National Technical University “Kharkiv Polytechnic Institute” (F3 Computer Science) and Educational programme “Intelligent Information Systems” (Bachelor’s degree) (n.d.) at Vinnytsia National Technical University (126 Information Systems and Technologies) – revealed both common features and differences in the priorities of training students.

The F2 “Software Engineering” (n.d.) educational programme has an applied focus, emphasising software development, testing, and quality assurance. Its content is geared towards developing the practical skills necessary for graduates to quickly integrate into the professional environment. Automated testing tools, software code construction principles, and working with

command development systems are given special attention. The programme demonstrates a clear connection between applied disciplines, ensuring the integrity of the training. The educational programme Computer science. Modelling, design and computer graphics (n.d.) is characterised by a fundamental orientation and a deep theoretical foundation. Its structure includes mathematical logic, algorithms, data structures, information theory, software engineering, and artificial intelligence. The sequential study of disciplines ensures gradual mastery of the basic and specialised aspects of computer science. The programme promotes the development of analytical thinking, which is critical for research and development and the creation of innovative IT products. Educational programme "Intelligent Information Systems" (Bachelor's degree) (n.d.) focuses on IT infrastructure management, information systems design and administration, and the implementation of digital services. Emphasis is placed on IT project management that meets market requirements in the context of the development of e-government, financial technologies, and the digital economy. Students receive IT project management as a key focus, meeting market demands in the context of e-government, financial technology, and the digital economy. Students learn about corporate systems, cybersecurity, user interaction, and technical support.

A substantial component of IT specialist training is the use of methodological materials that ensure high-quality assimilation of the educational material. For example, the manual by S.M. Dovgalets & R.V. Masliy (2009) serves as the main source for studying algorithms and programming languages such as C++ and Python. It is notable for its logical structure and contains practical tasks for independent study. In turn, the textbook by T.A. Butenko & V.M. Syry (2020) covers a wide range of topics: from databases and telecommunications to the basics of cybersecurity and the organisation of IT systems. Additional resources include interactive online courses, including CS50: Introduction to Computer Science from Harvard University, which provides basic training in computer science, and the Machine Learning specialisation from Stanford University (Coursera), which introduces students to modern machine learning algorithms and their practical application. Authored teaching materials are also widely used, including the presentations [RE-183] Machine learning theory and algorithms (n.d.).

The organisation of the educational process in IT specialities is characterised by flexibility and practical orientation. The main forms include lectures, laboratory and practical classes, seminars, project-based learning, participation in hackathons, internships and workshops. A significant part of the educational process aims to solve real-life cases, develop software products, and defend coursework and theses of an applied nature. Pedagogical support for learning is based on the principles of constructivism, active independent acquisition

of knowledge through practice, and the principles of andragogy, which incorporate the needs and motivation of adult learners. Modern methodological approaches are used: problem-oriented learning, project method, case method, blended learning, flipped classroom, and elements of gamification. Digital platforms (GitHub, Microsoft Teams) are actively used to provide asynchronous learning, teamwork, and individual educational trajectories. This approach contributes not only to the formation of professional knowledge and skills but also to the development of critical thinking, responsibility, time management, and effective communication.

The educational programmes of specialities F2 Software Engineering, F3 Computer Science, and 126 Information Systems and Technologies have both strengths and certain limitations that affect the quality of training of specialists in the field of IT. The Computer Science and Intelligent Systems programme provides a thorough study of algorithms and data structures, which are fundamental to the development of high-performance systems and machine learning systems. Practical training is prioritised: laboratory assignments are conducted using the Python and Java programming languages, as well as modern artificial intelligence libraries such as TensorFlow and PyTorch, which meet the requirements of employers. Students can work on projects involving the development of intelligent agents and robotic systems, gaining practical experience in solving real-world problems. The academic programme is complemented by the integration of online courses, such as Machine Learning, which provides access to relevant case studies and the latest tools. At the same time, there are certain shortcomings, in particular the use of outdated methodological manuals (Dovgalets & Masliy, 2009; Butenko & Syry, 2020), which do not cover modern AI frameworks and cloud services. There are also no separate training modules on cybersecurity and building DevOps pipelines using Docker, Kubernetes, and CI/CD systems. In addition, cooperation with IT companies on organising internships and implementing practical case studies in the local market is limited.

