МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
УНІВЕРСИТЕТ ГРИГОРІЯ СКОВОРОДИ В ПЕРЕЯСЛАВІ

ПРОФЕСІЙНА ОСВІТА:
МЕТОДОЛОГІЯ, ТЕОРІЯ ТА ТЕХНОЛОГІЇ

Том 12, № 1
2026

Науковий журнал

Переяслав
2026

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

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES

Vol. 12, No. 1
2026

Scientific Journal

Pereiaslav
2026

ISSN 2415-3729
e-ISSN 2415-3737

УДК 37

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 № 10 від 12 травня 2026 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:
А5 Професійна освіта (за спеціалізаціями)
(Наказ Міністерства освіти і науки України № 928 від 11.06.2026)

Кластер: Розвиток людського капіталу, соціальні науки та журналістика

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;
ERIH PLUS; GALE

Адреса редакції:
Університет Григорія Сковороди в Переяславі
08401, вул. Сухомлинського, 30, м. Переяслав, Україна
Тел.: +380 (44) 293-11-10
E-mail: mail@profedu.com.ua
https://profedu.com.ua/uk

ISSN 2415-3729
e-ISSN 2415-3737

UDC 37

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. 10 of May 12, 2026)

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:
0114 Teacher training with subject specialisation
(Order of the Ministry of Education and Science of Ukraine No. 928 of 11.06.2026)

Cluster: Human capital development, social sciences and journalism

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;
ERIH PLUS; GALE

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ПРОФЕСІЙНА ОСВІТА:
МЕТОДОЛОГІЯ, ТЕОРІЯ ТА ТЕХНОЛОГІЇ

Том 12, № 1, 2026

Редакційна колегія

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES

Vol. 12, No. 1, 2026

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ЗМІСТ/CONTENTS

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 8-18
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 15.10.2025 Revised: 24.03.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 378.147:004:658.8
DOI: 10.69587/pemtt/1.2026.08

Assessment of factors influencing the development of digital competence among Bachelor's students in marketing at higher education institutions

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■ **Abstract.** The study aimed to identify the determinants of the development of digital competence among Bachelor's students in marketing and to assess their significance in the context of the digital transformation of higher education, with a view to strengthening the requirements for their professional training. The research methodology included a structured questionnaire developed based on the DigComp 2.2 and DigCompUA digital competence frameworks, enabling a comprehensive assessment of the importance of regulatory, content-related, technological, methodological and personal factors. A rating scale was used to assess the significance of selected factors, followed by summarisation of the results using descriptive statistics and comparative analysis. The study involved 245 prospective marketing specialists in their second to fourth years of study and 16 academic staff from higher education institutions involved in delivering the programme. Respondents identified priority areas for developing digital competence, assessed the role of the educational environment, the extent to which digital tΦools were integrated into educational components, and their readiness to use these tools in their professional activities. The study focused on analysing institutional conditions, the content of the educational programme, the use of modern digital platforms and services, pedagogical approaches, and the personal characteristics of future specialists, particularly their motivation for digital self-development and their ability to learn independently. The results showed differences in the perception of priorities among different groups of respondents. Students focused more on technological resources and the practical use of digital tools in marketing activities. At the same time, academic staff prioritised regulatory support, methodological support and the systematic integration of digital technologies into educational content. It was established that the effective development of digital competence requires a coordinated combination of institutional support, the updating of educational programmes, the introduction of modern teaching methods and the development of

Suggested Citation:
Voloshyna, T., Sydoruk, Y., & Korolchuk, V. (2026). Assessment of factors influencing the development of digital competence among Bachelor's students in marketing at higher education institutions. *Professional Education: Methodology, Theory and Technologies*, 12(1), 8-18 doi: 10.69587/pemtt/1.2026.08.

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students' personal responsibility for their own professional developmentcombination of students' intellectual, emotional, and practical development

Keywords: educational process; professional training; educational programme; determinants; future specialists

Introduction

The rapid development of digital technologies, particularly marketing automation systems, web analytics tools, customer relationship management platforms and social media ecosystems, is significantly transforming the professional activities of modern marketers. Marketing practice requires mastery of data-driven decision-making skills, the use of digital platforms, such as Google Analytics, and the interpretation of consumer behaviour through digital footprints. At the same time, research results and analytical reports on the labour market indicate a persistent gap between the digital competences required by employers and those developed by graduates of higher education institutions (HEIs). In the context of Ukraine's digital transformation and its integration into the European educational and economic space, this problem is becoming particularly urgent. HEIs should provide not only theoretical training, but also the development of applied digital competences in accordance with international frameworks, such as DigComp 2.2, and their national adaptations, including DigCompUA. At the same time, the development of digital competence is a complex, multifactorial process influenced by the content of educational programmes, the level of technological support, teaching methods and the individual characteristics of students.

An insufficient level of digital competence among prospective Bachelor's students in marketing can lead to difficulties in applying digital tools in professional activities, reduced adaptability to labour-market requirements and a loss of competitiveness in the digital economy. Therefore, it is important to identify and empirically assess the significance of the key factors influencing the development of digital competence among Bachelor's students in marketing, taking into account the structural and organisational characteristics of HEIs. This will make it possible to substantiate scientifically sound approaches to improving educational programmes and enhancing the quality of professional training for Bachelor's students in marketing. According to R. Vuorikari *et al*. (2022), improving the digital literacy of the population and developing digital skills have been identified as key priorities of the European Union up to 2030, with a focus on achieving a basic level of digital competence in at least 80% of the population. In contemporary research, digital competence is defined as the safe, critical and responsible use of digital technologies. It is applied in educational activities, the professional sphere and participation in society.

In accordance with R. Vuorikari *et al*. (2022), digital competence encompasses working with information and data, communication and collaboration, creating digital content, security and problem-solving. At the same time, empirical research by O. Hlazunova *et al*. (2024) confirmed that students' level of digital competence is associated with their successful employment and career prospects, and, according to V. Kovalchuk (2023), contributes to the high-quality integration of digital technologies into the learning process and the formation of professional identity. Contemporary scientific research focuses on approaches to assessing students' digital competence and on identifying conditions that promote its effective development. For example, A. MejíasAcosta *et al*. (2024) proposed and validated a method for assessing digital competence along key dimensions. In the research by A. Zubizarreta Pagaldai *et al*. (2025), predictors related to support in the educational environment, attitudes towards information and communication technologies, and the frequency of their use were identified. A. Sotelo-Núñez *et al*. (2024) concluded that the analysis of students' digital competence extends beyond the individual level to include educational practices, policies, technological support and the socio-labour context. Considering the approaches outlined above and the requirements arising from the digital transformation of marketing activities, this study examines the components of digital competence for Bachelor's students in marketing as defined by Y. Sydoruk (2025). These components include: (C1) information literacy; (C2) ethics and security; (C3) digital marketing and social media; (C4) data analysis and insights; (C5) UX design and development; and (C6) artificial intelligence and machine learning.

A review of scientific sources has provided grounds for asserting that the development of digital competence results from the interaction of a set of factors: regulatory, content-related, technological, methodological and personal. At the same time, existing studies mainly focus on individual factors or dimensions of digital competence without analysing their integrated interaction in the context of training Bachelor's students in marketing. This study aimed to identify the main determinants of the development of digital competence among Bachelor's students in marketing and to assess their significance using survey data from participants in the educational process. In accordance with the stated aim of the study, the following tasks were defined: to analyse and identify factors that influence the development of digital competence among Bachelor's students in marketing; to investigate the relationships between individual factors and assessments of their significance provided by students and lecturers; and to substantiate the practical significance of these factors for improving

the educational process in the professional training of Bachelor's students in marketing. This determines the scientific novelty of the study, which offers an integrative approach to assessing the interrelationships between key factors in the development of digital competence in the university educational environment.

Materials and Methods

The study was conducted as an online survey to determine the significance of factors shaping the digital competence of Bachelor's students in marketing in the educational process of HEIs. The study sample was purposive. A total of 245 students majoring in marketing in their second to fourth years of study, and 16 lecturers from the National University of Life and Environmental Sciences of Ukraine, participated in the study. The inclusion criteria for students required enrolment in a Bachelor's programme in marketing, completion of at least one course involving digital tools or digital marketing, and active engagement in the learning process during the study period. Lecturers were included if they were responsible for teaching marketing-related subjects and had practical experience in integrating digital technologies into teaching. Participants who did not meet these criteria or provided incomplete responses were excluded from the analysis. This sample composition ensured representation of the key groups involved in the training of Bachelor's students in marketing.

Empirical data were collected between 2023 and 2025 using Google Forms. The research toolkit was developed based on the DigComp 2.2 and DigCompUA digital competence frameworks, as well as contemporary scientific approaches to assessing digital competence. The developed questionnaire consisted of 33 questions and was structured into five thematic blocks reflecting key groups of factors in the development of digital competence: regulatory, content-related, technological, methodological and personal. The regulatory block, comprising 4 questions, was designed to assess the impact of regulatory documents and educational standards on the development of digital competence among Bachelor's students in marketing. The content-related block, comprising 5 questions, covered issues related to the educational programme "Marketing", in particular the alignment of academic disciplines and materials with contemporary requirements, as well as opportunities for the practical and independent development of digital competence. The technological block, comprising 9 questions, was designed to assess the level of technical and informational support for the educational process. The methodological block, comprising 9 questions, enabled analysis of the impact of pedagogical approaches and teaching methods on the development of digital competence. The personal block, comprising 6 questions, involved assessing respondents' individual characteristics, in particular motivational, cognitive and behavioural factors that influence the development of digital competence. The significance of each factor was assessed using a five-point Likert scale ranging from 0 to 4.

The data obtained were analysed using descriptive statistics. A comparative analysis of students' and lecturers' assessments was conducted, and the relationships among the identified groups of factors were examined. Throughout the study, respondents' anonymity and voluntary participation were ensured in accordance with the ethical requirements for conducting socio-pedagogical research. The study was conducted in accordance with the ethical principles of educational research involving human subjects, as set out in the British Educational Research Association guidelines (2018). All participants provided informed consent. The study was conducted as a quantitative, cross-sectional online survey aimed at determining the significance of factors shaping the digital competence of Bachelor's students in marketing in HEIs. A purposive sampling method was employed to ensure that both key stakeholder groups in the educational process, namely students and lecturers, were adequately represented. The study sample included 245 students majoring in marketing in their second to fourth years of study and 16 lecturers from the National University of Life and Environmental Sciences of Ukraine, providing a sufficient basis for both descriptive and inferential statistical analysis. Empirical data were collected between 2023 and 2025 using Google Forms. The research instruments were developed on the basis of the DigComp 2.2 and DigCompUA digital competence frameworks, as well as contemporary scientific approaches to evaluating digital competence. The questionnaire consisted of structured blocks corresponding to five groups of factors: regulatory, content-related, technological, methodological and personal. Each factor within these blocks was assessed on a five-point Likert scale, where 0 indicated the lowest perceived significance, and 4 indicated the highest. The instrument's design enabled systematic comparison of student and lecturer perceptions and ranking of the factors according to their average importance.

For data processing, descriptive statistical methods were applied, including the calculation of mean values, standard deviations and percentages to summarise respondents' evaluations. Factor values were computed as mean scores across all items within each block, reflecting participants' aggregated perceptions. The significance of differences between student and lecturer evaluations was assessed using Student's t-test with Welch's correction, which accounts for unequal variances between groups. A significance level of 0.05 ($p < 0.05$) was used to determine statistical significance. Effect sizes were calculated using Cohen's d to quantify the magnitude of observed differences. Factor ranking was performed according to these mean values, yielding a clear hierarchy of the relative importance of each

factor group for the development of digital competence. In addition to survey data, secondary sources such as institutional documents, educational programmes and statistical reports were consulted to contextualise the empirical findings and support the interpretation of the results. Archival materials and official statistics were used to verify the relevance of the selected factors and ensure alignment with current educational standards and practices. Mathematical formulas underlying the calculation of means, t-values and Cohen's d were applied to ensure the accuracy and reproducibility of the analyses. The use of a structured online survey facilitated systematic data collection while maintaining respondent confidentiality. Overall, the combined application of descriptive and inferential statistics, structured questionnaires and relevant documentary sources enabled a rigorous and comprehensive evaluation of the factors influencing the development of digital competence among Bachelor's students in marketing in higher education settings.

Results

Based on the analysis and synthesis of the studies of O. Hlazunova *et al*. (2024), A. MejíasAcosta *et al*. (2024) and A. Sotelo-Núñez *et al*. (2024), five groups of factors influencing the development of digital competence among Bachelor's students in marketing at HEIs were identified: regulatory, content-related, technological, methodological and personal. Their characteristics, their impact on the components of competence and their manifestation in professional training are summarised in Table 1.

Table 1. *Factors shaping the digital competence of Bachelor's students in marketing and their corresponding areas of manifestation*

Factor	Characteristic	Digital competence	Area of application
Regulatory	■ academic and professional requirements ■ regulatory documents of the HEI	(C1) Information literacy (C2) Ethics and safety	Educational process: performing tasks in accordance with standards; assessing the reliability of sources; adhering to academic integrity Professional activity: complying with professional standards and policies; adhering to ethical standards for working with data; preparing reports
Content-related	■ educational and professional programme ■ content of educational components	(C1) Information literacy (C3) Digital marketing and social media (C4) Data analysis and insights (C5) UX design and development (C6) AI and machine learning	Educational process: completing tasks in accordance with the course syllabus; working with activities and resources in electronic training courses Professional activity: ensuring the effective application of digital knowledge in marketing, analytical, UX and AI projects
Technological	■ cloud services ■ platforms, resources ■ specialised software	(C1) Information literacy (C3) Digital marketing and social media (C4) Data analysis and insights (C5) UX design and development (C6) AI and machine learning	Educational process: using cloud services, platforms, resources, and specialised software Professional activity: using analytics and AI in marketing; creating UX/UI solutions; automating processes; establishing communication and interaction
Methodological	■ teaching methods and technologies ■ assessment and feedback methods	(C3) Digital marketing and social media (C4) Data analysis and insightsW	Educational process: case studies; team projects; interactive tasks; retrospective analysis Professional activity: working on marketing projects in companies; conducting market analysis; making decisions
Personal	■ personal resources ■ ability to adapt ■ social prerequisites ■ reflective potential	(C1) Information literacy (C2) Ethics and security (C3) Digital marketing and social media (C4) Data analysis and insights (C5) UX design and development (C6) AI and machine learning	Educational process: showing initiative in performing tasks with the support of digital technologies; independently selecting tools; actively participating in teamwork; reflecting on results Professional activity: independently implementing digital solut ions; showing initiative in team marketing projects

Source: *compiled by the authors*

The development of digital competence among Bachelor's students in marketing is influenced by external and internal factors in the educational and professional environment. The regulatory factor covers several key components defined in regulatory and conceptual documents. Specifically, these include the Order of the Ministry of Education and Science of Ukraine No. 1323 "On Approval of the Higher Education Standard for Specialty 075 "Marketing" for the First (Bachelor's) Level of Higher Education" (2021), and the Digital Competence Framework for Ukrainian Citizens, developed by the Ministry of Digital Transformation of Ukraine (2023), based on the European DigComp model. In addition, the regulatory framework includes the Register of Professional Standards of the National Agency for Qualifications of Ukraine,

particularly the professional standard "Specialist in Market Expansion Methods (Marketer)" (National Agency for Qualifications, 2025), the educational programme of the relevant HEI, and the institution's internal regulations and procedures. This factor contributes to a high level of professional training and to the development of students' ability to adapt quickly to the challenges of digital transformation and to interact effectively in the digital economy. Thus, the regulatory factor underpins the development of the other factors.

Along with regulatory requirements, the content-related factor plays a key role in the training of Bachelor's students in marketing, shaping the educational components and ensuring their alignment with general and professional competences. It covers both compulsory and elective components of the educational programme, aimed at developing students' knowledge, skills and abilities. Consistency between general and professional competences is ensured by a matrix that links programme competences to educational components and specifies the expected learning outcomes for each component. The educational programme is implemented through course syllabuses and the corresponding electronic training courses (ETCs). The course syllabuses contain a brief description of each discipline, its purpose, structure, programme and assessment methods, as well as recommended teaching and methodological literature. ETCs provide students with access to varied educational content and facilitate interactive communication among participants in the educational process. Thus, the content-related factor puts into practice the competences defined in regulatory documents, serves as the basis for other components of digital competence and ensures the integrity of the educational process, so that the training of Bachelor's students in marketing meets the current requirements of the labour market.

The technological factor in shaping the digital competence of Bachelor's students in marketing determines their access to modern IT infrastructure and digital resources at HEIs, thereby providing the basis for effective, practice-oriented learning. It includes university platforms, an electronic library and external professional services that provide a wide range of opportunities for working with information, analysing data and creating marketing products. The availability of modern training laboratories enables students to gain practical experience with digital marketing tools. Such laboratories create conditions close to those of real professional activity by modelling work with market simulations, advertising campaigns, consumer behaviour data and related activities. Access to learning platforms, cloud services, specialised software solutions, professional communities and databases helps students master modern digital technologies and business analytics tools. Modern marketers actively use these tools, which correspond to the knowledge, skills and abilities required by professional standards. Cybersecurity and data protection issues, which are critical to the security of personal and corporate information, occupy a special place within the technological factor. Developing students' understanding of the basics of cybersecurity, privacy policies and data protection technologies under current conditions ensures an adequate level of information security in their future professional activities. The combination of these components creates favourable conditions for the development of digital competence among Bachelor's students in marketing, providing access to relevant platforms, tools and technologies aligned with the requirements of the modern labour market.

The methodological factor facilitates the development of digital competence among Bachelor's students in marketing through the integration of digital tools into teaching. Project-based learning has been shown to enhance digital skills and collaborative problem-solving (Pandazi & Stanzhur, 2023; Granado-Alcón, 2023; Karampa & Paraskeva, 2024). Problem-based and project-oriented approaches effectively foster higher-order thinking (Hmelo-Silver, 2004). Experiential learning, grounded in Kolb's (1984) theory, remains relevant in contemporary digital education (Rahmi, 2024). Blended and flipped learning models provide flexible formats that support student engagement and autonomy (Garrison & Vaughan, 2007). Agile learning approaches, increasingly applied in higher education, enhance adaptability and responsiveness to changing professional contexts (Demydovych & Karapetian, 2024). Overall, these pedagogical strategies contribute to the development of critical thinking, adaptability and the ability to respond effectively to professional challenges (Pocsova *et al.*, 2020; Kampa & Bakke, 2023; Pombo & Cunha, 2025).

Their application ensures the comprehensive development of students' digital competence, critical thinking and robust professional identity, as well as the acquisition of practical skills. Methodological solutions increase the flexibility of the educational process, enabling rapid adaptation of learning to the demands of the labour market and technological change. Student support mechanisms, such as mentoring, coaching, counselling and systematic feedback, combined with digital platforms, including LMS Moodle, Google Workspace and Microsoft 365, enable blended learning, interactive assessment and learning analytics. The integration of simulations, marketing campaign modelling, business analytics and data visualisation tools, including Power BI, Tableau and Google Analytics, enables students to acquire practical skills and apply theoretical knowledge in authentic professional contexts. Such approaches encourage independence, reflection and continuous self-improvement, thereby increasing the readiness of marketing graduates for professional activity in the digital economy.

The technological and methodological factors in the development of digital competence are closely interrelated. Technologies, digital platforms and software create a basis for students' practical activities, while methodological approaches determine how these technologies are used in the learning process to develop competences. In other words, the technological factor provides the tools and resources, whereas the methodological factor determines effective ways of applying them, integrating theory with practice, organising learning, supporting students and developing adaptive skills. Together, they form a holistic educational ecosystem that maximises the development of professional adaptability and readiness for change in the digital economy.

The personal factor in shaping the digital competence of Bachelor's students in marketing encompasses individual psychological characteristics and personal qualities that determine the effectiveness of professional development, the ability to learn independently and the ability to adapt to digital change. Its key components include motivation for learning and self-development, which support students' continuous improvement of their knowledge and skills. Adaptability to new technologies allows them to quickly master innovative digital tools and apply them effectively in practical activities. Critical thinking provides the ability to evaluate information, analyse data and make informed decisions in marketing processes. Analytical and communication skills facilitate effective interaction with teams, clients and digital platforms, while reflective ability enables students to evaluate their own actions, draw conclusions and pursue continuous improvement. Professional orientation and value orientations shape internal motivation, responsibility and ethical behaviour in the digital environment.

The development of these personal skills creates the foundation for the effective mastery of digital tools, critical thinking about information and the implementation of innovations in marketing practice. These skills contribute to the development of not only technical competence but also a stable professional identity, readiness for self-development and the ability to adapt to rapid changes in the digital economy. The link with the methodological factor lies in the fact that personal characteristics are practically realised through the application of modern pedagogical methods and teaching technologies. Project-based and problem-oriented learning, blended and flipped formats, as well as experiential and flexible approaches, create conditions for the development of students' motivation, critical thinking, reflection and adaptability. They provide opportunities to apply digital tools in professionally relevant situations and contribute to the development of a stable professional identity. Thus, teaching methods and technologies are key mechanisms for combining learners' personal potential with the acquisition of well-developed digital competence.

To determine the overall structure for assessing the factors that shape digital competence, an analysis of mean values across the entire sample was conducted. The summarised indicators enabled the establishment of an internal hierarchy of the significance of these factors. The highest mean value (3.180) was obtained for the regulatory factor, indicating a strong assessment of the role of higher education standards, professional requirements and institutional regulations in the development of digital competence. The technological factor (3.154) ranked second, reflecting the importance of digital infrastructure, platforms and specialised software for the professional training of Bachelor's students in marketing. The content-related (3.102) and methodological (3.060) factors followed in descending order of mean values. The lowest scores were recorded for the personal factor (2.917). The resulting hierarchy confirms the dominance of external, institutionally determined conditions over internal personal prerequisites in respondents' perceptions of the development of digital competence. This assessment structure makes it possible to interpret the model of digital competence development as a system in which regulatory, organisational and technological components are the basic conditions, while personal resources constitute an additional, albeit important, factor. To identify possible differences between groups of respondents, Student's t-test for independent samples with Welch's correction was applied, and Cohen's d effect size was calculated. The results are presented in Table 2.

Table 2. *Comparison of students' and lecturers' assessments of factors influencing digital competence*

Factor	M_students	SD	M_lecturers	SD	t_Welch	p	Cohen's d
Regulatory	3.164	0.656	3.422	0.285	−3.119	0.004	0.402
Content-related	3.080	0.655	3.438	0.457	−2.936	0.008	0.554
Technological	3.141	0.629	3.347	0.523	−1.512	0.148	0.332
Methodological	3.032	0.686	3.486	0.448	−3.779	0.001	0.674
Personal	2.888	0.647	3.354	0.884	−2.075	0.054	0.704

Source: *compiled by the authors*

Statistically significant differences were found for the regulatory (t = −3.119, p = 0.004), content-related (t = −2.936, p = 0.008) and methodological factors (t = −3.779, p = 0.001). In each case, the mean ratings given by lecturers exceeded the corresponding ratings given by students. Cohen's d effect size makes it possible to assess the practical significance of the identified differences. For the regulatory factor, d = 0.402 corresponds to a small-to-moderate effect, indicating a moderate difference in the perception of the role of regulatory and institutional foundations. For the contentrelated factor, d = 0.554 indicates a moderate effect, suggesting a systematic difference in understanding the importance of educational components and programme structure. The most pronounced statistically significant effect was recorded for the methodological factor (d = 0.674). This value indicates that the distributions of student and lecturer assessments differ significantly, with the mean lecturer assessment exceeding the mean student assessment by approximately two-thirds of a standard deviation. In practical terms, this indicates a significant difference in professional perception: lecturers consider methodological approaches, pedagogical technologies and the assessment system to be key mechanisms for developing digital competence, while students are less aware of their system-forming role.

Regarding the personal factor, a d value of 0.704 was obtained with p = 0.054. Although the level of statistical significance is marginal, the effect size indicates a substantial practical difference between the groups. This combination of indicators can be explained by the imbalance in sample size, particularly the significantly smaller group of lecturers, which reduces the test's statistical power. In practical terms, it can be concluded that lecturers rated motivation, adaptability and critical thinking as factors in the development of digital competence more highly than students did. No statistically significant differences were found for the technological factor (p = 0.148; d = 0.332), indicating relative consistency in the positions of both groups regarding the importance of digital infrastructure and instrumental support for the educational process. The results confirm the existence of professionally determined differences in perceptions of the determinants of the development of digital competence. Lecturers assigned statistically significantly higher ratings to regulatory, content-related and methodological factors, while students demonstrated relatively higher ratings of the technological component. Among the statistically significant differences, the largest effect size was found for the methodological factor (d = 0.674), indicating moderate practical significance in the differences between the groups. The difference in the personal factor was also practically meaningful, although it did not reach the conventional level of statistical significance.

Discussion

The findings of this study confirm that the development of digital competence among Bachelor's students in marketing is a multidimensional and hierarchically organised process shaped by the differing perspectives of key stakeholders. The identified differences between students and lecturers reflect not only their distinct professional roles but also different cognitive frameworks for interpreting the conditions of digital learning. While students tend to prioritise the practical use of digital tools, lecturers emphasise methodological, regulatory and content-related aspects of training. This divergence suggests that digital competence is perceived either as an applied skill set or as a structured educational construct, depending on the stakeholder's position within the learning process. Such differentiation supports prior findings that stakeholders interpret digital competence through the lens of their experience and responsibilities (Zhao *et al.*, 2021), while also indicating that these perspectives may shape how competence development is operationalised in practice.

At the same time, the results show that the development of digital competence is structured around a hierarchy of factors, with regulatory and technological components forming the foundational level. The predominance of the regulatory factor (M_students = 3.164) highlights the central role of institutional norms, educational standards and digital competence frameworks in shaping the learning environment. This conclusion is consistent with the research by A. Rakisheva & A. Witt (2023), L. Yulin & S. Danso (2025) and A. Barrios-del-Ángel *et al.* (2026), which emphasises the importance of institutional support systems and regulatory frameworks in organising an effective digital learning environment. However, a statistically significant difference between lecturers (M = 3.422, p = 0.004) and students (M = 3.164) indicates a discrepancy in how these structures are perceived. While lecturers emphasise the importance of regulatory mechanisms as a foundation for competence development, students may not fully appreciate their direct impact on skill acquisition. A similar gap between institutional intentions and student perceptions was noted by Y. Zhao *et al.* (2021), highlighting the broader challenge of translating regulatory frameworks into perceived educational value.

In contrast, the technological factor (M = 3.141) received the highest ratings from students, reflecting their strong focus on the practical mastery of digital tools, platforms and applications. This result is consistent with the findings of B. Mohamed (2025), who demonstrated that the use of digital tools during learning significantly influences the labour-market readiness of digital marketing students. It is noteworthy that this factor did not show a statistically significant difference between students and lecturers (p = 0.148), indicating a shared understanding of the importance of technological support in marketing education. Thus,

access to digital resources and their active use serve as key drivers in the development of applied competence in the digital economy.

The content-related factor acts as a bridge within this framework, linking theoretical knowledge with its practical application. Students' ratings of this factor reflect their intention to integrate conceptual understanding with professional practice through contextualised and practice-oriented tasks. This finding supports the argument that the development of digital competence is context-dependent and must integrate both general and subject-specific skills adapted to professional needs (European Commission, 2022). In the case of marketing education, this implies the need for a "hybrid" competence model that combines digital literacy with marketing analytics and communication skills. This conclusion is further supported by recent studies highlighting the growing demand for integrated digital and analytical competences in the business and marketing sectors (World Economic Forum, 2023), as well as research by S. Ye *et al.* (2024), which emphasised the importance of combining digital marketing and analytics within a unified educational framework. At the same time, the need for such hybridisation distinguishes marketing students from those studying technical disciplines, confirming the findings of A. Çebi & I. Reisoğlu (2023), who demonstrated disciplinary differences in digital competence priorities.

Lecturers, on the other hand, placed greater emphasis on methodological factors, highlighting pedagogical strategies, competence-based assessment and the development of guidelines as key conditions for the effective development of digital competence. This perspective stems from their role as designers and facilitators of the educational process, which naturally directs their attention to the systemic and organisational aspects of learning. Together with regulatory factors, these components form the structural and procedural framework within which digital competence develops. Regarding the methodological factor, the highest effect size was observed (d = 0.674), with lecturers emphasising pedagogical strategies significantly more than students. This "methodological gap" is consistent with research by I. Noguera *et al*. (2024), which demonstrates differences in how lecturers and students perceive digital and pedagogical practices, with educators focusing more on instructional design and integration, while students tend to prioritise the practical use and outcomes of digital tools.

An important cross-cutting element of the model is the personal factor (M_students = 2.888), which, despite having the lowest overall score, shows substantial differences in perception (d = 0.704). Lecturers tend to value motivation, adaptability and critical thinking more highly than students, who often prioritise technical proficiency. This is consistent with the systematic review by Y. Zhao *et al*. (2021), which indicated that students often underestimate the cognitive and reflective aspects of digital competence. However, all respondents acknowledge the importance of personal characteristics as internal prerequisites for competence development. Motivation stimulates continuous learning, reflection allows learning strategies to be evaluated and adjusted, while adaptability and critical thinking support the effective and responsible use of digital technologies. Underestimating these soft skills may limit students' reflective potential, particularly in a rapidly changing marketing environment driven by artificial intelligence.

Taken together, the findings reveal two complementary perspectives on digital competence: an instrumental perspective focused on tool use and a systemic perspective emphasising pedagogical and institutional structures. Rather than viewing these perspectives as contradictory, the results suggest that their integration is essential for effective educational design. Importantly, the study indicates that misalignment between these perspectives may reduce the overall effectiveness of competence development if left unaddressed. Overall, the results support the adoption of a comprehensive approach that integrates regulatory, technological, content-related, methodological and personal factors. Such an approach aligns students' demand for practical digital skills with lecturers' emphasis on educational quality and structure. This alignment is particularly important in the context of the digital economy and the transformation of the marketing profession, where the ability to combine technical expertise with critical and adaptive thinking is increasingly recognised as a key determinant of professional success.

At the same time, the findings should be interpreted with caution. The observed differences may be influenced by contextual factors, including the specific institutional environment and the characteristics of the sample. Future research could extend this analysis by examining crossinstitutional or cross-cultural variations in stakeholder perceptions, thereby providing a more generalisable understanding of the development of digital competence. In summary, the study confirms the validity of a holistic approach to digital competence that integrates multiple interrelated factors and accounts for stakeholder-specific perspectives. By empirically identifying both commonalities and discrepancies in how these factors are perceived, the research contributes to a more nuanced understanding of the development of digital competence and provides a basis for improving the design of educational programmes in marketing and related fields.

Conclusions

The results of the study support the value of a comprehensive approach to developing digital competence among Bachelor's students in marketing, integrating regulatory, technological, contentrelated,

methodological and personal factors. Empirical analysis showed that these factors form a hierarchical structure of influence on competence development. In particular, the mean values indicated that regulatory (M_students = 3.164; M_lecturers = 3.422; p = 0.004) and technological (M_students = 3.141; M_lecturers = 3.347; p = 0.148) factors received the highest ratings, highlighting the significance of the institutional framework and access to digital infrastructure. Content-related (M_students = 3.080; M_lecturers = 3.438; p = 0.008) and methodological (M_students = 3.032; M_lecturers = 3.486; p = 0.001) factors occupied an intermediate position, reflecting their role in the practical implementation of educational standards. The personal factor, although rated lower (M_students = 2.888; M_lecturers = 3.354; p = 0.054), demonstrated a substantial practical difference in perception (Cohen's d = 0.704), indicating discrepancies in the priorities assigned to motivational and cognitive characteristics.Statistical analysis revealed statistically significant differences between students and lecturers in relation to regulatory, content-related and methodological factors, with lecturers consistently rating them more highly, highlighting their emphasis on the regulatory and methodological foundations of the development of digital competence. In contrast, the technological factor did not show statistically significant differences (p = 0.148), indicating a shared understanding of the importance of digital tools and resources in the learning process. The personal factor, despite a p-value close to the significance threshold (p = 0.054), showed a substantial practical effect, indicating the need for greater attention to the development of motivation, adaptability and critical thinking among Bachelor's students in marketing. These results confirm that the development of digital competence is shaped by both the structural conditions of the educational environment and stakeholders' perspectives. The identified mismatch between Bachelor's students' focus on the practical application of tools and lecturers' emphasis on systemic and methodological foundations underscores the need to integrate these perspectives into the content of the educational programme.

Overall, the data obtained provide an empirica basis for aligning institutional policy, the content of the educational programme, teaching methods and student-centred approaches to ensure the balanced development of digital competence. Such alignment is particularly relevant in the context of the digital transformation of marketing activities, where professional effectiveness depends on the ability to combine technological proficiency with critical thinking, adaptability and continuous learning. Prospects for further research include analysing the impact of digital competence levels on graduates' actual professional outcomes and exploring the potential for integrating new technologies, particularly artificial intelligence tools, into the training of Bachelor's students in marketing.

Acknowledgements
None.

Funding
None.

Conflict of Interest
None.

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Оцінювання факторів формування цифрової компетентності бакалаврів маркетингу у закладі вищої освіти

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■ **Анотація.** Метою дослідження було визначення детермінантів формування цифрової компетентності бакалаврів маркетингу та оцінювання їх значущості в умовах цифрової трансформації вищої освіти з метою посилення вимог до їх професійної підготовки. Методологія дослідження передбачала використання структурованого опитувальника, розробленого на основі рамок цифрових компетентностей DigComp 2.2 та DigCompUA, що дало змогу комплексно оцінити важливість нормативного, змістового, технологічного, методичного і персонального факторів. Опитування проводилося із застосуванням шкали оцінювання значущості визначених чинників та подальшим узагальненням результатів методами описової статистики і порівняльного аналізу. У дослідженні взяли участь 245 майбутніх фахівців спеціальності «Маркетинг» (2-4 курсів) та 16 викладачів закладу вищої освіти, які забезпечували їх професійну підготовку в межах освітньої програми. Респонденти визначали пріоритетні напрями формування цифрової компетентності, оцінювали роль освітнього середовища, рівень інтеграції цифрових інструментів у освітні компоненти та готовність до їх застосування у професійній діяльності. Дослідження було зосереджене на аналізі інституційних умов, змісту освітньої програми, використання сучасних цифрових платформ і сервісів, педагогічних підходів, а також особистісних характеристик майбутніх фахівців, зокрема мотивації до цифрового саморозвитку та здатності до самостійного навчання. Результати засвідчили відмінності у сприйнятті пріоритетів різними групами респондентів. Студенти більшою мірою акцентували увагу на технологічних ресурсах і практичному використанні цифрових інструментів у маркетинговій діяльності, тоді як викладачі надавали перевагу нормативному забезпеченню, методичній підтримці та системній інтеграції цифрових технологій у зміст навчання. Встановлено, що ефективне формування цифрової компетентності потребує узгодженого поєднання інституційної підтримки, оновлення освітніх програм, впровадження сучасних методик навчання та розвитку персональної відповідальності здобувачів освіти за власний професійний розвиток

■ **Ключові слова:** освітній процес; професійна підготовка; освітня програма; детермінанти; майбутні фахівці

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 19-30
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 03.11.2025 Revised: 31.03.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 378.147:37.015.3
DOI: 10.69587/pemtt/1.2026.19

Growth mindset in the context of rapid technological change: Psychological mechanisms of fear of mistakes and principles of pedagogical support

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■ **Abstract.** The accelerating pace of technological change and the continual renewal of professional practices increase the demand for specialists who can learn rapidly, reskill, and operate under uncertainty. In this context, a growth mindset was viewed as a core cognitive and motivational frame that supports engagement with complex tasks, readiness for iterative improvement, and a constructive approach to mistakes, in contrast to a fixed mindset that foregrounds "innate ability" and increases the risk of avoidance behaviours. The aim of this article was to provide a theoretical and conceptual rationale for the relevance of a growth mindset in conditions of technological change, to analyse the psychological mechanisms underlying fear of mistakes, and to formulate principles of pedagogical support for fostering growth mindset in higher education. The study combined a narrative review, a targeted literature search across academic databases, interpretive synthesis of selected sources, and analysis of generalised authorial observations from teaching practice. The findings showed that fear of mistakes may suppress participation, initiative, and engagement with complex tasks because error was often

Suggested Citation:
Savchenko, A., Haluza, O., Akhiiezer, O., Kostiuk, O., & Protsai, N. (2026). Growth mindset in the context of rapid technological change: Psychological mechanisms of fear of mistakes and principles of pedagogical support. *Professional Education: Methodology, Theory and Technologies*, 12(1), 19-30. doi: 10.69587/pemtt/1.2026.19.

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experienced as socially exposing and personally costly. The study demonstrated that growth mindset cannot be sustained by verbal explanation alone and requires an educational environment that lowers the subjective cost of being wrong. A set of pedagogical principles for supporting a growth mindset was proposed, including normalising mistakes as part of learning, providing process-focused feedback, fostering psychologically safe interactions, systematically reinforcing key growth mindset ideas, and scaffolding self-regulation through staged completion of complex tasks. The article's practical contribution lay in the feasibility of integrating these principles across disciplines and formats, including project-based learning, to strengthen students' readiness to learn in conditions of continuous change

■ **Keywords:** implicit theories of ability; social-evaluative threat; loss avoidance; academic avoidance; self-regulated learning; error-tolerant learning environment; higher education

■ Introduction

Rapid technological change is transforming not only the instruments of professional activity but also the conditions under which specialists learn. New digital tools, AI-based systems, automated routines, and changing workflows make professional competence less dependent on stable bodies of knowledge and more dependent on the capacity to adapt, relearn, and act under uncertainty. In such circumstances, mistakes become an inevitable part of entering new domains, testing unfamiliar solutions, and refining incomplete attempts. Higher education must therefore prepare students not only to demonstrate knowledge, but also to remain intellectually active when certainty is absent and interim failure is unavoidable.

Recent research shows that this challenge is systemic. OECD (2023) argued that education should support not only the acquisition of skills, but also the attitudes and dispositions that enable their development and effective use. The World Economic Forum (2023) likewise showed that technological and socio-economic shifts are changing labour-market demands. Together, these reports strengthen the educational importance of adaptability, reskilling, and learning capacity. Within this context, growth mindset becomes relevant as a framework for explaining how students interpret challenge, effort, and temporary failure. In contemporary educational research, growth mindset is understood as the belief that abilities can be developed through learning, effort, and effective strategies; mistakes, setbacks, and critical feedback are therefore treated not as evidence of deficiency but as opportunities for analysis, adjustment, and development. By contrast, fixed mindset refers to the belief that abilities are largely predetermined and not substantially changeable through education, practice, or support. These beliefs influence whether students approach difficulty as a developmental task or as a situation likely to expose limited ability. At the same time, recent studies do not uncritically adopt this framework. J.L. Burnette *et al*. (2023), in a systematic review and meta-analysis, showed that the effects of growth mindset interventions vary across contexts and depend on implementation fidelity and learner characteristics. This indicates that the educational value of growth mindset cannot be assumed in advance. B.N. Macnamara & A.P. Burgoyne (2023), examining the same field from a more critical perspective, concluded that many reported effects of such interventions on academic achievement become weak or non-significant when greater weight is given to the most methodologically rigorous studies. Their analysis redirects attention to the conditions under which growth-oriented beliefs can become behaviourally effective.

K. Zhang & W.-J. He (2025) demonstrated that teachers' growth mindset and perceived school climate positively moderate the relationship between students' growth mindset and academic achievement. Their study shows that mindset does not function as an isolated internal belief. Its effects depend on whether the educational environment supports persistence, revision, and engagement with difficulty. Another line of research clarifies why a challenge may become threatening. C.J. Pigart *et al*. (2024), studying fear of negative evaluation in large-enrollment college science courses, showed that this fear is closely linked to academic social comparison and to students' sense of belonging and fit within their field of study. Their findings show that the significance of mistakes in higher education is not purely cognitive. It is also social, since an error may be experienced as a threat to one's image of competence, status, or sense of belonging.

Ukrainian researchers have also addressed related aspects of this problem. V.H. Kremen *et al*. (2023), analysing higher education in Ukraine under wartime and post-war conditions, emphasised that the system faces profound instability and requires new responses to educational transformation. Although their work is not focused specifically on growth mindset, it supports the broader argument that adaptability in higher education has become a practical necessity. L. Petrenko & O. Zelikovska (2025) argued that higher education should develop meta-skills related to rapid learning, self-development, and adaptation to change, and directly connected this task with growth mindset and lifelong learning. S. Sokolovska (2025), examining first-year non-philological students, showed that fear of mistakes functions as a psychological barrier that reduces classroom activity and complicates competence development.

Taken together, these studies show that adaptability is becoming important under technological change, that growth mindset remains educationally relevant but context-sensitive, and that students' responses to difficulty are shaped by the social and evaluative organisation of learning. However, the literature remains fragmented. Some studies focus on macro-level educational transformation, others on the mixed effects of mindset interventions, and still others on fear of negative evaluation or supportive teaching practices. Much less attention has been paid to an integrated pedagogical explanation of how fear of mistakes connects these strands in higher education, namely, how technological uncertainty, beliefs about ability, and evaluative features of the educational environment shape students' readiness to engage with challenge or avoid it.

Thus, the purpose of this study was to examine how fear of mistakes shapes students' readiness to engage with complex tasks under conditions of technological change, to explain this role through the interaction of key psychological mechanisms, and to formulate and substantiate principles of pedagogical support aimed at fostering a growth mindset in higher education and lowering the subjective cost of mistakes.

Materials and Methods

This study had a theoretical and conceptual design and was conducted as a narrative review and interpretive synthesis of scholarly literature in educational psychology, higher education research, motivation and stress psychology, and studies of cognitive mechanisms relevant to learning behaviour. In addition, the study included a descriptive analysis of generalised authorial observations, incorporating simple frequency summaries and descriptive comparisons of recurrent fear-related and avoidance-oriented patterns. The purpose of this study was to integrate heterogeneous theoretical and empirical findings into a coherent explanatory framework clarifying the psychological mechanisms underlying fear of mistakes in learning and, on this basis, to formulate principles of pedagogical support aimed at fostering a growth mindset in higher education under conditions of rapid technological change. The study was not designed as a systematic review in the strict methodological sense and did not aim to provide exhaustive coverage of all publications on the topic. Rather, it focused on conceptually significant sources that were directly relevant to the article's research problem.

The literature search included peer-reviewed journal articles, review papers, meta-analyses, monographs, book chapters, and analytical reports addressing growth mindset, fixed mindset, fear of mistakes, fear of failure, social-evaluative threat, negative experiences of error, loss aversion, feedback, avoidance behaviour, and related pedagogical conditions. Sources were identified through Google Scholar, Education Resources Information Center, PsycINFO, Scopus, and Web of Science using combinations of English and Ukrainian keywords corresponding to these constructs. In addition, the reference lists and citation trails of key publications were examined in order to identify foundational primary sources and conceptually relevant studies. Priority was given to recent publications, especially those from the last five to ten years, while earlier works were retained only when they were necessary for defining the core conceptual framework of the field.

Among the candidate mechanisms considered in the review, particular attention was given to loss avoidance, drawing on the broader literature on loss aversion, because the present study addressed situations in which participation in learning involved not only potential educational gains but also socially meaningful losses, such as loss of status, confidence, or perceived competence. This mechanism was retained as analytically relevant because it offered a direct explanation for why students may avoid difficult tasks, safer subtasks, or public participation when mistakes are experienced as socially costly. Its selection was also supported by recurrent authorial observations of risk minimisation and postponement of uncertain integrative stages of project work.

The analytical procedure combined interpretive synthesis of the selected literature with descriptive analysis of recurrent observational patterns. The selected literature was examined to clarify how growth mindset and fixed mindset are conceptualised in educational research and how these constructs are linked to students' responses to challenge, effort, feedback, and temporary failure. Studies from psychology and behavioural research were then analysed to identify mechanisms that may explain why mistakes are often experienced not simply as cognitive errors, but as emotionally and socially threatening events. Particular attention was paid to findings related to social evaluation, the disproportionately strong impact of negative experiences of error, and loss avoidance. Publications on teaching practices, classroom climate, feedback, and student participation were also considered in order to identify features of the educational environment that either intensify or reduce fear of mistakes. On this basis, a conceptual framework was constructed and used to formulate pedagogical principles relevant to higher education.

The literature synthesis was complemented by generalised authorial observations drawn from the shared teaching practice of all five authors between 2018 and 2025. These observations covered 196 first-, second-, and third-year students enrolled in the Applied Mathematics degree programme. They were accumulated across lectures, practical classes, and project-based learning, including teamwork, interim project work, and final project defence situations. Because the authors taught different disciplines within the same educational programme, the observations made it possible to compare recurring behavioural patterns across different instructional formats and subject areas rather than within

a single course only. The observations were conducted in accordance with the Code of Ethics of Academic Relations and Integrity of the National Technical University "Kharkiv Polytechnic Institute" and with the Ethical Guidelines for Educational Research of the British Educational Research Association (National Technical University "Kharkiv Polytechnic Institute", 2023; British Educational Research Association, 2024). These norms emphasise respect for participants, academic integrity, confidentiality, and the minimisation of potential harm in educational research. In the present study, the observational material was used only in generalised form and without disclosure of identifying personal data. The study was conducted in accordance with international ethical requirements for conducting research involving human subjects. All respondents participated voluntarily and had previously given their informed consent to take part in the study. During the collection and analysis of empirical data, the anonymity of participants and the confidentiality of the information obtained were ensured. The study was conducted in accordance with the principles of respect for human dignity, beneficence, and the protection of the rights and well-being of participants (World Medical Association, 2013).

These observations were not collected as a formal qualitative dataset with standardised coding after every class. Instead, each author kept individual reflective notes on salient and recurrent episodes, especially those involving silence after an incorrect public answer, visible fear of saying something wrong before peers or instructors, avoidance of difficult tasks, procrastination in situations of uncertainty, preference for safer subtasks during project work, and difficulties with the timely integration of separately completed project components. The observations were subsequently discussed collectively by the authors across semesters, especially after project defences, when recurrent patterns of student behaviour became particularly visible. In this way, the observational material was not treated as isolated anecdotal evidence, but as repeatedly compared and generalised pedagogical experience accumulated over several years. In the present study, these authorial observations did not function as an independent empirical dataset and were not used to derive statistical estimates or formal qualitative categories. Their role was illustrative and interpretive. They were used to compare the conceptual patterns identified in the literature with stable patterns repeatedly encountered in actual teaching practice. In particular, they helped to confirm the pedagogical relevance of several recurring tendencies, such as students' reluctance to answer after an initial incorrect response in front of others, their preference for safer subtasks when given a choice, the postponement of complex integrative stages of project work until deadlines, and the heightened difficulty of combining individually completed parts into a coherent interdisciplinary project product. Thus, the observations supported the plausibility of the theoretical synthesis but did not replace it.

The study's methodological limitations stemmed from this design. Since the review is narrative and interpretive, source selection was necessarily selective rather than exhaustive. In addition, the authorial observations, although extensive and accumulated over several years, were based on reflective pedagogical notes and collective professional discussion rather than on a formally standardised empirical protocol. For this reason, they should be regarded as contextualised illustrative material that strengthens the pedagogical grounding of the proposed framework, but not as standalone evidence for causal claims. Their main value lies in showing that the mechanisms discussed in the literature are consistent with stable patterns repeatedly observed in higher education practice and in indicating directions for further research using more formalised qualitative and quantitative designs.

Results

To clarify how fear of mistakes relates to mindset in higher education, growth and fixed mindsets were analysed along dimensions particularly salient to students' academic experience. In contemporary research, growth mindset is not reduced to the simplistic message "try harder"; rather, it concerns the perceived developmental potential of abilities and the meaning assigned to difficulty, effort, mistakes, and feedback. This made it possible to identify paired contrasts that show more precisely how the two orientations differ in the student learning context, especially with regard to learning goals, response to challenge, the role of effort, attitudes to mistakes and feedback, and the significance of social comparison. These contrasts were summarised in Table 1.

Table 1. *Typical features of growth mindset and fixed mindset (paired contrasts)*

Aspect	Growth mindset: typical beliefs and responses	Fixed mindset: typical beliefs and responses
Nature of abilities	Abilities can develop (within realistic constraints); improvement relative to one's own starting point is emphasised	Abilities are largely fixed; outcomes reflect "how much one is naturally given"
Learning goals	Preference for mastery goals; focus on progress and competence development	Preference for performance goals; focus on demonstrating and confirming ability
Response to challenge	Difficulty is seen as a normal part of learning; willingness to try strategies and seek help	Difficulty is perceived as a threat to self-worth and as "evidence" the task is "not for me"; tendency to avoid
Explaining failure	Failure provides information for strategy adjustment; increased effort combined with new approaches	Failure signals low ability; tendency toward helpless attributions

Table 1. Continued

Aspect	Growth mindset: typical beliefs and responses	Fixed mindset: typical beliefs and responses
Role of effort	Effort is a tool for development, but effectiveness depends on strategy quality and support	Effort may be interpreted as a sign of low ability ("if I have to try this hard, I must not be capable")
Attitude to mistakes and feedback	Mistakes are learning resources; critique is treated as data for improvement (in a supportive environment)	Mistakes are threats; critique is perceived as an evaluation of personal qualities, reinforcing avoidance
Strategic approach to learning	Search for alternative strategies, reflection, and readiness to change one's approach	Strategy rigidity; rapid reduction of effort after early signs of difficulty or failure
Social comparison	Social comparison is less decisive; one's own trajectory and learning process matter more	Social comparison becomes a key criterion of "capable vs not capable"
Explaining others' success	Others' success can inform strategy, modelling, and inspiration	Others' success intensifies self-worth threat, leading to envy or distancing

Note: *the table summarises typical patterns described in the literature. In real educational settings, mindsets may be mixed, and their manifestations depend on context (group norms, teaching style, and assessment practices)*
Source: *developed by the authors based on C.S. Dweck (2006), C.S. Dweck & D.S. Yeager (2019)*

Table 1 shows that the contrast between growth mindset and fixed mindset is expressed not in abstract declarations alone, but in how learners interpret challenge, effort, mistakes, feedback, and social comparison. In growth-oriented patterns, difficulty is more likely to stimulate reflection, strategy adjustment, and further engagement. In fixed-mindset patterns, the same difficulty is more readily experienced as a threat to competence and social image. In higher education, this distinction is especially important because it shapes whether students approach academic difficulty as a developmental opportunity or avoid it as a potentially exposing situation. This contrast becomes especially important in situations where students make mistakes. In such situations, fear of making mistakes can be interpreted as a multi-component phenomenon emerging at the intersection of social-evaluative threat, the disproportionately strong impact of negative experiences of error, and loss avoidance. Taken together, these mechanisms helped explain why avoidance-oriented learning behaviour may be misread as passivity, weak motivation, or insufficient ability, even though its immediate function is often self-protection against social and reputational risk. Social-evaluative threat changes the status of a mistake from a purely cognitive event to a socially exposed event. Under conditions of public response, peer comparison, or visible instructor judgment, an incorrect answer may be experienced not simply as an unsuccessful attempt, but as a sign of incompetence before others (Somerville, 2013; Downing *et al*., 2020). In such situations, answering orally, proposing a hypothesis, asking a question, or defending an interim result may be perceived as a high-risk act. This mechanism is especially important in youth, when peer evaluation, status, and belonging remain psychologically salient.

Negative experiences of public error may carry a disproportionately strong weight in later participation. Shame, harsh criticism, or ridicule are often remembered and emotionally encoded more strongly than multiple neutral or supportive experiences (Baumeister *et al*., 2001; Rozin & Royzman, 2001; Brown *et al*., 2024). As a result, even a single negative episode may reshape expectations about future participation and increase the likelihood of avoidance. This also means that an objectively safer learning environment may still be interpreted as threatening if prior negative experience has not been counterbalanced by repeated situations in which mistakes are treated constructively. Loss avoidance affects the moment of decision about whether to participate, attempt, or remain silent. In a pedagogical context, a perceived "loss" may involve not only a grade, but also time, reputation, confidence, or social status. If learning interaction is structured so that a mistake is experienced as a sanctioned "loss of face", then participating in discussion, asking a question, or publicly attempting to solve a problem becomes psychologically costly (Kahneman & Tversky, 1979; Downing *et al*., 2020). From this perspective, minimising participation may appear rational as a form of self-protection.

This framework is especially relevant under conditions of technological change, which increase the frequency of situations characterised by novelty, uncertainty, and partial incorrectness. Mastering new tools, methods, and practices predictably involves trial, hypothesis generation, revision, and inevitable errors. If the educational environment continues to function primarily as a public test of "ability," the gap widens between the declared need to "learn how to learn" and the actual tendency to avoid situations in which such learning must occur. Within this model, academic procrastination may be interpreted as one possible manifestation of avoidance. Postponing a complex task delays the immediate testing of competence and temporarily reduces exposure to potentially negative evaluation, although procrastination itself remains a multifactorial phenomenon and cannot be reduced to mind*set al*one. To make the recurrent patterns identified in the authorial observations more explicit, the observational material was additionally summarised through simple descriptive indicators. Table 2 presents the frequency of the main fear-related and avoidance-oriented patterns

documented among the observed students before project-based learning and after repeated project-based learning. This comparison was intended to show not only the initial prevalence of these patterns, but also their descriptive change after students had accumulated sustained project experience under pedagogical support.

Table 2. *Frequency and descriptive change of fear-related and avoidance-oriented patterns before and after repeated project-based learning among 196 unique students*

Observed pattern	Before project-based learning: number of students	Before project-based learning: percentage of the total sample	After repeated project-based learning: number of students	After repeated project-based learning: percentage of the total sample	Change in percentage points
Reduced further participation after an incorrect public answer	129	65.8	72	36.7	-29.1
Explicit fear of negative evaluation in reflection	73	37.2	61	31.1	-6.1
Preference for safer subtasks in project work	143	73.0	118	60.2	-12.8
Postponement of integrative project stages until the deadline	117	59.7	80	40.8	-18.9
Difficulty integrating individually completed components into a coherent product	103	52.6	95	48.5	-4.1

Source: *developed by the authors*

In Table 2 "Before project-based learning" refers to observations made prior to students' first project experience, whereas "after repeated project-based learning" refers to observations made after two completed projects, at the stage of the third project. The table reports the number and share of unique students for whom each pattern was documented at least once in the authors' reflective notes. Because one student could contribute to more than one category, the percentages do not sum to 100. The broader instructional context included 9 academic course groups and 91 project teams observed between 2018 and 2025. As shown in Table 2, several fear-related and avoidance-oriented patterns were widespread before project-based learning, especially the preference for safer subtasks and reduced further participation after an incorrect public answer. At the same time, comparing the period after repeated project-based learning with the period before indicates that these patterns did not remain equally pronounced. The most substantial decrease concerned reduced participation after an incorrect public answer, while postponement of integrative stages until the deadline also declined noticeably. Preference for safer subtasks remained relatively frequent, yet became less pronounced after repeated project experience. By contrast, explicit fear of negative evaluation and difficulty integrating individually completed components changed only modestly. These descriptive dynamics suggest that repeated project-based learning, combined with sustained pedagogical support, may reduce some manifestations of fear of mistakes and avoidance, especially those related to public participation and delay of uncertain tasks. At the same time, the more limited change in other categories indicates that such support should not be interpreted as a universal or immediate solution.

The generalised authorial observations were broadly consistent with this explanatory model. Across lectures and practical classes, it was repeatedly observed that after an initial incorrect public answer some students became markedly less willing to participate further in the discussion. In subsequent reflection, this withdrawal was often associated with fear of appearing incompetent before both instructors and peers. In project-based learning, students and teams tended to prefer safer and more predictable subtasks when such choice was available, while more uncertain and integrative components were avoided or postponed. A further recurrent pattern concerned the delayed integration of individually completed project components into a coherent interdisciplinary product. Although separate parts were often completed earlier, teams repeatedly postponed the most complex integrative stage until the deadline approached, which suggested avoidance of the phase most strongly associated with uncertainty and the possibility of visible failure. These patterns do not constitute independent empirical proof, but they strengthen the pedagogical plausibility of the proposed model by showing its consistency with stable features of real instructional practice.

The analysed material also indicates that fixed mindset should be interpreted not only as an individual belief, but also as a mode that may be reproduced by recurring environmental signals. When assessment and communication are organised around a rigid "right or wrong" scheme with immediate public sanction, learners may develop learned caution: participation is perceived as a risk to one's social image, and a mistake is experienced as a reputational rather than an educational cost. Under such conditions, even explicit growth-oriented messages do not translate easily into behaviour

because the environment itself reinforces avoidance as an adaptive strategy. This helps explain why approaches reduced to motivational slogans often have limited effects. A particularly influential type of contextual signal involves stereotypical labels about "natural" suitability for subject domains, for example, distinctions between "humanities-oriented" and "technical" types or self-descriptions such as "I'm not a math person." Such labels simplify explanations of success and failure but simultaneously strengthen fixed interpretations of ability. Difficulty and early mistakes are then read as evidence that something is "not my domain," which fuels withdrawal from further attempts. Research on mathematics identity shows that students' perceptions of themselves as a "math person" are linked to motivation and achievement (Radišić *et al*., 2024). Other studies show that preservice teachers do not always recognise fixed-ability beliefs in students' statements and may lack ready-to-use pedagogical responses to them (Rieche *et al*., 2019). In higher education, instructors' own fixed beliefs about ability are likewise associated with less motivating learning experiences and with larger achievement gaps in demanding courses (Canning *et al*., 2019). The reduction of fixed mindset is therefore relevant not only at the level of learners' beliefs, but also at the level of pedagogical communication and classroom norms. If educational reality rewards error-free performance and penalises attempts, learners are more likely to prefer silence, adopt minimally risky strategies, and avoid difficult tasks.

These results also make it possible to formulate principles of pedagogical support for fostering a growth mindset in higher education. Their common logic consists in reducing the subjective cost of mistakes while increasing their value as learning information. Assessment design plays a key role here. When only final correctness is rewarded, mistakes retain the status of costly failure. When assessment also recognises iterations, reasoning, hypothesis testing, reflection, and strategy adjustment, the reputational price of being wrong decreases and participation becomes more psychologically acceptable. The social risk of participation likewise requires deliberate reduction. Students are more willing to speak, test ideas, and offer tentative answers when the learning process includes intermediate low-risk stages before public exposure. Brief individual note-taking, short pair or small-group discussion, and anonymous collection of preliminary assumptions or typical errors can provide such a "safe attempt" and help shift participation away from immediate public self-exposure (Fraile *et al*., 2024).

The framing of questions and tasks is equally important. Questions such as "Who knows the correct answer?" are more likely to activate social-evaluative threat. By contrast, formulations such as "What assumptions are plausible?", "What data would be needed to test this?", "What strategy might work?", or "Where is the weakest point in the reasoning?" shift attention from the person to the task. This makes partiality, incompleteness, and revision more legitimate and reduces the likelihood that a mistake will be interpreted as evidence of personal deficiency. A productive learning environment also depends on how partially correct answers and feedback are handled. When partial correctness, an error in one step, or an inaccurate assumption is treated as diagnostically useful material rather than as grounds for stigmatisation, the disproportionately strong impact of previous negative experiences can be softened. Supportive feedback is especially important in this respect (Soncini *et al*., 2022). Feedback that specifies what has already been done well, what requires correction, and what alternative steps are available helps preserve a sense of control and keeps critique within the logic of development rather than personal deficiency. Long-term and complex tasks require special attention, especially in project-based learning. Avoidance often appears not at the stage of routine execution but at the stage of integration, uncertainty, and visible incompleteness. Large tasks therefore benefit from staged planning, short interim outcomes, clear progress criteria, and regular feedback points. These measures reduce the likelihood that the most difficult phase of the task will be postponed until the deadline as a form of self-protective procrastination.

Because fear of mistakes is strongly shaped by anticipated peer response, safe participation also depends on explicit norms of group interaction. Respect for questions, rejection of ridicule, recognition of alternative hypotheses, and clear separation between critique of ideas and evaluation of persons must be reinforced consistently rather than declared once. Without such norms, even well-designed pedagogical interventions remain fragile. Pedagogical support for fostering a growth mindset also requires alignment between declared values and actual procedures. If mistakes are verbally presented as learning resources but assessment and classroom interaction continue to penalise attempts, learners quickly detect the contradiction and return to avoidance strategies. Growth-oriented communication therefore has to be maintained through repeated micro-messages that normalise uncertainty, revision, the temporary absence of correct answers, and the legitimacy of trying again. In high-complexity learning environments, including project-based learning, this consistency may be strengthened through the role of a trainer or coach who helps students interpret critique, presentations, and interim setbacks within a developmental rather than punitive frame. Taken together, these results showed that fear of mistakes in higher education could not be reduced either to individual student beliefs or to isolated motivational messages. It emerges from the interaction between beliefs about ability, the social meaning of mistakes, and the evaluative structure

of the educational environment. Pedagogical support for fostering a growth mindset, therefore, had to be understood not as a single intervention, but as a consistent redesign of how difficulty, participation, feedback, and error were organised in learning.

Discussion

The results of this study suggest that fear of mistakes in higher education should not be treated as a secondary emotional response or merely as a minor issue of classroom confidence, since it directly shapes students' willingness either to engage with challenge or to avoid it. Rather, it appears to be a central mechanism through which students' beliefs about ability, the social meaning of evaluation, and the organisation of the learning environment are translated into either engagement or avoidance. In this sense, the interpretation developed in this article was consistent both with recent research showing that the educational significance of growth mindset is strongly context-dependent and with the broader conceptual tradition established in the foundational work of C.S. Dweck (2006) and C.S. Dweck & D.S. Yeager (2019). These earlier studies framed mindset in terms of beliefs about the malleability of ability and linked such beliefs to responses to challenge, effort, and failure. The current study did not revise this conceptual core; rather, it extended it by placing greater emphasis on the social and evaluative conditions under which these beliefs become behaviourally consequential in higher education.

In this respect, the present results are broadly aligned with J.L. Burnette *et al*. (2023), who showed that growth mindset interventions produce heterogeneous effects across contexts and student groups. Their conclusions are important because they caution against treating growth mindset as a universally effective intervention. The results obtained in the present study support this caution. They likewise suggest that the educational relevance of growth mindset depends less on verbal endorsement alone than on whether the learning environment reduces the subjective cost of challenge, error, and revision. At the same time, the present study differs from researchers' in its analytical focus. Whereas their work evaluates intervention outcomes across empirical studies, the present article addresses a conceptual question that remains less explicit in such syntheses, namely, why students may continue to avoid challenge even when growth-oriented values are formally communicated. The proposed answer is that fear of mistakes acts as an intermediary mechanism linking mindset-related beliefs to behaviour under conditions of uncertainty.

B.N. Macnamara & A.P. Burgoyne (2023) took a more critical view and argued that the positive effects of growth mindset interventions may seem more convincing when all available studies are considered together, whereas this conclusion becomes much less certain when the evidence is judged primarily on the basis of the most methodologically rigorous studies. The present results do not contradict this critique. On the contrary, they help explain why such variability may emerge. If classroom communication, peer response, and assessment practices continue to code mistakes as socially costly events, then interventions aimed only at changing students' beliefs are unlikely to yield stable behavioural change. In this sense, the current study shares the scepticism of the authors toward simplified applications of mindset theory, but it does not treat this as grounds for abandoning the construct. Instead, it argues that the weak or inconsistent effects found in some studies may partly reflect insufficient attention to the emotional and evaluative conditions under which developmental beliefs must operate.

The importance of context in the present results is also supported by K. Zhang & W.-J. He (2025), who found that teachers' growth mindset and perceived school climate positively moderate the relationship between students' growth mindset and academic achievement. Their findings are especially close to the present interpretation because they shift the discussion away from isolated student beliefs and toward the broader ecology of learning. The current results extend this logic by specifying one mechanism through which such ecology operates. It is not only that climate matters in general terms. More specifically, the educational environment matters because it shapes whether mistakes are experienced as manageable stages of learning or as events of public exposure. In this respect, the present study offers a more explicit psychological account of why climate matters. The role of social exposure is strongly supported by C.J. Pigart *et al*. (2024), who showed that fear of negative evaluation in college science courses is closely connected with academic social comparison and students' sense of belonging within their field of study. The present results are consistent with this line of work. They likewise indicate that the significance of mistakes in higher education is not purely cognitive. It is also social, because being wrong may threaten a student's image of competence in the eyes of instructors and peers. At the same time, the present study places this insight within a broader explanatory framework. It suggests that fear of mistakes is strengthened not only by the possibility of being judged, but also by the fact that negative experiences of public error may influence later behaviour more strongly than routine classroom episodes, while participation itself may be avoided if it is associated with a possible loss of status, confidence, or perceived competence.

A similar point applies to the relation between the present findings and the work of V.R. Downing *et al*. (2020). Their study demonstrated that fear of negative evaluation is associated with anxiety in active-learning science courses, which is highly relevant to the present argument. The current results support

this interpretation but also suggest that anxiety alone does not fully capture the pedagogical problem. Avoidance may occur even when students are not visibly anxious, because silence, delay, and risk minimisation can function as strategic forms of self-protection. This distinction is important for higher education practice. If teachers interpret non-participation only as low motivation or weak preparation, they may overlook its defensive function and inadvertently intensify the very mechanisms they wish to overcome. The present results also resonate with L.H. Somerville (2013) work on heightened sensitivity to social evaluation in adolescence and early youth. This developmental perspective helps explain why public mistakes in higher education may acquire disproportionate emotional significance. The current study is consistent with this argument, but it also suggests that developmental sensitivity does not by itself determine behaviour. Its educational consequences depend on whether the institutional setting amplifies or softens this sensitivity. In other words, age-related vulnerability may be a background condition, but classroom norms and assessment practices decide whether it becomes educationally disabling.

The study's interpretation of fixed mindset as a mode sustained by environmental signals rather than as a purely internal belief is also supported by work on identity and pedagogical expectations. J. Radišić *et al*. (2024) showed that mathematical identity, including seeing oneself as a "math person," is associated with motivation and achievement. E.A. Canning *et al*. (2019), in turn, demonstrated that instructors' beliefs in fixed ability are associated with lower student motivation and larger achievement gaps in demanding courses. The present results are close to both studies in showing that beliefs about ability are socially mediated and institutionally reinforced. The difference lies in emphasis. Rather than focusing primarily on identity or teacher beliefs as separate variables, the current study brings them together within a common explanatory frame: when difficulty and mistakes are repeatedly interpreted through labels of natural suitability or insufficiency, fixed-mindset responses become easier to reproduce. This means that reducing fear of mistakes is important because otherwise students may gradually internalise the idea that they are not capable of succeeding in a given academic field.

The pedagogical implications of the present results are also comparable, in part, to the arguments of S. Sokolovska (2025) and L. Petrenko & O. Zelikovska (2025). First author showed that fear of mistakes can function as a direct psychological barrier to student participation and competence development, while the second work linked higher education to the development of meta-skills associated with adaptation, self-development, and lifelong learning. The current study supports both perspectives. It agrees that fear of mistakes is pedagogically consequential and that adaptability must be treated as a central educational outcome. At the same time, it differs from these works by making the mechanism of connection more explicit. The argument here is that adaptability cannot be developed fully where mistakes continue to carry a high social and evaluative price. Thus, the cultivation of meta-skills and the reduction of fear of mistakes should not be treated as separate pedagogical tasks.

At the same time, the present interpretation invites discussion rather than closing it. One possible objection is that fear of mistakes may be overemphasised relative to other factors affecting student behaviour, such as workload, prior knowledge, general anxiety, self-regulation, or institutional pressure. This objection is valid. The current study does not claim that fear of mistakes explains all forms of passivity, procrastination, or low engagement. Nor does it claim that all fixed-mindset behaviour is reducible to defensive avoidance. Rather, its argument is narrower and more precise: in contemporary higher education, especially under conditions of technological change and complex project work, fear of mistakes is a neglected but powerful mediator that helps explain why students may retreat from the very forms of activity that adaptive learning requires. Another important issue concerns the scope of pedagogical intervention. The results suggest that supportive communication, assessment redesign, and safer participation formats are necessary. Yet this raises a legitimate question: how far can higher education reduce the cost of mistakes without weakening standards, rigour, or accountability? The present study does not advocate eliminating difficulty or evaluation. Its position is different. Rigour is not undermined when mistakes are treated as part of the path toward mastery rather than as evidence of personal inadequacy. What should be reduced is not the cognitive demand of learning, but the unnecessary social penalty attached to visible incompleteness, revision, and interim failure. This distinction is crucial and deserves further empirical debate.

Overall, the present discussion suggests that the main contribution of the study lies in integrating several strands that are often examined separately: mindset theory, fear of negative evaluation, cognitive asymmetries in processing negative experience, and pedagogical conditions for adaptive learning. The resulting framework does not replace empirical intervention research, but it does offer a clearer account of why growth mindset may remain behaviourally weak in environments where mistakes are still experienced as socially risky events. It also helps explain why pedagogical support must extend beyond motivational discourse to the redesign of participation, feedback, assessment, and the broader organisation of teaching and learning. Taken together, these considerations indicate that the problem is not whether students should simply be encouraged to believe in development, but

how higher education can be organised so that developmental engagement becomes psychologically and socially sustainable.

Conclusions

This article showed that, in higher education, fear of mistakes constitutes a central barrier to students' readiness to engage with challenge, uncertainty, and complex learning tasks. Within this context, growth mindset was conceptualised not simply as a positive belief in development, but as a framework that changes the meaning of difficulty, effort, feedback, and error in the learning process. The study also demonstrated that students' willingness to participate, persist, and revise their approach depends not only on individual beliefs, but also on whether the educational environment lowers the social and psychological cost of being wrong and treats mistakes as a normal part of mastery rather than as evidence of inadequacy. This barrier can be explained through the interaction of several mechanisms, including social-evaluative threat, the strong impact of negative experiences of error, and loss avoidance. In educational practice, these mechanisms may produce avoidance behaviours such as silence, reduced initiative, and the postponement of complex tasks. When mistakes retain punitive, reputational, or socially exposing meaning, such patterns may stabilise and reduce students' readiness to engage with complex, long-term, and open-ended forms of learning.

The study has also shown that growth mindset cannot be fostered effectively through verbal explanation alone. What proves decisive are the stable rules of the educational environment: how questions are posed, how feedback is given, how partial answers are treated, how assessment is organised, and how instructors communicate expectations about ability, effort, and error. In this respect, particular importance belongs to the language, success criteria, and interaction norms transmitted by instructors, especially where widespread labels about "natural" suitability for subject domains may reinforce fixed interpretations of ability and narrow students' learning trajectories. A central contribution of the study is the formulation of pedagogical principles that support the development of a growth mindset in higher education by reducing the fear of mistakes and reframing errors as opportunities for learning, reflection, and further development. These principles are united by a common pedagogical logic: reducing the punitive meaning of mistakes, redirecting attention toward thinking and strategy rather than final correctness alone, treating partial answers as a learning resource, supporting self-regulation in long-term tasks, establishing explicit norms for safe discussion, and maintaining consistency between declared values and actual educational practices. Taken together, these principles point to a broader shift in educational culture in which learning depends on the willingness to try, revise one's approach, and continue despite difficulty and temporary failure. A promising direction for further research is the systematic empirical examination of how these principles operate in long-term high-complexity formats, including project-based learning. This would make it possible to clarify the contribution of particular support elements and to determine the conditions under which their effects are most durable.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Настанова на розвиток (growth mindset) у світі швидких змін: страх помилки та принципи педагогічної підтримки

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■ **Анотація.** Прискорення технологічних змін і регулярне оновлення професійних практик посилили запит на здатність фахівця швидко вчитися, перенавчатися та працювати з невизначеністю. У цих умовах настанова на розвиток (growth mindset) розглядалася як ключова пізнавально-мотиваційна рамка, що підтримує залученість у складні завдання, готовність до ітеративного вдосконалення та конструктивне ставлення до помилок, на відміну від fixed mindset, що фокусує увагу на «природних здібностях» і підвищує ризик поведінки уникання. Мета статті полягала у теоретико-концептуальному обґрунтуванні актуальності growth mindset в умовах технологічних змін, аналізі психологічних механізмів страху помилки та формулюванні принципів педагогічної підтримки розвитку growth mindset, релевантних насамперед для закладів вищої освіти. Дослідження поєднало наративний огляд, цільовий пошук літератури в академічних базах даних, інтерпретативний синтез відібраних джерел та аналіз узагальнених авторських спостережень із викладацької практики. Було показано, що страх помилки та негативного оцінювання міг блокувати участь у взаємодії й ініціативу навіть за наявності навчальної мотивації; його підсилювали непропорційно сильний вплив негативного досвіду помилки, уникання втрат і висока чутливість до соціального оцінювання у підлітковому та ранньому студентському віці. Було запропоновано комплекс принципів педагогічної підтримки growth mindset: нормалізація помилки як частини навчання, процесно-орієнтований зворотний зв'язок, психологічна безпека взаємодії, систематичне коротке підкріплення ключових ідей growth mindset, а також навчання саморегуляції і поетапному виконанню складних завдань. Практична значущість полягала у можливості інтегрувати ці принципи в різні дисципліни та формати, зокрема у проєктно-орієнтоване навчання, для підвищення готовності студентів до навчання в умовах постійних змін

■ **Ключові слова:** уявлення про змінюваність здібностей; соціально-оцінювальна загроза; уникання втрат; академічне уникання; саморегульоване навчання; помилкотолерантне освітнє середовище; вища освіта

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 31-44
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 12.12.2025 Revised: 07.04.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 811.161:378.14
DOI: 10.69587/pemtt/1.2026.31

Interactive methods of teaching professional Ukrainian in the training of legal professionals

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■ **Abstract.** The study aimed to determine the impact of interactive teaching methods on the development of professional language competence among future legal professionals. The research methodology included a theoretical and methodological analysis, a comparative analysis of academic approaches, a review of pedagogical experience, and a teaching experiment conducted at higher education institutions in Ukraine. The study determined that interactive methods in the professional language training of lawyers include role-playing, the case method, discussions, simulations and work with professional scenarios, and ensure the development of communicative competence, the development of argumentation skills and the mastery of legal terminology in the context of simulating real professional activity. The study determined that the didactic basis of interactive learning is founded on the principles of activity, problem-solving and communicative orientation, which can be used for development of the ability to construct statements logically, apply linguistic structures and function in professional speech contexts. The effectiveness of interactive teaching methods was investigated in a pedagogical experiment, during which an increase in the average scores of the experimental group to a level of M ≈ 4.05-4.25 was recorded, whilst in the control group the corresponding values were M ≈ 3.4-3.6, indicating a more pronounced positive trend under experimental conditions. The results obtained confirm that the use of interactive teaching methods leads to a more significant improvement in the level of professional language competence compared to traditional approaches. As a result of the formative stage of the experiment, an increase in the average indicators of professional language competence was recorded in the experimental group across all criteria: accuracy of speech rose from 3.12 to 4.05, adherence to professional style from 3.18 to 4.18, communicative effectiveness from 3.2 to 4.1, logical coherence of statements from 3.22 to 4.12, and command of legal terminology from 3.3 to 4.25, which significantly exceeds the dynamics of the control group (an increase from 3.1-3.25 to 3.4-3.6), indicating the effectiveness of the interactive teaching methods employed. The study determined that the algorithm for implementing interactive methods includes the creation of a professionally oriented language environment, the simulation of legal situations, and work with case studies and regulatory texts, which ensures the practical acquisition of language material. The practical significance of the study is determined by the possibility of using its results to improve the methodology for teaching the Ukrainian language for professional purposes in the training of future lawyers through the implementation of interactive teaching methods

■ **Keywords:** legal language; formal and business language structures; legal argumentation; interactive methods; communicative competence

Suggested Citation:
Melnychenko, T. (2026). Interactive methods of teaching professional Ukrainian in the training of legal professionals. *Professional Education: Methodology, Theory and Technologies*, 12(1), 31-44. doi: 10.69587/pemtt/1.2026.31.

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Introduction

Interactive methods of teaching professional Ukrainian are becoming increasingly relevant in the training of legal professionals, due to the growing demands placed on the level of professional communication expected of future lawyers, their ability to formulate thoughts precisely, defend their position with sound reasoning, and use specialist terminology correctly in both spoken and written communication. Training as a lawyer requires the ability to handle legal texts, draft procedural documents, conduct business communication and participate in public speaking, all of which demand a high level of linguistic competence. Interactive teaching methods encourage active engagement of students in language practice, develop critical thinking, collaboration skills, the ability to analyse communicative situations, and the application of language knowledge in professionally relevant contexts. The use of such approaches increases motivation to learn, strengthens the practical focus of the educational process and ensures higher-quality training for future legal professionals.

Interactive teaching methods are increasingly being recognised as an effective means of improving the quality of professional training for future specialists, as they combine theoretical knowledge with practical activities. This is evident in the study by E.S. Boye & D.D. Agyei (2023), who investigated the effectiveness of problem-based learning in the training of future teachers. The authors analysed the impact of problem-based tasks on the level of learning and found an increase in student engagement during the learning process. The use of case-based methods in professional education contributes to the approximation of learning to the real-life conditions of future practice, which is also relevant for the language training of lawyers. This was confirmed by, for example, N. Kushevska *et al*. (2025), who examined the possibility of using international legal cases in the teaching of the Ukrainian language to law students. The authors analysed the use of case studies to develop the professional vocabulary of students. Simulating legal situations increases the motivation of law students to learn the language and improves the quality of language training. The development of interactive learning activities is associated with the use of digital systems for assessing and providing feedback on the language learning of students. Interactive learning systems were developed by, for example, D. Li (2024). The author developed an interactive learning assessment system based on machine learning algorithms. The study revealed the possibilities of automatically monitoring the language learning of students and the benefit of adapting the learning process to suit individual students.

The professional training of future lawyers requires certain improvements to language education to meet the challenges of new social and legal situations. V. Marchenko (2024) conducted an analysis of the challenges and prospects of lawyer training for the European future of Ukraine. The author examines the requirements of lawyer competencies, finding that professional communication is one of the substantial components of a lawyer's competencies. Furthermore, it is stated that language training of high quality is one of the essential competitiveness factors for law graduates. Interactive learning methods are becoming increasingly combined with virtual learning environments to expand the possibilities of such training. R. Rachmadtullah *et al*. (2023) investigated the potential of the metaverse as a transformative learning environment in education. As a result of the research conducted on educators, the researchers found that virtual environments have the potential to enhance educational interaction. Furthermore, the researchers found that organizing the collaboration of learners in the learning process increases the effectiveness of the learning process. As stated in a research study conducted by J. Rivadeneira & E. Inga (2023) on the implementation of interactive peer instruction in classrooms, students who participated in collaborative discussions displayed an increased mastery of the taught material and an increased development of communication skills. Furthermore, the combination of interactive learning methods with generative artificial intelligence (AI) is another improving method in language education for lawyers. S.J. Shi *et al*. (2024) studied the implementation of interactive learning methods using generative AI in legal education in China. The researchers concluded that the implementation of scenarios simulating real professional activities in the context of legal education using AI has the potential to enhance the interest of students in the learning process.

The training of specialists in various fields requires combining language education with education in their area of specialisation. An example of the importance of specialising in a particular language is demonstrated by the work of S.V. Symonenko *et al*. (2023). The authors investigated the teaching of the Ukrainian language to students who were specialising in information technology at Ukrainian universities. Their study showed that incorporating elements of the students' specialisation into the language classes produced the best results for the students. The success of interactive teaching methods also depends on the nature of the interaction between the teacher and the students. This is confirmed by Y. Wang & M. Kruk (2024), who modelled the relationship between trust in the teacher, support from the teacher, and students' academic engagement. The researchers analysed the factors influencing learners' engagement in the learning process. Positive pedagogical communication enhances motivation and learning outcomes. Online learning environments, which provide constant communication and access to resources, hold significant potential for the development of interactive methods. This was explored by Y. Xie *et al*. (2022), who

developed a model of teacher-student interaction in an online educational environment. The authors analysed the impact of structured interaction on learning outcomes and student engagement levels. Well-designed digital communication enhances the quality of the educational process.

Despite the findings highlighted by the authors mentioned above, there remain certain gaps in research into interactive methods for teaching the Ukrainian language for professional purposes in the training of legal professionals. The issue of adapting interactive technologies specifically to the development of legal discourse, working with procedural documents and the development of argumentation skills in Ukrainian has not been sufficiently explored. Further study is required to identify the most effective methodologies that combine language training with the simulation of the professional activities of future lawyers. The study aimed to examine the characteristics of the development of professional language competence among future legal professionals in the context of interactive teaching methods. The objectives of the study were: to analyse interactive teaching methods in the professional language training of lawyers; to assess the level of language competence development among students within the framework of a pedagogical experiment; to formulate an algorithm for the implementation of interactive methods for the development of professional speech.

Materials and Methods

The study was of a mixed (qualitative-quantitative) nature and was conducted as a quasi-experimental pedagogical design involving a control group (CG) and an experimental group (EG), with pre- and post-test measurements. The study examined the nature of interactive methods in professional language education for legal studies based on a comprehensive combination of theoretical and methodological analysis, comparative analysis of scientific approaches, and a synthesis of pedagogical experience presented in contemporary research by scholars. The theoretical and methodological basis was formed by works devoted to interactive learning, the development of language competence and the implementation of a competence-based approach in higher education by V. Miroshnichenko (2019), G. Bovsunivska & T. Trokhimenko (2022), N.P. Volkova (2022), and O.Y. Dobrovolska *et al*. (2025). The criteria for including sources were their academic relevance to the topics of interactive learning and the development of language competence in higher education, their recency (publications from 2019-2025), the presence of empirical or theoretical-methodological justification, as well as alignment with the competence-based approach and the professional orientation of the training. The effectiveness of interactive methods was assessed considering criteria such as the development of professional communicative competence, proficiency in legal terminology, the ability to speak coherently, logical presentation, and the correct use of standard linguistic constructions in professional contexts. In addition, the level of student engagement, their participation in communicative interaction, and their ability to simulate real-life legal contexts were addressed following up-to-date international educational standards (Council of Europe, 2020; European Commission, 2021).

The study was conducted at the Ukrainian State Flight Academy, which trains students in law-related disciplines. This higher education institution was selected due to its high standard of training in the field of law, the representation of various regions of Ukraine, and the presence of specialised faculties that provide a comprehensive legal education. The study involved 120 first- to fourth-year law students aged 18-22. The students were divided into a CG and an EG, each comprising 60 individuals. The students were allocated using a quasi-randomisation method (based on existing academic groups) to form two groups of equal size, with the CG taught using traditional methods, whilst the EG was taught using interactive teaching methods. The EG was taught using interactive teaching methods aimed at developing the professional and communicative competence of future lawyers. Role-playing exercises were used during the training, including "court hearings", "legal consultation with a client", "witness examination", "negotiations between parties to a dispute", "a lawyer's work with a client", "preparation of a prosecutor's speech" and "drafting a legal contract". The case method was also introduced, involving the analysis of legal situations, the examination of legal conflicts, the search for ways to resolve conflicts, and the preparation of procedural documents. The programme included discussions and debates on current legal issues, role-playing exercises simulating professional legal communication scenarios, small-group work, interactive training sessions, and simulations of professional interactions in the legal field.

The experiment was performed for one semester (September-December 2025). The classes were held both in person and online through Moodle and Google Classroom. The inclusion criteria for the experiment included the requirements that the student was enrolled in a law degree, between the ages of 18-22, had a basic level of proficiency in Ukrainian (not below average) and had to attend the classes. The students who were excluded from the experiment were those who missed more than 25% of the classes, failed to take the final assessment, or were pursuing individual areas of study. The ethical standards to which the students were required to adhere included giving their consent to participate in the study, the voluntary nature of the study, the anonymity of the results of the study, and that the study would only be used for scientific purposes (American Sociological Associations, 1997). The level of professional language skills that the students possessed was

assessed through a series of tasks. Each task was graded on a 1-5 point scale. The objectives of the study were to identify and correct linguistic, grammatical and stylistic errors in excerpts from legal documents; to draft a letter to the Dean of the Faculty requesting a postponement of an exam due to illness; to edit excerpts from procedural documents in accordance with the conventions of formal business writing; explaining the meaning of the legal terms "tort", "appeal" and "jurisdiction" and using them in sentences; preparing an oral presentation in the form of legal advice on the procedure for filing a claim; role-playing a court hearing with the roles of judge, lawyer and claimant; analysing a legal situation and formulating an oral conclusion regarding a dispute related to a rent increase and a demand for eviction without notice; drafting a brief written notice to the client regarding the outcome of the case; explaining the content of a legal provision in plain language to a client without legal training. To determine the degree of professional language competence of candidates a pre-test and post-test was conducted with the same set of tasks: editing a legal text, writing a formal application, explaining professional terms and simulating a communicative situation. This approach was chosen to ensure the objectivity and comparability of the results, as the use of identical tasks can record real changes in the level of competence development without the influence of variations in content. The assessment criteria ("Accuracy of speech", "Communicative effectiveness", "Logical coherence") were defined in advance and applied at both stages of the assessment to ensure consistent measurement standards. This was done to enhance the validity and reliability of the assessment, as well as to minimise subjectivity in the interpretation of results.

The nine tasks listed above were used for pre- and post-experiment assessment in both groups, but during the course of the programme, systematic work with case studies, role-plays and discussions was conducted only in the EG. Experts (six lecturers in Ukrainian language and legal linguistics) with between 8 and 20 years teaching experience were also involved in the assessment. The expert assessment was conducted following the criteria: accuracy of speech, adherence to professional style, communicative effectiveness, logical coherence of statements and command of legal terminology. The expert assessment was conducted using a scoring scale from 1 to 5, whereby each criterion (accuracy of speech, adherence to professional style, communicative effectiveness, logical coherence of statements and command of legal terminology) was assessed by the experts individually based on the degree to which the students' spoken responses met the established professional language requirements -language requirements is defined as the level of their adequacy, accuracy and correctness in the context of professional speech, after which the average score for each criterion was calculated. Each criterion was incorporated into the expert assessment through an analysis of students' oral and written, professionally oriented responses during role-plays, case studies, legal discussions and the simulation of communicative-legal situations, where the level of appropriateness, accuracy, logical coherence and stylistic correctness of professional speech was determined in accordance with professional language requirements. Each criterion was assessed on a scale of 1-5 points. Statistical analysis of the results included the calculation of means (M) and standard deviation (SD), as well as testing the significance of differences between the CG and the EG using Student's paired t-test. The level of statistical significance was set at $p < 0.05$. A paired t-test was used to compare pre- and post-test scores within a single group; additionally, a t-test for independent samples was used to compare the CG and EG with each other.

An algorithm for the use of interactive teaching methods in the professional Ukrainian language training of legal specialists has been formulated using the generalisation method; this includes key stages such as the organisation of learning activities based on communicative and legal situations, utilising role-play, case studies and discussions; systematic assessment of students' language proficiency levels, followed by the adjustment of learning tasks in accordance with the results identified. The key stages are specified in the research findings through corresponding teaching activities that reflect the specifics of their implementation in the educational process. The limitations of the study lay in the sample comprising only law students in a single semester of study and the application of the findings within the context of higher education institutions in Ukraine, without covering other educational contexts or longer observation periods.