The F2 "Software Engineering" (n.d.) programme specialising in Software Engineering focuses on a comprehensive study of the software development life cycle, from planning and coding to testing and support. Learning modern collaboration tools is a substantial part of the programme: version control systems (Git), agile methodologies (Agile, Scrum), and continuous integration tools (Jenkins, GitLab CI). Students complete project work on the development of web and mobile applications using React, Node.js, and REST API, which simulates typical commercial tasks. However, the programme lacks a practical component in the field of containerisation and orchestration, in particular, working with Docker and Kubernetes. In addition, there are no in-depth courses on cloud platforms such as Amazon Web Services, Azure or Google Cloud, which limits

students' preparation for deploying production environments. The block on machine learning or working with big data is also insufficiently represented, which reduces the interdisciplinary potential of the programme. In turn, the Information Systems and Technologies programme provides students with knowledge of comprehensive database processing (SQL, NoSQL), network technologies and server administration, which meets the market demand for specialists in the field of DBMS and infrastructure engineering. The programme also includes modules on IT governance, digital ethics and sustainable IT principles, which promote mastery of environmentally responsible design and provide knowledge on GDPR compliance. The ability to choose a specialisation (cybersecurity, data analytics or IoT) through elective disciplines makes the programme flexible and adaptable to the individual needs of students. An additional advantage is the use of the CS50 course, which provides a systematic awareness of the basic principles of computer science. At the same time, some teaching materials, such as the presentation [RE-183] Machine learning theory and algorithms (n.d.), are only of theoretical value and lack interactive components such as simulations or hackathons. There is also the use of outdated technologies, such as Hadoop and Spark, without adaptation to modern cloud data centres. Limited interaction with the business environment remains a significant problem: students lack access to open data and real-world cases from IT companies to address practice-oriented projects.

In general, educational programmes for training IT specialists in Ukrainian higher education institutions demonstrate compliance with international educational standards, in particular the recommendations of the ACM & IEEE Computer Society (2013) on training bachelors in computer science, as well as the standards of the European Committee for Standardisation (2014)

standards, which define professional competencies in the field of ICT (information and communication technologies) within the European Higher Education Area. This applies primarily to content, the use of digital resources, and the development of key professional and interdisciplinary competencies. However, there is still a need for further modernisation of educational programmes, updating of methodological materials, and more active integration of the principles of sustainable development and the development of digital culture. Such an update will contribute to more effective training of specialists capable of responding to the challenges of the digital economy and actively participating in the sustainable development of society.

Evaluating the effectiveness of methodological and theoretical approaches in training IT specialists

The quality of training for future IT specialists largely depends on the systematic evaluation of the methodological and theoretical approaches used. In the context of rapid technological change and growing demands on the qualifications of IT specialists, universities must not only update the content of their programmes, but also constantly review the effectiveness of their teaching methods. The quality of the educational process directly affects the ability of graduates to quickly adapt to the needs of the labour market, implement innovations and work in a highly competitive environment.

To identify the modern state of use of methodological and theoretical approaches in the training of IT specialists, as well as to assess the level of integration of modern educational practices in university courses, a questionnaire was developed for teachers of IT disciplines. The main aspects of the survey provided a comprehensive overview of the implementation of modern methodological approaches in higher IT education, as well as identifying areas for improvement (Table 1).

Table 1. Results of a survey of IT teachers

Question	Answer options	IAPM	NTU KhPI	VNTU	Total
Is the concept of sustainable development taken into account in your educational programmes?	Yes	8	10	7	25
	Partially	9	6	10	25
	No	3	4	3	10
What digital tools do you use most often in teaching?	Moodle	7	9	8	24
	Google Classroom	6	4	5	15
	Microsoft Teams	3	5	4	12
	Other	4	2	3	9
How would you rate the level of digital literacy among students?	High	5	8	6	19
	Average	13	10	11	34
	Low	2	2	3	7
What forms of training do you practise most often?	Face-to-face	4	5	6	15
	Remotely	6	5	4	15
	Mixed	10	10	10	30
Have you taken any advanced training courses in digital pedagogy?	Yes, regularly	5	6	4	15
	Yes, once	9	8	10	27
	No	6	6	6	18