Results

The core of interactive methods in professional language education for legal studies is viewed as a holistic system for organising the learning process, characterised by active interaction among all participants in the educational environment, which ensures not only the acquisition of language material but also the development of professionally oriented communicative competence. Interactive methods function as a pedagogical tool for modelling real or near-real legal situations, in which learners are constantly engaged in speech activity, argumentation, analysis of legal texts and decision-making (Miroshnichenko, 2019). Within the framework of contemporary approaches to teaching legal Ukrainian or other professional language training, interactivity is interpreted as a principle of organising learning based on subject-subject interaction, dialogue and cooperation, in accordance with the provisions of the competence-based paradigm of education.

The pedagogical foundations of interactive methods are defined by the principles of active participation,

critical thinking, problem-based learning, communicative focus and professional relevance. The principle of active participation is implemented by engaging students in continuous language practice, in particular through role-playing, mock trials and case studies. The principle of problem-based learning involves setting learning tasks in the form of legal cases requiring solutions, such as the analysis of an international contractual dispute or a criminal case, where students formulate legal positions in Ukrainian. The principle of communicative focus is implemented through the organisation of debates, discussions and negotiations that simulate a lawyer's real-life professional communication. The principle of professional relevance ensures that the course content is aligned with real-world legal practices, meeting the requirements of professional training in legal Ukrainian as a specialised area of professionally oriented language learning. An example of the implementation of these principles is the conduct of classes in the Moot Court format (Leaders in Law, 2024), where students take on the roles of judge, defence counsel and prosecutor, using specialist terminology and argumentative structures.

The methodological foundations of interactive methods are based on a combination of constructivist, communicative and activity-based approaches. The constructivist approach posits that knowledge is formed through active interaction with the learning environment, rather than being transmitted in a ready-made form, which is consistent with the concepts of modern pedagogy presented in the study by G. Bovsunivska & T. Trokhimenko (2022) on the social construction of knowledge. The communicative approach aims to facilitate the use of language for real communication within the classroom through the discussion of legal cases or debates on legal norms. The activity-based approach involves simulating the activities of a lawyer within the classroom through mock trials or the creation of legal documents.

Interactive methods are implemented in a variety of forms within the modern classroom. For instance, the case study method involves discussing cases that involve a breach of an international treaty and presenting solutions to those problems in Ukrainian. The debate method involves discussing problematic issues in the legal world, such as the balance between national security and human rights, to encourage critical thinking within students. In role-playing games, students simulate court hearings to practice the professional vocabulary associated with lawyers. Simulations of negotiations between parties to an international contract allow students to practice their intercultural communication skills. Finally, there are also online interactive platforms that accompany legal education in the classroom to test their knowledge of the topics and to participate in online forums to discuss legal texts together (Dobrovolska *et al*., 2025).

Interactive methods in professional language education for the legal sector are based on the integration of the principles of teaching with the methods of professional language education to provide students with a comprehensive understanding of the subject matter. Such methods allow the student to transition from acquiring knowledge to using it in professional scenarios, thus fulfilling the current requirements of international educational standards as stipulated in the documents of the European Commission (2021) and the recommendations on the development of language education in higher education (Council of Europe, 2020). Table 1 provides an overview of the main types of interactive methods that can be employed within professional language education for law students.

Table 1. *Types of interactive methods in professional language education for law students*

Type of interactive method	Brief description	Example of its use in legal language training
Role-play	Role-play exercises	Mock court hearing: Students take on the roles of judge, defence lawyer, prosecutor and witness, and practise legal vocabulary, forms of address and argumentation
Case study	Analysis of specific cases from legal practice	Hearing of an international contractual dispute: Students read the case study, identify the legal issue and prepare the parties' oral arguments in Ukrainian
Debates	Reasoned discussion of controversial issues	Debate on the merits of the death penalty or digital surveillance: developing skills in legal argumentation and counter-argumentation
Brainstorming	Brainstorming in a group	Drafting legal opinions on a cybercrime case using professional terminology
Discussion	Group discussion of key issues	Discussion of international legal norms and their interpretation, drawing on Ukrainian sources
Project-based learning	Independent development of a comprehensive task	Creating a presentation entitled "The International Court of Justice: Structure and Functions" using legal terminology
Simulations	Simulation of professional processes	Conducting negotiations between the parties to the agreement in Ukrainian
Digital tools	Use of digital platforms for interaction	Completing interactive tests on legal Ukrainian or taking part in forum discussions on case studies

Source: *compiled by the author based on N.P. Volkova (2022)*

Interactive methods in professional language education for law students form a comprehensive system for organising the teaching process, focused on active verbal interaction and the practical application of legal terminology in simulated professional situations. Their use ensures the integration of language training with elements of future professional practice, fostering the development of communicative competence, argumentation skills and the ability to effectively articulate legal positions in Ukrainian. In the process of applying such approaches, students are engaged in tasks that replicate real-life legal situations, thereby facilitating the natural acquisition of professional vocabulary and the development of skills to use it in various contexts. Overall, interactive methods enhance the effectiveness of language training for future lawyers and create conditions for a higher-quality mastery of professional communication in a foreign language.

The development of professional language skills among future lawyers requires the use of both correct linguistic structures and interactive teaching methods. Through interaction among the students, it is possible to create conditions in which the linguistic structures that are taught are actually utilized by those students in the performance of their tasks. Tasks that employ dialogue, mock court hearings, case studies, and discussions allow for the systematic incorporation of those linguistic structures into the tasks to be completed by the students. Through these methods, the future lawyers are able to learn the linguistic structures of the language and to utilize those structures in their speech. Beyond ensuring that the students learn the linguistic structures necessary to perform interactive tasks, the requirement of the use of correct linguistic constructions ensures that the tasks are completed in high quality by the students. Thus, interactive teaching methods and the use of linguistic structures creates a comprehensive method of training the future lawyers to effectively employ their learned linguistic knowledge in their careers (Pozdran *et al.* , 2020). The interaction among the students creates a readiness of the students for the demands of the legal profession, as well. Table 2 includes an explanation of the language patterns that are used in the interactive teaching of professional Ukrainian to future lawyers.

Table 2. *Language examples for interactive Ukrainian language learning (legal specialism)*

Type of language material	Example	Comment (professional use)
Legal terminology	Statement of claim, defendant, claimant, legal transaction, jurisdiction, evidence	Learning basic professional vocabulary through exercises involving explanation and use in context
Clichés of formal business style	In accordance with current legislation…, Based on the above…, I would ask you to consider…, In view of the above…	Used in the drafting of procedural documents and in structuring the logic of the argument
Statement of the legal position	I consider the defendant's actions to be unlawful…, The evidence indicates that…, The prosecution maintains that…	Developing argumentation skills in debates and moot courts
Syntactic structures (complex sentences)	In the event of a breach of obligations, the party shall be liable as provided for in the contract.	Developing skills in drafting complex legal texts
Passive constructions	The decision was handed down by the court…, The claim was filed within the prescribed time limit	Typical of formal style, used in documents
Lexical conventions (avoiding colloquial language)	Incorrect: "There was a problem", correct: "A legal conflict arose"	Developing stylistically correct speech
Document language templates	I, [Full Name], hereby request…, I enclose the following documents with this application…	For use when writing applications, complaints and petitions
Argumentative connections	Firstly…, so…, therefore…, at the same time…	Ensuring the coherence of legal discourse
Professional verb constructions	Enter into a contract, file a claim, appeal a decision, bring to justice	Building a lawyer's active vocabulary
Business etiquette	Your Honour…, Dear Sir…, Yours faithfully…	Use in formal correspondence and spoken language

Source: *compiled by the author*

Effective training of future lawyers in the area of language is achieved through a systematic combination of specialised vocabulary, established phrases, structurally complex sentences and logically constructed connections, which ensure the accuracy, consistency and persuasiveness of professional discourse. The use of such linguistic resources in the teaching process has contributed not only to improving literacy and the stylistic appropriateness of statements, but also to developing the ability to clearly articulate positions, analyse professional situations and draft documentation appropriately in accordance with the requirements of professional communication. This confirmed the advisability of integrating practice-oriented language models into the training of law students as a key factor in the development of their professional competence. To assess the effectiveness of implementing interactive methods for teaching professional Ukrainian to law students, the diagnostic and formative stages of the experiment were conducted (Table 3).

Table 3. *Results of the expert assessment of the development of professional language competence among students in the CG and EG (before and after the experiment)*

Evaluation criteria	CG before (M)	CG after (M)	EG before (M)	EG after (M)
Speech accuracy	3.1	3.4	3.12	4.05
Consistency with professional style	3.2	3.55	3.18	4.18
Communicative effectiveness	3.15	3.45	3.2	4
Logical coherence of the statement	3.18	3.5	3.22	4.12
Proficiency in legal terminology	3.25	3.6	3.3	4.25

Source: *compiled by the author*

Completing a set of nine practice-oriented exercises contributed to the targeted development of the candidates' professional language competence, as evidenced by the trends in the indicators shown in Table 3. In particular, the exercises on editing legal texts and drafting official documents had a direct impact on improving the scores for "accuracy of speech" (in the CG to 4.05) and "conformity to professional style" (in the CG to 4.18), as they required adherence to the norms of formal business style, terminological accuracy and structural clarity of expression. At the same time, tasks involving the explanation of legal terms and their use in sentences, as well as the simulation of communicative situations, contributed to an increase in the scores for "mastery of legal terminology" (in the EG up to 4.25) and "communicative effectiveness" (in the EG up to 4.10), as they developed the ability to accurately convey the meaning of legal concepts and adapt speech to various professional contexts. Furthermore, the completion of the analytical and simulation tasks had a positive impact on the aspect of "logical expression" (in the EG up to 4.12), which was reflected in the students' submissions. Together, these results confirm the impact of completing the nine exercises in total on each of the indicators of professional language skills.

Finally, the expert assessments of the students' writing samples all indicated that the students had achieved a high level of professional language skills. Each of these results were obtained as a result of the use of interactive teaching methods to teach the students how to speak and write in the field. The constant simulation of legal situations, participation in discussions, role-plays and case studies contributed to the development of accurate and standardised speech, the ability to structure statements logically, and the selection of language appropriate to a formal business style. A high level of proficiency in legal terminology was linked to the regular use of specialist vocabulary in practical communicative tasks, which ensured not only the memorisation of terms but also their conscious application in professional contexts. Communicative effectiveness was developed by creating conditions approximating real-life professional interaction, in which students learnt to express their views in a reasoned manner, conduct professional dialogue and respond promptly to legal communication situations. The results obtained permitted an analysis of the level of development of professional linguistic competence in the CG and EG before and after the pedagogical intervention. The summarised data are presented in Table 4.

Table 4.*Results of the assessment of language proficiency among law students*

Questions/tasks	CG before	CG after	EG before	EG after	CG before M ± SD	CG after M ± SD	EG before M ± SD	EG after M ± SD
Identify and correct any linguistic, grammatical and stylistic errors in the following excerpt from a legal document: "I, a citizen of Ukraine, ask you to consider my complaint regarding the fact that my salary has been calculated incorrectly, even though I have worked honestly and conscientiously, and I therefore ask you to take appropriate action"	1 – 12% 2 – 18% 3 – 34% 4 – 26% 5 – 10%	1 – 6% 2 – 12% 3 – 28% 4 – 34% 5 – 20%	1 – 14% 2 – 22% 3 – 33% 4 – 21% 5 – 10%	1 – 3% 2 – 6% 3 – 18% 4 – 38% 5 – 35%	3.04 ± 1.08	3.46 ± 1.02	2.98 ± 1.1	4.02 ± 0.88
Please submit a request to the Dean of the Faculty asking for the exam date to be rescheduled due to illness	1 – 10% 2 – 20% 3 – 30% 4 – 25% 5 – 15%	1 – 5% 2 – 14% 3 – 28% 4 – 33% 5 – 20%	1 – 12% 2 – 18% 3 – 35% 4 – 25% 5 – 10%	1 – 2% 2 – 5% 3 – 15% 4 – 40% 5 – 38%	3.15 ± 1.05	3.55 ± 0.97	3.02 ± 1.08	4.1 ± 0.85
Please edit the following excerpt from a legal document to comply with the conventions of formal business writing: "I filed a claim because I wasn't paid, even though we had agreed on it, and that's unfair"	1 – 15% 2 – 22% 3 – 28% 4 – 25% 5 – 10%	1 – 8% 2 – 15% 3 – 27% 4 – 30% 5 – 20%	1 – 13% 2 – 20% 3 – 34% 4 – 23% 5 – 10%	1 – 3% 2 – 7% 3 – 18% 4 – 40% 5 – 32%	2.98 ± 1.12	3.4 ± 1	3 ± 1.09	4.05 ± 0.9
Explain the meaning of the following legal terms and use them in a sentence of your own: "tort", "appeal", "jurisdiction"	1 – 8% 2 – 18% 3 – 32% 4 – 30% 5 – 12%	1 – 4% 2 – 10% 3 – 25% 4 – 38% 5 – 23%	1 – 10% 2 – 18% 3 – 36% 4 – 26% 5 – 10%	1 – 2% 2 – 6% 3 – 15% 4 – 42% 5 – 35%	3.2 ± 1	3.65 ± 0.95	3.05 ± 1.05	4.12 ± 0.82

Table 4. Continued

Questions/tasks	CG before	CG after	EG before	EG after	CG before M ± SD	CG after M ± SD	EG before M ± SD	EG after M ± SD
Prepare a short oral presentation (1–2 minutes) in the form of advice to a client on the procedure for filing a claim	1 – 14% 2 – 20% 3 – 30% 4 – 24% 5 – 12%	1 – 6% 2 – 14% 3 – 26% 4 – 34% 5 – 20%	1 – 16% 2 – 22% 3 – 32% 4 – 20% 5 – 10%	1 – 2% 2 – 5% 3 – 16% 4 – 40% 5 – 37%	3 ± 1.1	3.48 ± 0.98	2.92 ± 1.12	4.08 ± 0.86
Role-play a court hearing: take on the roles of the judge, the lawyer and the claimant (dispute concerning a breach of the terms of a tenancy agreement)	1 – 18% 2 – 24% 3 – 28% 4 – 20% 5 – 10%	1 – 10% 2 – 16% 3 – 26% 4 – 30% 5 – 18%	1 – 20% 2 – 25% 3 – 30% 4 – 18% 5 – 7%	1 – 3% 2 – 8% 3 – 18% 4 – 38% 5 – 33%	2.85 ± 1.15	3.3 ± 1	2.8 ± 1.18	4 ± 0.89
Analyse the legal situation and give an oral conclusion: "An individual has entered into a residential tenancy agreement, but the landlord has increased the rent without notice and is demanding that the premises be vacated immediately"	1 – 12% 2 – 18% 3 – 35% 4 – 25% 5 – 10%	1 – 6% 2 – 12% 3 – 28% 4 – 34% 5 – 20%	1 – 14% 2 – 20% 3 – 33% 4 – 23% 5 – 10%	1 – 2% 2 – 6% 3 – 16% 4 – 42% 5 – 34%	3.05 ± 1.06	3.5 ± 0.97	2.97 ± 1.1	4.09 ± 0.84
Please draft a brief written message to the client regarding the outcome of their case	1 – 10% 2 – 18% 3 – 32% 4 – 28% 5 – 12%	1 – 5% 2 – 12% 3 – 26% 4 – 35% 5 – 22%	1 – 12% 2 – 20% 3 – 34% 4 – 24% 5 – 10%	1 – 2% 2 – 5% 3 – 15% 4 – 40% 5 – 38%	3.12 ± 1.04	3.6 ± 0.95	3 ± 1.08	4.11 ± 0.83
Please explain the meaning of the legal provisions in simple terms for a client without a legal background: "Civil liability arises in the event of non-performance or improper performance of obligations"	1 – 16% 2 – 22% 3 – 30% 4 – 22% 5 – 10%	1 – 8% 2 – 14% 3 – 28% 4 – 30% 5 – 20%	1 – 18% 2 – 24% 3 – 32% 4 – 18% 5 – 8%	1 – 3% 2 – 6% 3 – 16% 4 – 40% 5 – 35%	2.9 ± 1.13	3.42 ± 0.99	2.85 ± 1.15	4.05 ± 0.88

Source: *compiled by the author*

The results obtained indicate that the introduction of interactive teaching methods has brought about a qualitative transformation in the language training of law students, as evidenced by a shift from a fragmented and predominantly rote-learning approach to the acquisition of language material towards a more conscious, practice-oriented and communicatively effective use of the Ukrainian language in professional contexts; at the same time, there was an increase in the level of independence in constructing legally correct statements, greater accuracy in terminological usage, and an improved ability to adapt linguistic means to various formal and business contexts, which generally confirms the pedagogical effectiveness of the interactive approach compared to traditional methods.

Table 5. *Results of a statistical analysis of changes in the level of professional language proficiency among students in two groups*

Indicator	Group	Before experiment (M ± SD)	After experiment (M ± SD)	t-test	p-level
Dynamics within the group	CG	3.06 ± 0.11	3.49 ± 0.09	2.14	$p < 0.05$
	EG	3.02 ± 0.12	4.07 ± 0.08	6.87	$p < 0.001$
Comparison after experiment	CG vs EG	3.49 ± 0.09	4.07 ± 0.08	5.92	$p < 0.001$

Source: *compiled by the author*

Statistical analysis of the study results revealed a positive trend in the level of professional language competence among students in both groups. In the CG, a moderate increase in scores was observed, from $M = 3.06 \pm 0.11$ to $M = 3.49 \pm 0.09$, with the differences being statistically significant ($t = 2.14$; $p < 0.05$). At the same time, a significant improvement in results was recorded in the EG – from $M = 3.02 \pm 0.12$ to $M = 4.07 \pm 0.08$, which is confirmed by a high level of statistical significance ($t = 6.87$; $p < 0.001$). A comparative analysis following the formative stage showed the EG superiority over the CG ($M = 4.07 \pm 0.08$ versus $M = 3.49 \pm 0.09$), and the difference between the groups is statistically significant ($t = 5.92$; $p < 0.001$), confirming the effectiveness of the interactive teaching methods used in the process of developing professional language competence.

The algorithm for using interactive teaching methods in the professional Ukrainian la nguage training of legal specialists involves a phased organisation of the educational process and the systematic engagement of students in professionally oriented language activities. At the first stage of the training process, a learning environment simulating legal practice is created. Language learning takes place within simulated professional interactions that require the use of formal business and legal language. Role-play situations such as court

hearings, legal consultations and correspondence allow students to naturally interact within the legal sphere.

The next stage of the course involves studying legal case studies that reflect typical situations that may arise in legal practice. The cases are studied in a way that requires an analysis of the cases and their requirements of the legal statements that must be made within legal practice. Analytical tasks are used to encourage the development of legal thinking and language. Tasks include formulating legal arguments based on legal principles such as "in accordance with current legislation", "taking into account the circumstances of the case", "on the basis of the evidence provided" and "the legal consequences are". This language and thinking skills are developed in tandem during this stage of the training course.

Handling of legal texts involves the analysis of legal texts and the transformation of their complex syntactic structures into professional language. Students learn to identify legal terms and explain legal provisions in a communicative format. Furthermore, legal documents must also be drafted by students, such as applications, complaints, contracts and other legal submissions. Within these legal documents, legal students must use phrases standard to formal business style, such as "I request that you consider", "on the basis of the above", "copies of documents are attached", and "with a view to protecting rights and interests". Additionally, editing of legal texts is also performed to correct inaccuracies in the language, style and terminology used in the legal text.

The programme incorporates oral communication exercises to develop the ability to speak coherently and persuasively. Discussions on legal issues, simulations of legal advisory activities and discussions of legal situations are held, during which the students develop the ability to formulate statements logically and to argue a position. This ensures the development of the students' abilities to speak persuasively and structurally in their professional careers. The next stage of the programme involves the transformation of everyday language constructions into professional legal ones. Through this stage, the students develop their abilities to adapt their speech to a professional legal context. Finally, all of the activities are integrated into a comprehensive programme for the students to learn and apply the various legal and professional communication skills. Furthermore, the programme incorporates assessments to determine the students' level of language competence within these areas, which are continually adjusted according to the assessments of the students' current knowledge. Through these stages, the students develop their professional language competence in Ukrainian, preparing them for their careers as lawyers in the profession.

In Ukraine, interactive teaching methods for the Ukrainian language for professional purposes are implemented in the training of future lawyers within the educational programmes of higher education institutions through a combination of classroom-based, practical and digital components of the learning process. Within the academic disciplines of "Ukrainian for Professional Purposes", "Legal Rhetoric" and "Business Ukrainian", a system of communication-oriented tasks is being introduced, which simulate real-life situations in legal practice. Universities use case studies, role-playing and mock trials, which are conducted in the form of practical sessions or training workshops in lecture theatres and legal clinics. The practical component is reinforced by the activities of university legal clinics, where students, under the guidance of lecturers, provide initial consultations to members of the public, draft applications and analyse legal situations. This creates conditions for the practical use of the Ukrainian language in a professional context. Additionally, interdisciplinary links with legal disciplines are utilised, which can be used to integrate language training into the overall legal education system and fostering readiness for professional communication in real-world legal practice.

Discussion

Interactive teaching methods for professional Ukrainian language training enhance the effectiveness of training for future lawyers, as they combine speaking practice, professionally oriented communication and the active involvement of students in solving professional tasks. The results of the EG demonstrated an increase in the level of professional language competence following the introduction of interactive teaching methods. In particular, the speech accuracy score in the EG rose from 3.12 to 4.05 points, indicating improved adherence to linguistic, grammatical and stylistic norms in professional speech. This view is supported by M. Abbasi *et al*. (2023). The authors analysed the impact of professionally oriented legal education on students' cognitive, emotional and practical skills. It is noted that active teaching methods ensure better acquisition of terminology, the development of critical thinking and readiness for professional practice. A similar approach is evident in the work of A. Al-Tarawneh *et al*. (2024). The researchers examined the prospects for professionalising the training of legal translators in a language-learning environment. They concluded that interactive teaching methods contribute to the development of professional language accuracy, the ability to work with legal texts, and communicative competence. This correlates with the findings of A. Anyan *et al*. (2023). The use of interactive multimedia resources in language teaching is described. It has been established that multimedia interaction boosts students' motivation, enhances their comprehension of the material and facilitates the acquisition of new vocabulary. Similar conclusions are presented by F. Ariai *et al*. (2025). The researchers reviewed the application of natural language processing technologies in the legal field. They emphasised that digital interactive tools can be effectively used to simulate legal communication and

develop professional language skills. In terms of compliance with professional style, the EGT score increased from 3.18 to 4.18 points. The results confirmed the development of skills in using formal business language structures and adapting speech to a legal context. This is also supported by A. Azaria *et al*. (2024). The authors investigated the potential of ChatGPT as a tool for expert activities. They noted that AI in education helps to create interactive exercises, generate case studies and provide personalised feedback. This thesis is further developed by I. Cheong *et al*. (2024). The researchers analysed the involvement of lawyers in shaping responsible policies for the use of large language models in legal consultations.

The results obtained showed that the use of interactive teaching methods led to a significant improvement in speech accuracy in the EG, from 3.12 to 4.05. This confirms the general trend towards more effective acquisition of linguistic norms in a practice-oriented learning environment. The use of such tools in teaching requires the development of critical thinking and the ability to verify information. The necessity of a digital component is confirmed by A. ElSayary (2023). The author investigated the impact of professional development programmes on the development of teachers' digital competence. A well-trained teacher implements interactive technologies more effectively and organises a modern educational environment. A similar position is expressed by J. Hao *et al*. (2024). The researchers examined the transformation of assessment under the influence of generative AI. Interactive assessment systems can be used for the rapid monitoring of students' language achievements and the adjustment of the educational process. This is consistent with the findings of A.J. Khasawneh *et al*. (2023). The authors investigated experts' views on the evolution of translation education in the 21st century. They emphasised the need to transition to student-centred and interactive teaching models geared towards professional needs. The relevance of this issue is confirmed by L. Kohnke *et al*. (2023). The researchers examined the readiness of language teachers to use generative AI. The effectiveness of interactive methods depends to a large extent on the teacher's digital literacy and their openness to innovation. This argument is supported by N. Lesiana *et al*. (2024). The authors analysed classroom interaction within the framework of the communicative approach to language teaching. Constant verbal interaction among students contributes to the development of confidence, argumentation skills and practical command of professional language. A comparative analysis showed that in the EG, all indicators exceeded a level of 4.0, whereas in the CG they did not reach this level. This demonstrates the significantly higher effectiveness of interactive teaching methods. This is consistent with M. Martín-Sómer *et al*. (2024). The effectiveness of using interactive applications in higher education and their impact on students' academic outcomes has been demonstrated. It has been established that digital interaction enhances motivation, engagement and the quality of learning. This is confirmed by K. Omuralieva *et al*. (2025). Approaches to language training for modern lawyers and the need to combine it with professional scenarios are outlined. It is emphasised that practice-oriented methods contribute to the development of future lawyers' language competences. This correlates with the findings of F. Prieto Ramos (2024). Changes in the structure of translation competence have been identified in the context of the use of AI in legal and institutional translation. The importance of combining digital tools with the development of critical thinking is emphasised. This is evident in the study by T. Shahzad *et al*. (2025). A model for the practical training of students is proposed, in which the activity-based approach and the simulation of professional situations is central. The study emphasised that learning through practice ensures a more effective transfer of knowledge into real-world professional practice.

Researchers have summarised the potential of large language models in education and the potential risks associated with their use. Such technologies can be used for personalised learning, automated feedback and expanded access to educational resources. This is consistent with the findings of L.P. Wanti *et al*. (2023). The researchers identified a positive impact of interactive media on language training and the communicative activity of learners. The level of communicative effectiveness among students in the EG increased from 3.2 to 4.1 points. This demonstrated the development of skills in articulating a position with reasoning, maintaining a professional dialogue, and interacting effectively in simulated legal situations. Such tools improve the perception of learning material and engagement in the learning process. This is confirmed by D. Yigci *et al*. (2024). The use of chatbots based on large language models in higher education is described. The authors demonstrate their role in supporting personalised learning, developing writing skills, and providing rapid academic support. This aligns with the position of R. Yuan (2021). The role of language specialists in modernising language teaching in higher education institutions was explored. The innovative approaches to language training were found to make a contribution to the improvement of the quality of language training and adaptation of students into the profession. These findings are supported by the work of L. Zhui *et al*. (2024) on the ethical principles of using large language models in vocational education. The authors note that upholding the principles of academic integrity and quality control of education is necessary. The logical coherence of speech increased from a mean of 3.22 to a score of 4.12 after the implementation of these methodologies based on analytical exercises and professional scenario simulations. The proficiency in legal terminology

increased from a mean of 3.3 to a score of 4.25 after the implementation of these approaches. In the CG, the corresponding indicators remained at a moderate level (up to 3.6). A summary of the results showed that the introduction of large language models and interactive digital technologies into higher education ensured an increase in the effectiveness of the learning process through personalisation, prompt feedback and expanded access to educational resources, whilst also fostering the development of students' communication and writing skills and their engagement in learning; however, the effectiveness of such implementation depended on adherence to ethical standards, principles of academic integrity and proper pedagogical quality control of educational outcomes.

Conclusions

The study found that teaching methods influence the acquisition of professional Ukrainian through the promotion of speaking practice, the simulation of professional communication situations, and the constant engagement of students in dialogue. This ensures more effective mastery of professional terminology, the development of grammatically and stylistically correct professional speech, and the development of the ability to apply linguistic means in accordance with the professional context. Interactive methods in professional language education in the legal field function as a holistic pedagogical system that combines the didactic principles of activity, problem-based learning and communicative orientation with constructivist, communicative and activity-based approaches, ensuring a transition from the rote acquisition of knowledge to its practical application in simulated professional situations, which contributes to the development of communicative and professional competence in future lawyers.

The results of the experiment helped to confirm the effectiveness of the approach. The initial scores of the CG and EG were almost identical in their initial scores ($M \approx 2.8\text{-}3.2$; $SD \approx 1\text{-}1.15$). Following the formative stage of the lesson, however, the CG experienced only a slight increase in their scores ($M \approx 3.3\text{-}3.65$), but the EG experienced an increase in their score to a level of $M \approx 4\text{-}4.12$ with a reduction in the standard deviation to $SD \approx 0.82\text{-}0.9$. The results of the statistical analysis revealed that there were changes to the level of professional language competence within both the CG and EG of students. The CG revealed only a slight increase in their scores (from $M = 3.06 \pm 0.11$ to $M = 3.49 \pm 0.09$; $t = 2.14$; $p < 0.05$), but the EG experienced changes to their scores from an initial mean of $M = 3.02 \pm 0.12$ to a final mean of $M = 4.07 \pm 0.08$ ($t = 6.87$; $p < 0.001$). Furthermore, the EG scores ($M = 4.07 \pm 0.08$) were found to be significantly higher than those of the CG ($M = 3.49 \pm 0.09$; $t = 5.92$; $p < 0.001$), confirming the effectiveness of the interactive teaching methods for improving the language competence of college students.

The proposed algorithm for using interactive methods involves a phased approach to the teaching process, which includes simulating professional scenarios, working with case studies, analysis and adaptation of legal texts, tasks involving the creation and editing of documents, the development of reasoned oral discourse, and the integration of various activities with systematic assessment of results. This ensures the development of the ability to speak accurately, logically and in a professionally oriented manner, and enhances the readiness of future lawyers for effective communication in the real-world conditions of legal practice. Prospects for further research include analysis of the effectiveness of interactive methods combined with digital AI technologies for the individualised development of professional language competence among future lawyers.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Інтерактивні методи навчання української мови професійного спрямування у підготовці фахівців юридичного профілю

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Анотація. Метою дослідження було визначення впливу інтерактивних методів навчання на формування професійної мовної компетентності майбутніх фахівців юридичного профілю. Методологія дослідження включала теоретико-методологічний аналіз, порівняльний аналіз наукових підходів, узагальнення педагогічного досвіду, навчальний експеримент на базі закладів вищої освіти України. Було досліджено, що інтерактивні методи у професійній мовній підготовці юристів включають рольові ігри, кейс-метод, дискусії, симуляції та роботу з професійними ситуаціями, і забезпечують формування комунікативної компетентності, розвиток аргументації та опанування юридичної термінології в умовах моделювання реальної професійної діяльності. Було вивчено, що дидактична основа інтерактивного навчання ґрунтується на принципах активності, проблемності та комунікативної спрямованості, що дозволяє формувати у студентів уміння логічно будувати висловлювання, застосовувати мовні конструкції та діяти в умовах професійного мовлення. Було досліджено ефективність інтерактивних методів навчання у педагогічному експерименті, в ході якого зафіксовано зростання середніх показників експериментальної групи до рівня M ≈ 4,05-4,25, тоді як у контрольній групі відповідні значення становили M ≈ 3,4-3,6, що свідчить про більш виражену позитивну динаміку в експериментальних умовах. Отримані результати підтверджують, що застосування інтерактивних методів навчання забезпечує суттєвіше підвищення рівня сформованості професійної мовної компетентності порівняно з традиційними підходами. У результаті формувального етапу експерименту в експериментальній групі зафіксовано зростання середніх показників професійної мовної компетентності за всіма критеріями: точність мовлення підвищилася з 3,12 до 4,05, відповідність професійному стилю з 3,18 до 4,18, комунікативна ефективність з 3,2 до 4,1, логічність висловлювання з 3,22 до 4,12, а володіння юридичною термінологією – з 3,3 до 4,25, що суттєво перевищує динаміку контрольної групи (зростання в межах 3,1-3,25 до 3,4-3,6), що вказує на ефективність застосованих інтерактивних методів навчання. Було досліджено, що алгоритм впровадження інтерактивних методів включає створення професійно орієнтованого мовного середовища, моделювання юридичних ситуацій, роботу з кейсами та нормативними текстами, що забезпечує практичне засвоєння мовного матеріалу. Практичне значення роботи полягає у можливості використання її результатів для вдосконалення методики викладання української мови професійного спрямування у підготовці майбутніх юристів шляхом упровадження інтерактивних методів навчання

Ключові слова: правниче мовлення; офіційно-ділові мовні конструкції; правова аргументація; інтерактивні методи; комунікативна компетентність

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 45-61
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 09.01.2026 Revised: 14.04.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 378.46:004.946
DOI: 10.69587/pemtt/1.2026.45

Development of simulation centres as an innovative technology in postgraduate medical education: Theoretical and methodological foundations and practical dimension

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■ **Abstract.** The article aimed to determine the role of simulation centres in modernising postgraduate medical education and strengthening practical training to develop professional competencies among healthcare professionals. The research methodology was based on an applied pedagogical design incorporating theoretical-analytical and quasi-experimental components. The empirical stage was conducted from 16 to 27 February 2026 at the Educational and Research Institute of Postgraduate Education at Zaporizhzhia State Medical and Pharmaceutical University, involving 48 intern doctors who underwent an initial and final comprehensive assessment of their professional competencies. The results showed that simulation centres function as organised educational environments in medical education, where clinical scenarios, the safe practice of algorithms, team interaction, standardised assessment and debriefing ensure the formation of professional competencies. The methodological analysis substantiated the integration of simulation technologies into postgraduate medical education through a combination of competency-, activity-, scenario-, problem-, interprofessional and reflective approaches. Following simulation training, assessment demonstrated statistically significant improvements in intern doctors' results: theoretical preparedness increased from 12.4 ± 2.1 to 17.1 ± 1.8 points; practical actions, from 24.6 ± 4.3 to 34.8 ± 3.1 points; and self-assessment of professional readiness, from 18.2 ± 3.5 to 25.7 ± 2.8 points. The greatest increase was recorded in the reflective component (44.8%), indicating the effectiveness of debriefing. Further development of simulation centres should focus on virtual simulations, telesimulation, digital checklists, electronic portfolios, and artificial intelligence tools. A one-group quasi-experimental study in the system of postgraduate medical education demonstrated a statistically significant improvement in professional competency indicators among intern doctors after simulation training, particularly in terms of theoretical preparedness, practical actions, team interaction and reflective readiness. These results could be utilised by higher

Suggested Citation:
Lukashenko, L., Sokolovska, I., & Ganzhiy, I. (2025). Development of simulation centres as an innovative technology in postgraduate medical education: Theoretical and methodological foundations and practical dimension. *Professional Education: Methodology, Theory and Technologies*, 12(1), 45-61. doi: 10.69587/pemtt/1.2026.45.

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medical education institutions, postgraduate education institutes, simulation centres, and clinical discipline teachers to develop, implement, and assess simulation training in professional development programmes for healthcare professionals

Keywords: debriefing; artificial intelligence; clinical scenarios; digital checklists; team interaction; professional competencies; patient safety

Introduction

Postgraduate medical education must ensure the renewal of knowledge and the reproducible readiness of healthcare professionals to perform clinical actions in situations where an error directly affects the patient's condition. Simulation centres facilitate the development of practical skills in a controlled environment, combining the practice of procedures, clinical algorithms, communication, and team interaction with the objective assessment of learning outcomes. The development of simulation centres is a prerequisite for strengthening the practical orientation of postgraduate training and for the structured continuing professional development of healthcare professionals. The absence of the systematic integration of simulation centres into postgraduate medical education can result in a discrepancy between theoretical training and clinical practice, uneven professional competency levels, and increased risks to patient safety. This complicates the provision of predictable quality medical care and poses challenges to the professional responsibility of healthcare providers.

In medical education in Ukraine, simulation-based learning should be considered a tool for preserving practical training, standardising clinical actions, and creating a safe environment for practising professional skills. A study by O. Yuryk *et al*. (2024) examined how Ukrainian higher medical education institutions used innovative simulation technologies to maintain practical training during wartime. The authors demonstrated that simulation-based learning not only ensured the continuation of the practical component of the educational process when access to clinical bases was limited, but also strengthened the opportunity to safely practise professional actions in a controlled environment. M. Chavarha *et al*. (2025) revealed how medical education was adapted to crisis conditions through organisational restructuring, digital support, and renewed methodological approaches. The results showed that simulation centres can ensure the continuity of practical training for healthcare professionals when access to the clinical environment is restricted. The article by Z.R. Kocherga *et al*. (2024) presented a development strategy for simulation-based learning through organisational, methodological, and resource conditions for its implementation in the educational process. Within this approach, the simulation centre is presented as an institutional environment combining technical equipment, scenario-based learning, pedagogical support, and control over the development of practical skills. The study by P. Ivanchov *et al*. (2024) considered integrated simulation-based training of surgical skills as a means of strengthening procedural training in medical universities. In that study, surgical simulation scenarios were presented as a means of combining intervention algorithms, technical accuracy, the sequence of clinical decisions, and safety controls during performance.

Integrating simulation technologies into postgraduate medical education is associated with a shift in focus from knowledge transmission to fostering practical, communicative, team-based, and reflective skills among healthcare professionals. A.S. Biduchak (2025) analysed team-oriented training in Ukrainian and European educational contexts. In this learning model, the simulation centre facilitates not only the practice of individual clinical actions, but also coordinated interprofessional interaction, the distribution of functions, communication, and joint decision-making in simulated clinical situations. The study by Y. Shpryakha *et al*. (2025) assessed the effectiveness of clinical simulation-based learning through the development of practical skills among medical students. The results obtained confirm that simulation training should be assessed not merely by participation, but by the dynamics of specific skills that can be evaluated using checklists and clinical scenarios. S. Shapovalov *et al*. (2025) linked the challenges of postgraduate medical education to the need to update the content, forms, and mechanisms of professional learning. This highlights the importance of simulation centres as tools for the regular practice of practical actions, clinical algorithms, and professional decisions throughout a doctor's career. Y. Nemyrovych *et al*. (2024) considered innovative educational technologies to be a factor in improving continuing professional development for doctors, as such approaches can adapt learning to the needs of adult professionals and increase its practical orientation. The researchers confirmed that simulation technologies can be integrated into both separate training modules and the system of continuous professional development, where flexibility, practical orientation, and the ability to repeatedly assess competencies are priorities.

International approaches to simulation-based medical education emphasise the need for evidence of its impact, the importance of debriefing, and the requirement to evaluate not only technical actions, but also clinical thinking, communication, and teamwork. C. Elendu *et al*. (2024) demonstrated the impact of

simulation training on medical education in terms of its contribution to the development of clinical skills, professional confidence, and a safe learning environment. In postgraduate education, these findings highlight the importance of learning formats that enable healthcare professionals to update their theoretical knowledge and assess their preparedness for clinical situations. C. Patocka *et al*. (2024) evaluated the impact of targeted simulation training on learning outcomes, professional preparedness, and the quality of practical actions performed by healthcare professionals prior to the execution of clinical procedures. The authors demonstrated that short simulation sessions can quickly restore or reinforce practical skills prior to performing responsible clinical procedures. J. Berger-Estilita *et al*. (2021) analysed the communicative content of debriefing in simulation-based medical education using an analytical framework and a mixed-methods approach. The results showed that the effectiveness of simulation-based learning depends not only on the realism of the scenario, but also on the quality of the subsequent analysis, during which errors are transformed into professional experience.

While previous studies have adequately covered the organisational, technological, and methodological foundations of simulation-based learning, the connection between institutional development of simulation centres and professional competency development among postgraduate medical students remains underdeveloped. This study aimed to determine the significance of simulation centres as an innovative educational environment for renewing postgraduate medical education, improving practice-oriented training, and forming professional competencies among healthcare professionals. To this end, the following tasks were defined: analysing trends in the development of simulation centres in professional education and continuing learning for healthcare professionals; characterising methodological approaches to integrating them into postgraduate medical education and assessing their impact on professional competencies; assessing changes in professional competency indicators among intern doctors after using simulation technologies; and outlining prospects for developing simulation centres in an era of educational digitalisation.

Materials and Methods

The work's methodology was based on an applied pedagogical design that combined theoretical-analytical and quasi-experimental components. The theoretical-analytical component involved studying scientific approaches to developing simulation centres, the methodological foundations for integrating them into postgraduate medical education, and the role of simulation technologies in developing professional competencies among healthcare professionals. The quasi-experimental component aimed to assess the development of professional competencies among learners before and after they completed simulation-based learning. Zaporizhzhia State Medical and Pharmaceutical University in Ukraine, specifically its Educational and Research Institute of Postgraduate Education, was selected as the location for the empirical stage. The study period was from 16 to 27 February 2026. This time interval was chosen to ensure a complete cycle of simulation-based learning, with initial and final assessments of professional competencies conducted sequentially.

The theoretical-analytical component of the study was based on scientific works revealing the content, functions, and educational potential of simulation-based learning in medical education (Saleem & Khan, 2023; Ajemba *et al*., 2024). To clarify the institutional dimension of the problem, studies devoted to the organisational and pedagogical foundations of simulation centre operation were analysed (Carter & Al-Shanteer, 2025; Zeng *et al*., 2025). As the study was conducted in the context of postgraduate medical education, attention was given to works addressing the continuing professional development of healthcare professionals (Tavares *et al*., 2023; Abdool *et al*., 2025). The methodological basis for evaluating simulation-based learning outcomes was defined in relation to the competency-based approach in medical education (Zafošnik *et al*., 2024; Fisk *et al*., 2025). The communicative and team-based aspects of professional training were analysed based on sources examining team interaction in medical education (Kiessling *et al*., 2022; Sung & Hsu, 2025). The reflective component of the study was substantiated through works examining the role of debriefing in simulation training (Ahmad *et al*., 2023; Salik & Paige, 2023). In light of changes to the educational process, studies examining the digitalisation of medical education and the use of digital tools in specialist training were also analysed (Almousa *et al*., 2021; Sun *et al*., 2024). To compare national and international experience, sources devoted to international approaches to organising simulation training were also considered (Rossler *et al*., 2021; Watts *et al*., 2021). The analysis of these works made it possible to clarify the functions of the simulation centre as an educational environment, determine the conditions for its integration into postgraduate medical education and substantiate the components of assessing professional competencies among intern doctors. The content of the clinical scenarios was linked to the criteria for standardised assessment of practical actions, which made it possible to align the learning situations with the expected outcomes of the simulation training (Bahattab *et al*., 2023; Klein *et al*., 2025). The organisation of pedagogical support, the role of the teacher-facilitator and the structure of post-scenario analysis were substantiated with regard to approaches to facilitation and debriefing (des Ordons *et al*., 2022; Dieckmann *et al*., 2023).

A total of 48 intern doctors specialising in "General Practice – Family Medicine" and undergoing training

at the research base took part in the empirical stage of the study. The sample was formed through purposive voluntary sampling, as it included doctors undertaking the relevant postgraduate training cycle, participating in simulation training, and consenting to the use of anonymised results for scientific purposes. Information about participant recruitment was provided during an organisational meeting before the training cycle began and via an information notice circulated among the intern doctors. Participants' ages ranged from 24 to 37 years, with an average age of 28.7 ± 3.4 years. The sample included 18 men and 30 women, reflecting the actual composition of the academic group of intern doctors, and this was not an additional criterion for sample formation. Inclusion criteria included being an intern doctor specialising in "General Practice – Family Medicine", participating in the full cycle of simulation training, completing initial and final assessments, and providing voluntary consent to participate in the study and to use anonymised results. The exclusion criteria were incomplete simulation training, absence of results from one of the assessment stages, refusal to participate, and impossibility of comparing initial and final data. All participants completed the simulation training and were included in the final analysis.

The empirical stage of the study was conducted in a training classroom equipped for simulation-based learning, team interaction and practical algorithms, at the research site. The study was conducted in accordance with the relevant ethical guidelines (European Commission, 2021; The Declaration of Helsinki, 2024). The simulation training comprised four sessions of three academic hours each, totalling 12 academic hours. Professional competencies were assessed using the authors' own instruments: a theoretical knowledge test, a self-assessment questionnaire on professional readiness, and an expert checklist for evaluating practical performance. These instruments underwent preliminary methodological verification before the main stage of the study. The content validity of the instruments was ensured through expert assessment of their structure, content, and alignment with the objectives of the simulation training. Five specialists were involved in the expert assessment: three clinical discipline teachers with experience of training intern doctors and two simulation-based learning specialists who had participated in the organisation and delivery of practice-oriented training in medical education. The experts analysed how well the test items, questionnaire statements and checklist criteria corresponded to the aims and objectives of the training, the components of professional competencies, the content of typical simulation tasks and the expected learning outcomes. The instruments were assessed according to the following criteria: content relevance; methodological appropriateness; clarity of wording for intern doctors; unambiguity of scaling; the possibility of objectively recording results; and suitability for comparing initial and final assessments. The correspondence between the test items and the content of the clinical algorithms, between the questionnaire statements and the indicators of subjective professional readiness, and between the checklist criteria and the practical, communicative and reflective actions performed during the simulation training was analysed separately. Following an expert discussion, the formulations of the test items, self-assessment indicators and practical assessment criteria were clarified. The pilot application of the instruments enabled the clarity of the instructions, the unambiguity of the scaling, and the convenience of recording results to be checked. To minimise subjectivity in expert assessment, the checklist was used in a standardised format with predefined criteria and the same assessment scale for all participants. To determine the cognitive component of professional competencies, a theoretical knowledge test was used to assess understanding of clinical algorithms, the sequence of actions, the principles of patient safety, and team interaction (Table 1).

Table 1. *Structure for assessing the theoretical preparedness of intern doctors*

Testing block	Content of assessment	Number of tasks
Clinical algorithm	Sequence of actions in a clinical situation	5 (1 point for each correct answer)
Initial assessment of the patient's condition	Determining examination priorities, recognising signs of an emergency condition, assessing risks	5 (1 point for each correct answer)
Patient safety	Compliance with rules for the safe performance of procedures, prevention of errors, risk control	4 (1 point for each correct answer)
Team interaction	Distribution of roles, transfer of information, coordination of actions within the team	3 (1 point for each correct answer)
Debriefing and error analysis	Understanding the importance of feedback, reflection and correction of subsequent actions	3 (1 point for each correct answer)

Note: *the test was administered before the beginning and after the completion of the simulation training; the final version was equivalent to the initial version in terms of structure, difficulty and distribution of thematic blocks*
Source: *compiled by the authors*

To assess the subjective-reflective component of professional readiness, a self-assessment questionnaire was used, which made it possible to identify how intern doctors assessed their own readiness to perform clinical actions, make decisions, engage in team interaction and analyse errors before and after the training (Table 2).

Table 2. *Self-assessment questionnaire of professional readiness of intern doctors*

Self-assessment indicator	Statement before training	Statement after training	Scale
Readiness to perform a clinical algorithm	I am ready to perform a clinical algorithm in a clinical situation	After the training, I am ready to perform a clinical algorithm in a clinical situation	1-5
Confidence in making clinical decisions	I am confident in making clinical decisions during an emergency condition	After the training, I am confident in making clinical decisions during an emergency condition	1-5
Readiness for practical actions	I am ready to perform practical actions in accordance with patient safety requirements	After the training, I am ready to perform practical actions in accordance with patient safety requirements	1-5
Team interaction	I am ready to interact with other team members while performing a clinical task	After the training, I am ready to interact with other team members while performing a clinical task	1-5
Professional communication	I am ready to communicate information clearly, ask clarifying questions and coordinate actions within the team	After the training, I am ready to communicate information clearly, ask clarifying questions and coordinate actions within the team	1-5
Reflection and error analysis	I am able to analyse my own errors after completing a clinical scenario	After the training, I am able to analyse my own errors after completing a clinical scenario	1-5

Note: *the questionnaire was administered before the beginning and after the completion of the simulation training; each of the 6 indicators was assessed on a five-point scale: 1 point – strongly disagree with the statement; 2 points – rather disagree; 3 points – partly agree/partly disagree; 4 points – rather agree; 5 points – strongly agree*
Source: *compiled by the authors*

To record the practical and communicative-team components of professional competencies, an expert assessment checklist was used. Practical actions were assessed by one teacher-facilitator with experience in conducting simulation-based learning. The facilitator assessed the actual performance of the clinical algorithm, technical accuracy, safety of actions, communication and decision-making during the simulation task using a standardised checklist with pre-defined criteria and the same assessment scale for all participants, which was used to minimise the subjectivity of expert assessment (Table 3).

Table 3. *Expert assessment checklist of practical actions during the simulation task*

Assessment criterion	Content of the criterion	Maximum score
Initial assessment of the patient's condition	Sequential determination of the patient's condition, recognition of signs of urgency, determination of action priorities	5
Compliance with the clinical algorithm	Performance of actions in accordance with the defined sequence, absence of critical omissions	5
Technical accuracy of practical actions	Correct performance of manipulations, accuracy of movements, compliance with the technique of performance	5
Patient safety	Compliance with safety rules, risk control, preventio of actions that may worsen the patient's condition	5
Team interaction	Distribution of roles, coordination of actions, involvement of other team members	5
Professional communication	Clarity of information transfer, use o clarifications, correctness of team messages	5
Clinical decision-making	Selection of justified actions according to the situation, timeliness of decisions	5
Reflection during debriefing	Ability to explain one's own actions, identify errors and propose ways of correction	5

Note: *the checklist was used for expert assessment of practical actions during the performance of the simulation task before the beginning and after the completion of the training; each criterion was assessed on a five-point scale: 1 point – the action was not performed or was performed with errors that compromised patient safety or made it impossible to achieve the aim of the clinical stage; 2 points – the action was performed fragmentarily, with the omission of several mandatory elements or with a violation of the sequence of performance; 3 points – the action was performed generally in accordance with the criterion, but with individual omissions of elements or inaccuracies in the sequence; 4 points – the action was performed in accordance with the criterion, sequentially, with isolated inaccuracies that did not alter the clinical logic of performance; 5 points – the action was performed fully, sequentially, independently and in accordance with patient safety requirements*
Source: *compiled by the authors*

To detail the results of the expert assessment from the checklist, the communicative and teamwork components were identified separately. The communicative-team component was calculated as the mean of the two criteria, "Team interaction" and "Professional communication", each of which was assessed on a scale of 1-5. The reflective component was determined according to the "Reflection during debriefing" criterion, which was also assessed within the 1-5 point range. Self-assessment of professional readiness was analysed separately using a questionnaire. Therefore, it did not replace the expert assessment of practical, teamwork and reflective indicators. The training content aimed to practise clinical algorithms in typical emergency situations relevant to intern doctors specialising in "General Practice – Family Medicine". During the simulation sessions, participants practised the following: initial assessment of the patient's condition; determination of clinical action priorities; compliance with emergency care algorithms; performance of practical actions; professional communication; team interaction; and error analysis during debriefing (Table 4).

Table 4. *Organisational structure of the simulation training and assessment of professional competencies*

Stage of study organisation	Content of the stage	Instruments/result
Initial assessment	Initial assessment of the baseline level of preparedness of intern doctors. Testing of theoretical knowledge, self-assessment questionnaire of professional readiness and primary performance of the simulation task were conducted	Theoretical knowledge test; self-assessment questionnaire; expert assessment checklist of practical actions. Baseline indicators of the cognitive, practical and subjective-reflective components were determined
Orientation-algorithmic stage	Orientation in the simulation environment, familiarisation with working rules, practice of initial assessment of the patient's condition, determination of clinical action priorities and the team interaction algorithm	Briefing; performance of a basic simulation task; short debriefing. Understanding of the structure of the simulation task and the requirements for safe performance of actions was formed
Practice-procedural stage	Practice of the sequence of practical actions in a clinical situation, compliance with patient safety requirements, technical accuracy of procedure performance, correction of typical errors	Simulation task; expert observation; debriefing. The correctness of the clinical algorithm and the safety of practical actions were clarified
Communicative-team stage	Practice of professional communication, distribution of functions within the team, transfer of information, coordination of actions and clinical decision-making in a team format	Team simulation task; facilitated debriefing. The quality of interaction, communication and coordination of participants' actions was assessed
Integration stage	Comprehensive performance of the simulation task with integration of the clinical algorithm, practical actions, team interaction, professional communication and reflective analysis	Final simulation task; expert observation; concluding debriefing. Participants' readiness for the holistic performance of a professional task was recorded
Final assessment	Final assessment of professional competencies according to the same components as at the beginning of the study. Repeated testing, questionnaire completion and expert assessment of simulation task performance were conducted	Theoretical knowledge test; self-assessment questionnaire; expert assessment checklist. The dynamics of the cognitive, practical, communicative-team and subjective-reflective components were determined

Source: *compiled by the authors*

The training was conducted by clinical discipline teachers and a teacher-facilitator. They provided instruction and support for simulation sessions and debriefing, as well as recording results using checklists. After completing the training tasks, participants discussed the sequence of actions, clinical decisions, communication, distribution of roles, and errors related to patient safety. The assessment results were compared at the start and end of the simulation training. The results were statistically processed using Statistica 13.0 (USA). Quantitative indicators from testing, questionnaire completion and expert checklist assessment were analysed by assigning a score to each indicator; the mean value and standard deviation were then determined for each indicator. The dynamics between the initial and final assessments were evaluated according to the difference in mean scores, percentage increase, and level of statistical significance of the differences. Additionally, the effect size was determined for the main indicators as the standardised mean change d_{av}, which is calculated as the ratio of the difference between the final and initial mean values to the average standard deviation of the two measurements. The normality of the distribution was checked using the Shapiro-Wilk test. Paired statistical analysis was applied to each indicator since the results of the same interns before and after simulation training were compared using a one-group 'before-and-after' design. Differences between the initial and final assessments were analysed using paired comparisons: Student's t-test for dependent samples was used for normal distribution and the Wilcoxon test for non-normal distribution. Differences were considered statistically significant at $p < 0.05$.

Results and Discussion

Trends in the development of simulation centres in medical education

The development of simulation centres in medical education reflects a shift from fragmented individual practices to the creation of a controlled educational environment. In this environment, clinical scenarios, practical actions, team interactions, assessments and reflections form a comprehensive learning cycle. According to this logic, a simulation centre is not merely a technical base equipped with mannequins, trainers and digital tools; it is also a space for developing professional competencies. For postgraduate medical education, this is significant, as intern doctors require not only an update to their knowledge, but also verification of their ability to act in situations requiring rapid clinical decision-making, adherence to an algorithm, communication, and ensuring patient safety.

The analysis showed that simulation-based learning is used to repeatedly practise clinical skills, correct errors and perform actions repeatedly, which corresponds to the understanding of healthcare simulation as an effective way of learning in medical and health care education (Saleem & Khan, 2023). This organisation of learning enables the risky elements of training to be transferred from the real clinical environment into a controlled educational situation, where an error does not harm the patient, but instead provides a basis for professional analysis. This is consistent with the view of P. Abdool *et al*. (2025), who linked simulation-based education to continuing professional development, quality improvement and patient safety. Unlike traditional learning, where errors are often only identified in clinical practice, the simulation format enables them to be recorded in the learning environment, their causes to be explained, and safer algorithms for subsequent actions to be developed. In this context, the simulation centre becomes a pedagogical environment in which the technical improvement of clinical actions and the professional responsibility of doctors are developed.

Within the structure of the identified trends, a distinct shift towards viewing the simulation centre as an organisational and pedagogical infrastructure combining space, equipment, scenarios, teacher training, assessment criteria, and feedback can be observed (Rege, 2020; Carter & Al Shanteer, 2025). The effectiveness of such a centre is not determined by the number of technical resources available, but by its ability to ensure a consistent learning process, from setting an educational objective to assessing the outcome. A similar position was taken by A. Zeng *et al*. (2025), who linked the establishment of a medical simulation centre to the modernisation of medical education content, technological provision, and interdisciplinary training organisation. Therefore, the simulation centre should be considered an integral part of the educational programme, rather than a supplementary space for isolated practical training. This is particularly evident in postgraduate education, since adult professionals require clear objectives, practical content, objective assessment and the ability to immediately correlate the completed task with future clinical activity.

Analysis of simulation-based learning design showed that, provided defined objectives, algorithms of action, assessment criteria and expected outcomes are in place, clinical scenarios can ensure the standardisation of practical training. As a result, different participants undergo comparable learning experiences and teachers have a basis for more objective assessment of their actions. K. Rossler *et al*. (2021) further developed this position in their standards for simulation-enhanced interprofessional education, emphasising the importance of aligning learning objectives, team interaction, scenario design and feedback. P.I. Watts *et al*. (2021) approach complements this position by considering the design of simulation-based learning in terms of the structured nature of the scenario, the realism of the environment, defined roles, and assessment criteria. Thus, standardisation in a simulation centre does not entail the mechanical repetition of identical exercises; rather, it ensures methodological transparency, reproducibility, and comparability of training outcomes.

In competency-based medical education, the effectiveness of a simulation centre is assessed differently: participation in training is not the criterion, but rather the ability to perform a professional action according to defined criteria. In such a model, the clinical scenario enables the simultaneous assessment of knowledge of the algorithm, the technical correctness of actions, the quality of communication, the ability to coordinate within a team, and reflection after completing the task. This is consistent with the conclusions of P. Fisk *et al*. (2025), who investigated the relationship between simulation-based education and competency-oriented medical training in the context of emergency clinical situations. This approach explains why the simulation centre is particularly well-suited to postgraduate education: competence can be verified not only declaratively, but also through observable action. Accordingly, assessment should cover not only test-based knowledge, but also the performance of practical algorithms, decision-making, communication, and the ability to analyse one's own errors.

In emergency care scenarios, the simulation centre provides an environment in which to practise not only individual actions, but also team coordination. The outcome of professional actions in such situations depends not only on the technical skill of individual participants, but also on team coherence, role distribution, the speed of information transfer, and the ability to make joint decisions. These findings are consistent with those of T. Sung & H. Hsu (2025), who demonstrated the link

between simulation-based interprofessional training and enhanced communication and safety in critical care settings. A. Kiessling *et al*. (2022) also found an association between interprofessional, simulation-based team training and participants' self-efficacy in emergency situations. In postgraduate education, this means that the simulation centre must develop not only the individual performance readiness of doctors, but also their ability to work in a team, coordinate actions, and maintain safe clinical processes.

Preparing for emergency conditions in a simulation environment requires consistent algorithms, timely decision-making, and safe action sequences. Such scenarios enable clinical pressure to be reproduced without risk to the patient, and allow assessment of whether the participant can act correctly within the appropriate time frame (Alinier *et al*., 2023). M.R. Klein *et al*. (2025) complement this position by linking the development of checklists in simulation-based learning to the need for standardised assessment of clinical skills. This position is methodologically justified since the effectiveness of simulation training cannot be determined by general impressions alone. It requires criteria that allow the sequence of actions, technical accuracy, safety, team interaction, and post-scenario reflection to be evaluated.

Alongside face-to-face training, there has been an increase in digital and hybrid formats of simulation-based learning. While digital tools do not replace the simulation centre, they do expand its capabilities by offering virtual scenarios, remote modelling, telesimulation and digital support for clinical situations (Herrera-Aliaga & Estrada, 2022). O. Almousa *et al*. (2021) also considered virtual reality and remote digital applications to be a hybrid system of clinical training. A shift in the research focus in simulation-based medical education can be traced in the bibliometric analysis by W. Sun *et al*. (2024) – from traditional educational modelling formats to digital and virtual simulations. For postgraduate education, this trend creates an opportunity to combine physical performance with digital modelling of complex or rare clinical situations that cannot always be reproduced in real educational processes.

The generalisation of the analysis revealed the following trends in the development of simulation centres in medical education: transitioning from trainer-based learning to organised educational environments; strengthening the relationship between simulation, patient safety and training quality; orientating towards measurable professional competencies; developing team-based training; standardising scenarios; and using digital formats. In postgraduate medical education, these trends ensure learning is organised as a complete cycle of professional improvement involving updating knowledge, performing a clinical scenario, expert assessment, debriefing, and correcting actions. According to this logic, the simulation centre emerges as an educational environment in which professional competencies are formed through repeated, observable and measurable professional actions.

Methodological approaches to the integration of simulation technologies into postgraduate medical education

Integrating simulation technologies into postgraduate medical education requires methodological coherence between learning objectives, clinical scenario content, expected professional competencies, assessment criteria, and post-scenario analysis. According to this logic, simulation training is not limited to demonstrating manipulations or performing a practical task once, but is instead structured as a sequential educational cycle involving updating knowledge, performing a professional action, receiving expert assessment, undergoing debriefing and correcting subsequent behaviour. This is significant for postgraduate training because intern doctors must not only know the clinical algorithm, but also be able to apply it in situations involving uncertainty, time constraints, team interaction and responsibility for patient safety.

The competency-based approach defines the basis for integrating simulation technologies, as it focuses learning on the ability to perform a professional action according to defined criteria rather than on the mere assimilation of theoretical information. Within this approach, the simulation scenario becomes a means of evaluating the practical, communicative, team-based and reflective elements of professional preparedness. G. Alinier *et al*. (2023) presented a methodologically similar approach, considering simulation as a means of developing clinical skills through practice-oriented tasks. This approach explains why competence in a simulation environment should be assessed through observable actions rather than formal training participation. This logic is justified for postgraduate education, since doctors must demonstrate their readiness for clinical decision-making, algorithm performance, communication and error analysis in professional situations.

The activity-based approach defines simulation-based learning as the process of carrying out professional tasks in an environment that closely resembles clinical practice. It assumes that learners do not merely become acquainted with algorithms, but sequentially perform practical steps, receive feedback, and repeatedly practise complex elements of actions (Elshama, 2020). This aligns with the competency framework of U. Zafošnik *et al*. (2024), where the learning outcome is linked to specific actions that must be developed and evaluated during the educational process. This comparison demonstrates that the activity-based approach provides a practical mechanism for implementing competency-based education. In postgraduate training, it enables the transfer of knowledge from theoretical understanding to controlled performance of a clinical algorithm.

The scenario-based approach provides the content-related and organisational basis for integrating simulation technologies into postgraduate medical education. A clinical scenario should include a learning objective, an initial situation, expected participant actions, possible errors, assessment criteria, and a post-scenario analysis stage. S.S. Elshama (2020) presented a methodologically related approach, considering simulation-based learning to be the reproduction of a professional situation involving the learner's active participation and sequential performance of a practical task. In this comparison, the scenario is not an arbitrary description of a clinical case, but rather a methodically constructed tool for developing professional behaviour. In postgraduate education, the scenario-based approach ensures that situations are modelled in which doctors determine priorities, select the sequence of interventions, coordinate communication, and explain clinical decisions.

The problem-oriented approach builds on the scenario-based logic by shifting the emphasis from mechanically reproducing an algorithm to solving a clinical task. In this model, the simulation situation involves a problem requiring analysis, risk differentiation, action selection and verification of their correspondence to the clinical context. In the context of continuing professional development, W. Tavares *et al*. (2023) specified this approach, considering simulation to be a strategy for maintaining doctors' professional readiness. This comparison demonstrates that problem-oriented simulation has educational, professional, and organisational value, as it fosters the ability to act in situations where an error could impact the quality of care. For an intern doctor, this means not merely knowing a standard algorithm, but being able to adapt it to a specific clinical situation.

Standardised assessment is essential for the methodologically correct use of simulation technologies in postgraduate education. A checklist enables assessment of specific parameters of professional action rather than a general impression of scenario performance: the sequence of the algorithm, technical accuracy, safety, communication, team coordination and decision-making. This is consistent with the approach of A. des Ordons *et al*. (2022), who demonstrated that the role of the simulation teacher involves more than just recording the outcome; it also involves facilitating educational analysis. This combination enables the distinction between control and pedagogical support: the checklist ensures an objective assessment, while the facilitator helps participants understand the causes of errors and how to correct them. In postgraduate education, this creates a basis for comparing initial and final levels of professional competency.

The interprofessional approach involves integrating simulation technologies into situations where the outcome depends on coherent action from several participants. In the context of postgraduate medical education, this encompasses role allocation, information exchange, decision-making coordination, mutual monitoring of activities, and ensuring a safe clinical process (Will & Essary, 2021). I. Salik & J. Paige (2023) elaborate on this logic by debriefing an interprofessional team after they have completed a simulation scenario. Thus, interprofessionality in simulation-based learning has organisational as well as communicative content, as it shapes doctors' ability to act within a system of interdependent professional decisions.

The reflective approach is implemented through debriefing, which transforms the completed scenario into a source of professional learning. Following the simulation task, the analysis encompasses not only correct and incorrect actions, but also the decision-making process, communication quality, role distribution, response to uncertainty, and the participant's ability to explain their behaviour. A. Biduchak (2025) developed this position, considering debriefing a method of practical training that structures post-scenario analysis and strengthens the educational value of the completed task. Compared to international approaches, this allows debriefing to be interpreted not as a final comment by the teacher, but as a separate methodological stage of simulation-based learning. For postgraduate education, the organisation of reflection is important because errors must be transformed from recorded facts into professional conclusions.

The effectiveness of scenario-, activity- and reflective-based approaches depends on the role of the teacher-facilitator. They provide instruction, support the logic of the scenario, observe participants' actions, organise debriefing, and help link the results of task performance to further professional development (Watts *et al*., 2021). This aligns with the debriefing practices outlined by P. Dieckmann *et al*. (2023), in which post-scenario analysis is viewed as a structured process aligned with the learning objectives of the simulation. This connection highlights the importance of facilitator training as an integral part of the simulation-based learning methodology. In postgraduate education, adult learners require reasoned feedback that helps them correlate the learning scenario with real clinical practice, as well as assessment.

Standardised patients or role-based modelling of clinical interactions strengthen the communicative component of simulation training. With their assistance, it is possible to practise gathering information, explaining clinical decisions, responding to patients' emotional reactions, briefing teams and safely transferring data. S. Kassutto *et al*. (2024) presented a related approach, describing a virtual simulation course in clinical skills as a format for practising practical readiness in a modelled environment. In this context, clinical skills are not just technical actions, but a combination of behavioural, communicative and procedural

elements. In postgraduate medical education, this broadens the scope of simulation-based learning beyond manipulative training to encompass professional communication as part of clinical competence.

Thus, the integration of simulation technologies into postgraduate medical education should be based on several methodological approaches. The competency-based approach defines the expected outcomes, while the activity-based approach ensures the performance of professional actions. The scenario-based and problem-oriented approaches structure the clinical situation, and the interprofessional approach facilitates team interaction. Finally, the reflective approach ensures comprehension of actions through debriefing. A complete simulation-based learning model should incorporate a clinical scenario, standardised assessment criteria, a checklist of practical actions, facilitation, and role-based or standardised modelling of clinical interactions, as well as post-scenario analysis. This transforms simulation technologies from a separate training element into a systemic tool for developing professional competencies among healthcare professionals.

Implementation of training and the dynamics of professional competencies after simulation

Practical implementation of simulation training enabled assessment of changes in intern doctors' professional competencies according to cognitive, practical, communicative-team, and reflective components. Comparing the initial and final indicators showed positive changes across all assessment instruments. This reflects a statistically significant improvement in theoretical preparedness, quality of clinical performance, self-assessment of professional readiness, and ability to engage in teamwork after the training was completed by the sample group. Table 5 summarises the initial and final assessment indicators of the professional competencies of intern doctors.

Table 5. *Dynamics of professional competencies of intern doctors*

Assessment indicator	Initial assessment, M ± SD	Final assessment, M ± SD	Increase, %	p	Effect size, d_av
Theoretical preparedness, 0-20 points	12.4 ± 2.1	17.1 ± 1.8	37.9	<0.001	2.4
Practical actions according to the checklist, 8-40 points	24.6 ± 4.3	34.8 ± 3.1	41.5	<0.001	2.72
Self-assessment of professional readiness, 6-30 points	18.2 ± 3.5	25.7 ± 2.8	41.2	<0.001	2.37
Communicative-team component, 1-5 points	3.1 ± 0.7	4.3 ± 0.5	38.7	<0.001	1.97
Reflective component, 1-5 points	2.9 ± 0.8	4.2 ± 0.6	44.8	<0.001	1.84

Note: *M – mean value; SD – standard deviation; p – level of statistical significance of differences between the initial and final assessments; dav – standardised mean change, calculated as the ratio of the difference between the final and initial mean values to the average standard deviation of the two measurements; the dav values were interpreted as indicating a small effect size at d ≈ 0.2, a medium effect size at d ≈ 0.5 and a large effect size at d ≥ 0.8*
Source: *compiled by the authors*

The data in Table 5 showed that all assessed indicators increased significantly after the simulation training was completed. Further analysis of the effect size showed that the changes had a high degree of practical significance across all components, with effect size values exceeding 0.8 and ranging from 1.84 for the reflective component to 2.72 for practical actions according to the checklist. Theoretical preparedness increased from 12.4 ± 2.1 to 17.1 ± 1.8, representing a 37.9% increase. These dynamics suggest an improved understanding of clinical algorithms, the sequence of actions, the principles of patient safety, and the fundamental principles of team interaction. The reduction in standard deviation from 2.1 to 1.8 points suggests that the participants' theoretical preparedness became more consistent after the training. This suggests that after completing the simulation training, the group's average result increased while the variability of indicators among learners with different baseline levels of preparation decreased. A.S. Dzhumatovich & E. Salimrouhi (2025) also emphasised the importance of simulation-based education in medical training since it enables the combination of knowledge acquisition and professional action practice in a practical format.

The number of practical actions according to the checklist increased from 24.6 ± 4.3 to 34.8 ± 3.1 points, representing a 41.5% increase. This is one of the most reliable indicators, since it reflects the quality of clinical scenario performance as recorded by experts, rather than the subjective assessment of participants. These findings are consistent with the systematic review by M.N. Ajemba *et al*. (2024), which confirmed the positive impact of simulation-based training on the acquisition and retention of clinical skills in medical education. An increase in the checklist score indicates a better sequence when performing the algorithm, greater technical accuracy, compliance with safety requirements, timelier clinical decision-making, and more coherent actions in the simulated situation. The decrease in standard deviation from 4.3 to 3.1 points

shows that practical preparedness became more consistent after training. Thus, the most pronounced positive changes were observed precisely in terms of professional performance, rather than merely theoretical preparedness. This is consistent with the approach of S. Archana *et al*. (2021), who linked the establishment of skills and simulation centres to the enhancement of practice-oriented medical education.

Self-assessment of professional preparedness increased from 18.2 ± 3.5 to 25.7 ± 2.8, a rise of 41.2%. This suggests that intern doctors rated their readiness to perform a clinical algorithm, make decisions, interact in a team, and analyse errors more highly after the training. However, this indicator should be interpreted with caution since self-assessment is subjective and cannot independently confirm the effectiveness of the training. However, it does have value in that it complements the results of testing and the checklist by showing the internal perception of professional readiness after practical experience. The consistent increase in self-assessment alongside the results of testing and expert assessment demonstrates that the rise in subjective professional readiness is accompanied by positive dynamics in cognitive and practical indicators.

The communicative-team component increased by 38.7%, rising from 3.1 ± 0.7 to 4.3 ± 0.5 points. This suggests that the participants improved their ability to distribute roles, transfer information, coordinate actions, and make decisions as a team. In postgraduate medical training, such dynamics highlight the importance of teamwork, as professional action in a clinical environment requires not only an individual's mastery of the algorithm, but also the coordination of decisions and communication within the team. The decrease in variability of the indicator after training suggests that team interaction became more structured and predictable. This may be due to the repeated performance of scenarios, the distribution of functions among participants, and the discussion of communication errors during debriefing. These dynamics are consistent with the findings of L.S. Mahmood *et al*. (2021), who demonstrated the role of interprofessional, simulation-based education in developing teamwork and communication skills.

The greatest percentage increase was recorded for the reflective component, at 44.8%, with the mean score rising from 2.9 (±0.8) to 4.2 (±0.6). Following training, participants demonstrated greater awareness of the sequence of their own actions, the causes of errors, the quality of clinical decisions, and methods for improving subsequent behaviour. The high dynamics of this particular component may be associated with the inclusion of debriefing after simulation scenarios. This created conditions for transitioning from simple task performance to comprehending professional action, ensuring a connection between simulation experience, error analysis, and subsequent correction of professional behaviour. Thus, positive dynamics were observed not only in the technical performance of the algorithm, but also in intern doctors' ability to analyse their own clinical behaviour after completion of the training. This is consistent with the approach of G. Şahin & T. Başak (2021), who viewed debriefing as a means of analysing experience, providing feedback, and correcting subsequent actions in simulation-based learning.

Overall, the results demonstrate statistically significant positive dynamics in the professional competencies of intern doctors after simulation training within the studied sample. The increase in theoretical preparedness, checklist indicators, self-assessment and the communicative, team and reflective components reflects an improvement in the cognitive, practical, subjective-reflective and behavioural components of professional readiness. The most notable changes are in practical actions according to the checklist and the reflective component, as these demonstrate positive dynamics in the performance, analysis and correction of the clinical algorithm. However, given the one-group quasi-experimental 'before-and-after' design without a control group, the results should be interpreted as indicating a statistically significant improvement in the indicators following training rather than as providing definitive confirmation of its causal effect.

Prospects for the digitalisation of simulation centres in medical education

The development of simulation centres in medical education is associated with a transition from local, trainer-based spaces to digitally supported educational environments. These environments combine face-to-face scenarios with virtual simulations, telesimulation, electronic assessment, digital checklists, remote debriefing, and analytics of learning outcomes. In postgraduate medical education, such a transformation is significant, as doctors require regular skill updates, access to different clinical scenarios, personalised feedback and standardised confirmation of professional readiness. The main directions of the digitalisation of simulation centres, their substantive content, and the expected educational outcomes are summarised in Table 6.

Table 6. *Directions of digitalisation of simulation centres in medical education*

Direction of digitalisation	Content of implementation	Expected educational outcome
Virtual simulations	Modelling of clinical scenarios in a digital environment for repeated practice of typical, rare and critical situations	Expansion of access to practical training and increased variability of clinical cases

Table 6. Continued

Direction of digitalisation	Content of implementation	Expected educational outcome
Virtual reality and telesimulation	Use of immersive environments, remote platforms and remote support for simulation scenarios	Support for hybrid learning and preservation of practical orientation in the absence of physical presence in the centre
Electronic clinical scenarios	Development of scenarios with digital logic of event progression, variable decisions and recording of participants' actions	Standardisation of scenario-based learning and strengthening of the relationship between the clinical decision and the outcome of the action
Digital checklists and standardised assessment	Electronic recording of clinical algorithm performance, safety, communication, team interaction and errors	Objectification of assessment, accumulation of data and comparison of competency dynamics
Artificial intelligence	Analysis of errors, decision-making pace, typical educational difficulties and individual learning trajectories	Personalisation of simulation training and early identification of competency deficits
Remote debriefing	Use of video recordings, digital platforms and remote facilitated post-scenario analysis	Deepening of reflection, feedback and analysis of professional errors
Hybrid model of the simulation centre	Combination of face-to-face scenarios, digital simulations, telesimulation, electronic assessment and outcome analytics	Transition from a local trainer-based space to a networked model of continuing zprofessional development

Source: *compiled by the authors on the basis of an analysis of scientific approaches to the digitalisation of simulation-based medical education by S.C. Watkins (2020), O. Almousa et al. (2021), E. Roach & A. Okrainec (2021), A. Bahattab et al. (2023), N. Komasawa & M. Yokohira (2023), W. Sin et al. (2024), A. Hamilton (2024), K. Tiazhkorob (2025)*

The data presented in Table 6 show how the simulation centre can develop in the context of educational digitalisation. Virtual simulations broaden the scope for practising clinical scenarios beyond the centre's physical boundaries, facilitating the modelling of rare, complex or high-risk situations that cannot be consistently replicated in a face-to-face setting. In postgraduate training, this allows for the repeated completion of scenarios, the comparison of different clinical decision-making variants, and the gradual improvement of professional performance. This approach aligns with that of Y. Fedorchenko *et al*. (2024), who linked virtual simulations to the modernisation of medical education due to the increased accessibility, interactivity, and technological flexibility they offer to the learning process. In the context of postgraduate training, virtual simulation does not simply replicate face-to-face training; rather, it offers variable, repeatable and controlled modelling of clinical decisions before or after physical simulation centre training.

The second approach involves the use of virtual reality, remote platforms and telesimulation, changing the spatial logic of how the simulation centre operates. Rather than being limited to a classroom for face-to-face training, the centre is transformed into a hybrid environment in which instruction, scenario modelling, observation, debriefing and elements of assessment can be carried out remotely. This expands access to simulation training and allows teachers or experts to participate regardless of their physical presence at the centre, supporting the continuity of learning despite organisational or territorial constraints. The telesimulation experience presented by J.P. Gerstenberger *et al*. (2023) demonstrates its suitability for practice-oriented learning in a remote format. Therefore, not only does telesimulation strengthen the flexibility of the simulation centre, it also requires clear digital protocols, assessment criteria, and feedback organisation so that the remote format does not reduce the quality of practical training.

Electronic clinical scenarios offer a different development perspective since the digital environment enables ariability in the course of events to be embedded, participant choices to be recorded and clinical decisions to be connected to subsequent outcomes. Unlike a static scenario, an electronic scenario can contain multiple situational development trajectories depending on the actions of the intern doctor. A. Bahattab *et al*. (2023) proposed an approach to electronic simulation scenario design in which the digital scenario is considered a combination of theoretical basis, practical structure, and educational outcome. In postgraduate medical education, this means that digital scenarios can be used to demonstrate clinical cases and to train clinical thinking, decision-making, error analysis and repeated completion of situations with different decisions.

Digital checklists and electronic assessments enable standardised control of professional competencies. They make it possible to record specific parameters of clinical algorithm performance rather than the teacher's general impression, such as the sequence of actions, technical accuracy, compliance with safety requirements, communication, team interaction, and the timeliness of decisions. S.C. Watkins (2020) analysed simulation training in the context of competency assessment, certification and maintenance of professional fitness. Digital checklists in postgraduate medical education enhance the scope for such assessments by ensuring electronic documentation of actions performed, tracking changes in training levels and identifying areas for individual professional development. In the future, these data could be integrated into doctors' electronic portfolios, combining the results of testing, expert assessment, self-assessment and debriefing. This would strengthen the connection

between simulation-based learning and continuing professional development.

Artificial intelligence in simulation-based medical education changes the way scenarios are constructed, errors are recorded, participants' actions are assessed, and feedback is provided, as demonstrated by A. Hamilton (2024). N. Komasawa & M. Yokohira (2023) also examined simulation-based education in the era of artificial intelligence, emphasising the need to adapt educational approaches to new digital tools. In simulation centres, artificial intelligence can analyse typical errors, decision-making speed, recurring difficulties and personalise learning trajectories. However, automated analytics should complement the teacher's expert assessment since pedagogical judgement is still necessary for interpreting the learner's clinical context, communicative behaviour and reflective readiness.

Remote debriefing is the latest development in the digital transformation of simulation-based learning. It involves using video recordings, digital platforms and remote facilitated analysis to repeatedly review key episodes of the scenario. This format enables post-scenario analysis to be more evidence-based, as participants can observe specific actions, decisions, communication errors, and instances of lost team coordination. E. Roach & A. Okrainec (2021) confirm that telesimulation can combine distance learning, assessment, and feedback. In postgraduate medical education, this enables debriefing to be organised not only immediately after a face-to-face scenario, but also remotely with repeated analysis of actions.

The simulation centre's hybrid model combines face-to-face clinical scenarios, digital simulations, telesimulation, electronic assessment and outcome analytics. In this model, the simulation centre functions as both a classroom for practical training and a digitally supported platform for continuing professional development. R. Yuriy *et al*. (2022) examined digital and simulation technologies in higher medical education through their innovative potential and ability to transform the presentation of educational material, organisation of practical training and assessment of learning outcomes. Y. Fedorchenko *et al*. (2024) linked the challenges of medical education under conditions of internationalisation and digitalisation to the need to update educational approaches, digital infrastructure, and training quality. When these approaches are compared, the hybrid model emerges as an organisational response to the need to combine practical, simulation-based training with digital learning support, remote supervision, and the accumulation of data on learners' professional development.

Thus, prospects for the digitalisation of simulation centres in medical education include virtual simulations, telesimulation, electronic clinical scenarios, digital checklists, remote debriefing, artificial intelligence, electronic portfolios, and hybrid learning formats. For postgraduate medical education, these developments allow for a more flexible, standardised and personalised approach to the professional development of doctors. While digitalisation does not eliminate the importance of face-to-face simulation centres, it does expand their functions, transforming them from spaces for practising practical actions into integrated systems for learning, assessment, analytics and support for continuous professional development.

Generalisation of the research results showed that, in postgraduate medical education, simulation centres should be considered an organised educational environment combining clinical scenarios, the practical performance of professional actions, team interaction, standardised assessment, debriefing and digital learning support. Theoretical analysis confirmed the methodological appropriateness of competency-, activity-, scenario-, problem-, interprofessional and reflective approaches. Empirical results demonstrated positive dynamics in theoretical preparedness, practical performance, self-assessment of professional readiness, team interaction and reflection among intern doctors after simulation training. Further development of such centres is associated with implementing virtual simulations, telesimulation, digital checklists, electronic portfolios, remote debriefing and artificial intelligence tools, thereby expanding the possibilities for continuing professional development of healthcare professionals.

Conclusions

The results of the theoretical analysis showed that, in medical education, simulation centres are gradually shifting from being trainer-based spaces to organised educational environments. This development is associated with the safe practice of clinical algorithms, preparation for emergency conditions, standardisation of practical skills, development of teamwork and risk reduction for patients. In postgraduate medical education, such centres provide technical training in individual actions and the formation of professional readiness through clinical scenarios, expert assessment, debriefing and the repeated improvement of actions. Methodological research into the integration of simulation technologies has demonstrated the effectiveness of combining competency-, activity-, scenario-, problem-, interprofessional and reflective approaches. The competency-based approach defines the expected learning outcomes, while the activity-based approach ensures the performance of professional actions. The scenario-based and problem-oriented approaches structure the clinical situation, the interprofessional approach coordinates the team, and the reflective approach facilitates error comprehension through debriefing. Therefore, simulation-based learning should be organised as a complete pedagogical cycle incorporating a clinical scenario, standardised assessment criteria, a checklist of practical actions, facilitation, team interaction, and post-scenario analysis.

The results confirmed positive developments in the professional competencies of intern doctors following the simulation training. Their theoretical preparedness increased from 12.4 ± 2.1 to 17.1 ± 1.8, their practical actions according to the checklist from 24.6 ± 4.3 to 34.8 ± 3.1, and their self-assessment of professional readiness from 18.2 ± 3.5 to 25.7 ± 2.8. The communicative-team component increased from 3.1 ± 0.7 to 4.3 ± 0.5, and the reflective component from 2.9 ± 0.8 to 4.2 ± 0.6. The reflective component demonstrated the most pronounced positive change – an increase of 44.8% – indicating an enhanced ability in intern doctors to analyse their own actions and determine ways to correct their professional behaviour following simulation scenarios. Statistically significant differences across all indicators demonstrate positive changes in the cognitive, practical, teamwork and reflective competencies of interns after simulation training within the studied sample. The development of simulation centres is associated with the digitalisation of the educational environment, including the introduction of virtual simulations, telesimulation, electronic clinical scenarios, digital checklists, remote debriefing, electronic portfolios, and artificial intelligence tools. These solutions broaden the scope of simulation centres, transforming them from local training spaces into hybrid platforms for continuing professional development. In postgraduate medical education, this creates conditions for the repeated practice of clinical decision-making, standardised assessment, personalised learning trajectories and the accumulation of data on doctors' professional development. Future studies should expand the sample size, involve several postgraduate medical education institutions and include a control group, as well as assessing the retention of formed competencies in the delayed period after training.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Розвиток симуляційних центрів як інноваційної технології післядипломної медичної освіти: теоретико-методологічні засади та практичний вимір

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■ **Анотація.** Мета статті полягала у визначенні ролі симуляційних центрів у модернізації післядипломної медичної освіти, посиленні практичної підготовки та розвитку професійних компетентностей медичних працівників. Методологія дослідження ґрунтувалася на прикладному педагогічному дизайні з теоретико-аналітичним і квазіекспериментальним компонентами; емпіричний етап проведено 16-27 лютого 2026 року на базі Навчально-наукового інституту післядипломної освіти Запорізького державного медико-фармацевтичного університету серед 48 лікарів-інтернів із вхідним і підсумковим комплексним оцінюванням професійних компетентностей. Результати дослідження показали, що симуляційні центри в медичній освіті функціонують як організоване освітнє середовище, у якому клінічні сценарії, безпечне відпрацювання алгоритмів, командна взаємодія, стандартизоване оцінювання та дебрифінг забезпечують формування професійних компетентностей. Методологічний аналіз дав змогу обґрунтувати інтеграцію симуляційних технологій у післядипломну медичну освіту через поєднання компетентнісного, діяльнісного, сценарного, проблемно-орієнтованого, міжпрофесійного та рефлексивного підходів. Оцінювання після симуляційного тренінгу засвідчило статистично значуще покращення результатів лікарів-інтернів: теоретична підготовленість зросла з 12,4 ± 2,1 до 17,1 ± 1,8 бала, практичні дії – з 24,6 ± 4,3 до 34,8 ± 3,1 бала, самооцінка професійної готовності – з 18,2 ± 3,5 до 25,7 ± 2,8 бала. Найбільший приріст зафіксовано за рефлексивним компонентом – 44,8 %, що свідчить про результативність дебрифінгу, тоді як подальший розвиток симуляційних центрів доцільно пов'язувати з віртуальними симуляціями, телесимуляцією, цифровими чек-листами, електронними портфоліо та інструментами штучного інтелекту. Отримані дані засвідчили статистично значуще покращення показників професійних компетентностей лікарів-інтернів після симуляційного тренінгу, зокрема теоретичної підготовленості, практичних дій, командної взаємодії та рефлексивної готовності в умовах одногрупового квазіекспериментального дослідження в системі післядипломної медичної освіти. Результати можуть бути використані закладами вищої медичної освіти, інститутами післядипломної освіти, симуляційними центрами та викладачами клінічних дисциплін для розроблення, впровадження й оцінювання симуляційних тренінгів у програмах професійного розвитку медичних працівників

■ **Ключові слова:** дебрифінг; штучний інтелект; клінічні сценарії; цифрові чек-листи; командна взаємодія; професійні компетентності; безпека пацієнта

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 62-71
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 26.09.2025 Revised: 25.03.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 378:614.253.5:37.091.12
DOI: 10.69587/pemtt/1.2026.62

Professional competence of lecturers at medical higher education institutions and its role in developing the clinical thinking of future nurses

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Abstract. In the context of healthcare reform and the integration of Ukrainian medical education into the international educational space, enhancing the professional competence of lecturers has become particularly important. The training of future nurses requires the implementation of an evidence-based approach, up-to-date clinical guidelines, and modern educational technologies to foster clinical thinking and readiness for professional decision-making. The aim of this study was to conduct a comprehensive analysis of the professional competence of lecturers at medical higher education institutions and to determine its role in the development of clinical thinking among future nurses. The study employed a mixed-methods design, combining a systematic review of scientific literature published between 2019 and 2026 with a cross-sectional questionnaire survey involving 31 lecturers from M. I. Pirogov Vinnytsia National Medical University in order to assess their professional competence and their use of innovative educational and clinical approaches. The findings revealed that 96.8% of lecturers confirmed that they possessed profound and systematic knowledge of the disciplines they teach, while no negative responses regarding the level of professional training were recorded. The majority of respondents (93.3%) apply modern clinical protocols and the principles of evidence-based medicine in their teaching practice, and all participants reported that they regularly update the content of academic disciplines in accordance with current scientific evidence. The integration of theoretical knowledge with clinical practice is ensured by 96.7% of lecturers, which contributes to the development of professional competencies and the enhancement of students' clinical thinking. The use of modern educational technologies was confirmed by 80.6% of respondents, while 96.8% stated that

Suggested Citation:
Petrushenko, V., Chorna, V., Matusevych, L., & Siusko,M. (2025). Professional competence of lecturers at medical higher education institutions and its role in developing the clinical thinking of future nurses. *Professional Education: Methodology, Theory and Technologies*, 12(1), 62-71. doi: 10.69587/pemtt/1.2026.62.