Table 1. Continued

Question	Answer options	IAPM	NTU KhPI	VNTU	Total
What topics should be covered more extensively in IT specialist training?	Ethical aspects of technology	6	4	5	15
	Green IT	5	7	6	18
	Cybersecurity	7	7	8	22
	Other	2	2	1	5
What difficulties do you most often encounter when introducing innovations in teaching?	Insufficient technical support	6	5	5	16
	Resistance to change	3	4	3	10
	Lack of time	7	8	8	23
	Other	4	3	4	11

Source: compiled by the author

An analysis of the results of a survey of IT teachers at three universities revealed quantitative and qualitative characteristics of the modern state of integration of digital tools and sustainable development principles into the educational process. Regarding the inclusion of the concept of sustainable development in educational programmes, 41.7% of respondents indicated that it is fully included, another 25% (41.7%) indicated that it is partially included, while 16.6% indicated that it is completely absent. Moodle was found to be the most widely used tool in teaching digital disciplines, with 40% of respondents using it. Google Classroom (25%) and Microsoft Teams (20%) are used slightly less frequently. Other tools were mentioned in 9 cases (15%). These results indicate a certain preference for locally installed learning management systems over cloud services. Regarding the assessment of students' digital literacy, most teachers (56.6%) consider it average, 31.6% consider it high, and 11.8% consider it low. This distribution shows that, according to teachers' observations, a significant proportion of students have only basic digital skills, which can be a barrier to the effective acquisition of the latest IT knowledge. In terms of teaching methods, blended learning prevails, practised by 30 teachers (50%). Fifteen teachers (25%) use both face-to-face and distance learning methods. This demonstrates the growing popularity of a combined approach, which correlates with global trends in the digital transformation of education. Regarding professional development in digital pedagogy, 45% of respondents

had taken relevant courses once, 25% had attended regularly, and 30% had never participated. Among the topics that, according to teachers, require more attention in the training of IT specialists, the most frequently mentioned were cybersecurity (36.6%), green IT (30%) and ethical aspects of technology (25%). This choice demonstrates the relevance of an interdisciplinary approach to training future IT specialists. Regarding the readiness of graduates for the challenges of the digital economy, the majority of respondents (36 people, or 60%) chose the option "partially". Only 23.3% of people consider the training to be sufficient, while 16.7% do not. This indicates a gap between the educational process and the demands of the labour market. Teachers cited lack of time (38.3%), insufficient technical support (26.6%) and resistance to change (16.6%) as the most common difficulties in implementing innovations. These barriers need to be addressed in the management decisions of higher education institutions.

The survey results indicate certain dynamics in the renewal of the educational process in the field of IT, revealing critical points that require further improvement. In the context of digital transformation, it is necessary not only to modernise the content of disciplines, but also to ensure sustained support for teachers, expansion of digital infrastructure and increased practical orientation of courses. The next stage of the study was a survey of students in technical specialities, which provided an insight into the educational process from the perspective of student experience (Table 2).

Table 2. Results of a survey of students studying technical subjects

Question	Answer options	IAPM	NTU KhPI	VNTU	Total
Learning format is considered to be the most effective	Face-to-face	17	15	19	51
	Remote	14	12	11	37
	Mixed	49	53	50	152
Familiarity with the concept of "sustainable development" in IT	Yes, well aware	19	18	16	53
	Aware of the concept, but have little knowledge about it	40	42	38	120
	No	21	22	24	67
Most commonly used digital platforms	Moodle	28	31	26	85
	Google Classroom	22	20	23	65
	Microsoft Teams	20	19	20	59
	Other	10	10	11	31

Table 2. Continued

Question	Answer options	IAPM	NTU KhPI	VNTU	Total
Share of independently learned material	More than 50%	26	28	25	79
	20-50%	36	37	38	111
	Less than 20%	14	11	12	37
	Online resources are not used	4	4	5	13
Sufficiency of practical training	Yes	21	23	25	69
	Partially	43	40	38	121
	No	16	17	17	50
Required skills for further development	Collaboration	27	24	26	77
	Critical thinking	22	23	20	65
	Big data handling	25	26	27	78
	Other	6	7	7	20
Level of digitalisation of higher education institutions	High	20	22	24	66
	Average	43	41	40	124
	Low	17	17	16	50
Desire to participate in international IT projects	Yes	50	53	54	157
	Possibly	24	22	20	66
	No	6	5	6	17