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they purposefully develop students' skills in clinical analysis and informed professional decision-making. All study participants noted that they create a professionally safe, supportive, and ethically comfortable learning environment. The results obtained confirm that a high level of lecturers' professional competence is a crucial factor in ensuring the quality of medical education and the effective preparation of competitive nursing professionals

■ **Keywords:** nursing; evidence-based medicine; educational technologies; digitalisation of learning; academic integrity; practice-oriented training; professional development

■ Introduction

Contemporary medical education in Ukraine is undergoing a process of intensive transformation under the influence of integration into the European educational area, the modernisation of educational standards, and increasing requirements for the professional training of future healthcare professionals, which is essential for the development of competencies among future nurses and for strengthening their mental well-being. This issue has become particularly relevant in the context of the full-scale war, when the professional resilience and psychological readiness of medical personnel are critically important for providing effective assistance to those affected and maintaining public health. Preparing nurses to work under extreme conditions requires the integration of modern clinical skills with the ability to self-regulate, maintain stress resilience, and provide psychological support to patients and colleagues.

One of the key directions of these changes is the introduction of a competence-based learning model, which involves the systematic development of professional competence among lecturers and higher education students, based on a combination of theoretical knowledge, practical skills and clinical reasoning. This is driven by the need to meet contemporary standards of professional practice in the healthcare sector and the ability to respond competently to the challenges of professional practice (Chorna *et al*., 2022; Chorna, 2024). In the context of the educational process, researchers T. Shevchuk & T. Vasenko (2023) concluded that it is imperative to study not only the effectiveness of educational technologies but also the professional competence of lecturers as the key factor in ensuring the quality of medical education. It is precisely the competence of lecturers that determines the effectiveness of implementing an evidence-based approach, integrating theoretical knowledge with clinical examples, and fostering critical thinking among students.

An analysis of contemporary academic sources highlights the relevance and urgency of research in the field of professional competence in medical education. Researchers A.M. Dashchuk & E.I. Dobrzhanska (2019) and Z. Popovych *et al.* (2024) have conducted research into the development of professional competence among medical specialists and examined ways of ensuring the professional competencies of medical students through simulation-based learning and practical skills that contribute to the professional competence of graduates. One aspect of the competence-based approach to the theoretical underpinnings of medical professionals' professional competence in contemporary research emphasises the multi-component structure of future medical professionals' professional competence, which involves the integration of theoretical knowledge, practical skills and personal and professional qualities. Separately, G. Kraevska *et al*. (2023) emphasised the importance of clinical and practical training and the development of the ability to make professional decisions in the dynamic conditions of medical practice. In academic discourse, considerable attention is paid to the general pedagogical aspects of training academic and teaching staff. In particular, researchers S. Sysoeva & I. Sokolova (2020) emphasised the role of non-formal education as an important resource for the professional development of lecturers and for enhancing their pedagogical flexibility. A separate area of focus is the use of project-based technologies in professional training, which contributes to the development of practice-oriented skills and the ability to work in a team (Kraevska *et al*., 2022). Furthermore, studies by L. Kozak *et al.* (2022) and O. Svintozelsky *et al.* (2023) emphasised the importance of developing teachers' research competence as the foundation for their academic activity and professional growth.

Despite some progress in the study of the professional competence of lecturers at higher education institutions (HEIs) in the medical field, contemporary Ukrainian academic literature contains a limited number of comprehensive empirical studies that systematically assess the level of lecturers' professional competence and its impact on the implementation of an evidence-based approach in the teaching process. In particular, there is a lack of studies that would explore the link between a lecturer's competence, the integration of theoretical knowledge and practical clinical skills among students, and the development of their clinical reasoning in the context of contemporary requirements for professional medical practice. This highlights the need for a targeted empirical study capable of making a significant contribution to the theoretical understanding and practical approaches to ensuring the quality of the educational process in medical education. The aim of the study was to examine the components of professional competence among lecturers at medical HEIs and to assess the effectiveness of innovative teaching methods in developing the clinical competence of students specialising in "Nursing".

Materials and Methods

The study was conducted using a mixed-methods design, combining a systematic analysis of scientific literature with an empirical cross-sectional survey of lecturers at a higher medical education institution. At the first stage, a systematic search and selection of scientific publications was carried out in order to analyse contemporary approaches to the development of the professional competence of lecturers at medical educational institutions, the application of evidence-based teaching, and the implementation of innovative educational technologies in the training of future nurses. The literature search was conducted using the international scientometric databases PubMed, Scopus, Web of Science, and Google Scholar. Publications issued between 2019 and 2026 were included in the analysis, provided that they addressed the professional competence of lecturers in medical education institutions, the application of evidence-based medicine principles in the educational process, the use of contemporary clinical guidelines, and digital learning technologies. The inclusion criteria comprised the availability of the full text, publication in peer-reviewed scientific journals, relevance to the research topic, and publication in either Ukrainian or English. Conference abstracts, editorials, duplicate publications, and studies unrelated to nursing education or pedagogical activity in medical education were excluded. The methods of analysis, systematisation, comparison, generalisation, and logical-structural analysis of scientific sources were employed to synthesise the findings.

The empirical part of the study was conducted at M.I. Pirogov Vinnytsia National Medical University. The study involved 31 lecturers responsible for the education of students specialising in I5 "Nursing" within the field of knowledge I "Healthcare and Social Welfare". The survey was conducted during February 2026, while data collection, coding, and statistical processing were performed in March 2026. Primary data were collected using an anonymous author-designed questionnaire consisting of 16 questions grouped into four thematic sections. The first section (Questions 1-3) concerned lecturers' professional competence and the level of their specialist training. The second section (Questions 4-7, 12, and 13) was aimed at assessing the organisation of the educational process, the use of contemporary teaching methods, digital resources, and evidence-based approaches. The third section (Questions 8-11) addressed pedagogical interaction, communication with students, and adherence to the principles of academic integrity. The fourth section (Questions 14-16) focused on the organisation of the educational process, the system of assessment of learning outcomes, and the professional profile of lecturers. Particular attention was paid to evaluating lecturers' level of specialist knowledge, the use of contemporary clinical protocols and principles of evidence-based medicine, their ability to integrate theoretical training with practical activities, and the application of innovative educational technologies in the preparation of future nurses.

Statistical analysis of the results was performed using descriptive statistical methods, including the calculation of absolute values, relative frequencies (%), and mean values. Spearman's rank correlation coefficient was used to assess the relationships between individual indicators. Data processing was carried out using Microsoft Excel 2021 and IBM SPSS Statistics software (version 27.0). The ethical aspects of the study complied with international bioethical standards, particularly the principles of respect for persons, beneficence, and justice set out in The Belmont report: Ethical principles and guidelines for the protection of human subjects of research (1979). Participation was voluntary, and the questionnaire contained no personal data, thereby ensuring the confidentiality and anonymity of the information obtained. The limitations of the study include the relatively small sample size, the fact that the research was conducted at a single HEI, and the use of self-assessment methods, which may have influenced the subjectivity of respondents' answers.

Results

According to the results of the survey conducted among lecturers at M. I. Pirogov Vinnytsia National Medical University (n = 31), who teach groups of future nurses within the field of knowledge I "Healthcare and Social Welfare", speciality I5 "Nursing", it was established that the overwhelming majority of respondents (96.8%) confirmed that they possess profound and systematic knowledge of the disciplines they teach. Only 3.2% of respondents selected the answer option "partially", which may indicate a critical self-assessment of their own professional level or a desire for further professional development. No respondents chose the answer "no". The findings demonstrate a high level of professional competence among the academic staff and a well-established confidence in their own specialist training. Such an indicator represents an important measure of the quality of the educational process, as the systematic nature and depth of lecturers' knowledge directly influence the effectiveness of students' learning, the development of clinical thinking, and the acquisition of professional skills (Fig. 1).

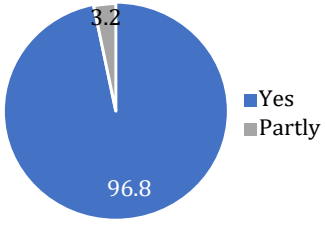

Figure 1. *Proportion of the professional competence of lecturers at medical HEIs and its importance for the development of students' clinical thinking, %*
Source: *compiled by the authors*

Among the respondents surveyed, 93.3% stated that they apply contemporary clinical protocols, the principles of evidence-based medicine, or up-to-date theoretical knowledge in their professional practice. A small proportion of respondents (3.7% and 3.0%, respectively) selected the options "partially" or "no". These findings indicate the predominance of an evidence-based approach within the educational process. The use of current clinical guidelines and updated scientific evidence constitutes a key component of high-quality training for future healthcare professionals, as it ensures that educational content corresponds to international standards and contemporary clinical practice. At the same time, the presence of isolated responses of "partially" or "no" may indicate the need for further improvement of the methodological support system for lecturers and for ensuring access to up-to-date resources (Fig. 2).

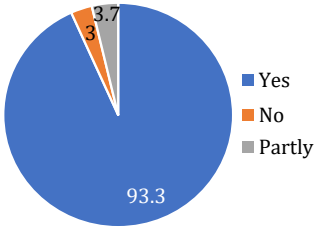

Figure 2. *Proportion of the implementation of the evidence-based approach in the professional activities of lecturers, %*
Source: *compiled by the authors*

All respondents (100%) confirmed that they regularly update the content of teaching materials in accordance with contemporary scientific evidence and current standards. No respondents selected the options "partially" or "no". This indicator reflects a high level of academic responsibility and professional adaptability among lecturers. Regular updating of course content is an essential prerequisite for ensuring the quality of medical education in the context of rapid scientific advancement, the introduction of new clinical guidelines, and changes in the regulatory framework. The overwhelmingly positive responses indicate a well-established culture of continuous professional development and a commitment to contemporary educational standards.

It was found that 96.7% of lecturers integrate theoretical knowledge with practical clinical examples, demonstrating the practice-oriented nature of the educational process. Only a small proportion of respondents indicated the absence of such integration, which may be associated with the specific characteristics of certain disciplines. This indicator is of particular importance for the development of the professional identity of future nurses, as the integration of theory with clinical experience ensures the development of clinical thinking and preparedness for real-world practice (Fig. 3).

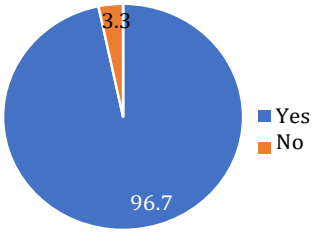

Figure 3. *Proportion of the integration of theory and practice in the educational process at medical HEIs, %*
Source: *compiled by the authors*

The overwhelming majority of respondents (100%) confirmed that they present educational material in a structured and logical manner. This reflects a high level of pedagogical expertise and proficiency in teaching methodology, which is an essential prerequisite for the effective assimilation of complex medical knowledge. With regard to the use of contemporary educational technologies (case-based methods, problem-based learning, simulation technologies, and clinical case discussions), 80.6% of respondents reported their active application, whereas 19.4% selected the response "partially". These findings demonstrate a relatively high level of implementation of innovative teaching methods; however, they also indicate the existence of opportunities for further methodological modernisation of the educational process (Fig. 4).

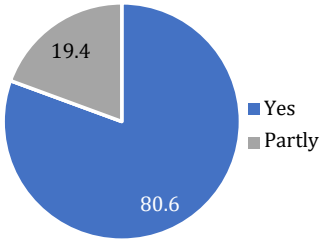

Figure 4. *Proportion of the use of contemporary educational technologies (case-based method, problem-based learning, simulation technologies, and clinical case discussions) in HEIs, %*
Source: *compiled by the authors*

The overwhelming majority of respondents (100%) confirmed that they present educational material in a structured and logical manner. This reflects a high level of pedagogical expertise and mastery of teaching methodology, which is an essential prerequisite for the effective assimilation of complex medical content. Regarding the use of contemporary educational technologies (case-based methods, problem-based learning, simulation technologies, and clinical case discussions), 80.6% of respondents reported their active application, while 19.4% selected the response "partially". These findings demonstrate a relatively high

level of implementation of innovative teaching methods; however, they also indicate that there remains scope for further methodological modernisation of the educational process (Fig. 5).

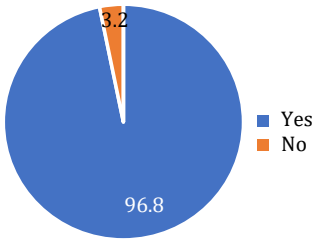

Figure 5. *Development of clinical thinking and provision of a professionally safe educationa environment by HEI lecturers, %*
Source: *compiled by the authors*

Encouragement of academic discussion and respect for diverse opinions and viewpoints were confirmed by 96.7% of respondents, while a small proportion answered "partially". This indicates a democratic style of pedagogical interaction and a focus on fostering students' critical thinking (Fig. 6).

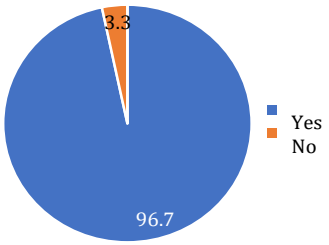

Figure 6. *A democratic style of pedagogical interaction and the fostering of critical thinking among HEI students, %*
Source: *compiled by the authors*

Adherence to the principles of academic integrity and professional ethics was confirmed by 100% of lecturers, which is consistent with the previously identified indicators of high professional responsibility and demonstrates the existence of a well-established culture of ethical interaction within the educational environment. Effective use of digital platforms and electronic resources was reported by 93.5% of respondents, while the remainder indicated partial use. A similar trend was observed with regard to the implementation of innovative educational approaches and the digitalisation of learning: 80.6% responded "yes", whereas 19.4% selected "partially". These findings confirm the ongoing digital transformation of the educational process, while also highlighting the need for further development of digital competencies among a proportion of lecturers (Fig. 7).

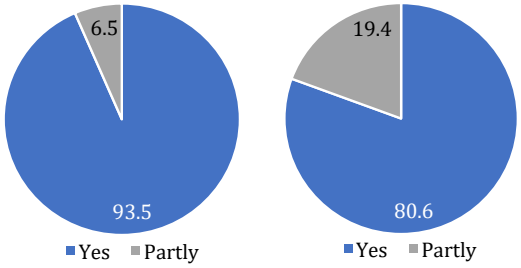

Figure 7. *Integration of digital competences and innovative approaches into the professional practiceof HEI lecturers, %*
Source: *compiled by the authors*

At the same time, 100% of respondents stated that they clearly define assessment criteria and adhere to them during the evaluation of students' knowledge. This indicates transparency and objectivity in assessment, which constitute key principles of contemporary quality assurance systems in higher education. Analysis of responses concerning the area of professional activity within the medical HEI revealed a relatively balanced distribution of respondents between theoretical and clinical departments. In particular, 53.3% of respondents represented theoretical departments, whereas 46.7% were affiliated with clinical departments (Fig. 8). The professional competence of lecturers at medical HEIs and its role in the development of clinical thinking among future nurses are determined, among other factors, by the fact that theoretical and clinical departments differ in the level and nature of their use of evidence-based medicine principles, innovative technologies, and digital tools. While theoretical departments primarily focus on the analytical interpretation of scientific evidence and the use of digital educational resources, clinical departments concentrate on their practical application in simulated and real clinical situations, thereby contributing to a more profound development of students' clinical thinking.

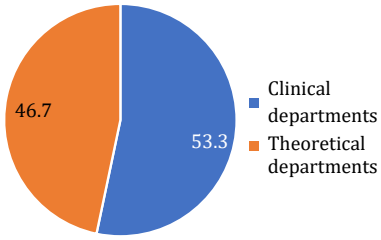

Figure 8. *Proportion of lecturers from theoretical and clinical departments in the study sample, %*
Source: *compiled by the authors*

Analysis of the data obtained revealed a correlation between the level of teachers' professional competence and the characteristics of the organisation of the educational process. In particular, the high level of self-assessed specialist knowledge (96.8%) is consistent

with the frequent use of contemporary clinical protocols and the principles of evidence-based medicine (93.3%), indicating a direct relationship between the depth of professional training and orientation towards current scientific evidence. A relationship was also identified between lecturers' academic responsibility and the quality of educational content: 100% of respondents who reported regularly updating teaching materials simultaneously demonstrated a high level of structure and logical organisation in presenting this content (100%), which points to a well-developed pedagogical culture and systematic approach to teaching. The practice-oriented approach (96.7% integration of theory with clinical examples) correlates with the use of contemporary educational technologies (80.6%), demonstrating the interdependence between innovative teaching methods and a focus on developing students' clinical thinking. A separate relationship can be observed between adherence to the principles of academic integrity (100%) and transparency in assessment practices (100%), confirming the consistency between the ethical and pedagogical dimensions of the educational process.

At the same time, the partial use of innovative technologies (19.4%) and digital tools (approximately 6-19%) is associated with the need for further development of digital competencies, which may influence the extent to which contemporary educational approaches are implemented. The distribution of respondents between theoretical departments (53.3%) and clinical departments (46.7%) suggests that the identified trends are characteristic of both areas of training and are systemic in nature rather than being determined solely by the specific characteristics of individual disciplines. Correlation analysis revealed that most indicators exhibited low variability, limiting the possibility of identifying statistically significant relationships. Moderate positive correlations were observed between the use of contemporary educational technologies, digital resources, and innovative approaches ($r \approx 0.5$-0.7). Other indicators demonstrated weak or absent correlations, which may be attributed to the high degree of homogeneity in respondents' answers and the relatively small sample size.

The data obtained indicate that the sample is representative and provide a comprehensive reflection of the educational process from both the fundamental theoretical and practical clinical perspectives of nursing education. The presence of an almost equal proportion of representatives from clinical departments strengthens the practice-oriented nature of the findings, as it allows consideration of the specific features of teaching disciplines directly related to clinical practice. At the same time, the predominance of representatives from theoretical departments within the sample structure ensures the assessment of methodological, organisational, and didactic aspects involved in the development of core professional competencies. Taken together, these factors provide a holistic understanding of the current state of lecturers' professional competence and the specific characteristics of the implementation of the educational process within the system of medical education.

Discussion

Contemporary challenges, including the digitalisation of education, the implementation of simulation-based learning, distance and blended learning formats, as well as the need to adhere to the principles of academic integrity, require a reconsideration of approaches to the organisation of the educational process and the role of the lecturer as a facilitator of learning. In this context, the analysis of factors influencing the effectiveness of the educational process is of particular relevance, especially the use of innovative technologies, interactive teaching methods, and the provision of high-quality feedback. The findings of studies by N. Volodka (2020) and L. Bilyk (2021) emphasised the importance of a comprehensive examination of the quality of teaching in medical HEIs against the backdrop of the transformation of the healthcare system and the educational landscape. The authors emphasised the need to integrate the principles of evidence-based medicine, an interdisciplinary approach, patient-centred care and modern educational technologies into the professional training of future healthcare professionals. Particular attention is paid to the development of clinical reasoning, evidence-based decision-making skills, effective communication and the ability to adapt to the rapid evolution of medical knowledge.

The findings are generally consistent with the conclusions of the aforementioned authors. In particular, it was found that 96.7% of lecturers integrate theoretical knowledge with practical clinical examples, which demonstrates the practice-oriented nature of the educational process and contributes to the development of clinical reasoning in students. In line with the findings of L. Bilyk (2021) and N. Volodka (2020), this study confirms the importance of combining theoretical training with real clinical situations for the development of professional competences among future nurses. The structured and logical presentation of teaching material is also an important indicator of teaching quality. In this study, all the lecturers surveyed (100%) confirmed that they adhered to these principles in their teaching practice. The data obtained indicate a high level of pedagogical skill among the lecturers and their ability to ensure the effective assimilation of complex medical material, which meets contemporary requirements for medical education.

Contemporary scientific sources, such as the studies by E. Arruzza & M. Chau (2021) and A.E. van Gaalen *et al.* (2021), also emphasise the need for the digitalisation of the educational process, the implementation of simulation-based learning, problem-based approaches and interactive teaching methods. The results

of this study confirm this trend: 80.6% of lecturers actively use modern educational technologies, in particular the case method, problem-based learning, simulation technologies and clinical case discussions. At the same time, 19.4% of respondents indicated that they use such technologies only to a limited extent. The findings demonstrate a fairly high level of readiness among lecturers to use modern educational tools. Indeed, a common thread between the results of this study and the findings of other authors is the recognition of the decisive role of a lecturer's professional competence in ensuring the quality of medical education and in developing the clinical thinking of future nurses. At the same time, a distinguishing feature is the high level of practical integration of teaching and the use of innovative technologies observed in this study, which may indicate positive trends in the development of the educational environment and the readiness of teachers to meet the modern requirements of medical education.

One of the promising avenues for improving the training of future nurses is the use of gamification technologies, which involve the integration of game elements (points, rankings, quests, the case method, simulation technologies and clinical debriefings, competitions, achievements and instant feedback) into the educational process. In the current context of medical education, gamification is regarded not only as a tool for enhancing learning motivation, but also as an effective means of developing clinical reasoning, professional judgement and decision-making skills. According to C.Y. Lee *et al*. (2024), gamification is a promising strategy for bridging the gap between theoretical training and the practical application of knowledge in the process of teaching clinical reasoning. The author argued that the use of game mechanics helps to increase student engagement, stimulate learning activities and improve long-term retention of information. In a subsequent review study, C.Y. Lee *et al*. (2025) found that the implementation of gamified educational strategies has a positive impact on the development of clinical reasoning, analytical skills and students' ability to make evidence-based clinical decisions.

A systematic review by A.E. van Gaalen *et al*. (2021) and E. Arruzza & M. Chau (2021), focusing on gamification in the training of healthcare professionals, demonstrated a growing interest in the use of game-based approaches in medical education. The authors concluded that gamification helps to improve academic performance, student engagement and the quality of learning. Of particular interest are the studies in the field of nursing education by M.E. Elzeky *et al.* (2022), which found that the use of a gamified "flipped classroom" helps to increase nursing students' motivation to learn, improve the development of professional competences and encourage independent learning. The results confirmed the effectiveness of integrating game mechanics into the training of future nursing professionals.

An important contribution to the study of the impact of gamification on the development of clinical reasoning was made by K. Ishizuka *et al.* (2023). The study utilised Diagnostic Management Cards (DMCs), through which the process of clinical decision-making was transformed into an interactive educational game. The study found a statistically significant increase in students' confidence in making diagnostic decisions, a rise in motivation to learn clinical reasoning, and an improved awareness of the economic aspects of healthcare. Furthermore, the study participants demonstrated a better understanding of clinical situations and the ability to justify their choice of diagnostic and treatment strategies.

A similar trend can be observed regarding the implementation of innovative educational approaches and the digitalisation of learning: in this study, 80.6% of lecturers stated that they actively use modern educational technologies, whilst 19.4% implement them to some extent. The results obtained are consistent with data from recent scientific studies by A.E. van Gaalen *et al.* (2021) and C.Y. Lee *et al*. (2024; 2025). Studies by E. Arruzza & M. Chau (2021), M.E. Elzeky *et al.* (2022) and K. Ishizuka *et al.* (2023) have shown that the incorporation of gamification elements into the learning process has a positive impact on learning satisfaction and academic motivation among medical students. The study demonstrated that a gamified learning format contributes to the development of professional competencies and increases motivation among nursing students. It was shown that the use of gamified clinical scenarios improves students' confidence in making diagnostic decisions, promotes the development of clinical reasoning and enhances the quality of practical knowledge acquisition.

Simulation-based learning is an effective approach to the development and assessment of clinical competencies among medical students. In the context of enhancing the professional competence of lecturers at medical HEIs, the organisation of simulation sessions, particularly those involving first-year students, is of particular importance, as it facilitates the development of clinical thinking. Similar findings were reported by S.L. Rudinsky *et al*. (2024), who demonstrated that the combination of brief clinical scenarios with low-fidelity simulation represents a resource-efficient approach that optimises the educational process, reduces resource expenditure, and simultaneously ensures the effective development of clinical reasoning among future healthcare professionals. The authors emphasised that well-structured simulation sessions are especially effective during the early stages of education, when fundamental clinical competencies are being established.

Expanding upon this concept, R. Cole (2026), in a study of a long-standing progressive simulation programme, found that simulation-based learning should be continuous and gradually increase in complexity

throughout the entire training period. This approach, based on the theory of experiential learning and the theory of cognitive load, ensures the step-by-step development of clinical, communication and teamwork competencies, whilst also preparing trainees to act in crisis and high-risk clinical situations. The author emphasised that the integration of simulations as part of a long-term educational pathway contributes to the development of resilience, adaptability and professional confidence in future doctors. Thus, the results of this study are consistent with the findings of the current scientific literature and confirm that simulation-based learning is one of the key tools for developing clinical reasoning in medical students. At the same time, the effectiveness of its implementation depends to a large extent on the methodological training of lecturers, the structure of the scenarios and a systematic approach to integrating simulations into the teaching process.

As demonstrated by the research of J. Knopes *et al*. (2024), medical students and doctors encounter an extremely large volume of knowledge during their studies and professional practice, making it impossible to fully master all information in the field of biomedicine. In this context, a key component of the professional competence of lecturers at medical HEIs is fostering students' ability to prioritise knowledge according to its clinical significance and practical relevance. Even before commencing clinical placements, students learn to select information based on its relevance to examinations and their future professional practice. Teamwork, facilitated by lecturers to promote peer learning and collegial support, plays a vital role in this process. In such an environment, students learn to interact effectively, compensating for individual gaps in knowledge at a group level, which is a key element in the development of clinical reasoning.

Peer learning, integrated into the educational process through the professional competence of lecturers, has proven highly effective in higher medical education institutions, although its application in clinical practice remains under-researched. At the same time, a significant proportion of nursing students' training, particularly in the United Kingdom, takes place within clinical practice settings, where peer learning occurs in both formalised and informal contexts. When lecturers create a supportive educational environment that fosters partnership, professional interaction and constructive feedback, this promotes the development of clinical competencies, boosts students' confidence and reduces levels of stress and anxiety. A lecturer's pedagogical expertise is a key factor in the effective implementation of peer-based learning as a tool for developing clinical reasoning in future nurses.

Conclusions

The results of the questionnaire survey (n = 31) demonstrated a high level of professional competence among lecturers at medical HEIs: 96.8% of respondents confirmed that they possess profound and systematic knowledge of the disciplines they teach, while no responses of "no" were recorded. This indicates well-established professional confidence and an appropriate level of specialist training among academic staff. The predominance of an evidence-based approach within the educational process was established, with 93.3% of lecturers applying contemporary clinical protocols and the principles of evidence-based medicine, and 100% regularly updating the content of academic disciplines in accordance with current scientific evidence and standards. These indicators confirm that the educational process is aligned with contemporary clinical practice and international requirements for the training of healthcare professionals.

The practice-oriented nature of education is ensured through the integration of theoretical knowledge with clinical examples in 96.7% of cases, which correlates with the high proportion of lecturers focused on the development of clinical thinking (96.8%). This confirms the alignment of the educational process with the competency-based model of training future nurses. Contemporary educational technologies, including case-based methods, problem-based learning, and simulation techniques, are actively employed by 80.6% of lecturers, while 19.4% apply them only partially. This indicates a satisfactory level of innovation within the educational process while simultaneously highlighting opportunities for its further methodological modernisation. All respondents (100%) stated that they provide a structured presentation of educational material, offer constructive feedback, and maintain a professional and ethically safe atmosphere during classes, thereby creating a psychologically supportive educational environment and promoting the development of the professional identity of future nurses. Prospects for further research include the development and validation of innovative models aimed at enhancing the professional competence of lecturers at medical HEIs in accordance with the principles of evidence-based medicine, as well as investigating the impact of integrating WHO standards on the development of clinical thinking among future nurses within the context of the ongoing transformation of the healthcare system.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Професійна компетентність викладачів медичних ЗВО та її роль у формуванні клінічного мислення майбутніх медичних сестер

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Анотація. В умовах реформування охорони здоров'я та інтеграції медичної освіти України до міжнародного простору особливе значення має підвищення професійної компетентності викладачів. Підготовка майбутніх медичних сестер потребує впровадження доказово-орієнтованого підходу, актуальних клінічних рекомендацій і сучасних освітніх технологій для розвитку клінічного мислення та готовності до професійних рішень. Метою дослідження був комплексний аналіз професійної компетентності викладачів медичних закладів вищої освіти та визначення її ролі у формуванні клінічного мислення майбутніх медичних сестер. Дослідження виконано за змішаним дизайном, що поєднує систематичний аналіз наукової літератури 2019-2026 років із поперечним анкетним опитуванням 31 викладача Вінницького національного медичного університету ім. М. І. Пирогова для оцінки їх професійної компетентності та використання інноваційних освітніх і клінічних підходів. За результатами дослідження встановлено, що 96,8 % викладачів підтвердили наявність глибоких і системних знань із дисциплін, які викладають, а негативних відповідей щодо рівня фахової підготовки не зафіксовано. Більшість респондентів (93,3 %) застосовують у своїй педагогічній діяльності сучасні клінічні протоколи та принципи доказової медицини, а всі опитані зазначили, що регулярно оновлюють зміст навчальних дисциплін відповідно до актуальних наукових даних. Інтеграцію теоретичних знань із клінічною практикою забезпечують 96,7 % викладачів, що сприяє формуванню професійних компетентностей та розвитку клінічного мислення здобувачів освіти. Використання сучасних освітніх технологій підтвердили 80,6 % респондентів, а 96,8 % зазначили, що цілеспрямовано формують у студентів навички клінічного аналізу та прийняття обґрунтованих професійних рішень. Усі учасники дослідження відзначили створення професійно безпечного, доброзичливого та етично комфортного освітнього середовища. Отримані результати підтверджують, що високий рівень професійної компетентності викладачів є важливим чинником забезпечення якості медичної освіти та ефективної підготовки конкурентоспроможних фахівців у галузі сестринської справи

Ключові слова: медсестринство; доказова медицина; освітні технології; цифровізація навчання; академічна доброчесність; практико-орієнтована підготовка; професійний розвиток

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 72-86
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 18.11.2025 Revised: 06.04.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 378.147:004.8:377
DOI: 10.69587/pemtt/1.2026.72

Contemporary approaches to the implementation of digital technologies (artificial intelligence) in the professional training system for teaching staff of vocational education institutions

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■ **Abstract.** The study aimed to define the prospects, prerequisites, and limitations of using artificial intelligence technologies to train the teaching staff of vocational education institutions, using the method of analysis of regulatory documents and educational programmes. The study was carried out using regulatory and documentary analysis, content analysis of educational programmes, and comparative analysis of educational practices. Results revealed that the theoretical and regulatory foundation for vocational teaching staff training was a prerequisite for the use of digital technologies, but it did not provide enough specifics about the implementation of artificial intelligence. The analysed educational programmes included digital technologies as a direction, a means of education, and a component of professional activities, but not the use of artificial intelligence as a systemic component of training. Information and communication competence was considered a multidimensional formation of the technical, methodological and organisational components of readiness of teachers, but not full-fledged working with intelligent systems. As a result of the comparison with the best examples of European educational programmes, it was revealed that the integration of artificial intelligence into the system of vocational education was provided in the form of separate modules, separate projects and special state programmes, which ensured the systematic nature. It has been established that the use of artificial intelligence opens up opportunities to expand the didactic potential of professional education in order to implement the provisions on individualisation of education, including automated learning materials development, the introduction of simulations and the use of analytical systems. However, the use of artificial intelligence technologies in professional education is limited by the problems of a legal, methodological, educational and technical nature. The practical significance of the results obtained lies in the possibility of using them to update educational programmes, create educational materials in the context of the use of artificial intelligence, specify the learning outcomes in the aspect of digital competence, as well as to develop a set of methodological materials on the use of artificial intelligence for vocational education educators, specialist subject teachers and industrial training masters

■ **Keywords**: educational programmes; digital competence; regulatory framework; competence; personalisation

■ Introduction

The relevance of the study is determined by the fact that the digital transformation of education is reshaping both the content and organisation of the professional training of teaching staff, particularly for vocational education institutions. Artificial intelligence (AI) technologies are gradually becoming integrated into the educational process, influencing the ways educational content is created, learning outcomes are assessed,

Suggested Citation:
Dobroskok, I., (2026). Contemporary approaches to the implementation of digital technologies (artificial intelligence) in the professional training system for teaching staff of vocational education institutions. *Professional Education: Methodology, Theory and Technologies*, 12(1), 72-86. doi: 10.69587/pemtt/1.2026.72.

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training is individualised, and professional situations are modelled. The research problem lies in the need to determine how artificial intelligence can be integrated into the training of vocational teachers, lecturers of specialised disciplines, and industrial training masters. Examination of this issue is necessary in order to establish whether current standards and educational programmes provide a sufficient basis for the development of digital competence related to the use of AI. It also makes it possible to identify the changes that should be introduced into the content of professional training so that future teaching staff can apply AI safely, methodologically appropriately, and in accordance with the objectives of vocational education.

In scholarly literature, the issue of implementing artificial intelligence in education has been examined in relation to the digitalisation of the educational environment, changes in the role of teachers, and the renewal of approaches to the organisation of learning. One of the leading areas of research concerned the potential of AI for the individualisation of educational trajectories. Intelligent systems were found to enhance the adaptability of learning, optimise the assimilation of educational material, and strengthen interaction among participants in the educational process. In this context, S. Vasylyuk-Zaitseva *et al*. (2023) linked the effectiveness of such changes to teachers' readiness to use digital tools in educational practice. Further development of this issue was associated with the adaptation of the educational process to AI technologies at the systemic level. V. Motorina *et al*. (2025) concluded that intelligent technologies contributed to the transition towards more flexible learning models. Their effectiveness depended on institutional support, digital infrastructure, and methodological provision, which highlighted the organisational dimension of AI implementation.

From the vantage point of the concept Education 4.0, digital and intelligent technologies have been viewed as those that transform the very logic of the educational process. S. Kryshtanovych *et al*. (2025) noted that their introduction had expanded the flexibility and interdisciplinarity of the educational process and its practice-based direction. Especially for vocational education and training, as the competences formed were to be manifested in real or model professional situations. At the same time, the use of AI was accompanied by mixed attitudes among participants in the educational process. S. Dovgyi *et al*. (2024) pointed out that interest in AI among both teachers and students was coupled with worries about academic integrity, credibility of sources, and ethical aspects of the use of AI. This highlighted the importance of developing not only technological but also critical and ethical components of digital competences.

Professional activities of teachers with regard to AI were considered with a view to improving the effectiveness of the educational process. S. Skvortsova *et al*. (2025) showed that AI contributed to the optimisation of educational material preparation and reduced the routine workload of teachers. At the same time, the effectiveness of its use depended on the level of digital competence among teaching staff and their readiness to work with intelligent tools. At the level of broader challenges facing the educational system, AI was regarded as a factor expanding learning opportunities. O. Kletskov & O. Onopriienko (2025) have found that introducing AI could enable personalisation of the educational process, but it also requires changes in regulatory and methodological support. This highlighted the necessity of combining technological solutions with pedagogical principles to guide their use. Particular attention was devoted to AI as a tool for the scientific and educational activities of teachers. A. Bruiaka *et al*. (2025) established that such tools increased productivity, expanded analytical capacities, and contributed to the improvement of educational content. At the same time, teachers were expected to retain responsibility for expert review, editing, and the careful selection of generated materials. In the training of vocational education teachers, the development of creative potential remained an important issue. V. Kovalchuk *et al*. (2024) demonstrated that modern digital technologies promoted the development of flexible thinking, professional initiative, and readiness for innovative activity. In this context, AI could be regarded as a resource for designing educational situations, modelling professional tasks, and developing creative competences.

The broader experience of using digital resources in Ukrainian education demonstrated that the effectiveness of digitalisation depended on the level of teacher training, the availability of resources, and methodological support. O. Ovcharuk *et al*. (2023) established that digital resources contributed to the development of key competences and expanded learning opportunities. This finding was important for understanding AI as a component of the broader digital ecosystem of education. A similar relationship was observed in the context of distance learning. O. Budnyk *et al*. (2021) demonstrated that digital technologies created new opportunities for the training of future teachers while also requiring the adaptation of teaching methods. This corresponded to the logic of AI implementation, as its use involved the renewal of the content, methods, and outcomes of professional training.

An analysis of academic studies on the topic of artificial intelligence use in the educational process was mostly devoted to the issues of general digitalisation or the work of teachers in higher educational institutions. However, there was not enough attention paid to the issue of the use of AI in the system of professional training for the teaching staff of vocational education institutions, considering the specifics of their professional

activity. There was also no correlation between the regulatory, educational programme, and operational conditions of AI use that could form a comprehensive understanding of the problems. Therefore, the study analysed the conditions for the use of artificial intelligence technologies in the system of professional training of teachers for vocational education, as well as the regulatory, content and organisational constraints. To achieve the aim of the study, the following objectives were formulated: to consider the theoretical and regulatory basis for the implementation of digital technologies and artificial intelligence in the system of training teaching staff in vocational education; to analyse the educational programmes for specialty A5 "Vocational education (by specialisation)" in Ukraine and international practice; to identify the opportunities and limitations of integrating artificial intelligence into the training system of the teaching staff of vocational education institutions.

Materials and Methods

The study was conducted as a qualitative, theoretical and analytical examination of regulatory documents, educational programmes, and practices related to the integration of AI into teacher training. Materials were selected according to thematic relevance, regulatory significance, and the presence of provisions concerning digital technologies or AI, while the analysis covered regulatory guidelines, educational programmes, opportunities, and barriers to integration. The empirical basis of the study consisted of regulatory documents, methodological recommendations, international frameworks, educational programmes, and educational initiatives related to the digitalisation of vocational education and the use of AI in teacher training (Ministry of Education and Science of Ukraine, 2019; UNESCO, 2023; Resolution of the Cabinet of Ministers of Ukraine No. 1021, 2024; Order of the Ministry of Education and Science of Ukraine No. 192, 2025). The analysis included three educational programmes in specialty A5 "Vocational Education (Digital Technologies)", published 2021-2025, as well as Ukrainian and international materials concerning the application of AI in education (Educational and Research Institute of Vocational and Pedagogical Studies, Ukrainian Academy of Engineering and Pedagogy, 2021; Ministry of Education and Science of Ukraine & Ministry of Digital Transformation of Ukraine, 2024; Ukrainian State University of Chemical Technology, 2024; Ministry of Education and Science of Ukraine, 2025; Lutsk National Technical University, 2025). The comparative dimension of the study was supported by the initiatives AI VET Project, AI Pioneers, Estonia AI Leap 2025, and materials published by Reuters concerning the preparation of teachers for the use of AI, as these reflected project-based, institutional, and state-level approaches to the integration of intelligent technologies into education (AI Pioneers, n.d.; AI VET Project Consortium, 2025; Education Estonia, 2025; Reuters, 2025).

The research used methods of regulatory and documentary analysis, content analysis, comparative analysis, generalisation and systematisation. The research was performed in three sequential stages: search and selection of sources, grouping of materials based on analytical categories and analysis and synthesis of the obtained results. At the stage of searching and selecting sources, consideration was given to regulatory significance, relevance to the digitalisation of vocational education, and the presence of provisions related to digital competence, AI, or teacher training. Regulatory documents were analysed with regard to the representation of speciality A5, its specialisations, digital competence, and the possibilities for using AI in professional training. Within the framework of the content analysis, educational components, programme learning outcomes, general and professional competences, content modules, and practical skills directly or indirectly related to digital technologies and AI were examined. Particular attention was paid to whether digital technologies were presented as an independent area of training content, a tool for organising learning, or a component of the teacher's future professional activity. Learning outcomes were compared with the technical, pedagogical, ethical, and social dimensions of AI competence presented in international frameworks. This made it possible to determine which aspects of preparation for the use of AI had already been reflected in educational programmes and which required further specification. The comparison of Ukrainian and international approaches was conducted according to the criteria of regulatory definition of AI, the presence of educational modules, practical orientation, methodological support, ethical aspects, staff training, and the relationship between AI and the professional functions of teachers. At the final stage, the results of the analysis were generalised in order to identify the main directions and limitations of AI integration into the training of vocational education teachers. The framework of information and communication competence, together with the functional differentiation of AI use, was developed through structural and functional generalisation and by comparing the professional functions of teachers with scenarios for the application of intelligent technologies.

Results and Discussion

Regulatory guidelines for the digital training of vocational education teachers

The training of teaching staff in vocational educational institutions is proceeding in the conditions of an updated regulatory framework, which integrates the requirements for professional and pedagogical specialisation of a specialist and readiness for digital transformation. The implementation of digital technologies and artificial intelligence in such a system is determined not only

by the technical modernisation of the educational process, but also by changes in the content of professional education and training. Digital tools are becoming an integral component of the professional activity of future teachers in vocational educational institutions, educators of specialised disciplines, and industrial training masters, since they are used in the development of educational courses, organisation of practical training, creation of educational materials, modelling of professional situations and assessment of the educational process. Therefore, the understanding of digitalisation of teacher training in the regulatory aspect begins with defining the position of the speciality A5 "Vocational Education (by specialisations)" in higher education (Ministry of Education and Science of Ukraine, 2019), since the framework of the system of competences, specialisations and educational results is determined on the basis of this. Resolution of the Cabinet of Ministers of Ukraine No. 1021 (2024), the speciality A5 "Vocational Education (by specialisations)" has been formally defined within the updated structure of fields of knowledge and specialities.

This means that vocational education has officially become a special area for the preparation, linked not only to teaching as an educational process, but also in specific fields of professional activity. Future teachers were prepared for work at the intersection of pedagogy, vocational pedagogy, and the industry. Order of the Ministry of Education and Science of Ukraine No. 192 (2025) further specified speciality A5 through the approval of a list of specialisations used for the allocation of state and regional educational orders. Such a definition implied that the training in the speciality A5 is not uniform. It involves different professional and industrial directions – in construction and welding, electronics and electrotechnics, energy engineering and power engineering, mechanical engineering and engineering in agricultural production, transport, and digital technologies. This made it possible to consider the implementation of digital technologies and AI as a component that needed to correspond to the profile of a particular specialisation. In the technical specialisations, the focus had been on digital modelling, virtual simulators, automated systems and data analysis. In the fields linked to digital technologies, communication, design or service, priority has been given to the use of generative tools, visualisation, support for individualised learning and work with digital services. The higher education standards for the speciality A5 "Vocational Education (by specialisations)", for bachelor, master and Doctor of Philosophy were kept as the base for the formation of the competences and learning results in current and transitional educational programmes. In these standards, the digital component was presented as the capacity to use information and communication technologies to select contemporary teaching tools, organise the educational process and professional training of learners. These provisions laid the basis for further expansion of digital competence content, taking into account the AI technologies.

Digital competence has emerged as a component of professional readiness in the training of vocational education teachers. For teachers of vocational education, it was related to planning the educational process, selecting digital tools, and creating educational materials. For the teachers of specialised disciplines, it implied the ability to explain the complex professional processes with digital modelling, simulations and visualisations. For the industrial training masters, the digital competence was important in the organisation of training, demonstration of professional actions, evaluation of practical skills, and work with digital simulators. The content of this competence gradually expanded. Basic knowledge of information and communication technologies (ICT) was not enough to ensure the professional training quality. Teachers should use digital educational environments, electronic resources, distance learning platforms, simulators, analytical services, and AI tools. Thus, the role of digital technologies in education has also changed; they are used not only for the transfer of information, but also for professional situation modelling, learning tasks adaptation, independent work support and learners' outcomes analysis. However, digital competence consolidation within the professional training structure did not address the issue of AI introduction. The higher education standards were defining only the general capacity of work with ICT, digital technologies; the educational documents of the contemporary period and international recommendations have determined how educators should apply intelligent systems in educational practice. The need to expand digital competence through the inclusion of AI corresponded with the findings of Y. Bekdemir (2024), where the integration of artificial intelligence into teacher training was viewed as a condition for the renewal of the teaching profession. It was established that future teachers should be prepared not only to use individual digital services but also to work with intelligent systems that influence lesson planning, educational content creation, assessment, and interaction with learners. In this regard, the author's conclusions confirmed that digital competence requires substantive expansion through an AI component. The study results have complied with this position, further specifying it in vocational education. It was shown that the introduction of AI should be taken into account in the training of teaching staff, not only the general pedagogical functions, but also sectoral specialisation, specific nature of professional tasks, and different roles of vocational education teachers, specialised discipline educators and industrial training masters.

Recommendations from the Ministry of Education and Science of Ukraine & Ministry of Digital Transformation of Ukraine (2024) regarding the integration of

AI into the education process outline how generative tools can be used in the teaching process responsibly. AI was defined in these documents as an assistance resource in creating teaching materials, designing assignments of various complexity levels, searching and generalising information, as well as creating conditions for individualisation of learning. For example, teachers were able to form a pool of example exercises on a topic using AI, create tests and control questions, adapt the level of explanation of a specific topic for the learners, and develop a lesson plan. However, in the recommendations, it is stated that AI outputs should be checked, since AI can produce inaccurate, incomplete, or misinterpreted information. The Ministry of Education and Science guidelines on the use of AI in higher education further extended this perspective in relation to the training of future professionals (Ministry of Education and Science of Ukraine (2025). AI was also viewed as an additional resource for performing individual tasks, as well as a resource embedded into the educational, research and independent learning process. For professional training of vocational education teachers, it meant that the curricula had to cover the topics of pedagogical use of artificial intelligence, critical analysis of information generated by machines, choice of the AI technologies for solving certain educational tasks and their ethical use. In particular, future teachers should not only learn how to use AI to obtain notes, control materials, training tasks, etc., but also to check their completeness, relevance to learning objectives, scientific correctness, terminological correctness, and relevance to the specific target audience of learning. The UNESCO AI Competency Framework for Teachers (UNESCO, 2023) describes teachers' competency in AI in more detail, including aspects of technical, pedagogical, ethical and social nature. Under the technical nature, the authors understood knowledge of the principles of functioning of artificial intelligence systems, their capabilities and limitations. Under the pedagogical, there is a connection with learning objectives, the choice of methods and procedures for learning, the assessment of learning outcomes, and student support. Under the ethical, the transparency of actions, responsibility for the results, data security, plagiarism and authorship rights, academic integrity. Under the social, an understanding of the influence of AI on interaction in learning, fairness, accessibility and inclusion, the professional role of the teacher. This conceptualisation was the theoretical basis for teaching and training to view AI as one of the components of professional competency of the vocational education teachers, with particular emphasis placed on the integration of technology, pedagogical content, and ethical considerations. A comprehensive understanding of AI competence is aligned with the position of R. Daher (2025), where the integration of artificial intelligence literacy into teacher education was examined from a critical perspective. It was stressed that teacher training cannot be limited to knowledge of how intelligent systems work; educators need to comprehend the effects of these systems on the content of the curriculum, on educational interaction, on learner autonomy, and on the evaluation process. It was noted that the ability to critically assess an artificial intelligence's answers, to reveal bias, to evaluate the degree of transparency of digital tools, and to preserve pedagogical responsibility should be considered an element of AI literacy. The findings of this study were consistent with this approach in recognising the ethical and critical components of AI literacy. At the same time, they refined this concept in the context of vocational education: they proved that the critical employment of AI was not just associated with universal pedagogical threats, but also with the specifics of a particular area of knowledge, with educational and training opportunities within an industry, and with the variety of roles that educators fulfil.

By aligning national documents with international ones, it became possible to define the priorities for reforming the educational programmes of discipline A5 "Vocational Education (by specialisations)". While the state regulations of Ukraine regulate the content of the discipline by means of establishing a framework, a list of specialities, and general requirements for the expected results of learning, the recommendations of international organisations focus on the content of AI competency of the future teacher in technological, pedagogical, ethical and social dimensions. In the system of professional training of teachers of vocational education, this means a modernisation of educational components focused on digital technologies, the inclusion of materials on generative AI, the creation of practical assignments on simulating professional situations, training of skills on checking AI-generated content, and determining the ethical boundaries of its use. In this way, the theoretical and regulatory prerequisites for the progressive introduction of AI into the system of preparing future teachers of vocational education have been laid. The new version of the classification of disciplines has shown the place of the discipline A5 in the structure of higher education, the list of specialisations has clarified the sectoral orientation of training, the new standards have established digital competency as one of the components of professional development, while national and international recommendations have given this category content on responsible artificial intelligence application. The correlation of national documents with international ones allowed determining the areas for updating the educational programmes on speciality A5 "Vocational Education (on specialisations)"

Representation of digital technologies and AI in educational programmes

The analysis of the educational programmes of the discipline A5 "Vocational Education (by specialisations)"

shows the practical level of implementation of requirements of regulatory documents concerning digital competency and the use of modern technologies in the process of professional training of the teaching staff. Their content makes it possible to see how digital technologies are incorporated into professional training, how they are implemented and what aspects are considered basic and what are still undefined. Analysing the content of programmes gives the opportunity to determine how the general requirements for standards intersect with the specific features of professional education training, how digital technologies are implemented within the educational standards and where artificial intelligence is used. In addition, a comparison of Ukrainian and foreign experience makes it possible to determine how vocational teacher training is organised, to see what methods for implementing AI exist and where the education programme could improve.

Moving from regulatory documents to the analysis of the content of educational programmes allowed determining how the requirements for digital competence and the implementation of modern technologies have been implemented in the content of teacher training in the vocational education system. The content of educational programmes showed that digital technologies have been gradually introduced as an additional tool or as part of a professional specialisation, as part of the formation of the subject and professional competences of future teachers. For example, the digital component is introduced at the level of the goals of the educational programme "A5 Vocational Education (Digital Technologies)" at Lutsk National Technical University (2025). The aim was to train specialists capable not only of using digital tools, but also of teaching specialist subjects related to digital technologies. The content of this programme provides for a combination of pedagogical skills and professional knowledge to develop and design educational software, create digital educational products, and use digital technologies within the framework of educational activity. The implementation of these types of education programmes shows that digital technologies are not an addition to the training, but its content. In the Ukrainian State University of Chemical Technology (2024) educational programme "Vocational Education. Digital Technologies", such an educational programme also contains digital technologies, but digital technologies in the programme are emphasised more by its relationship with the practical component. The content of the study is implemented in the context of professional activity through the use of digital technologies to solve applied tasks, create digital products and conduct teaching in industrial production. The content of training is oriented towards combining theoretical knowledge with practical skills, in particular through elements of dual education involving engagement with real professional settings. In this approach, digital technologies function as a tool that ensures the connection between learning and professional practice. A common trend for educational programmes in Ukraine is also presented in the standard educational programme of a bachelor's degree in accordance with the requirements of speciality A5 (Educational and Research Institute of Vocational and Pedagogical Studies, Ukrainian Academy of Engineering and Pedagogy, 2021). In this programme, digital technologies appear either as a specific field of study or as a means of organising the educational process. Therefore, even if they are not a separate subject of professional preparation in the study area, they remain an inevitable part of the future teachers' professional activity. Thus, a basic level of digital training is ensured for all students of the programme, and at the same time, the possibility of additional digital specialisation. According to the results of synthesising the analysed programmes, digital technologies were presented in the training of vocational education teachers as an object of study, a means of implementation, and a component of professional activity. This allowed the laying of the foundation for further introduction of more complex digital technologies, including artificial intelligence, into educational programmes. In the content analysis of the programmes, digital technologies were most often represented by the components of the use of information and communication technologies, digital educational resources, educational software and distance learning platforms. At the same time, the direct inclusion of artificial intelligence as a content component was rather scarce. In the educational programmes considered, AI was often referred to indirectly as part of the broader concept of digital technologies or as an innovative tool for teaching, without specifying specific tools, learning outcomes, or a module on working with intelligent systems.

In the analysis of the content of educational programmes, the components of digital training were most often found in the following areas. Most often, digital tools were used to organise the educational process, create educational materials, work with electronic resources, and support vocational training. The grouping of the most frequently encountered functions made it possible to reveal the technical, methodological, organisational and resource components of the information and communication competence. Thus, knowing the place of digital technologies in educational programmes, there is a need to understand by means of which components the information and communication competence of the future vocational education teachers is trained. The digital component in the contents of educational programmes was not presented in one educational component and one discipline, but it was distributed among different disciplines and educational components. Each of them guaranteed one of the sides of professional preparation of a teacher: technical, methodological, organisational or resource.

Thus, the ICT competence is represented by a certain functionally organised system and is associated with a number of pedagogical and practice-oriented professional activities (Fig. 1)

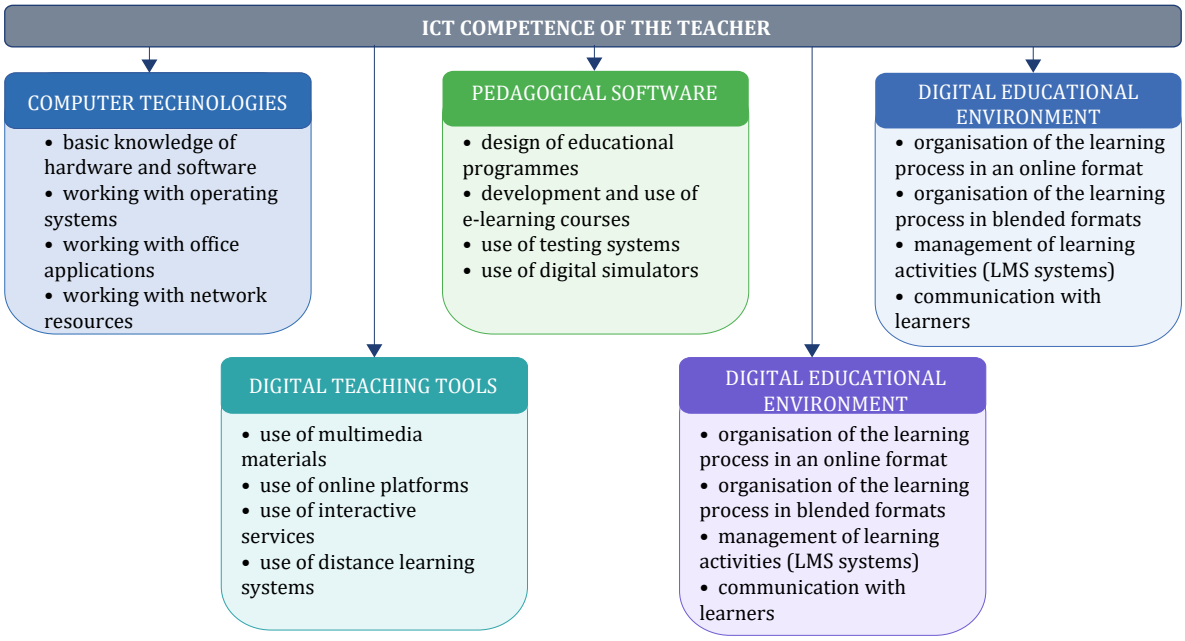

Figure 1. *Structure of ICT competence representation in educational programmes*
Source: *developed by the author based on research I. Andrusiak & M. Slyvka (2022), L. Lukianova (2022)*

The identified components demonstrated that the information and communication competence had been formed as a compound ability including technical knowledge, pedagogical skills, and organisational skills. It is formed not only by mastering some technical tools, but also implies the integration of their use in the professional activity, in full compliance with the goals and objectives of the educational process. This way of doing it gradually moved from using technology for operational tasks to using it in a more conscious, purposeful way for educational work. A similar understanding of the structure of digital competence aligns with the findings of S.R. Chohan & G. Hu (2022), who established that the effective development of digital skills is achieved not through the isolated mastery of individual tools, but through systematically organised training programmes that combine technical skills, practical application, and institutional support. It is known that digital competence is developed as a person's ability to exist in the digital medium as an integrated skill. It is very important to have access to technology and be able to use digital technology for professional tasks and challenges. The results confirmed that a structured training approach, which ensures interconnection between different components of digital activity, enhances the effectiveness of competence development. In the present study, this approach was further refined through a more detailed specification of the content of ICT competence in the training of vocational education teachers. Unlike the generalised approach, which focuses on institutional programmes for the development of digital skills, it was found that in vocational pedagogical training, such integration is implemented through the distribution of functions across educational components corresponding to different types of teaching activity. This made it possible to specify the mechanisms of competence formation and directly link them to the professional tasks of future teachers.

Practical level of competence development could be observed in the content of disciplines related to the usage of computer technology in the educational process. In these educational components, digital technologies are used as a means of educational organisation, preparing learning materials, using electronic resources, applying software tools for organising teaching activity, and assessing student learning outcomes. Within the content of such components, the students acquire the ability to choose digital resources according to educational purposes, adapt digital tools in conditions of vocational teaching, and assess the efficiency of the tool usage. In this way, this type of discipline could be considered as providing not only an introduction to technologies but also as providing tools to develop practical digital skills that relate to vocational teachers' professional activity. This is also the feature that is typical for the Ukrainian vocational teacher training programmes – ICT competence is integrated so that technology can be used as a basis for a learning organisation. However, the links with using digital tools such as artificial intelligence are still inconsistent.

These findings regarding the necessity for the functional differentiation of training are in line with those presented by R.W. Daryono *et al*. (2023). It has been established that the assessment of the competences of vocational education students should consider not just the level of acquired knowledge, but also the ability to apply it in real situations that are relevant to the professional activities that students are expected to carry out in the future. These are the applied, operational and contextual characteristics that constitute professional readiness. The present study corroborates this, showing a link between the use of AI and the real, professional functions of teachers. It became evident that for vocational teachers, educators of specialised subjects, and industrial training masters, different situations of application for the artificial intelligence tools were needed, so that the skills related to the use of intelligent technologies could not be defined as something universal. Consequently, competence in working with intelligent technologies cannot be formed as a universal skill but must correspond to the type of professional tasks, the nature of learning activities, and the methods used to assess training outcomes. The selective inclusion of artificial intelligence in training should be refined by considering that the training for various categories of teachers must be functional. It is the professional activities that define the characteristics of using digital tools, which determine different ways of using the artificial intelligence content that is part of the training.

An analysis of the content of educational programmes and professional functions shows that the directions of the use of digital technologies and AI tools will vary according to the type of professional activity. For vocational teachers, emphasis was given to design and assessment; for lecturers of specialised subjects, emphasis was on professionally oriented digital materials and the modelling of situations; and for industrial training masters, on demonstration of a technique, instruction and the use of simulators. This allowed for a functional differentiation of the domains in which the AI is applied. This type of role differentiation makes it possible to establish more specific ways of using intelligent tools for each category of teaching staff in line with its professional functions (Table 1).

Table 1. *Use of artificial intelligence in the training of different categories of vocational education teachers*

Category of teaching staff	Areas of AI use	Functional purpose
Vocational teacher	curriculum design; adaptation of educational materials; assessment of learning outcomes; support for individual learning pathways	organisation and personalisation of the learning process
Lecturer of specialised disciplines	modelling of professional situations; work with sector-specific data; creation of visualisations; preparation of technical explanations; development of case studies and simulations	provision of the content and applied components of vocational training
Industrial training master	delivery of instruction; analysis of production errors; development of action algorithms; use of virtual simulators; practice of professional operations in a safe environment	formation of practical skills and competences

Source: developed by the author based on research V. Umanets *et al*. (2024), I. Marynchenko (2025), O. Derevyanchuk *et al*. (2025)

The relationship that was identified confirms that the integration of artificial intelligence into professional training has a differentiated approach. The use of AI was determined not only by the level of digital literacy, but above all by the teacher's professional role and the type of educational tasks. In turn, this led to the question of functional specialisation in the training of pedagogical staff, and included relevant components oriented towards a practical use of intelligent technologies in certain areas of pedagogical activity. Having clarified the functional differences in the training of categories of teaching staff, it made sense to look at the situation with the training of pedagogical staff in the countries of the European Union, in which the integration of artificial intelligence into vocational training has already taken on an orderly nature. These approaches involved not only the use of individual digital tools, but also of coherent models of training for pedagogical staff in the vocational field.

For instance, within the framework of the European project AI VET (AI VET Project Consortium, 2025), training materials specifically for vocational education teachers were prepared. It followed a model of modular content organisation, with each module focused on the use of AI tools in various aspects of the training activity (development of teaching materials, organisation of the learning process, assessment, data analysis and learning adaptation according to learner needs). It also paid particular attention to the technical and pedagogical nature of the use of AI technologies, which made it possible to view AI as a tool integrated into vocational education rather than as a universal digital tool. This model of training was oriented to the use of the practical application of technology within specific industrial and educational contexts. A similar approach was adopted in the AI Pioneers (n.d.) project in the field of adult education and vocational training. In this context, AI was used as a tool for continuous professional development and training, and teachers were trained in the use of intelligent technologies. The programme covered training in the

use of intelligent systems, the creation of educational content, the use of analytics to assess outcomes, and the organisation of personalised learning pathways. This approach has made it possible to integrate AI into the professional practice of teachers as a tool to improve the quality of teaching, and in the course of AI learning to use intelligent technologies, respectively. At the national level of development, the AI experience of Estonia is particularly interesting. The introduction of AI in education has already taken on a certain systematic nature. Within the framework of the AI Leap (Education Estonia, 2025) initiative, AI technologies were made available to both students and teachers, and the teacher training process was supported through training and methodological materials. A distinctive feature of this model is the combination of technological accessibility with the promotion of responsible attitudes towards the use of AI, including ethical considerations, critical thinking, and learner autonomy. All this allowed the integration of AI tools into the educational process at all levels, including vocational education.

Greece started teacher training on the use of AI in the educational process in 2025-2026, which included the relevant modules in the continuing professional development systems (Reuters, 2025). The content of this training covered lesson planning with the use of intelligent tools, the application of AI in research activities, and the organisation of personalised learning. This approach focused on the gradual introduction of technologies into the teachers' professional activities through acquiring practical skills and methodological competences. The discussed approaches can be compared in that the integration of AI into the system of vocational education within the European educational space was carried out on the basis of the educational programmes, projects and public policy. In all of the considered models, the role of artificial intelligence as a part of teachers' professional competence, which is developed during specialised training and practical preparation, as well as through methodological support, is acknowledged. At the same time, Ukrainian educational programmes already provide a developed digital foundation, but the introduction of AI still requires clarification of its contents, results of learning and ways of implementation. This determined the necessity to identify the opportunities and obstacles for AI implementation in the system of vocational teacher training. Comparative analysis has shown that, while in European practice the integration of AI in the educational process is carried out through the creation of training modules, scenarios for the practical use of intelligent technologies and providing the teachers with methodological support. In contrast, digital training in Ukrainian educational programmes preserves a more general approach to digital training and the AI-related components are included only partially in the teachers' professional activities.

Opportunities and barriers to AI integration in teacher training

The implementation of AI in the system of vocational teacher training was accompanied simultaneously by the expansion of didactic possibilities and the appearance of obstacles associated with regulatory, methodological, staffing and technological support. These changes occurred in the framework of the existing digital foundation of educational programmes. While it created prerequisites for the integration of AI, it did not ensure its systematic introduction. This determined the necessity of considering the introduction of intelligent technologies as not only a technical upgrade but a comprehensive transformation of the content, organisation and results of the vocational teacher training. The use of AI has led to the expansion of the range of tools for the organisation of the learning process in vocational teacher training. The main directions of such expansion included the personalisation of learning, which was associated with the possibility to adapt the content, learning pace and complexity based on the individual characteristics of learners. The result has been a more differentiated approach to training future teachers, enabling the level of preparation, professional needs and interests of future teachers to be taken into account in the course design.

Another key element in this process has been the automated production of learning materials. AI made it possible to generate texts, tests, training cases and scenarios of professional situations for the training process, which facilitated and accelerated the preparation of lessons, broadened the range of teaching materials and ensured greater flexibility in their use. Simulations and virtual educational environments have helped to create conditions for training in a digital environment, so in vocational teacher training, it has become possible to model industrial situations, train students in performing sequences of actions, and train them in professional skills in a digital environment, without having to be involved in real production processes. Another direction has been the analysis of educational data, which made it possible to track the student's progress, analyse results and adjust the educational process. Use of data analysis made it possible to increase the validity of pedagogical decisions and to achieve a more objective analysis of learning results (Boiko *et al*., 2024). As a result of the integration of artificial intelligence, there are now reasons to reconsider the content of the educational programme in speciality A5. One of the directions has been the creation of educational blocks for more specific training for the use of AI in vocational education. This content includes familiarity with intelligent systems, the possibilities of their use in professional education, and their limitations. Another area has been the inclusion of AI content in the curricula of other educational disciplines.

When considering digital technology courses, teaching methodology for vocational education, professional

skills, and student performance assessment, there is a clear understanding that AI is an available tool for various sectors of pedagogical practice. This approach makes it possible to introduce intelligent technologies without radically changing the structure of the educational programme. A separate focus has been placed on developing learning outcomes related to the responsible use of AI. The need to develop such outcomes aligns with the position of A.C. Saglam (2025), where the integration of artificial intelligence in education is linked primarily to preparing teachers for informed pedagogical use of intelligent tools. The study emphasised that the effectiveness of AI depended not on the mere fact of its use, but on the teacher's need to be able to identify the technology they should be using to teach students, select the appropriate one based on the objectives of their teaching activity and monitor the impact of the technology on the educational interaction. AI competence is seen as a necessary part of professional training for vocational teachers, not as a separate technology. The current study extends this concept with a specific list of learning outcomes for speciality A5. Responsible implementation of AI in training future vocational education teachers involves, first of all, assessing the quality of the generated content, ethical work with data, the relevance of the chosen tools to the professional task and verifying the educational value of the developed digital products.

This involves training in assessing the quality and reliability of generated content, observing ethics and taking security into account, as well as the use of AI, in line with educational objectives. The findings didactic possibilities correspond to the results of A. Suparyati *et al*. (2023), where they identify the main role of AI in vocational education as providing learning adaptability, automating some pedagogical processes, and developing opportunities for practice-oriented training. The authors state that with the help of intelligent technologies, it is possible to personalise the content of learning tasks, improve the procedures for assessing students, provide students with access to digital resources and create prerequisites for modelling professional situations. All this testifies to the relevance of considering AI not just as a supporting tool for vocational education, but as a technology for the didactic transformation of vocational education. In this study, the above theses are further developed with regard to vocational teacher training. Whereas the authors primarily present AI as a resource for the broader development of vocational education, this study clarifies the specific didactic functions it can perform in the training of future teachers: the creation of learning materials, the design of scenarios of industrial situations, the support of simulations, learning analytics, and the development of the ability to use intelligent tools in a pedagogically appropriate manner.

The use of artificial intelligence has facilitated a shift from basic use of digital tools to their critical selection and application. The training of future teachers has involved the development of the ability to select appropriate AI services depending on educational objectives, evaluate their effectiveness, and adapt them to specific learning contexts. An important aspect was the formation of skills for quality and reliability verification of generated AI content, namely the quality of the provided information, its compliance with learning goals, awareness of the limitations of automated systems and many other aspects. Such knowledge and skills become relevant for the professional activity of teachers in digital environments. The digital competence is also prepared for work in digitalised professional environments. Future teachers must be prepared to use AI as a tool for organising teaching, interacting with learners and professional development. Alongside these opportunities, the integration of AI has been accompanied by a number of constraints emerging at different levels of the vocational teacher education system (Honcharuk *et al*., 2024). The transition from the general use of digital tools to a critical selection of AI services corresponds to the results of T. Rachbauer *et al*. (2025), where they highlight digital literacy and artificial intelligence literacy as related but not identical components of teacher preparation. The research suggests that digital competence involves the skills and abilities that are necessary to function in a digital environment, whereas AI literacy relates to understanding the operation of systems that utilise intelligence, assessing AI-generated outputs, recognising the potential risks associated with such technologies, and considering the pedagogical implications. This has clarified the content of digital competence, which, in the current circumstances of the active introduction of AI, cannot be limited solely by technical skills for the use of digital tools. The findings of the present research correspond to this differentiation, but at the same time specify it with reference to the process of preparing teachers to work in technical and vocational education. It is concluded that AI literacy should not only imply the ability to understand intelligent technologies, but also to correlate them with professional tasks and their content, specialisations of the sector, production contexts, and the educational content of practical training of learners.

The identified duality of opportunities and limitations also confirms the results obtained by A. Zary & N. Zary (2025), in which the role of artificial intelligence in technical and vocational education is considered from the combination of the demonstrated positive and the revealed negative. It has been established that AI makes it possible to organise adaptive training, carry out automation of assessment, create a simulation-based environment, and prepare students for performing professional tasks; however, the use of such tools depends on the readiness of the implementation, organisational aspects, infrastructure, teacher

competence, as well as the availability of appropriate mechanisms. In turn, the results of the present research correspond to these results, in which the potential of AI is not considered separately from the conditions of its implementation. At the same time, these results are complemented by the specifics that are presented only in the study of training of teaching staff in technical and vocational education. The authors describe the issues and challenges in the broader sense for technical and vocational education, while current research specifies them through the lens of educational programmes, as well as the digital competence of the future teacher and the differences in the functions of teachers of vocational education, the educators of specialised disciplines, and industrial training masters.

Unevenness of the preconditions for AI implementation confirms the results of the research of W. Flores & A. Chiappe (2025), according to which the introduction of AI in education should be considered as a combination of various preconditions and digital competence of the teacher. It has been established that the readiness of teachers to use artificial intelligence is not limited by digital skills and the ability to work with tools, but is determined by the possibility of using their teaching value and the ability to adjust them to teaching content and the presence of support conditions from the educational organisation. This made it possible to view digital competence as a prerequisite for implementation, rather than merely as an outcome of learning. The findings of the present study are consistent with this conclusion in recognising staffing and methodological factors as key to AI integration. At the same time, they further specify the structure of constraints in vocational education: it has been shown that teacher readiness depends on regulatory clarity, methodological provision, access to technology, and the alignment of AI with specific professional tasks. This allows barriers to be described more broadly as an interrelated system rather than a collection of separate difficulties. The conditions for the systematic implementation of AI have proved uneven, which has necessitated a synthesis of the main barriers (Table 2).

Table 2. *Barriers to the implementation of artificial intelligence in vocational teacher education*

Group of barriers	Nature of the barrier	Manifestations in vocational teacher training
Regulatory	lack of clear requirements for the use of AI; transitional nature of the classification of specialities; insufficient detail regarding ethical and legal aspects	limited integration of AI into standards and educational programmes; unclear learning outcomes
Methodological	lack of models for AI integration; insufficient methodological materials; formalised use of AI	use of AI without clear links to professional competences; limited methodological support
Staff-related	uneven levels of teachers' digital training; insufficient readiness to use AI; need for further professional development	fragmented implementation of technologies; dependence on individual teacher experience
Technological	unequal access to infrastructure; restricted access to services; issues of security and data protection	limited use of AI in teaching; risks to academic integrity

Source: *developed by the author based on research S. Nykyporets (2024)*

These grouped barriers correspond to the results of a systematic review conducted by Y. Aljemely (2024), which reveals that teacher readiness to apply artificial intelligence is impeded by a complex of technical, organisational, ethical, and professional-methodical factors. According to its results, the training process of teachers includes not only the availability of artificial intelligence tools, but also a well-organised programme of training of teachers, a set of scenarios of their application, institutional support of innovations, as well as a clarification of issues such as confidentiality, academic integrity and proper use of data. The researchers noted the key role of long-term professional support of teachers, since short-term training in artificial intelligence is insufficient to form a stable readiness to use intelligent means. The findings of this study coincide with this position in emphasising the multilevel structure of the barriers. At the same time, they refine them within the context of vocational education: it has been shown that methodological and staff readiness must correspond to the profile of specialisation, the functions of vocational teachers, educators of specialised disciplines, and industrial training masters, as well as the requirements of learners' practical preparation. The systematisation of the barriers reflects their interconnectedness and mutual influence. Regulatory uncertainty limits methodological development, staff-related difficulties reduce the effectiveness of available technologies, and technological constraints hinder the implementation of even those approaches that have already been developed. This indicates the need for a comprehensive approach to AI implementation that takes into account all levels of the educational system. The integration of artificial intelligence into vocational teacher education thus combines significant potential for renewing the learning process with a range of systemic constraints. The didactic opportunities associated with the personalisation of learning, the automation

of content creation, and the use of simulations and analytics have created preconditions for improving the quality of training. At the same time, the integration of AI has required the revision of educational programme content and the development of digital competence at a new level. The ratio of advantages and barriers to the use of artificial intelligence confirms the results of S. Ahmed *et al*. (2022), which showed that the motivation of teachers to apply these technologies is high, given the transparency of the advantages of its use for learning organisation, materials preparation, result evaluation, and students' support. At the same time, in practice, the development of AI is limited by low preparation of teachers, lack of methodical support, technical difficulties and ambiguity of ethical principles. Accordingly, the positive attitude towards the use of AI did not guarantee its effective use without the appropriate organisational and professional conditions. The findings of the present study are consistent with this conclusion in that the didactic potential of AI is considered alongside a system of constraints. At the same time, the results further specify the nature of these constraints in vocational teacher education: it has been shown that barriers arise not only at the level of individual teacher readiness, but also at the level of educational programmes, regulatory clarity, access to infrastructure, and the alignment of AI with specific professional functions of teachers. The existing barriers demonstrate that the implementation of AI cannot be limited to isolated initiatives or localised changes. This requires harmonisation of the regulatory framework, development of methodological solutions, preparation of teaching staff, and provision of appropriate technological conditions. Under these conditions, the effectiveness of AI integration depends on the capacity of the education system to combine the potential of intelligent technologies with the requirements of vocational teacher education.

Conclusions

It has been established that the theoretical and normative foundations for the preparation of the pedagogical staff of vocational education laid the foundation for the digital transformation, and did not specify in detail the use of artificial intelligence in the training process. The accreditation of the speciality A5 "Vocational Education (by specialisations)" confirms the autonomy and interdisciplinarity of this speciality, the national recommendations on the definition of requirements for digital competences and their international interpretation extend the understanding of digital professionalism by including the ethical and social aspects of interaction with intelligent technology. An analysis of educational programmes revealed that the use of digital technologies was represented as a component of specialisation content, while in most cases, the use of AI was indirect. In comparison with the European practices, it was found that, in the latter case, the introduction of AI was more systematic, and was realised as specialised modules, project activities or as state-level programmes.

The generalisations of findings have shown the following: The introduction of artificial intelligence into vocational teacher education has the potential to open up new didactic perspectives. These included personalising the learning process, automating the creation of educational content, using simulations and virtual learning environments, and employing learning analytics to evaluate the quality of learning outcomes. At the same time, these opportunities were associated with the need to update curricula, introduce dedicated components, define new learning outcomes, and develop digital competence oriented towards the critical and responsible use of AI. There are, however, a number of barriers to the systematic introduction of artificial intelligence. Regulatory barriers, such as an absence of clear requirements for the use of AI as part of standards or in educational programmes. Methodological barriers are connected to underdeveloped models of how to introduce AI into vocational teacher education. Staff-related barriers resulting from the uneven level of digital readiness of lecturers and their insufficient readiness to use intelligent technologies. Technological barriers, including problems with access to digital infrastructure and the use of specialised services, and the issue of data security. The barriers identified are interrelated, and it is necessary to adopt an integrated approach to overcoming them.

The findings confirmed that the effective integration of artificial intelligence into vocational teacher education is possible, but only if the regulatory requirements, methodological support, lecturer training and technical infrastructure are developed and properly implemented. This highlights the need for further updates to educational programmes, which are necessary for the incorporation of AI within the professional competence of vocational teachers. Further research needs to be done in the context of the increasing sample size of analysed educational programmes and legal acts, which need to include a variety of educational programmes in terms of different specialisations and organisations. It is also necessary to conduct research in the field of empirical analysis of the efficiency of the introduction of artificial intelligence in vocational teacher education while taking into account the rapid development of technology and changes in educational practice.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Сучасні підходи до впровадження цифрових технологій (штучного інтелекту) у системі професійної підготовки педагогічних кадрів закладів професійної освіти

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Анотація. Метою дослідження було з'ясування умов, потенціалу та обмежень використання технологій штучного інтелекту у підготовці педагогічних працівників для закладів професійної освіти шляхом аналізу нормативних документів і змісту освітніх програм. Методологія дослідження ґрунтувалася на поєднанні нормативно-документального аналізу, контент-аналізу освітніх програм і порівняльного аналізу освітніх практик. У результаті дослідження було встановлено, що теоретико-нормативна база підготовки педагогічних кадрів професійної освіти сформувала передумови для впровадження цифрових технологій, однак не забезпечила достатньої конкретизації застосування штучного інтелекту. Виявлено, що освітні програми інтегрували цифрові технології як зміст спеціалізації, інструмент навчання та компонент професійної діяльності, проте використання штучного інтелекту залишалося фрагментарним і не набуло статусу системного елементу підготовки. Встановлено, що інформаційно-комунікаційна компетентність формувалася як багаторівнева структура, яка забезпечувала технічну, методичну та організаційну готовність педагога, але не повною мірою охоплювала роботу з інтелектуальними системами. Порівняння з європейськими освітніми практиками показало, що інтеграція штучного інтелекту в професійну освіту здійснювалася через спеціалізовані модулі, проєктні ініціативи та державні програми, що забезпечувало її системний характер. Визначено, що використання штучного інтелекту розширило дидактичні можливості професійної підготовки за рахунок персоналізації навчання, автоматизації створення освітнього контенту, застосування симуляцій і освітньої аналітики. Одночасно встановлено наявність нормативних, методичних, кадрових і технологічних бар'єрів, які стримували повноцінну інтеграцію інтелектуальних технологій. Практична значимість дослідження полягає в тому, що його результати можуть бути використані для оновлення освітніх програм, розроблення освітніх компонентів із використання штучного інтелекту, уточнення результатів навчання щодо цифрової компетентності та підготовки методичних матеріалів для педагогів професійного навчання, викладачів спеціальних дисциплін і майстрів виробничого навчання

Ключові слова: освітні програми; цифрова компетентність; нормативна база; компетентність; персоналізація

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 87-100
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 05.12.2025 Revised: 10.04.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 3378.147:004.8:005.336.2
DOI: 10.69587/pemtt/1.2026.87

Application of artificial intelligence technologies and services in the professional training of managers in the field of education

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■ **Abstract.** The purpose of the study was to evaluate the possibilities of using artificial intelligence technologies in the professional training of future managers. The methodology included system and structural analysis, comparative analysis, and experimental research, modelling educational and professional scenarios conducted based on four higher educational institutions of Ukraine and involved 120 students enrolled in second-cycle (Master's) degree programmes. The results confirmed the effectiveness of integrating artificial intelligence technologies into the professional training of future education managers. International analysis has shown that in the United States of America, Singapore, Finland, and South Korea, artificial intelligence is used as a tool for analysing educational data, strategic planning, and managerial decision-making, which ensures the development of a data-driven approach in educational management. Comparative analysis of digital platforms showed that generative models contribute to analytical support and modelling of solutions; integrated systems automate management processes; and services provide organisation, communication, and visualisation of educational data. It was shown that in the experimental group, the level of professional competence increased from M ≈ 2.87-2.90 to M = 3.85-3.94 (SD ≈ 0.89-0.93), while in the control group, the increase was insignificant and amounted to M ≈ 2.80-2.88 to M = 3.16-3.25 (SD ≈ 1.00-1.03). The highest value was the indicator of presentation of research results (M = 3.94), the level of digital transformation was slightly lower (M = 3.93), which indicates a high development of communication and digital skills among respondents. The strategic planning indicator (M = 3.74) was not among the highest values, which indicates a relatively weak development of long-term managerial thinking in comparison with practice-oriented digital competencies. The data proved that the use of artificial intelligence technologies increased the level of managerial, analytical, and digital competence of future education managers

■ **Keywords:** digital tools; data analytics; training personalisation; educational and professional scenarios; ethical standards

■ Introduction

The rapid development of artificial intelligence technologies and services is changing approaches to organising the educational process and managing educational institutions. Intelligent digital tools expand the opportunities for professional training of managers in the field of education, promote the development of analytical thinking, managerial decision-making skills, planning, and effective communication. The use of artificial intelligence improves the quality of work with information, optimises the performance of professional tasks, and creates new opportunities for training specialists who can effectively act in the context of digital transformation of the educational sphere.

Suggested Citation:
Zarva, A. (2025). Application of artificial intelligence technologies and services in the professional training of managers in the field of education. *Professional Education: Methodology, Theory and Technologies*, 12(1), 87-100. doi: 10.69587/pemtt/1.2026.87.

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The problem of using artificial intelligence technologies and services in the professional training of managers in the field of education attracts increasing attention of researchers, since the digitalisation of the educational space changes the requirements for management activities and professional competencies of future specialists. Bibliometric analysis of scientific publications on the use of artificial intelligence in management education was carried out by H. Dissanayake *et al.* (2025). The researchers identified the main areas of development of this topic and traced the dynamics of growth of scientific interest in it. The results showed that the integration of intelligent technologies contributes to updating the content of management training and expands the possibilities for developing professional competencies. The possibilities of using artificial intelligence for professional training of specialists were considered by W. Holmes & A. Littlejohn (2024). The researchers noted that intelligent systems support the personalisation of the educational process and the adaptation of educational materials to the individual needs of educational applicants. Such technologies contribute to the development of independent learning skills and more effective assimilation of professional knowledge.

The development of the Ukrainian education system in the context of the spread of artificial intelligence and information technologies was analysed by S. Kryshtanovych *et al.* (2025). The researchers emphasised the need to modernise educational programmes in accordance with new technological challenges. The use of digital tools helps to prepare education managers to work with large amounts of data and manage innovation processes. The problem of knowledge management during the digital transformation of education and science in Ukraine was investigated by A. Iatsyshyn *et al.* (2024). The researchers noted that the effective use of digital resources improves the quality of professional training and improves the process of making managerial decisions. Artificial intelligence systems provide quick access to information and support the analytical activities of future managers. The use of artificial intelligence in education management was investigated by I. Igbokwe (2023). The paper showed that intelligent technologies help automate administrative procedures and increase the efficiency of management activities. They create conditions for the development of new professional skills necessary for working in a digital environment. The role of artificial intelligence in educational administration was analysed by N. Ogunode & D. Gregory (2025). The researchers noted that digital systems support the processes of planning, monitoring, and evaluating the activities of educational institutions. Their use contributes to the preparation of managers to perform managerial functions using innovative technologies.

The contribution of artificial intelligence to stimulating innovation in educational services and university programmes was investigated by R. Popescu *et al.* (2023). The researchers noted that digital solutions contribute to updating the content of management training and developing entrepreneurial thinking. The use of intelligent services increases the flexibility of educational programmes and expands professional training opportunities. The problem of combining artificial intelligence and digital learning was considered by K. Suryanarayana *et al.* (2024). The researchers have proven that intelligent technologies increase the efficiency of the digital learning environment and support the sustainable functioning of education management systems, and provide better interaction between participants in the educational process and contribute to the optimisation of educational activities. The issue of introducing artificial intelligence in Ukrainian education of the future was highlighted by S. Vasylyuk-Zaitseva *et al.* (2023). They stressed that intelligent technologies open up new opportunities for organising the educational process and professional training of specialists. Their use contributes to the development of digital literacy and readiness for innovation. The use of artificial intelligence to improve the effectiveness of education management was investigated by C. Xing (2023). The researcher noted the ability of intelligent systems to improve the efficiency of management processes and the quality of educational services. Such technologies support data-based decision-making and contribute to the development of professional competencies of future managers in the field of education.

Despite the areas highlighted by the above researchers, the gaps included a lack of studies on the pedagogical conditions for the effective use of artificial intelligence technologies and services in the professional training of managers in the education sector. Attention remained limited to the development of readiness of future education managers to integrate intelligent digital tools into the practice of management activities. The purpose of the study was to substantiate the potential of using artificial intelligence technologies in the professional training of future managers in the field of education. The objectives of the study were: to summarise the international experience of using artificial intelligence technologies in the professional training of education managers; to assess the effectiveness of using AI services in the development of managerial and digital competencies of future heads of educational institutions; to develop and substantiate a system of educational and professional scenarios for integrating artificial intelligence into the educational process of training education managers.

Materials and Methods

Based on the method of system and structural analysis, international practices of using artificial intelligence technologies in the professional training of future education managers were summarised. The study

examined the systemic components of training educational leaders in the United States (United States of America), Singapore, Finland, and South Korea as countries characterised by a high level of digital maturity of educational systems, the presence of strategies for state support of artificial intelligence, and a developed infrastructure for training managerial personnel for education. The source database consisted of the University of Pennsylvania Graduate School of Education (2024), Moravian University (n.d.). The following sources were also used: Lee Kuan Yew School of Public Policy. (n.d.), WIRED (2019) and Sentry Magazine (2026). The documents were selected according to the criteria of relevance and representativeness of leading international practices in the introduction of artificial intelligence in education, and their focus on the development of managerial, analytical, and digital competencies in future educational managers.

Within the framework of the study, the method of comparative analysis was applied to carry out a systematic study of digital technologies and artificial intelligence services used in the professional training of education managers. Comparisons were made between leading generative and analytical AI platforms, in particular ChatGPT (n.d.), Microsoft Copilot (n.d.), and Google Gemini (n.d.). Claude (n.d.) (Anthropic), Notion AI (n.d.), and GrammarlyGO (n.d.) were also considered. Canva AI (n.d.) and the integrated educational solution Microsoft 365 Copilot for Education (n.d.). The choice of these services is conditioned by their wide application in educational management, functional diversity, and ability to support managerial, analytical, and communication processes in educational institutions. The comparative analysis was carried out according to the following criteria: functional multifunctionality, pedagogical, and managerial potential, integration capabilities, user-friendliness of the interface, the level of automation of data analytics, language and cultural adaptability, data security, and compliance with ethical standards for the use of artificial intelligence, and accessibility and scalability for educational organisations.

The experimental study was conducted during September 2025 – May 2026 at the higher educational institutions of Ukraine that train managers in the field of education: National Pedagogical University named after M.P. Drahomanov (n.d.), Ternopil National Pedagogical University named after V. Hnatyuk (n.d.). Khmelnytskyi Humanitarian and Pedagogical Academy (n.d.) and Hryhoriy Skovoroda University in Pereyaslav (n.d.) were also selected. The experimental and control groups were formed by randomly assigning 120 students pursuing a second (Master's) level of higher education (30 from each university) to two samples of equal size and initial level of preparation: the experimental group, in which the developed didactic model was implemented, and a control group, where teaching was carried out using conventional methods. The participants were aged between 21 and 28. Among the participants were 82 women and 38 men. The inclusion criteria were training in the educational programme; consent to participate in the study; systematic attendance of classes; availability of access to the Internet and digital devices. The exclusion criteria were missing more than 20% of classes; refusal to participate at any stage of the study; and incomplete completion of diagnostic tasks. Participants were divided into a control group (CG, n = 60) and an experimental group (EG, n = 60). The control group followed the conventional professional training programme for education managers, which involved studying academic subjects within the framework of the approved curricula without the systematic use of artificial intelligence services.