Source: compiled by the author

A survey of students revealed key features of their perception of the educational process and their level of preparation for professional activity in the IT industry. First of all, the results showed a predominance of interest in a blended learning format: it was supported by more than 60% of respondents. The traditional face-to-face format was supported by about a fifth of respondents, while fully distance learning proved to be the least popular, with less than 16%. This indicates that students are keen on combining the flexibility of online learning with the effectiveness of live communication. In terms of awareness of the concept of “sustainable development” in the IT field, only 22% of respondents indicated a mastery of the topic. Half of the students are only superficially familiar with it, while 28% have never heard of this concept. This indicates a need for the targeted introduction of relevant disciplines into technical education programmes. When it comes to the use of educational digital platforms, students most often turn to Moodle, followed by Google Classroom and Teams. In particular, these three platforms together account for over 85% of responses, confirming their dominance in the educational process. The share of alternative platforms was insignificant, which indicates a limited range of digital tools in everyday learning. Most students actively use online resources for self-study: over 79% of respondents study 20 to 50% or more of the educational material independently. Only a small proportion of students (approximately 5%) do not engage in independent work with digital resources, indicating a general trend towards digital autonomy among students. As for practical training, only slightly more than a quarter of respondents consider it sufficient. Instead, the majority (71%) assess their level of practical skills as partial or insufficient. This highlights the need for more active implementation of practice-oriented courses, internships, and project activities. The identification of

the most sought-after skills yielded an interesting result: approximately one-third of students chose working with big data, almost as many chose teamwork, and one-quarter chose critical thinking. This demonstrates awareness of the importance of both technical and soft skills in professional growth. Most respondents rated the level of digitalisation in educational institutions as average, slightly less than a third rated it as high, and one in five rated it as low. Such variability in ratings may indicate both differences between institutions and uneven implementation of digital practices within a single institution. Lastly, 65% of respondents expressed high motivation to participate in international IT projects, with more than a quarter considering such an opportunity. Only a small number of students rejected such initiatives, demonstrating the potential for active international integration.

During the survey of all participants in the study, several aspects were identified that indicate non-compliance with substantial principles of the modern educational process in technical specialities. One of these principles is the principle of practical orientation of education, which is critical for training specialists in the field of IT. Most students rate the level of practical training as insufficient, which indicates that the educational process does not sufficiently address the development of practical skills. This is also confirmed by the high level of independent learning using online resources, which highlights the lack of practical tasks and projects in the academic programme. The lack of a practical component in education may result in graduates not having the necessary skills to work in real labour market conditions. Another principle that has not been sufficiently reflected in the educational process is the personalisation of learning. According to the survey results, students believe that the blended learning format has become the most effective, but most of them do not

receive enough individual attention during their studies, which is confirmed by the lack of adequate practical training. This also indicates that the educational process needs to be adapted to different types of students and their needs, particularly those who are interested in specific technologies or methods, such as working with big data or teamwork.

According to the survey results, most students actively use online resources for self-study, which expands the knowledge of students outside the scope of the academic programme. At the same time, this self-study process is a substantial tool for the development of critical thinking. The use of online courses, videos, articles, and practical learning tools not only improves mastery of new technologies among students but also helps them evaluate them from different perspectives, which contributes to the development of analytical skills and further research of the material. A substantial component of self-learning is that it promotes the development of critical thinking in students, especially in the context of technological innovation. When students learn new technologies independently, they often encounter problems that require a creative approach to solving tasks. Therefore, students can develop skills for solving non-standard problems by evaluating different options and justifying their choices. Thus, self-study not only provides the necessary knowledge but also actively influences the formation of critical thinking, which is one of the key competencies of a future IT specialist.

Recommendations for improving educational programmes, incorporating the requirements of IT companies and trends in the development of the technology sector

Improved educational programmes for IT specialisations are necessary in light of the rapid development of digital technologies and growing employer demands for specialists in this field. To improve the learning process and eliminate identified shortcomings, it is necessary to comprehensively modernise the content of education, methodological approaches and forms of learning organisation, focusing on the real needs of the labour market and the experience of leading IT companies. In particular, it is necessary to integrate educational programmes with the practical activities of IT companies. This can be achieved through the introduction of dual education, where part of the training takes place directly at the companies' premises, using their technical environment, tools and practices. It is also advisable to create joint educational trajectories with the participation of practising specialists who will be involved in developing courses, giving lectures, conducting workshops, and mentoring student projects.

Leaders of IT companies such as EPAM System and SoftServe note that specialists who have not only technical knowledge but also critical thinking skills, teamwork skills, the ability to quickly adapt to new technologies,

mastery of the principles of software architecture, DevOps approaches, systems thinking, and Agile frameworks are most valued. They also emphasise the need for knowledge of cybersecurity, cloud technologies (Amazon Web Services, Azure), artificial intelligence, machine learning, and working with big data. For educational programmes to meet these expectations, the content of academic disciplines needs to be reviewed. For example, it is advisable to include courses on modern programming languages, as well as a more in-depth study of frameworks. It is advisable to integrate classic relational systems, namely MySQL and PostgreSQL, into the educational process, as they provide a high level of data consistency, support for complex transactions, and the SQL standard. Modern NoSQL solutions, such as MongoDB, should be used for their flexible document storage scheme, which facilitates scaling, and Cassandra, which is notable for its high fault tolerance and linear scaling when processing large amounts of data. In addition, cybersecurity modules should be strengthened, particularly in the areas of penetration testing, cryptography, and secure coding, as these areas provide practical skills for identifying vulnerabilities, ensuring data confidentiality, and developing secure software products, which are critical in the context of growing threats to information security.

Theoretical and methodological approaches should be modernised separately. Traditional lectures should be replaced by interactive formats: live case discussions, simulations of real projects, the use of peer learning methods, and the active introduction of problem-oriented and project-based learning. Methodologically, textbooks should be updated, for example, by replacing outdated materials with modern interactive platforms such as Codecademy, LeetCode, and HackerRank, where students can practise practical tasks with automatic code verification. It is worth following the example of CS50, Stanford CS229, Google Career Certificates, Microsoft Learn, and IBM SkillsBuild courses, which combine short theoretical blocks with practical tasks, certification, and career growth recommendations. Some ideas that can be borrowed from modern IT courses include the use of mentoring, adaptive learning with automatic task difficulty selection, integration of real cases from open source projects, and involvement of applicants in competitions such as Google Summer of Code. Another positive practice is individual development trajectories, where students can choose their specialisation: backend, frontend, data science, DevOps, cybersecurity, game development, etc. The feasibility of methodological and theoretical approaches needs to be assessed systematically. In particular, surveys of students can be used to assess the quality of teaching, the level of material assimilation, and the relevance of the subject matter. For example, if most students indicate that the tasks are theoretical and do not correspond to modern tools (e.g., they do not use Git, Docker, or CI/CD

systems), this indicates a need to change the methodology. Another substantial indicator is the results of independent testing, student participation in hackathons, competitions, open-source projects, and start-ups. Assessment can also be conducted through external audits by IT companies: experts can analyse curricula, attend coursework defences and internships, and review projects. For instance, EPAM Systems can provide its mentors to evaluate students' teamwork in a real project. Constant monitoring and open dialogue between education and business can ensure contribution of methodological and theoretical approaches to the formation of true specialists in the modern IT industry.

The learning process can also be improved through regular analysis of learning outcomes using digital tools (LMS analytics, performance tracking, reflective journals) and feedback from students and employers. Involving IT companies in certification commissions, participating in joint research projects, and introducing start-up incubators at universities contribute to the formation of a professional environment during the learning process.