The educational process was based mainly on the lecture and seminar form of training, performing standard practical tasks, working with textbooks and methodological materials, and conventional forms of knowledge control, such as tests, assessments, and exams. Educational work with applicants of the experimental group was carried out in a format with a combination of classroom classes, independent work, project activities, and performing professionally oriented tasks using artificial intelligence services. Training was conducted in a blended format using the Moodle platform and the Google Classroom service. All participants were informed about the purpose of the study and gave voluntary informed consent to participate (American Sociological Association, 2018). The study was conducted in accordance with the principles of academic integrity, confidentiality, and voluntary participation. A set of 15 practical tasks was used to assess the development of professional competence of education managers:

1. Analyse the activities of the educational institution and identify the main management problems.
2. Prepare a strategic plan for the development of the educational institution for three years.
3. Develop a draft order on the introduction of educational innovation.
4. Create an analytical report based on the results of monitoring the quality of education.
5. Develop a plan for an internal system for ensuring the quality of education.
6. Prepare an information sheet for the teaching staff on the implementation of changes.
7. Conduct a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) of the educational institution's activities.
8. Develop a professional development plan for teachers.
9. Prepare a draft decision of the pedagogical council on the proposed situation.
10. Develop an algorithm for responding to a crisis management situation.

11. Prepare a draft budget for the educational project.

12. Create a digital transformation plan for an educational institution.

13. Develop a system of indicators for evaluating the performance of an educational institution.

14. Prepare a presentation of the results of management research.

15. Develop a set of measures to improve the competitiveness of an educational institution.

Tasks were performed by students before and after the experiment. The tasks were evaluated by 7 experts aged 35 to 58 years (M = 46.2; SD = 7.1), including 4 women and 3 men. The professional experience of experts ranged from 10 to 28 years. The criteria for the inclusion of experts were a Candidate of Sciences or Doctor of Sciences degree; at least 10 years' experience in the field of education management; and experience of teaching at a higher education institution. The exclusion criteria were lack of managerial experience or participation in the training of applicants. Experts evaluated each task on a five-point scale (from 1 to 5 points). Statistical processing of the results was carried out using the SPSS Statistics package (IBM SPSS Statistics, n.d.). The arithmetic mean (M), standard deviation (SD), and Student's t-test for independent samples were used to analyse the data. Differences at the level $p < 0.05$ were considered statistically significant. Based on the conducted research, a modelling method was applied, which allowed developing a system of educational and professional scenarios for training future education managers with the integration of artificial intelligence technologies. A limitation of the study is that it was conducted at higher education institutions in Ukraine and involved only a sample of Master's degree candidates specialising in "Educational Management", which may limit the generalisability of the results to other levels of education, other specialists, and broader international educational contexts.

Results

The use of artificial intelligence technologies and services in the professional training of managers in the field of education is considered as a systematic process of integrating digital tools into the content, methods, and organisational forms of training, aimed at forming analytical, managerial, and innovative competence among future managers of educational institutions. Artificial intelligence in this context performs the function of a decision support tool that provides processing of large amounts of educational data, modelling management situations, forecasting the results of the educational process, and optimising organisational strategies for the development of educational institutions (Bankins *et al*., 2024).

International experience shows the gradual introduction of artificial intelligence technologies in the professional training of future education managers through specialised programmes for the development of educational leadership and digital management. One of the most developed examples is the United States, where the University of Pennsylvania Graduate School of Education implements the Pioneering AI in School Systems (PASS) programme, aimed at school principals and educational administrators. As part of the programme, students learn to use generative artificial intelligence to analyse educational data, predict learning outcomes, develop management strategies, and form policies for using AI in educational institutions (University of Pennsylvania Graduate School of Education, 2024). Additionally, Moravian University has an AI Leadership Lab, where future educational leaders master the practical use of ChatGPT and other AI services for preparing reports, strategic planning, analysing the effectiveness of educational programmes, and supporting management decision-making processes (Moravian University, n.d.). In Singapore, managers are trained to work in a digital transformation environment through the Leading an AI-Powered Future programme developed by the Lee Kuan Yew School of Public Policy. Training involves analysing real-world management cases, using artificial intelligence tools to assess risks, processing large amounts of data, and developing organisational development strategies. Considerable attention was paid to the development of data-based decision-making skills, innovation management, and ethical aspects of using AI in educational institutions. This approach is aimed at training managers who are able to work effectively in the face of rapid technological change (Lee Kuan Yew School of Public Policy, n.d.).

In Finland, an example of the development of AI competencies is the international educational initiative Elements of AI, created by the University of Helsinki and Reaktor (WIRED, 2019). Although the programme is aimed at a wide audience, it is actively used for training management personnel and educational workers. The course covers the basics of artificial intelligence, the principles of algorithms, ethics, data analysis, and decision-making. For future education managers, it is particularly valuable to develop the ability to assess the opportunities and risks of using AI, organise digital transformation of the educational environment, and implement management based on analytical data. In South Korea, the development of competencies in the field of artificial intelligence is supported through the activities of specialised leadership training centres, in particular, the AI Leadership Centre. The training is aimed at developing skills in managing organisational change, using decision support systems, and implementing AI technologies in the activities of institutions. Participants work with practical cases related to digital transformation of organisations, data analysis, performance forecasting, and development strategies (Sentry

Magazine, 2026). This approach allows future managers to master artificial intelligence tools not only as users of technologies, but also as managers responsible for their effective and safe implementation in the educational environment.

The international experience of implementing artificial intelligence technologies in the professional training of educational managers indicates the transition to a new paradigm of management education based on the data-driven approach, digital analytics, and the use of generative AI tools to support decision-making. In the leading countries (USA, Singapore, Finland, South Korea), the training of heads of educational institutions focuses on the development of practical competencies in the field of educational data analysis, strategic planning, change management, and digital transformation of educational organisations. Common characteristics of certain programmes are the use of real management cases, the integration of AI services into educational tasks, the emphasis on the ethical use of technologies, and the development of decision-making abilities in conditions of digital uncertainty. The use of artificial intelligence is considered not as a separate technological skill, but as a tool for improving the efficiency of management activities, providing analytical support, forecasting educational results, and optimising organisational processes. The results obtained confirm the expediency of integrating AI-oriented scenarios into the system of professional training of future education managers and the need to develop a comprehensive digital, analytical, and innovative competence as a key condition for the effective functioning of contemporary educational systems.

Artificial intelligence technologies in education are considered in scientific sources as tools for expanding managerial, analytical, and cognitive capabilities of a person, providing automation of data processing, decision support, and improving the efficiency of organisational management. The study by F. Miao *et al*. (2021) highlighted that AI in education contributes to the transition to data-driven approaches in managing and personalising educational processes, while requiring compliance with ethical principles and transparency in the use of algorithms. In particular, the OECD (Organisation for Economic Co-operation and Development) (n.d.) report on digital transformation of Education noted that the use of AI and Big Data Analytics allows educational managers to improve the quality of decision-making, predict learning outcomes, and optimise management processes in educational organisations. Table 1 provides a comparative analysis of digital platforms and artificial intelligence services used in the professional training of education managers by key functional, pedagogical, integration, and analytical characteristics.

Table 1. *Comparative analysis of digital platforms and artificial intelligence services used in the professional training of education managers*

AI platform/ service	Functional versatility	Pedagogical and managerial potential	Integration capabilities	Convenience of the interface	Data analytics and automation	Language/ cultural adaptability	Safety and ethical standards	Availability and scalability
ChatGPT (OpenAI)	Text generation, information analysis, solution support, content creation	Management decision support, strategic planning, scenario modelling	API-integration with external systems, use in LMS via third-party services	Intuitive interaction through the dialogue interface	Processing of text data, generalisation of information, development of analytical conclusions	Support for multilingualism, adaptation to different educational contexts	Content security policies, filtering of sensitive data	Use via the web and API, scaling depending on needs
Microsoft Copilot	Document generation, automation of office processes, working with spreadsheets and presentations	Support for management reporting, analysis of educational data, activity planning	Deep integration with Microsoft 365, Teams, Power BI	Interface within office applications	Automated data analysis in Excel, generating reports and dashboards	Support for the Microsoft multilingual environment	Corporate data protection standards, access control	Use in educational and corporate environments
Google Gemini	Text generation, data analysis, search support	Analysisof educational processes, preparation of management materials	Integration with Google Workspace, Classroom	Work through the web interface and Google services	Processing of structured and unstructured data	Support for multilingualism and global educational contexts	Google security policies, user data control	Use in Google's educational ecosystems
Claude (Anthropic)	Text generation, analytical generalisation, working with large documents	Support of analytical thinking, preparation of management documents	API integration with individual services	Simple text interface	Analysis of text arrays, information structuring	Support for multilingualism with an emphasis on the English-language context	Increased ethical restrictions in content generation	Use via cloud services

Table 1. Continued

AI platform/ service	Functional versatility	Pedagogical and managerial potential	Integration capabilities	Convenience of the interface	Data analytics and automation	Language/ cultural adaptability	Safety and ethical standards	Availability and scalability
Notion AI	Creation and organisation of texts, knowledge management, and planning	Support for the organisation of educational management, documentation of processes	Integration with workspaces and external services	Work in a single work environment	Information structuring, basic content analytics	Support for multilingual content	Standard privacy policies	Use in team and individual projects
Grammarly GO	Text editing, generation of communication materials	Support of professional communication in education management	Integration with browsers and office applications	Built-in hints in text editors	Analysis of speech errors, improvement of text structure	Adapting to English and multilingual writing	Personal data protection policies	Widespread use in digital commun-ication
Canva AI	Creation of visual content, presentations, and infographics	Support for visualisation of management and educational data	Integration with LMS, social platforms	Visual drag-and-drop interface	Visual representation of data, infographics	Support for multilingual content	Content security policies	Mass use in education
Microsoft 365 Copilot for Education	Document automation, analytics, and creation of training materials	Support for the management of educational institutions, data analysis, planning	Full integration with the Microsoft Education ecosystem	Interface in a familiar office environment	Educational data analytics, reporting automation	Support for multilingual educational environments	Educational standards of security and adminis-tration	Use in large-scale educational systems

Note: *API – Application Programming Interface*
Source: *compiled by the author based on the analysis of ChatGPT (n.d.), Microsoft Copilot (n.d.), Google Gemini (n.d.), Claude (n.d.), Notion AI (n.d.), GrammarlyGO (n.d.), Canva AI (n.d.), Microsoft 365 Copilot for Education (n.d.)*

A comparative analysis has shown that the AI platforms under consideration form a comprehensive digital ecosystem for the professional training of education managers, within which not only is technological support provided for the educational process, but also a profound transformation of the managerial mindset and professional behaviour of future leaders takes place. The author's interpretation of the results indicates that generative models contribute to the transition from reproductive assimilation of managerial knowledge to their analytical and predictive application, ensuring the development of a strategic vision, the ability to model managerial decisions, and critical work with educational data. Simultaneously, integrated digital solutions contribute to streamlining management processes, increasing their transparency and efficiency, which leads to a transition to a more structured, data-driven approach in educational management.

Communication and organisational tools strengthen coordination, efficiency of decision-making and quality of professional interaction, forming a new culture of digital leadership in education. In general, the use of these technologies in the professional training of future education managers ensures the development of integrated digital, analytical, and innovative competence necessary for effective management of educational organisations in the context of digital transformation. A pedagogical experiment was conducted to test the effectiveness of the system using artificial intelligence technologies and services. At the beginning and after the completion of the formative stage, an assessment of the development of professional competence of future education managers in a set of practical tasks was carried out. The obtained results of the control and experimental groups determined the dynamics of changes in the studied indicators and evaluated the effectiveness of the proposed training system. The results of the experiment are presented in Table 2.

Table 2. *Results of expert assessment of the development of professional competence of future education managers*

Tasks	CG before	M ± SD	CG after	M ± SD	EG before	M ± SD	EG after	M ± SD
1. Analyse the activities of the educational institution and identify the main management problems	1-12%, 2-26%, 3-34%, 4-20%, 5-8%	2.86 ± 1.05	1-6%, 2-18%, 3-36%, 4-28%, 5-12%	3.22 ± 1.01	1-10%, 2-28%, 3-33%, 4-21%, 5-8%	2.89 ± 1.04	1-2%, 2-8%, 3-20%, 4-38%, 5-32%	3.90 ± 0.92
2. Prepare a strategic plan for the development of the educational institution for three years	1-14%, 2-24%, 3-32%, 4-20%, 5-10%	2.88 ± 1.09	1-8%, 2-18%, 3-34%, 4-28%, 5-12%	3.18 ± 1.03	1-12%, 2-27%, 3-31%, 4-20%, 5-10%	2.90 ± 1.06	1-3%, 2-10%, 3-22%, 4-40%, 5-25%	3.74 ± 0.95

Table 2. Continued

Tasks	CG before	M ± SD	CG after	M ± SD	EG before	M ± SD	EG after	M ± SD
3. Develop a draft order on the introduction of educational innovation	1-11%, 2-25%, 3-35%, 4-20%, 5-9%	2.90 ± 1.02	1-7%, 2-17%, 3-36%, 4-29%, 5-11%	3.20 ± 1.00	1-13%, 2-26%, 3-32%, 4-20%, 5-9%	2.87 ± 1.05	1-2%, 2-9%, 3-18%, 4-41%, 5-30%	3.88 ± 0.91
4. Create an analytical report based on the results of monitoring the quality of education	1-15%, 2-23%, 3-33%, 4-20%, 5-9%	2.83 ± 1.07	1-8%, 2-19%, 3-34%, 4-27%, 5-12%	3.17 ± 1.02	1-12%, 2-28%, 3-30%, 4-21%, 5-9%	2.86 ± 1.05	1-3%, 2-8%, 3-19%, 4-39%, 5-31%	3.85 ± 0.93
5. Develop a plan for the internal quality assurance system of education	1-13%, 2-24%, 3-34%, 4-21%, 5-8%	2.85 ± 1.06	1-7%, 2-18%, 3-35%, 4-28%, 5-12%	3.19 ± 1.02	1-11%, 2-27%, 3-33%, 4-20%, 5-9%	2.88 ± 1.04	1-2%, 2-7%, 3-17%, 4-42%, 5-32%	3.92 ± 0.90
6. Prepare an information letter for the teaching staff on the implementation of changes	1-12%, 2-25%, 3-33%, 4-20%, 5-10%	2.88 ± 1.06	1-6%, 2-18%, 3-34%, 4-28%, 5-14%	3.25 ± 1.00	1-11%, 2-26%, 3-32%, 4-21%, 5-10%	2.90 ± 1.04	1-2%, 2-7%, 3-18%, 4-40%, 5-33%	3.92 ± 0.90
7. Conduct a SWOT analysis of the educational institution's activities	1-14%, 2-24%, 3-32%, 4-20%, 5-10%	2.86 ± 1.08	1-8%, 2-18%, 3-34%, 4-28%, 5-12%	3.20 ± 1.02	1-12%, 2-27%, 3-31%, 4-20%, 5-10%	2.89 ± 1.05	1-3%, 2-9%, 3-20%, 4-40%, 5-28%	3.76 ± 0.94
8. Develop a professional development plan for teachers	1-13%, 2-26%, 3-33%, 4-20%, 5-8%	2.83 ± 1.07	1-7%, 2-19%, 3-34%, 4-28%, 5-12%	3.18 ± 1.03	1-11%, 2-28%, 3-32%, 4-20%, 5-9%	2.87 ± 1.05	1-2%, 2-8%, 3-18%, 4-42%, 5-30%	3.88 ± 0.91
9. Prepare a draft decision of the pedagogical council	1-15%, 2-23%, 3-33%, 4-20%, 5-9%	2.82 ± 1.09	1-8%, 2-18%, 3-34%, 4-28%, 5-12%	3.16 ± 1.03	1-13%, 2-26%, 3-31%, 4-20%, 5-10%	2.88 ± 1.06	1-3%, 2-9%, 3-19%, 4-39%, 5-30%	3.85 ± 0.93
10. Develop an algorithm for responding to a crisis management situation	1-14%, 2-25%, 3-32%, 4-20%, 5-9%	2.84 ± 1.08	1-7%, 2-18%, 3-34%, 4-28%, 5-13%	3.21 ± 1.02	1-12%, 2-27%, 3-31%, 4-20%, 5-10%	2.90 ± 1.05	1-2%, 2-8%, 3-17%, 4-41%, 5-32%	3.90 ± 0.90
11. Prepare a draft budget for the educational project	1-15%, 2-24%, 3-32%, 4-20%, 5-9%	2.81 ± 1.09	1-8%, 2-18%, 3-33%, 4-28%, 5-13%	3.18 ± 1.03	1-13%, 2-26%, 3-31%, 4-20%, 5-10%	2.87 ± 1.06	1-3%, 2-8%, 3-18%, 4-41%, 5-30%	3.86 ± 0.92
12. Create a digital transformation plan for an educational institution	1-14%, 2-25%, 3-33%, 4-20%, 5-8%	2.83 ± 1.08	1-7%, 2-19%, 3-34%, 4-28%, 5-12%	3.19 ± 1.02	1-12%, 2-27%, 3-31%, 4-20%, 5-10%	2.89 ± 1.05	1-2%, 2-7%, 3-17%, 4-42%, 5-32%	3.93 ± 0.90
13. Develop a system of performance evaluation indicators	1-13%, 2-26%, 3-33%, 4-20%, 5-8%	2.82 ± 1.07	1-7%, 2-18%, 3-35%, 4-28%, 5-12%	3.20 ± 1.02	1-11%, 2-28%, 3-32%, 4-20%, 5-9%	2.88 ± 1.05	1-2%, 2-8%, 3-18%, 4-41%, 5-31%	3.89 ± 0.91
14. Prepare a presentation of the research results	1-12%, 2-24%, 3-34%, 4-20%, 5-10%	2.86 ± 1.06	1-6%, 2-17%, 3-35%, 4-29%, 5-13%	3.23 ± 1.01	1-10%, 2-27%, 3-33%, 4-21%, 5-9%	2.91 ± 1.04	1-2%, 2-7%, 3-16%, 4-43%, 5-32%	3.94 ± 0.89
15. Set of measures for competitiveness	1-15%, 2-23%, 3-33%, 4-20%, 5-9%	2.80 ± 1.10	1-8%, 2-18%, 3-34%, 4-28%, 5-12%	3.17 ± 1.03	1-13%, 2-26%, 3-31%, 4-20%, 5-10%	2.86 ± 1.06	1-3%, 2-8%, 3-17%, 4-42%, 5-30%	3.88 ± 0.92

Source: *compiled by the author based on the conducted research*

The results of the pedagogical experiment showed the positive dynamics of the development of professional competence of future education managers in both groups, but the intensity of changes significantly differed,

which is conditioned by the different level of integration of technological and activity components of training. In the control group, a slight increase in indicators (from M ≈ 2.8-2.9 to M ≈ 3.1-3.2) is explained by the predominance of conventional teaching methods focused on reproductive assimilation of managerial knowledge without systematically involving students in data analysis, modelling of managerial situations, and digital decision support.

In the experimental group, a significant increase in results to the level of M ≈ 3.8-3.9 is conditioned by the complex action of the proposed training system, the key components of which were practice-oriented training, work with real management cases, analysis of educational data, development of digital literacy, and regular performance of tasks that model the activities of the head of an educational institution in the context of digital transformation. The greatest influence on the results obtained was precisely the analytical and practical component (working with data and management situations), the reflexive and evaluation component (analysing their own management decisions and errors), and the technological and instrumental component (using digital tools to support decision-making), which ensured the transition from theoretical assimilation of the material to its applied use. Statistical analysis using the Student's t-test for independent samples confirmed the reliability of differences between the indicators of the control and experimental groups after the formative stage ($t = 4.2$-5.6; $p < 0.05$), which indicates a statistically significant effect of the implemented system and its impact on the development of managerial and digital competencies.

Educational and professional scenarios ensure the development of comprehensive digital, analytical, and managerial competence of future education managers, contribute to the development of the ability to make informed decisions based on data, effective use of artificial intelligence technologies in the strategic and operational management of educational institutions, and increase readiness for innovation and digital transformation of educational systems. Table 3 presents a generalised system of educational and professional scenarios for training future education managers with the integration of artificial intelligence technologies, developed based on international experience in the USA, Singapore, Finland, and South Korea.

Table 3. *Educational and professional scenarios for training future education managers with the integration of artificial intelligence technologies (based on international experience)*

Preparation scenario	International practice / international example	AI platforms and tools	Content of educational and professional activities	Developed competencies
Analysis of educational data and forecasting of results	University of Pennsylvania Graduate School of Education (PASS, USA)	ChatGPT (OpenAI), Microsoft Copilot, Google Gemini	Analysis of large amounts of educational data, forecasting of educational results, modelling of management decisions	Analytical competence, data-driven thinking, management forecasting
Strategic management and decision-making	Moravian University AI Leadership Lab (USA)	ChatGPT, Claude (Anthropic), Microsoft 365 Copilot	Preparation of strategic plans for the development of an educational institution, creation of management reports, decision support	Strategic thinking, managerial competence, digital leadership
Digital transformation of educational systems	Leading an AI-Powered Future (Singapore)	Microsoft Copilot, Google Gemini, ChatGPT	Modelling of digital educational policies, risk assessment, innovation change management	Innovative competence, system management, digital transformational capacity
AI-literacy and critical thinking in education	Elements of AI (University of Helsinki, Finland)	ChatGPT, GrammarlyGO, Claude	Mastering the principles of AI, ethical analysis of the use of algorithms, risk and opportunity assessment	AI-literacy, critical thinking, ethical competence
Change management and educational innovation	AI Leadership Centre (South Korea)	Microsoft 365 Copilot for Education, Canva AI, Notion AI	Management of educational changes, development of innovative solutions, support of organisational development	Innovation management, organisational competence, project thinking

Source: *compiled by the author based on the analysis of University of Pennsylvania Graduate School of Education (2024), Moravian University (n.d.), Lee Kuan Yew School of Public Policy (n.d.), WIRED (2019), Sentry Magazine (2026), ChatGPT (n.d.), Microsoft Copilot (n.d.), Google Gemini (n.d.), Claude (n.d.), Notion AI (n.d.), GrammarlyGO (n.d.), Canva AI (n.d.), Microsoft 365 Copilot for Education (n.d.)*

Ukraine could adapt the international scenarios outlined above for training future education managers by integrating AI-focused modules into professional development programmes for heads of educational institutions and into master's programmes in educational management. In particular, the educational data analytics scenario can be implemented using ChatGPT (n.d.) platforms, Microsoft Copilot (n.d.), and Google Gemini (n.d.) to train managers to work with large amounts of educational statistics, monitor the quality of education, and predict students' learning outcomes. This will allow switching to data-driven management of schools and universities, which is necessary in the context of digital transformation of the Ukrainian educational system. Scenarios of strategic management, digital transformation, and AI literacy can be implemented through the creation of national laboratories of educational leadership, similar to international models,

where future education managers will work with real cases, digital simulations. Adaptation of international scenarios for training education managers in Ukraine involves the integration of AI-oriented training modules into master's programmes and advanced training systems, which will contribute to the development of skills in educational data analytics, strategic planning, and quality management of education, and ensure the development of a contemporary model of data-driven educational management in the context of digital transformation. It is advisable to focus on the ethical use of artificial intelligence, the development of critical thinking and change management in conditions of uncertainty, which will ensure the development of a comprehensive digital, analytical and innovative competence of education leaders who can effectively implement AI solutions in Ukrainian educational institutions.

Discussion

Artificial intelligence technologies and services have taken a significant place in the professional training of managers in the field of education and contributed to the development of competencies necessary for management activities in a digital educational environment, improving the efficiency of information processing, supporting managerial decision-making, expanding opportunities for personalisation of training, and the development of strategic planning skills, providing a combination of theoretical knowledge with practical digital skills. The results obtained were consistent with the conclusions of F. Aslam (2023), who revealed the potential of intelligent chatbots to support learning activities and automate communication processes.

The identified effectiveness of using generative services in the training of education managers confirms their ability to provide quick access to information, advice, and support for the educational process, which is reflected in the high average indicators of the development of relevant competencies ($M \approx 3.8$-3.9). This indicates that the integration of such tools contributes to improving the quality of management training, developing digital and analytical skills, and making educational decisions quickly. The results coincided with the provisions of M. Bassey & E. Owushi (2023), who analysed the advantages and difficulties of implementing artificial intelligence in the library and information sphere. The established advantages of using intelligent systems in the professional training of education managers are accompanied by an awareness of the need to overcome organisational and technological barriers. The study showed that the use of artificial intelligence contributes to improving the quality of management training by optimising data analysis and decision-making processes. The results obtained were consistent with the reasoning of J. Berg *et al.* (2023), who proved that artificial intelligence creates new opportunities for generating value through more efficient use of information resources. The identified advantages of digital tools confirm their ability to support the activities of future heads of educational institutions.

Comparative analysis showed that generative AI models (ChatGPT, Google Gemini, Claude) provide analytical support and modelling of solutions, while integrated systems (Microsoft Copilot, Microsoft 365 Copilot for Education) automate management processes, and services (Notion AI, GrammarlyGO, Canva AI) contribute to the organisation and visualisation of educational data. Artificial intelligence services allow adapting the educational process to the individual needs of educational applicants, providing flexible trajectories of professional development. Such conclusions were consistent with the results of the study by Z. Chen (2022), who introduced the concept of a virtual trainer for personalised training. The obtained data confirm the effectiveness of individualisation of the educational process using intelligent technologies. Similar trends were observed in the study by M.R. Bilad *et al*. (2023), whp described the current areas of using artificial intelligence tools in education. The data confirmed that generative services, analytical platforms, and intelligent training support systems expand the opportunities for professional training of future education managers and contribute to improving the effectiveness of the educational process.

The established increase in the level of involvement of educational applicants and the improvement of educational outcomes was consistent with the conclusions of C. Davis *et al.* (2024). The study proved that adaptive mechanisms of artificial intelligence provide a personalised learning experience. The use of intelligent services contributes to greater motivation to master management disciplines and develop professional competencies. The study showed that the training of education managers requires the development of skills in working with digital data and understanding the principles of managing educational processes using intelligent technologies. Such results correlate with the results of F. Filgueiras (2023), who examined the impact of artificial intelligence on educational management. The identified need for the development of managerial competencies confirms the relevance of training specialists to work in the context of digital transformation of education. The results were consistent with the study by B. George & O. Wooden (2023), dedicated to the strategic transformation of higher education institutions using artificial intelligence. The established advantages of using intelligent technologies for management activities confirm their role as a tool for improving the effectiveness of strategic planning and organisational development.

International experience has shown that in the USA, Singapore, Finland, and South Korea, the training of education managers is based on the use of artificial intelligence for data analytics, strategic planning, and

support of management decisions, which forms a data-driven approach and digital readiness of educational leaders. Generative artificial intelligence has become an effective tool for creating educational materials, preparing analytical reports, and supporting educational communications. These conclusions were consistent with the results of M. Liu *et al.* (2023), who reached a scientific consensus on the prospects for using ChatGPT in the educational sphere. The data obtained confirmed the potential of generative models for improving educational activities and professional training.

The effectiveness of using artificial intelligence depends on the level of digital readiness of users. This conclusion was consistent with the results of D. Mah & N. Groß (2024), who examined teachers' self-assessment of the use of smart technologies and the need for professional development. The data obtained confirm the need for systematic improvement of digital competencies of all participants in the educational process. Future education managers need knowledge about implementing innovative technologies in the professional environment. Experimental results confirmed the effectiveness of AI-oriented training, since in the experimental group the indicators of professional competence increased from $M \approx 2.87\text{-}2.90$ to $M = 3.85\text{-}3.94$ ($SD \approx 0.89\text{-}0.93$), while in the control group the changes were less pronounced – from $M \approx 2.80\text{-}2.88$ to $M = 3.16\text{-}3.25$ ($SD \approx 1.00\text{-}1.03$), which showed the superiority of the innovative training model. Statistical analysis using the Student's t-test ($t = 4.2\text{-}5.6$; $p < 0.05$) confirmed the significance of the differences obtained between the groups, which indicates the influence of artificial intelligence technologies on the development of managerial and digital competencies. Similar conclusions were presented by J. Menzies *et al.* (2024), who described the opportunities and challenges of using artificial intelligence in international business.

The study found that the effective use of artificial intelligence requires compliance with ethical principles. It was established that the integration of artificial intelligence into the educational process contributes to the transition to the data-driven model of education management and improves the quality of training of future managers. The results obtained were consistent with conclusions of A. Mouta *et al.* (2023), who proposed a toolkit for the ethical implementation of artificial intelligence in education. The identified need to ensure transparency, responsibility and control over the use of digital systems confirms the relevance of the ethical dimension of training educational managers. Similar results were demonstrated by S. Narayanan *et al.* (2023), who examined the transformation of medical education under the influence of artificial intelligence.

The identified advantages of automation, personalisation, and data analysis coincide with the results of training education managers, which indicates the universality of the capabilities of intelligent technologies in various fields of professional education. Thus, the problem of ethical use of digital tools has become important. The results obtained were consistent with the study by A. Nguyen *et al.* (2022), who outlined ethical standards for the use of artificial intelligence in education. The identified need to ensure data confidentiality, the fairness of algorithms, and responsible use of information confirms the relevance of ethical training of future heads of educational institutions. The results also demonstrated the feasibility of forming specialised knowledge about the use of artificial intelligence in professional training. Such conclusions were consistent with the results of W. Park & H. Kwon (2023), who substantiated the need for systematic implementation of education in the field of artificial intelligence. The identified need for the development of digital literacy and algorithmic thinking confirms the prospects of relevant educational programmes.

It was proved that the use of AI technologies provides a comprehensive development of analytical, managerial, and innovative competence, since it allows combining the processing of large amounts of data with modelling of management situations and forecasting results. It was confirmed that educational and professional scenarios with AI integration are an effective tool for developing practical management skills and digital literacy. Such conclusions coincided with the results of M. Sposato (2024), who investigated the specifics of training leaders in the era of artificial intelligence. The established need to combine technological knowledge with strategic management skills confirmed the relevance of updating the content of professional training. The results obtained were consistent with the study by X. Yu *et al.* (2023), dedicated to the use of artificial intelligence in music education. The data obtained confirmed that, regardless of the educational field, intelligent technologies contribute to the personalisation of learning, support for creative activities and improve educational practices. It was established that a positive attitude to the use of artificial intelligence contributes to more effective implementation of digital innovations. This conclusion was consistent with the results of D. Uygun (2024), who examined the views of educators on the use of artificial intelligence in education. The data obtained confirmed that readiness for technological changes is becoming one of the factors for successful integration of intelligent services into professional activities. In particular, the area of analysis is the issue of responsible use of intelligent systems. The results were consistent with the conclusions of G. Uunona & L. Goosen (2023), who developed guidelines for compliance with ethical standards when using artificial intelligence in training.

The identified need for the development of digital responsibility and critical assessment of the results of algorithms confirms the need to include such components in training programmes for education managers.

The results obtained confirm the effectiveness of using artificial intelligence to support educational activities, create educational content, and improve professional competencies. Such conclusions were consistent with the findings of Y. Wang (2023), who demonstrated the capabilities of intelligent technologies when teaching translation. The identified advantages of automated information analysis and training support confirmed a wide range of artificial intelligence capabilities in educational practice. The results showed that the use of artificial intelligence in the training of future education managers contributes to the development of leadership and managerial competencies, improving the effectiveness of educational activities, supporting personalised learning and forming a positive attitude to digital innovations. Simultaneously, the need to integrate ethical principles and develop digital responsibility as mandatory components of professional training in the context of expanding the use of intellectual technologies was confirmed.

Conclusions

International experience has shown that the integration of artificial intelligence technologies into the professional training of education managers is developing as an integral system for developing educational leadership. In the United States, Singapore, Finland, and South Korea, training of education managers is based on the use of AI as a tool for data analytics, strategic planning, forecasting educational results, and modelling management decisions. The educational programmes of these countries are focused on the development of a data-driven approach, digital literacy, and the ability to manage change, which ensures the development of competent managers ready to function in the context of digital transformation of education. A comparative analysis of digital artificial intelligence services has shown their systemic role in training future education managers. Generative models, such as ChatGPT, Google Gemini, and Claude, provide support for analytical thinking, creating management texts, and modelling decisions. The integrated Microsoft Copilot and Microsoft 365 Copilot for Education platforms are aimed at automating management processes, processing educational data, and generating reports. Notion AI, GrammarlyGO, and Canva AI tools provide information organisation, communication support, and visualisation of management processes, which together forms a comprehensive digital ecosystem of educational management.

The results of the pedagogical experiment showed a statistically significant effectiveness of the implemented system. In the experimental group, the average indicators of professional competence development increased to the level of M = 3.85-3.94 (SD ≈ 0.89-0.93), while in the control group they remained lower than M = 3.16-3.25 (SD ≈ 1.00-1.03). The initial values in both groups were comparable (M ≈ 2.80-2.90). The highest results were recorded in terms of presentation of research results (M = 3.94), digital transformation (M = 3.93), and data analysis (M = 3.90), which indicates the leading role of communication-presentation, digital-transformation, and analytical components in the development of professional competence of future education managers. In comparison, strategic planning (M = 3.74) showed slightly lower values, which indicates a relatively slower development of long-term managerial thinking compared to practically oriented digital and analytical skills. Statistical verification confirmed the significance of differences between the groups ($t = 4.2\text{-}5.6$; $p < 0.05$), which indicates the effectiveness of using AI technologies in the development of managerial and digital competencies.

The proposed scenarios for the introduction of artificial intelligence in the professional training of education managers provided for the integration of AI-oriented scenarios into educational programmes, the development of practice-oriented learning, and the creation of digital educational environments. The main focus is on building analytical, managerial, and innovation competence through the use of AI for decision-making, forecasting, and change management. This ensures the transition to a contemporary model of data-driven education management and increases the effectiveness of training future heads of educational institutions. Prospects for further research lie in the development of adaptive models of AI-integrated learning considering educational contexts and levels of digital maturity of educational systems.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Застосування технологій і сервісів штучного інтелекту у професійній підготовці менеджерів у галузі освіти

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■ **Анотація.** Мета полягала в оцінюванні можливостей використання технологій штучного інтелекту в професійній підготовці майбутніх менеджерів. Методологія включала системно-структурний аналіз, порівняльний аналіз та експериментальне дослідження, метод моделювання навчально-професійних сценаріїв, яке було проведено на базі чотирьох закладів вищої освіти України із залученням 120 здобувачів другого (магістерського) рівня освіти. Результати підтвердили ефективність інтеграції технологій штучного інтелекту у професійну підготовку майбутніх менеджерів освіти. Міжнародний аналіз показав, що у Сполучених Штатах Америки, Сінгапурі, Фінляндії та Південній Кореї штучний інтелект використовується як інструмент аналітики освітніх даних, стратегічного планування та прийняття управлінських рішень, що забезпечує розвиток data-driven підходу в освітньому менеджменті. Порівняльний аналіз цифрових платформ засвідчив, що генеративні моделі сприяють аналітичній підтримці та моделюванню рішень, інтегровані системи автоматизують управлінські процеси, а сервіси забезпечують організацію, комунікацію та візуалізацію освітніх даних. Показано, що в експериментальній групі рівень професійної компетентності зріс із M ≈ 2,87-2,90 до M = 3,85-3,94 (SD ≈ 0,89-0,93), тоді як у контрольній групі підвищення було незначним і становило M ≈ 2,80-2,88 до M = 3,16-3,25 (SD ≈ 1,00-1,03). Найвище значення мав показник презентації результатів дослідження (M = 3,94), дещо нижчим є рівень цифрової трансформації (M = 3,93), що свідчить про високий розвиток комунікативно-цифрових умінь у респондентів. Показник стратегічного планування (M = 3,74) не належить до найвищих значень, що вказує на відносно слабшу сформованість довгострокового управлінського мислення порівняно з практико-орієнтованими цифровими компетентностями. Дані довели, що використання технологій штучного інтелекту підвищує рівень управлінської, аналітичної та цифрової компетентності майбутніх менеджерів освіти

■ **Ключові слова:** цифрові інструменти; аналітика даних; персоналізація навчання; навчально-професійні сценарії; етичні стандарти

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 101-110
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 22.10.2025 Revised: 27.03.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 374.7:37.013.2. DOI: 10.69587/pemtt/1.2026.101

Methodological foundation of pedagogical design in non-formal adult education

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■ **Abstract.** The relevance of the study was driven by the need to rethink traditional approaches to organising adult learning in the context of globalisation, digitalisation, and the growing demand for adaptive educational systems. The purpose of the article was to systematise and integrate the methodological foundation of designing the educational process in non-formal adult education through a combination of systemic, andragogical, competency-based, and activity-contextual approaches. Research methods encompassed a theoretical analysis of scientific sources, a comparison of methodological frameworks, and the synthesis and modelling of the logic of an andragogue's design activity. The article examined the theoretical substantiation of the methodological foundations of pedagogical design in non-formal adult education. The results obtained allowed for a clear differentiation of the objects and functions of general pedagogical methodology, the methodology of andragogy, and the methodology of pedagogical design. It was proven that the andragogical approach determines the subjective position of the adult learner, while the competency-based approach sets the logic for constructing the educational process according to the principle of "from expected results to content". The role of activity-based and contextual approaches in creating a reflective educational environment based on the professional and life experience of the adult learner was substantiated. Systemic-integrative logic was identified as a leading strategy ensuring the integrity, flexibility, and dynamic stability of educational projects. It was established that pedagogical design marks a paradigmatic shift from learning management to the creation of a managed educational environment for adult self-directed learning. The practical value of the study lay in defining specific methodological guidelines for andragogues engaged in pedagogical design within non-formal adult education. The developed conceptual framework can be used to improve the professional training of andragogues, develop their design competence, and create innovative educational products adapted to the changing demands of society

■ **Keywords:** andragogue; andragogical approach; systemic-integrative logic; methodology of education; professional development

■ Introduction

The modern development of non-formal adult education (NFAE) necessitates a radical rethinking of the methodological foundations for organising the educational process, primarily in terms of its scientifically grounded design. In a situation of dynamic changes in the educational needs of the adult population, pedagogical design transcends the boundaries of a purely technical planning procedure and transforms into a complex professional phenomenon requiring solid methodological support. The global challenges

Suggested Citation:
Radomski, I. (2025). Methodological foundation of pedagogical design in non-formal adult education. *Professional Education: Methodology, Theory and Technologies*, 12(1), 101-110. doi: 10.69587/pemtt/1.2026.101.

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associated with the COVID-19 pandemic during 2020-2022 and the mass transition to distance and hybrid learning formats clearly demonstrated the vulnerability of traditional pedagogical models and confirmed the urgent need for developing flexible, adaptive systems of interaction between learning subjects in the modern educational space.

The theoretical and methodological foundation of design in adult education was thoroughly covered in scientific discourse. The issues of non-formal education strategies were detailed by L. Lukianova (2025), the andragogical model of professional training of specialists was analysed by M. Dernova (2021), and the principles of didactic design and the systemicity of such processes became the object of study in the works of L. Lebedyk (2020). Within the study of the multidimensionality of the adult learner's experience as a central mechanism of learning, scholars S. Merriam & L. Baumgartner (2020) emphasised the priority of the individual's subjective position. The importance of rethinking classical andragogical foundations in the era of globalisation, which highlights differences in educational preferences depending on individual and cultural factors, was underlined by researchers K. Roessger *et al*. (2022). The issues of using the potential of non-formal education as a resource for social inclusion and intergenerational interaction were examined by M. Kicherova *et al*. (2022). In the studies by M. Bond *et al*. (2021), the importance of new models of digital interaction between learning participants was highlighted.

The findings of K. Pierścieniak (2024) are of particular importance in the context of NFAE conceptualisation, according to which non-formal education has ceased to be a "reserve" category and requires the development of a new descriptive language and theoretical clarification for its effective implementation in practice. Complementing this view, researcher H. Solarczyk-Swec (2024) noted that the development of technologies acts as a constant impetus for the development of non-formal learning, forcing people to adapt and master new tools. Thus, pedagogical design appears not merely as a plan of action, but as a conceptual comprehension of the goals and content of non-formal learning, taking into account the changing social context and the possibilities of the educational environment. However, despite the thoroughness of the aforementioned works, the problem of incorrect identification of related methodological frameworks remains relevant in the scientific space, which complicates the practical implementation of pedagogical design in NFAE. The purpose of the study was to theoretically substantiate and systematise the methodological foundation of pedagogical design in non-formal adult education through the integration of systemic, andragogical, competency-based, and activity-contextual approaches.

Literature Review

The theoretical comprehension of the methodological foundations of non-formal adult education requires an analysis of the essence of the category of methodology itself within the context of modern pedagogical science. Within the theory of professional education, methodology was traditionally viewed as a system of principles, approaches, and methods of scientific cognition and the practical transformation of pedagogical reality. The development of scientific views on this issue demonstrates a gradual deepening of the content of methodological support. Specifically, the researcher S. Nahorniak (2023) highlighted the role of methodological approaches in the formation of the professional identity of future specialists. The importance of a systemic combination of theoretical foundations with the practical implementation of educational programmes was emphasised in the works of scholars O. Dubaseniuk & N. Myronchuk (2025). Furthermore, a holistic vision of methodology as a tool for the transformation of the educational space was substantiated in the study by L. Rybalko (2025). However, in the context of NFAE, this system undergoes significant transformations, as the object of pedagogical influence is not a standardised educational process, but a flexible, open, and contextually determined educational practice. Under such conditions, it is appropriate to consider pedagogical design as a reflective activity aimed at the construction of adaptive educational systems, which requires a detailed analysis of its essential characteristics within non-formal learning.

As noted by L. Lebedyk (2020), design is present in all spheres of human activity, constitutes an essential component of one's life activity, and is a system-forming activity in human life activity. From this perspective, pedagogical design in non-formal adult education should be viewed as the result of a synthesis of the general scientific logic of the systemic approach, the didactic toolkit of general pedagogy, and the specific principles of andragogy as a concrete-scientific methodology. The researcher M. Sas (2013) determined that the main function of pedagogical design consisted in the creation of an andragogue's vision of the future educational process – the construction of a new, optimal product that did not yet exist. Unlike planning, which was viewed primarily as an executive process, in the works of I. Ziaziun (2008), design emerged as a reflective-analytical activity that combined prognostic, constructive, and organisational components.

In such a context, pedagogical design cannot rely on a single methodological tradition. Its complex, multidimensional nature necessitates turning to various methodological frameworks, each of which highlights specific aspects of design activity. At the same time, their incorrect identification is often observed in scientific discourse, which complicates both theoretical analysis and the practical implementation of pedagogical design

in NFAE. In this regard, it is appropriate to clearly differentiate between general pedagogical methodology, the methodology of andragogy, and the methodology of pedagogical design. General pedagogical methodology, as noted by S. Sysoieva & T. Krystopchuk (2013), traditionally focuses on the theoretical foundations of designing didactic systems and is aimed at ensuring the stability, reproducibility, and efficiency of the educational process. The object of its focus is the didactic process and pedagogical interaction in general. General pedagogical methodology, particularly through the systemic approach, puts forward a requirement for the integrity and logical consistency of the elements of the educational system.