Among the key recommendations for improving educational programmes, the following can be highlighted: integration of new technologies and trends; regular updating of course content to reflect trends in IT, such as generative artificial intelligence (GPT, LLM), Web3, blockchain, quantum computing; updating teaching materials; creating interactive textbooks with multimedia elements; integrating learning platforms into the overall teaching system; refocusing on practice: 70% of learning should be practice-oriented, including project creation, stage-based learning, and working with real technical tasks; career guidance and mentoring; creating educational tracks that can be used by students to choose a specialisation and orient themselves in real professions; interdisciplinarity and soft skills; introduction of courses in project management, communication, entrepreneurship, and digital ethics.

Thus, the modernisation of educational programmes, incorporating the requirements of IT companies, must be systematic, dynamic and based on partnership between higher education institutions and industry representatives. Only under such conditions is it possible to train competitive specialists who are not only able to work effectively in an IT environment, but also to be a driving force for innovation in the digital economy.

■ Discussion

The results of this study showed that updating the content of IT specialist training programmes is necessary to ensure compliance with digitalisation and sustainable development trends. This is consistent with the findings of O. Popelo *et al.* (2024), emphasising that the digitalisation of universities must be integrated into educational processes, providing not only technical knowledge but also the development of competencies related to the digital economy. Similar conclusions were

also made by P. Vinh (2021), emphasising that global trends in the digital transformation of education require the adaptation of IT education programmes to the real needs of the labour market. In addition, personalised training programmes contribute to improving the level of training of IT specialists, as they incorporate the individual needs of students. This is partly consistent with the findings of F. Fraile *et al.* (2023), proposing a methodological model of personalised learning to support professional development in Industry 5.0, based on an analysis of students' competencies and needs. Another substantial aspect is the development and accreditation of educational programmes for IT specialists. The results of this study demonstrate that the use of dynamic software contributes to the development of students' analytical thinking, which is substantial in the training of IT specialists. A similar point of view is supported by V. Yunchyk *et al.* (2021), arguing that cognitive modelling of the learning process has a positive effect on the formation of professional skills of IT specialists. The results of the study confirmed that the use of a new approach to curriculum design can effectively adapt the content of education to the requirements of the labour market. This is consistent with the findings of T. Kovaliuk *et al.* (2020), noting that ontological models can be used to create structured educational programmes that meet the real needs of the IT industry and promote greater flexibility in curricula. In addition, a substantial aspect of updating the training of IT specialists is the development of soft skills, in particular communication, teamwork and critical thinking skills. This correlates with the conclusions of B. Zulauf & N. Knipprath (2020), noting that modern IT specialists must have not only technical competencies but also well-developed interpersonal skills. I. Shishenko *et al.* (2020) also noted the same idea, highlighting that the use of interactive teaching methods can be used by students to develop both technical and social skills.

The results of this study showed that the use of new learning models in the professional training of IT specialists contributes to the development of analytical thinking, the optimisation of learning processes, and the improvement of the effectiveness of independent learning. This is consistent with the findings of S. Jacobs & S. Jaschke (2023), arguing that integrating different models into the learning process can accelerate adaptation of future IT specialists to the changing demands of the labour market and improve efficiency of complex programming task solution. The authors also emphasised that artificial intelligence models can act as mentors, promoting personalised learning and expanding students' opportunities for independent mastery of complex material. The study also found that the use of a cloud environment in database training has become an effective tool for training IT specialists, as it provides practice with real technologies and develops practical skills. This is consistent with the findings of

O. Korotun *et al.* (2020), demonstrating that cloud-based learning models improve students' big data skills and increase their competitiveness in the labour market. This is also confirmed by the research of O. Kopishynska *et al.* (2020), noting that the integration of cloud technologies can be used by students to access advanced information systems and promotes closer interaction between educational institutions and the IT industry. The results of this study indicate the significant role of additional online courses in the training of IT specialists, especially in the context of developing flexible educational models. This is consistent with the research of T. Sobchenko & O. Zhelizniak (2023), who noted that this contributes to the formation of professional competence by increasing the accessibility of knowledge and providing personalised learning. Similar conclusions were also made by S. Sharov *et al.* (2021) in an analysis of the effectiveness of massive open online courses in programming education, and they concluded that such courses are a powerful tool for expanding the professional opportunities of future IT specialists. The structured organisation of such courses affects student success. This is consistent with the findings of E. Kaila & K. Lemström (2023), demonstrating that well-organised courses with a defined schedule promote improved learning, while flexible courses without a fixed schedule can lead to lower student engagement.

The results of the study also demonstrated that the continuous improvement of information technologies in the educational process of future IT specialists contributes to the formation of professional skills. This is consistent with the findings of O. Karupu *et al.* (2021), confirming that the use of digital technologies in mathematical disciplines improves mastery of algorithms, technical literacy, and contributes to the development of logical thinking among students. In addition, interactive teaching methods can also be an effective means of increasing student motivation to study IT disciplines. This correlates with the findings of M. Sade *et al.* (2021), confirming that after completing programming courses based on game mechanics, students demonstrated better results in mastering the material. A similar study by U. Stoltenberg & G. Michelsen (2023) noted that digital technologies and interactive methods can contribute to the development of competencies necessary for sustainable development by combining technical and ethical aspects of learning. In the context of sustainable development, the results of this study confirm that the digital transformation of higher education is a key factor in ensuring sustainable management of the educational process. This is consistent with the findings of E. Abad-Segura *et al.* (2020), demonstrating that digitalisation contributes to improving the effectiveness of learning, expanding access to educational resources and reducing environmental impact by reducing the use of paper materials. The results of this study also demonstrated that integrating sustainable development principles into

higher education can help train IT specialists who prioritise not only technological progress but also environmental and social responsibility. This is consistent with the study by D.A. Charkova & E. Somova (2023), conducted among IT students in Bulgaria. In particular, 67.3% of respondents believe that university education should promote the development of social and environmental skills, and a significant proportion of students are willing to refuse jobs related to fossil fuels or choose lower salaries in favour of environmental principles.

The study revealed several issues in the professional training of IT specialists, including insufficient practical training and a gap between theoretical knowledge and labour market requirements. This is consistent with the findings of O. Sysoiev (2022), identifying a similar situation in the economic sphere, where educational programmes do not always meet the real needs of professional activity. Similar results were obtained by G. Tomer & S.K. Mishra (2023), determining that many IT specialist training programmes do not include enough case studies related to real work situations, which makes it difficult for graduates to find employment. Nevertheless, the results of this study confirm that updating the training of IT specialists in the context of the digitalisation of education and sustainable development should be based on a personalised approach, the integration of the latest technologies, close cooperation with the IT industry, and the use of innovative teaching methods.

■ Conclusions

An analysis of curricula and teaching materials for training IT specialists showed that the educational programmes F2 Software Engineering, F3 Computer Science and 126 Information Systems and Technologies are sufficiently structured and practically oriented. The programmes combine fundamental knowledge with applied competencies relevant to the digital economy and Industry 4.0. Teaching materials, including printed manuals, author presentations and online courses, meet the modern challenges of digitalisation. Interactive forms of learning are substantial, promoting the development of analytical thinking and teamwork skills necessary for successful professional fulfilment in the IT field.

The study, which covered both IT teachers at three higher education institutions in Ukraine and students, identified modern trends, problems and potential in the organisation of the educational process in the field of information technology. An analysis of the teachers' questionnaires showed that although the concept of sustainable development is partially integrated into the curricula, the full inclusion of this topic still needs to be strengthened. The results of a survey of 60 IT teachers indicate a low level of integration of the concept of sustainable development into the curricula. The results of the survey of IT teachers showed that 56.6% consider

the level of student preparation to be average for the challenges of the digital economy, and 31.6% consider it to be high, while 11.8% assess it as low, indicating a need to update the content of education. Despite the popularity of the blended format (50%) and the active use of Moodle (40%), only 25% of teachers regularly took advanced training courses in digital pedagogy, which may hinder the effective integration of modern digital solutions into the educational process. Teachers and IT company managers noted the relevance of developing not only technical skills, but also soft skills: critical thinking, teamwork, and adaptability to technological changes. The blended learning format, supported by over 60% of respondents, along with a high level of digital autonomy (79% of students master a significant part of the material independently) and active use of three main educational platforms (85% of responses cover Moodle, Google Classroom and Teams), demonstrates the adaptability of students to the modern integrated learning environment. At the same time, only 22% of respondents are deeply familiar with the concept of “sustainable development”, and 71% indicate an insufficient level of practical training, which highlights the need to strengthen the applied component of education and include relevant thematic courses in educational programmes.

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Inclusion of topics such as cybersecurity, DevOps, cloud technologies, big data, artificial intelligence, as well as modern programming languages and frameworks in the curriculum, was emphasised. Methodological approaches need to be modernised: instead of traditional lectures, simulations, case studies, peer learning, project-based and problem-oriented learning should be used. This will not only improve the assimilation of material but also develop critical thinking and the ability to solve complex problems independently. The limitations of the study are its focus on a sample of only three universities and the lack of a detailed qualitative analysis of motivational factors. The prospects for the study lie in further analysis of the effectiveness of the educational innovations implemented and the development of dual IT education models in collaboration with leading companies in the industry.

■ Acknowledgements

None.

■ Funding

None.

■ Conflict of Interest

None.

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Теоретичні та методичні підходи до оновлення підготовки ІТ-фахівців в умовах сталого розвитку та цифровізації освіти

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■ **Анотація.** Метою дослідження було проаналізувати ефективність освітніх програм спеціальностей F2 Інженерія програмного забезпечення, F3 Комп'ютерні науки й 126 Інформаційні системи та технології та визначити шляхи їх удосконалення відповідно до вимог даної індустрії. Методологія дослідження включала анкетування, кількісний аналіз, порівняльний аналіз освітніх програм і експертну оцінку методичних матеріалів. У ході дослідження, проведеного впродовж вересня 2024 року, було виявлено, що освітні програми підготовки фахівців з комп'ютерних наук, інженерії програмного забезпечення та інформаційних систем потребують оновлення відповідно до вимог ринку праці. У результаті аналізу методичних матеріалів з'ясовано, що більшість освітніх програм не актуалізують технології та інструменти професійної сфери, а також не враховують розвиток цифрових умінь та принципів сталого розвитку. Найпопулярнішою платформою для навчання став Moodle, який використовували 40 % опитаних. Цифрова грамотність студентів, за оцінками викладачів, здебільшого середнього рівня (56,6 %). Високий рівень відзначили лише 31,6 % респондентів, що вказало на потребу в розвитку професійної компетентності. Щодо опитування студентів, то виявлено, що домінує саме змішана форма організації освітнього процесу (понад 60 % підтримки) у поєднанні з високою цифровою автономією студентів (79 % самостійного опрацювання матеріалів). Аналіз підготовки виявив, що хоча є окремі спроби інтегрувати інноваційні технології, зокрема штучний інтелект, його впровадження є недостатнім для повного розвитку фахівців. Виявлено потребу в удосконаленні методичних підходів до викладання, через інтеграцію онлайн-курсів і проектної діяльності. Отримані результати можуть бути використані викладачами, адміністраціями закладів вищої освіти для удосконалення методик підготовки фахівців, зокрема для оновлення освітніх програм відповідно до вимог сучасного ринку праці

■ **Ключові слова:** цифрові технології; технологічні зміни; захист інформації; критичне мислення; самонавчання

Науковий журнал
«ПРОФЕСІЙНА ОСВІТА: МЕТОДОЛОГІЯ, ТЕОРІЯ ТА ТЕХНОЛОГІЇ»

Том 11, № 2
2025

Відповідальний редактор:
Н. Сердюк

Підписано до друку з оригінал-макета 24.12.2025
Ум. друк. арк. 10,5
Тираж 100 примірників

Видавництво:
Університет Григорія Сковороди в Переяславі
08401, вул. Сухомлинського, 30, м. Переяслав, Україна
E-mail: mail@profedu.com.ua
<https://profedu.com.ua/uk>

Scientific Journal

“PROFESSIONAL EDUCATION: METHODOLOGY, THEORY AND TECHNOLOGIES”

**Volume 11, No. 2
2025**

Managing Editor:
N. Serdiuk

Signed to the print with the original layout 24.12.2025
Conventional Printed Sheet 10.5
Circulation 100 copies

Publisher:
Hryhorii Skovoroda University in Pereiaslav
08401, 30 Sukhomlynskyi Str., Pereiaslav, Ukraine
E-mail: mail@profedu.com.ua
<https://profedu.com.ua/en>