The methodology of andragogy, based on the classical works of M. Knowles (1980) and the conceptual approaches to adult education in Ukraine by L. Lukianova (2020; 2025), fundamentally changes the object: it is the adult as a subject of learning, their experience, motivation, and self-directedness. Within the theory developed by D. Kolb (1984), it was determined that the methodology of andragogy indicated what and how had to be changed to correspond to the individual educational trajectories of the adult, which were grounded in prior experience. Its key function is the substantiation of principles, content, and forms of work that correspond to the specifics of the adult. The methodology of pedagogical design performs an integrative, overarching function concerning general pedagogical methodology and the methodology of andragogy. The studies by J. Dietrych *et al*. (1974) and N. Seel *et al*. (2017) substantiated that its object is not the process or the subject, but the Project as a holistic, optimal system of the future educational process. In general, the methodology of pedagogical design substantiates the logic, procedures, and criteria for creating a new educational product, integrating the requirements of the methodology of andragogy into the systemic form of general pedagogical methodology.

The comparative analysis of these methodological frameworks demonstrates that none of them alone is sufficient for a full substantiation of pedagogical design in non-formal adult education. Specifically, general pedagogical methodology provides structural logic and ensures the stability of the educational process by focusing on didactic interaction. The methodology of andragogy provides a humanistic and subjective orientation, focusing on the adult as a subject of learning with their experience and self-directedness. Meanwhile, the methodology of pedagogical design integrates these dimensions into a holistic model, where the Project as an optimal system of the future educational process emerges as the primary object.

In view of this, in the actual design activity of an andragogue, the integration of various methodological approaches occurs not declaratively, but through the logic of sequential professional actions. Thus, at the stage of analysing the educational needs of adults and the social context, the systemic approach is actualised. The studies by A. Kolomiiets & N. Lazarenko (2016) substantiate that this approach allows for viewing the educational process as a holistic, open system with interconnected elements and external influences. The subsequent definition of learning goals and content relies on the andragogical approach. As M. Knowles (1980) and L. Lukianova (2025) note, this approach orients design decisions towards the subjectivity of the adult, their prior experience, motivation, and the need for the practical significance of learning. In the process of constructing the educational process and forming programme learning outcomes, the competency-based approach acquires key importance, ensuring the project's focus on the formation of professionally significant results capable of practical application in the activities of adult learners.

The final stages of design, associated with assessing the feasibility, efficiency, and effectiveness of educational decisions, actualise the praxeological approach. The scientific works of I. Ziaziun (2008) and M. Skrypnyk (2011) substantiate that this approach orients the andragogue towards the optimisation of the educational process, the rational use of resources, and the reflective adjustment of design decisions. Collectively, these approaches form a methodological synergism that is adequate to the complexity and dynamics of non-formal adult education. Finally, it should be emphasised that the methodology of pedagogical design marks a paradigmatic shift – whereas traditional pedagogy focuses on the methodology of learning management (control of the knowledge transfer process), andragogy and design require a methodology for creating an educational system (the creation of a managed environment for self-directed learning). An andragogue must be prepared not only to "know how to teach", but to "know how to create a system" in which an adult can learn effectively, utilising their own experience and resources.

Materials and Methods

The methodology of the conducted theoretical research was based on the comprehensive use of general scientific and special methods, which ensured the integrity of the analysis of pedagogical design in non-formal adult education. In accordance with the requirements of the logic of scientific search, the study was organised in the form of sequential stages – from the systematic collection and critical analysis of the source base to the synthesis of conceptual provisions. At the first stage, methods of terminological analysis and definition were applied, which made it possible to clarify the essence of the basic categories, in particular, "pedagogical design", "methodology of andragogy", and "reflective activity" in the context of non-formal adult education. Particular attention was paid to the differentiation between the

concepts of "planning" and "design", which allowed for the interpretation of the latter as a holistic intellectual activity aimed at creating a forward-looking model of the educational process.

The second stage involved the use of comparative-pedagogical analysis to differentiate the objects, functions, and tools of three key methodological frameworks: general pedagogical, andragogical, and design-based. The comparison was carried out according to defined criteria, namely: target orientation (from the transmission of knowledge to the transformation of experience), the position of the subjects of the educational process (from the object of influence to an active co-designer), and expected results. This allowed for identifying areas of intersection and establishing differences that manifest in the process of designing educational programmes for adults. The third stage was based on the application of the systemic approach as a leading tool for modelling the educational process. Within this approach, non-formal adult education was considered as an open, adaptive system in which goals, content, methods, and results exist in a state of dynamic equilibrium and interaction with the external environment. This made it possible to treat the educational project not as a static document, but as a flexible algorithm of professional interaction. The final stage of the research encompassed methods of theoretical synthesis and generalisation, within which the provisions of the andragogical (orientation towards experience), competency-based (orientation towards results), and activity-contextual (orientation towards the situational nature of learning) approaches were integrated into a holistic system of design solutions. This allowed for the formulation of a conceptual framework for an andragogue's activity, adequate to the modern challenges of a digital and globalised society.

The research materials included regulatory acts in the field of adult education, European Union conceptual documents on micro-credentials and skills development, and scientific works published in 2015-2025. Classical works on andragogy, pedagogical design, experiential learning, and systems theory were also included to substantiate the theoretical framework (Knowles, 1980; Merriam & Caffarella, 1999; Jarvis, 2004). The search for relevant sources was conducted in the Google Scholar, Scopus, and Web of Science scientometric databases. The selection criteria were: relevance (priority was given to publications from the last five years), authority (indexed journals and monographs), alignment with the research topic, and scientific novelty. The search was performed using keywords and their combinations: "pedagogical design", "methodology of andragogy", "non-formal education", and "integrated approach" (with corresponding English equivalents). An important methodological caveat is that the study is theoretical in nature and does not involve the collection and analysis of empirical data. At the same time, the proposed sequence of analytical procedures ensures an appropriate level of reproducibility of the results. The developed systemic-integrative logic can be used by other researchers for constructing educational models in various segments of professional and adult education.

Results and Discussion

Integration of the andragogical approach into the pedagogical design of non-formal adult education

Pedagogical design in non-formal adult education (NFAE) cannot be adequately comprehended outside the methodology of andragogy, as it is precisely this methodology that defines the specifics of the adult as a subject of learning and a co-creator of the educational process. Unlike formal education, where design often relies on standardised goals, normatively defined content, and pre-set results, in non-formal adult education, the educational process emerges as open, contextually conditioned, and largely individualised. In this sense, the andragogical approach serves as the basic methodological foundation for pedagogical design, determining its value orientations, logic, and tools (Table 1).

Table 1. *Comparative analysis of methodological frameworks in non-formal adult education*

Criterion	General Pedagogical Methodology	Methodology of Andragogy	Methodology of Pedagogical Design
Object of focus	Didactic process and pedagogical interaction	Adult as a subject of learning	Project as a holistic model of the future educational process
Target orientation	Transmission of knowledge; stability and reproducibility of the educational process	Transformation of experience; alignment with individual educational trajectories	Integration of goals, content, and outcomes into an optimal educational system
Position of subjects	Learner as object of pedagogical influence	Learner as active, self-directed subject	Learner and andragogue as co-designers of the educational process
Expected results	Mastery of standardised content	Development of self-directedness, reflection, and practical application of experience	A flexible, adaptive educational project aligned with real needs of adult learners
Key function	Ensuring structural logic and didactic stability	Humanistic and subjective orientation of the design process	Integrative: synthesises general pedagogical and andragogical dimensions into a coherent design model

Source: *compiled by the authors*

A key starting point here is the understanding of the adult as an autonomous, self-directed subject of learning and a bearer of unique experience. In the works of M. Knowles (1980), the adult is defined as possessing a formed identity and a need to realise the practical value of learning. These ideas find a logical continuation in the research of D. Kolb (1984), where experience is considered the central mechanism of learning. The interpretation of these provisions allows one to assert that experience in design is not merely a prerequisite but an active semantic construct. The study of scientific works has evidenced the absence of a single definition of the andragogical approach. Specifically, V. Kremen & Yu. Kovbasiuk (2014) defines it as a category of scientific methodology for solving theoretical and practical problems. At the same time, the position was shared of L. Lukianova (2020; 2025) and M. Dernova (2021), who deepened these provisions through an emphasis on the social conditioning of educational needs and personal development. In such logic, the adult appears not only as a consumer of a service but as an active participant in the design process.

M. Dernova (2021) considered the andragogical approach as a methodological category based on the characteristics of the adult person, their needs and values, and involves taking into account the specifics of the purposeful process of stimulation, upbringing, learning, and improvement of the adult during professional training. However, it is worth supplementing that the subjective position of the adult in NFAE necessitates a move away from targeting the "average learner" in favour of a multiplicity of educational trajectories. The andragogical approach in pedagogical design is implemented through specific decisions regarding the goals, content, and forms of learning. At the level of goals, this involves their alignment with the actual motivation of learners, where design decisions are formed "from the subject". For instance, an andragogue designing a short-term professional development course for nurses begins not with a curriculum outline, but with an analysis of actual workplace challenges participants face – medication errors, communication with patients, or documentation overload. Based on this needs assessment, learning goals are co-constructed with participants, ensuring that the content directly addresses their professional reality rather than abstract disciplinary knowledge.

Regarding the content, L. Lukianova (2020) rightly noted that it should be constructed as a constantly updated "open system". This correlates with the views of M. Livingston & D. Cummings-Clay (2023), who emphasises the advantage of interactive and problem-oriented forms that allow for the integration of new knowledge with experience. It can be argued that it is precisely such an approach that transforms design from the transmission of knowledge into the creation of conditions for professional interaction. Moreover, the learning outcomes, as asserted by P. Jarvis (2004) and O. Ohiienko (2015), included not only the sum of knowledge but also the development of the capacity for self-directed learning and reflection. The application of the andragogical approach fundamentally changes the role of the andragogue. Drawing on the findings of L. Lukianova (2025) and S. Brookfield (2011), the role of the andragogue is defined as a facilitator, co-designer, and moderator of the educational environment. The author's interpretation of this transformation lies in the fact that the boundary between "the one who teaches" and "the one who learns" becomes conditional, and design acquires the character of a collaborative activity. A logical consequence of this is the orientation towards individual trajectories, which L. Lukianova (2020) viewed as dynamic projects capable of adjustment. Thus, it can be concluded that without considering these provisions, pedagogical design in NFAE loses its subject matter and is unable to ensure the alignment of the educational process with the actual needs of the adult population.

The competency-based approach in non-formal adult education

In modern theory and practice of adult education, the competency-based approach is increasingly viewed not only as an orientation towards learning outcomes but as the methodological logic of the pedagogical design of the educational process. In this context, it defines the mindset of the andragogue, who designs the educational process based not on a list of educational topics but on the expected changes in the professional, social, and personal activities of the adult learner. It should be noted that in the national scientific discourse, particularly in the works of V. Kremen & Yu. Kovbasiuk (2014), S. Sysoieva & T. Krystopchuk (2013), and this approach is interpreted as a strategic response of education to the demands of the knowledge society. The opinion shared by I. Ziaziun (2008), alongside the positions from The definition and selection… (2005) experts and the research of J. Raven (1984), indicates that competence emerges not as a sum of knowledge but as an integrated result of an activity-based and contextual nature. The interpretation of these provisions allows one to assert that for NFAE, this approach is critically important, as it shifts the emphasis from formal material mastery to solving real-life tasks according to the logic of "from result to process".

In the modern conditions of the global educational space, such design logic finds its embodiment in the concept of micro-credentials. For example, a social worker seeking to expand competencies in crisis intervention may enrol in a targeted micro-credential programme consisting of thematic modules in psychological first aid, conflict de-escalation, and documentation of critical incidents. Each module concludes with an assessment directly linked to authentic professional situations.

Upon completion, the learner receives a stackable credential that may be recognised within a broader qualification framework. Such an approach enables adults to construct flexible and self-directed educational trajectories by acquiring competencies relevant to their immediate professional needs rather than committing to a full degree programme. Analysing the provisions of Council Recommendation 2022/C 243/02 (2022), as well as the studies of D. Oliver (2019) and M. Brown *et al*. (2020), it can be stated that fixing learning outcomes based on the mastery of small educational volumes requires a special level of detail regarding target competencies from the andragogue. It can be argued that the implementation of micro-credentials, which aligns with the strategic orientations of the European skills agenda (2023), allows the adult learner to flexibly construct their own educational trajectory. This thesis finds theoretical support in the concept of constructive alignment by J. Biggs & C. Tang (2011), which emphasised that all components of the educational process must be logically subordinated to the planned learning outcomes. Such alignment, in the author's conviction, is the overarching logic of design rather than merely an assessment stage.

An important aspect of competency-oriented design is the link between the construction of the educational space and authentic assessment. Researchers S. Merriam & R. Caffarella (1999) rightly emphasised that for adult learners, assessment performs the function of reflection and feedback in real professional situations. In competency-oriented design for non-formal adult education, assessment typically encompasses three interconnected dimensions: professional (application of specialised skills in authentic workplace contexts), communicative (ability to collaborate, negotiate, and present solutions), and reflective (capacity for critical self-evaluation of learning processes and outcomes). Feedback is integrated throughout the educational process rather than limited to a final evaluation stage. In practice, this may include peer-review discussions following case-based tasks, structured self-assessment checklists aligned with predefined learning outcomes, and portfolio-based evidence accumulated during the programme.

Reflective instruments, such as learning journals and guided debriefing after role-play scenarios, enable adult learners to connect newly acquired competencies with prior professional experience, thereby strengthening the transferability of learning outcomes to real professional practice. This correlates with the position on the necessity of embedding self-assessment tools as early as the pedagogical design stage. The competency-based approach in this case acts not as a neutral activity but as a process of creating conditions for transferring knowledge into practice. This thought is consonant with the ideas of D. Schön (1983) regarding "reflective practice", where the learner learns to act and analyse their own actions. The issue of the andragogue's design competence requires special attention. Drawing on the definition by V. Strelnikov (2006), it is considered a meta-competence that integrates the professional, methodical, and reflective components of an andragogue's activity.

Thus, it can be concluded that the competency-based approach performs a system-forming function in NFAE. It not only sets the design logic "from results to process" but also provides the methodological prerequisites for forming the professional excellence of specialists, transforming design into a holistic methodology for personal development throughout life. Contemporary research further substantiates these positions. In particular, according to Council Recommendation 2022/C 243/02 (2022), collaboration with external professional stakeholders, and intentional learner-centred design, all of which correspond to the systemic-integrative logic proposed in this study. Collectively, these findings indicate that competency-based design in non-formal adult education should be understood not as a static methodological model, but as a dynamic and adaptive practice responsive to the evolving needs of adult learners and labour market transformations.

The activity-based and contextual approaches in pedagogical design for non-formal adult education

In NFAE, the pedagogical design of the educational process cannot be limited merely to defining goals, content, and learning outcomes. Its effectiveness largely depends on the organisation of the adult's activity and the context in which it occurs. S. Honcharenko (2010) viewed the essence of the activity-based approach through the real process of human interaction with the world, where the individual acts as an active subject performing a sequence of vital actions**.** For non-formal education, this approach is decisive, as it allows for the transformation of learning into an activity that carries personal meaning for the adult. For instance, a mid-career engineer participating in a non-formal leadership development programme may perceive generic management theory as insufficiently relevant to their professional needs. However, when the programme is designed around authentic workplace challenges – such as managing cross-functional teams under time pressure or navigating organisational change – learning acquires immediate practical significance. In this case, the activity-based approach transforms abstract educational content into a personally meaningful activity directly connected with the learner's professional identity and career trajectory.

The methodological weight of the activity-based approach is reinforced by modern research in the field of neuroandragogy. Analysing the findings of J. Zull (2002), it can be stated that the learning process is a biological change in the brain that occurs most

effectively when information is transformed into the subject's own action. In the author's view, this proves that design in NFAE is not merely a methodical technique but a necessary condition for activating the cerebral cortex. At the same time, L. Lebedyk (2018) rightly noted that this approach requires special efforts from the andragogue in organising didactic systems, planning, and project quality control. The educational process is designed as a system of actions in which learners analyse experience, perform practical tasks, and model professional situations. In this sense, pedagogical design represents a second-order activity – the design of the learning activity itself.

The contextual approach, closely related to the activity-based one, shifts the emphasis towards accounting for the social, professional, and life environment. Drawing on the research of V. Zhelanova (2013), contextual learning can be defined as the organisation of a process where the content is as close as possible to the real conditions of future activity. This thesis correlates with the views of J. Hirv-Biene *et al*. (2025) and M. Livingston & D. Cummings-Clay (2023), who emphasised that adults learn more effectively when knowledge can be immediately applied in practice. It is argued that in pedagogical design, contextuality is implemented through the analysis of the social context of the target group, the selection of cases, and the creation of an environment that stimulates the transfer of learning outcomes into practice. In the process of designing NFAE, the activity-based and contextual approaches exist in close interaction: the former addresses the mechanisms of adult learning, while the latter defines the conditions and purposes that frame this process. It can be argued that their integration allows for the avoidance of formalism and ensures the practical value of the results. Thus, the unity of activity and context becomes the foundation for creating educational projects where learning acquires real meaning. This logic is fundamental for the subsequent analysis of systemic and integrative approaches.

Systemic and integrative approaches in the pedagogical design of non-formal adult education

Pedagogical design in non-formal adult education deals with complex, open systems operating within a shifting social and cultural context. Under such conditions, effective design is impossible without relying on systemic and integrative approaches, which ensure a holistic vision of the educational process. The systemic approach is traditionally regarded as the methodological basis for analysing objects consisting of interconnected elements. Drawing on the fundamental provisions of L. von Bertalanffy (1968) and the research of S. Honcharenko (2010), this study defines the educational process not as a sum of activities, but as a system with its own structure and internal connections. This position finds wide confirmation in the work of V. Kremen & Yu. Kovbasiuk (2014), S. Sysoieva & T. Krystopchuk (2013) and O. Dubaseniuk (2016), where it is emphasised that systemicity manifests in the interdependence of goals, content, and results.

It is argued that any change in one component inevitably transforms the entire design model. The expediency of applying the systemic approach, as noted by L. Lebedyk (2018), is due to the fact that didactic design is essentially the creation of didactic systems. An interesting comparison in this context can be made with the views of J. Dietrych *et al*. (1974), who considered a project as a system of concepts providing an abstract representation of a future product. For NFAE, this is of particular importance due to the variability of goals and the flexibility of learning forms. The interpretation of these provisions suggests that, under the conditions of digitalisation, the systemic approach is transformed into the design of educational ecosystems. Using the principles of connectivism by G. Siemens (2005), the andragogue designs the process as a network of information sources that stimulates the self-organisation of learners.

Alongside the systemic approach, the integrative approach, aimed at creating a qualitatively new integrity, is gaining increasing importance. The systemic-integrative logic of pedagogical design in non-formal adult education generates practical benefits across three interrelated dimensions. First, in terms of adaptability, the integrative approach enables educational projects to be restructured in response to changing professional contexts, emerging learner needs, and broader social transformations without compromising the coherence of the overall design. Second, regarding flexibility, the integration of andragogical, competency-based, and contextual approaches allows adult learners to engage in individualised learning trajectories by selecting learning pathways, pacing, and content relevant to their prior experience and current professional demands. Finally, from the perspective of design effectiveness, the systemic approach ensures that goals, content, methods, and assessment criteria function as interconnected components of a unified educational system rather than isolated elements.

This increases the likelihood that learning outcomes will be meaningful, applicable, and transferable to authentic professional practice. As rightly noted by V. Lavnikov & O. Lesyk (2020), integration is not a mechanical union of elements. The researchers C. Grus *et al*. (2025) emphasised the importance of developing a holistic integrative model for designing continuing education programmes as complex andragogical systems. In NFAE, this manifests in the combination of formal and non-formal experience, as well as the interpenetration of various methodologies. Consequently, the synthesis of systemic and integrative approaches forms a cohesive logic that allows for

viewing the project simultaneously as a stable structure and a dynamic model. Integration in adult education does not negate systemicity but rather deepens it, filling the system with new meanings. Thus, the systemic approach ensures the structural orderliness of the project, while the integrative approach ensures its flexibility and alignment with the actual needs of adults. It is precisely such a combination that creates a reliable methodological basis for developing effective educational solutions.

Conclusions

As a result of the research conducted, the methodological foundation of pedagogical design in non-formal adult education has been theoretically substantiated and systematised based on the analysis of national and international scientific discourse. Primarily, the differentiation of adjacent methodological frameworks allowed for overcoming the problem of their incorrect identification. It has been established that while general pedagogical methodology ensures the didactic stability of the process and the methodology of andragogy focuses on the subjectivity of the adult, the methodology of pedagogical design performs a specific integrative function, the object of which is the Project as a holistic, optimal model of future educational interaction.

The substantiation of the dominant role of andragogical and competency-based approaches demonstrated their significance as the foundation of design decisions. It has been proven that the andragogical approach transforms the role of the andragogue from a transmitter of knowledge into a facilitator and co-designer, while the competency-based approach in NFAE is defined as a cross-cutting logic that implements the principle of "from expected outcomes to process", correlating with current global trends in the implementation of micro-credentials. A significant result was the revelation of the specific application of activity-based and contextual approaches, which ensure the meaningful content of the educational project.

It has been established that design in NFAE is effectively a "second-order activity" – the construction of the adult's learning activity, which must be inextricably linked to their life and professional context to activate the mechanisms of neuroandragogy and reflective experience. In conclusion, the systemic-integrative logic has been defined as a holistic methodological strategy that allows the educational process in NFAE to be viewed as an open, adaptive ecosystem. Within this strategy, the systemic approach ensures the internal order of the project elements, while the integrative approach allows for the flexible combination of formal, non-formal, and informal experiences of adult learners within a single educational trajectory. Future research should focus on further conceptualising the structure of design competence among adult education specialists and substantiating technological tools for the development of adaptive educational programmes in digital and hybrid learning environments.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Методологічне підґрунтя педагогічного проєктування в неформальній освіті дорослих

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■ **Анотація.** Актуальність дослідження була зумовлена необхідністю переосмислення традиційних підходів до організації навчання дорослих у контексті глобалізації, цифровізації та зростаючої потреби в адаптивних освітніх системах. Метою статті виступала систематизація та інтеграція методологічного підґрунтя проєктування освітнього процесу в неформальній освіті дорослих через поєднання системного, андрагогічного, компетентнісного та діяльнісно-контекстного підходів. Методи дослідження охопили теоретичний аналіз наукових джерел, порівняння методологічних рамок, синтез і моделювання логіки проєктувальної діяльності андрагога. У статті було розглянуто питання теоретичного обґрунтування методологічних засад педагогічного проєктування в умовах неформальної освіти дорослих. Отримані результати дозволили чітко диференціювати об'єкти та функції загальнопедагогічної методології, методології андрагогіки та методології педагогічного проєктування. Було доведено, що андрагогічний підхід визначає суб'єктну позицію дорослого учня, тоді як компетентнісний підхід задає логіку конструювання освітнього процесу за принципом від очікуваних результатів до змісту. Обґрунтовано роль діяльнісного та контекстного підходів у створенні рефлексивного освітнього середовища, що базується на професійному та життєвому досвіді дорослого учня. Визначено системно-інтегративну логіку як провідну стратегію, що забезпечує цілісність, гнучкість та динамічну стійкість освітніх проєктів. Встановлено, що педагогічне проєктування знаменує парадигмальний перехід від управління навчанням до створення керованого освітнього середовища для самонавчання дорослих. Практична цінність проведеного дослідження полягає у визначенні конкретних методологічних орієнтирів для андрагогів, які займаються педагогічним проектуванням в неформальній освіті дорослих. Сформована концептуальна рамка може бути використана для вдосконалення професійної підготовки андрагогів, розвитку їхньої проєктувальної компетентності та створення інноваційних освітніх продуктів, адаптованих до мінливих запитів суспільства

■ **Ключові слова:** андрагог; андрагогічний підхід; системно-інтегративна логіка; методологія освіти; професійний розвиток

PROFESSIONAL EDUCATION:
METHODOLOGY, THEORY AND TECHNOLOGIES
Journal homepage: https://profedu.com.ua/en
Vol. 12, No. 1, 2026, 111-128
ISSN 2415-3729;
e-ISSN 2415-3737

Article's History: Received: 19.12.2025 Revised: 14.04.2026 Accepted: 12.05.2026 Published: 19.06.2026

UDC 37.091.12:37.018.46
DOI: 10.69587/pemtt/1.2026.111

Organisation of teachers' professional learning within the system of continuing education

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■ **Abstract.** The aim of this article was to provide a theoretical synthesis of models of continuing professional development for teachers, effective forms of professional development, and the possibilities for their application in postgraduate education. The research methodology was based on a theoretical and analytical approach and involved the integration of theoretical analysis of scholarly sources, content analysis of regulatory and programme materials, the comparative method, systematisation, generalisation, and pedagogical modelling. This approach enabled the analysis of 64 sources published between 2018 and 2025, the comparison of models of teachers' professional development, the systematisation of forms of professional learning, and the substantiation of the rationale for an integrated model within the postgraduate education system. The findings demonstrated that the continuing professional development of teaching staff in postgraduate education constitutes a holistic process of professional renewal encompassing not only formal professional development but also self-directed learning, reflective practice, digital readiness, professional collaboration, and the practical enhancement of teaching practice. Professional development models fulfil different functions: the course-based model provides organisational structure, the competency-based model focuses on professional outcomes, the andragogical model takes account of adult learners' prior experience, the personalised model supports individual learning pathways, the network-based model strengthens collegial collaboration, the digital model expands access to learning opportunities, while the mentoring and supervision model ensures sustained support for implementing changes in professional practice. The effectiveness of professional development is determined not by its format or title, but by its capacity to ensure teachers' active participation, the completion of practical tasks, the creation of educational products, constructive feedback, post-course support, and the evaluation of changes in professional practice. The integrated model of professional development should be implemented as a continuous cycle combining needs assessment, an individual learning pathway, modular and

Suggested Citation:
Borysov, V., Dudar, V., & Bokshyts, O. (2025). Organisation of teachers' professional learning within the system of continuing education. *Professional Education: Methodology, Theory and Technologies*, 12(1), 111-128. doi: 10.69587/pemtt/1.2026.111.

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blended learning, professional learning communities, mentoring, supervision, an electronic portfolio, and the evaluation of changes in teaching practice

Keywords: reflection; competence; self-directed learning; mentoring; supervision; microlearning

Introduction

The continuing professional development of teaching staff requires thorough scholarly consideration, as the digital transformation of education, the expansion of blended and online learning, the development of inclusive education, efforts to address learning loss, the changing role of the teacher, the growing need for lifelong learning, and the ongoing renewal of the competency-based approach have intensified the demands placed upon the quality of postgraduate education. These developments determine teachers' capacity to update their pedagogical approaches, adapt teaching to meet learners' diverse educational needs, and respond effectively to changes in curriculum content, educational technologies, and the organisation of the educational process. Professional development based solely on the periodic completion of courses fails to establish a sufficient connection between teachers' learning and changes in their professional practice. Consequently, there is a need to examine models that integrate individual learning pathways, practice-oriented learning, digital formats, mentoring, and professional collaboration. The absence of a coherent approach to organising teachers' continuing professional development within postgraduate education results in the formalisation of postgraduate learning, fragmented renewal of teachers' competencies, and a reduced capacity of schools to respond effectively to learners' educational needs.

In the scholarly literature, teachers' professional learning throughout their careers is associated with rethinking the role of the teacher, renewing educational content, and adapting pedagogical practice to the principles of the New Ukrainian School (NUS). The theoretical aspects of teachers' continuing professional development within the NUS were linked by N. Kurysh (2025) to innovative practices, professional mobility, and teachers' capacity to construct their own professional learning pathways. This perspective made it possible to conceptualise professional development not as an isolated stage of professional learning but as a continuous process of renewing methodological, digital, and reflective competencies. L. Khomych (2021) examined the directions of teachers' professional development through the integration of the value orientations of the NUS, pedagogical mastery, and readiness to work within a reformed educational environment. This approach clarified the relationship between teachers' professional competence and their ability to implement competency-based teaching. R. Chernovol-Tkachenko (2025) interpreted teachers' professional development within the postgraduate education system as a response to dynamic social change and emerging demands in educational practice. This interpretation broadened the understanding of postgraduate education from course-based provision to an environment supporting teachers' professional adaptation, continuous support, and the renewal of pedagogical practice. Through international collaboration, L. Kolesnyk & H. Biseth (2024) presented professional development as a mechanism for supporting educational reform in Ukraine. Their findings demonstrated that inter-institutional cooperation, partnership, and the comparison of educational practices enhance the openness and development of teacher education.

A separate body of literature addresses models of teachers' professional development that integrate formal, non-formal, network-based, and postgraduate education. V. Fritsiuk & O. Shvets (2025) systematised continuing professional development through practices of lifelong learning, teachers' professional autonomy, and sustained professional support throughout their careers. From this perspective, postgraduate education is understood not as periodic course-based learning but as a comprehensive system of professional support for teachers. M. Vovk *et al*. (2021) examined formal and non-formal education as interconnected means of supporting teachers' professional growth. Their synthesis demonstrated that professional development is strengthened through the integration of institutional programmes, self-directed learning, professional collaboration, and the recognition of learning outcomes achieved outside the formal education system. Yu. Kesner & O. Antonova (2025) presented network-based collaboration as a model of non-formal professional development for teachers working in out-of-school education institutions. Their proposed model demonstrated the potential of professional networks to facilitate the exchange of experience, collegial learning, methodological support, and the dissemination of pedagogical practices beyond the boundaries of traditional course-based professional development.

Digitalisation, theoretical modelling, and the evaluation of professional development effectiveness constitute a distinct body of literature concerned with the modernisation of teachers' professional development. S. Shara & I. Kalinichenko (2025) examined approaches to professional development in the context of digitalisation through online learning formats, digital tools, and flexible educational resources. Within this analysis, digitalisation emerged not merely as a means of delivering distance learning for teachers, but as a catalyst for restructuring postgraduate education according to the principles of accessibility, modularity, and

personalisation. Y. Kapranov *et al*. (2025) analysed digital competencies through the lens of European experience, Ukrainian priorities in teacher education, and lifelong professional learning. Within this framework, the development of digital competence is associated with pedagogical content, the values of open education, and teachers' readiness for continued self-directed professional learning. A. Fodor & I. Albulescu (2025) developed a theoretical framework for professional development centred on the interrelationship between knowledge, practice, reflection, and teachers' professional identity. From this perspective, professional development is understood as a multidimensional process rather than the accumulation of isolated learning activities. R. Magwenya *et al*. (2023) synthesised trends in continuing professional development over the past decade, emphasising organisational conditions, participants' motivation, and the practical orientation of learning. Their synthesis demonstrated that teachers' professional growth is more effective when learning is sustained over time, practice-oriented in content, supported by participants' intrinsic motivation, and reinforced by the educational institution.

Despite the existence of academic research on teachers' professional development, there remains a lack of a coherent, holistic vision for its implementation in postgraduate education, taking into account content-related, technological and practice-oriented components. The aim of this study was to provide a theoretical justification for approaches to organising the continuing professional development of teaching staff through an analysis of professional development models, effective forms of professional learning, and the conditions required for their institutional implementation. The objectives of the study were to analyse the course-based, competency-based, andragogical, personalised, network-based, digital, and mentoring and supervision models of teachers' professional development; to identify effective forms of professional development; and to substantiate the sequence for implementing an integrated model of teachers' professional learning within postgraduate education.

Materials and Methods

The study adopted a theoretical and analytical design. The identification and verification of sources were conducted using Scopus, Web of Science, Google Scholar, CrossRef, the open websites of academic journals, electronic archives of Ukrainian scholarly publications, and repositories of research and educational institutions. The inclusion criteria were as follows: relevance to the topic of the continuing professional development of teaching staff; the presence of a theoretical, review, or applied analysis of professional development models, forms of professional learning, or postgraduate education; publication in peer-reviewed academic journals or open-access academic repositories; availability of the full text or sufficient bibliographic information; and chronological relevance to the research topic within the period 2019-2025, as this period reflects the accelerated digitalisation of education, the expansion of online and blended learning, the increasing emphasis on individual learning pathways, and the renewal of approaches to teachers' professional development within postgraduate education. A total of 64 sources published between 2018 and 2025 were ultimately included in the analysis.

The study employed methods of general theoretical inquiry together with content analysis of regulatory and programme documents. Analytical methods were used to identify the course-based, competency-based, andragogical, personalised, network-based, digital, and mentoring and supervision models of teachers' professional development. These models were systematised according to the following criteria: conceptual orientation, organisational logic, the teacher's role in the learning process, the degree of individualisation, forms of professional collaboration, the presence of a digital component, mechanisms for post-course support, and the transfer of learning outcomes into teaching practice (Sancar *et al*., 2021; Fairman *et al*., 2022; Phuong & Duong, 2022). These models were selected because they encompass the principal dimensions of continuing professional development within postgraduate education: institutionally organised learning, competency renewal, adult learning, individual learning pathways, professional learning communities, digital learning environments, and support for implementing change in professional practice (Tymchuk *et al*., 2021; Meesuk *et al*., 2021; Chaipidech *et al*., 2022). Mentoring and supervisory support were additionally considered as mechanisms facilitating the transfer of professional development outcomes into teaching practice (Toh *et al*., 2022; Hinon *et al*., 2024).

The comparative method was used to examine these models in terms of their conceptual foundations, organisational logic, modes of implementation, and potential for application within postgraduate education (Kaminska, 2018; Kowalczuk-Walędziak *et al*., 2022; Aitken *et al*., 2023). Systematisation enabled the classification of professional development activities according to their functional purpose into course-based, training-based, digital, network-based, mentoring, supervision, and practice-oriented forms (Williams, 2020; Bragg *et al*., 2021; Morcom & MacCallum, 2022). Content analysis was undertaken to examine the regulatory and programme framework governing the professional development of teaching staff, including the regulation on teachers' professional development (Resolution of Cabinet of Ministers of Ukraine No. 800, 2019), the regulation governing the activities of Centres for the Professional Development of Teaching Staff (Resolution of Cabinet of Ministers of Ukraine No. 672, 2020), and the Professional Standard for Teachers (Order of Ministry of Education and Science of Ukraine No. 1225, 2024).

The analysis also covered the Model Programme for Teachers' Professional Development (Order of Ministry of Education and Science of Ukraine No. 904, 2022) and the catalogue of professional development programmes published by the Institute of Education Content Modernisation (n.d.). This analysis made it possible to identify which professional development models, learning formats, support mechanisms, and approaches to evaluating professional outcomes are represented within the institutional practice of postgraduate education. Generalisation was employed to identify the conditions required for integrating professional development models and forms into the postgraduate education system. Pedagogical modelling was used to develop the framework for implementing an integrated model of teachers' professional development. This framework was constructed on the basis of the findings of the theoretical analysis of scholarly literature, the content analysis of regulatory and programme documents, the comparison of professional development models, and the systematisation of professional development formats.

Results and Discussion

The content of teachers' professional growth in the context of educational change

The continuing professional development of teaching staff within postgraduate education should be regarded as a continuous process of renewing professional competence, pedagogical thinking, methodological practice, digital readiness, reflective culture, and the capacity for self-directed learning. Its scope extends beyond professional development, as it is not confined to attending courses, accumulating training hours, or obtaining certificates. Based on the theoretical analysis of scholarly literature and the content analysis of regulatory and programme documents, this process encompasses institutionally organised learning, non-formal educational practices, self-directed learning, reflective practice, professional collaboration, and the practical improvement of teaching practice. Regulatory and programme documents define professional development as a component of teachers' professional growth associated with the renewal of competencies, the selection of learning formats, the development of an individual learning pathway, the documentation of professional growth outcomes, and their subsequent application in teaching practice (Resolution of Cabinet of Ministers of Ukraine No. 800, 2019; Order of Ministry of Education and Science of Ukraine No. 904, 2022). To avoid conflating the concepts of "professional development", "postgraduate education", and "continuing professional development", it is appropriate to distinguish them according to their content and function within teachers' professional development (Table 1).

Table 1. *Distinction between the key concepts of teachers' professional development*

Concept	Main content	Function within postgraduate education
Professional development	Courses, training programmes, certified programmes, and short-term professional learning activities	Updating specific knowledge, skills, and professional practice
Postgraduate education	The institutional framework for learning following the completion of initial professional education	The organisation, support, and coordination of professional growth
Continuing professional development	Formal, non-formal, informal, reflective, and self-directed learning	The continuous development of competencies and teaching practice

Source: *compiled by the author based on an analysis of M. Kaminska (2018), Resolution of Cabinet of Ministers of Ukraine No. 800 (2019), V. Sydorenko et al. (2020), Resolution of Cabinet of Ministers of Ukraine No. 672 (2020), R. Sancar et al. (2021), Order of Ministry of Education and Science of Ukraine No. 904 (2022), A. Friedman (2023), M. Njenga (2023), Order of Ministry of Education and Science of Ukraine No. 1225 (2024), Institute of Education Content Modernization (n.d.)*

The content analysis of regulatory and programme documents demonstrated that, within the regulatory framework, teachers' professional development is interpreted as an organised process of professional renewal that may be implemented through various forms, types, and providers of educational activities, while also providing for the recognition of professional learning outcomes (Resolution of Cabinet of Ministers of Ukraine No. 800, 2019). The regulation governing the activities of Centres for the Professional Development of Teaching Staff further specifies the institutional support provided for teachers' professional growth through consultation, professional guidance, the identification and synthesis of professional learning needs, and assistance in developing individual professional learning pathways (Resolution of Cabinet of Ministers of Ukraine No. 672, 2020). The Professional Standard for Teachers establishes the competency-based foundation of continuing professional development by linking teachers' professional activities with professional functions, competencies, and expected professional outcomes (Order of Ministry of Education and Science of Ukraine No. 1225, 2024). The Model Programme for Teachers' Professional Development and the catalogue of educational programmes published by the Institute of Education Content Modernisation reflect the programmatic level of professional development implementation through thematic modules, digital and blended learning formats, practice-oriented activities, post-course support, and an emphasis on applying learning outcomes within the educational process (Institute of Education Content Modernization, n.d.; Order of Ministry of Education and Science of Ukraine No. 904, 2022).

Continuing professional development differs from professional development in terms of its scope, duration, and the nature of its influence on teachers' professional practice. Whereas professional development is primarily delivered through organised learning activities, the broader concept of professional growth encompasses teachers' formal, non-formal, and self-directed learning aimed at renewing professional experience and pedagogical decision-making (Sydorenko *et al.*, 2020; Friedman, 2023). This interpretation is consistent with the conclusions of M. Njenga (2023), who examined teachers' participation in professional development in relation to motivation, professional learning needs, and the conditions supporting engagement in learning. At the same time, M. Irshad (2025) extended this perspective by demonstrating the importance of non-formal and self-directed learning beyond the boundaries of traditional professional training. Consequently, continuous professional development cannot be reduced to the institutional provision of courses, as it requires teachers to take an active stance towards their own professional renewal.

The competency-based dimension of teachers' professional learning involves the continuous renewal of knowledge, practical skills, methodological approaches, and readiness to operate effectively within a changing educational environment. The analysis of the literature demonstrated that professional growth encompasses not only subject-specific and methodological knowledge but also the capacity to adapt teaching to different educational contexts, maintain the quality of the educational process, and evaluate the effectiveness of one's own professional practice (Sancar *et al*., 2021; Wolde, 2021). This conclusion is reinforced by the findings of C. Lai & T. Jin (2021), who associated technological integration not only with technical proficiency but also with teachers' professional identity. A similar emphasis on teachers' internal readiness is evident in the work of E. Garzón-Artacho *et al.* (2021), in which digital competence is examined within the broader context of lifelong learning. At the regulatory level, the competency-based content of professional development is specified through the Professional Standard for Teachers, which links teachers' professional activity with professional functions, competencies, and expected professional outcomes (Order of Ministry of Education and Science of Ukraine No. 1225, 2024). Consequently, competency renewal within postgraduate education should encompass not the isolated acquisition of skills but the integration of knowledge, professional values, digital readiness, and effective professional practice.

The role of postgraduate education extends beyond organising learning activities to creating an environment that supports professional development, reflective reinterpretation of experience, and the gradual renewal of teaching practice. The postgraduate educational environment can fulfil a transformative function when teachers' learning is combined with research activity, reflective practice, and the expansion of professional perspectives (Kaminska, 2018; Kowalczuk-Walędziak *et al.*, 2022). This position is further supported by G. Aitken *et al.* (2023), who conceptualised postgraduate education as a space for broadening teachers' understanding of teaching. P. Taylor (2023) likewise emphasised that professional growth depends upon the interaction between teachers' goals, opportunities for development, and their responses to professional challenges. Institutional support for professional development is associated not only with the delivery of courses but also with consultation, ongoing professional support, the identification of teachers' professional learning needs, and assistance in developing individual learning pathways (Resolution of Cabinet of Ministers of Ukraine No. 672, 2020). Taken together, these perspectives provide grounds for interpreting postgraduate education not as the final stage following initial teacher preparation but as an environment that sustains and supports continuous change in teachers' professional practice.

The individualisation of professional development is associated with teachers' capacity to independently plan, sustain, and adjust their own professional growth. The analysis demonstrated that self-directed learning activities and motivation to engage in professional learning strengthen the connection between professional development and teachers' actual professional needs rather than merely fulfilling formal requirements for professional development (Zhang *et al.*, 2021; Koay, 2023). This finding is consistent with the position of S. Efu (2023), who argues that reflective practice promotes teachers' conscious engagement in professional development rather than passive participation in training activities. At the same time, H. Haruna *et al.* (2025) extended this individual perspective by introducing a social and organisational dimension, demonstrating the importance of collaborative learning, technological integration, and professional interaction in developing teachers' professional capacity. Within the regulatory and programme framework, individualisation is reflected in teachers' opportunity to choose the forms, types, and providers of professional development, as well as in the role of Centres for the Professional Development of Teaching Staff in providing consultation and support for teachers' professional learning needs (Resolution of Cabinet of Ministers of Ukraine No. 800, 2019; Resolution of Cabinet of Ministers of Ukraine No. 672, 2020). Thus, an individual learning pathway should not be understood as isolated self-directed learning; rather, it requires a combination of autonomy, reflective practice, collaboration with colleagues, and support from the educational institution.

The reflective component is an essential condition for transforming formal learning into meaningful changes in teaching practice. Professional growth becomes

substantive when teachers relate new knowledge to their own experience, analyse professional challenges, reconsider their pedagogical decisions, and transfer learning outcomes into the educational process (Efu, 2023; Taylor, 2023). This conclusion, regarding reflection as a prerequisite for transferring learning into professional practice, is consistent with the position of D. Mayer & M. Mills (2021), who associate teacher professionalism not only with professional preparation but also with responsibility and the capacity to respond appropriately to the educational context. This implies that professional development requires not the mechanical adoption of new approaches but their conscious alignment with teachers' professional roles and working conditions. A similar perspective is evident in the work of R. D'Agostino & E. Pace (2025), who examined professional identity through a conceptual understanding of the teacher's role. At the programme level, the reflective component is associated with practice-oriented activities, the analysis of learning outcomes, and post-course support, thereby facilitating the transition from participation in professional development programmes to meaningful changes in teachers' professional practice (Institute of Education Content Modernization, n.d.; Ministry of Education and Science of Ukraine, 2022). Reflection in postgraduate education should therefore support not only the evaluation of completed learning but also a deeper understanding of changes in pedagogical practice.

The digital dimension of continuing professional development should not be reduced to the acquisition of individual technological tools. The analysis demonstrated that technology-supported learning, digital formative assessment, and electronic resources transform the nature of professional development by requiring the integration of technical proficiency with methodological appropriateness and pedagogical responsibility (Williams, 2020; Zhorova *et al*., 2022). This finding is consistent with the conclusions of Rasdiana *et al.* (2024), who examined teachers' digital competence within the broader organisational context of supervision, technological leadership, and the digital culture of educational institutions. Teachers' digital preparation cannot be confined to the individual acquisition of software skills but should be supported through managerial, methodological, and supervisory mechanisms. A similar perspective is presented by V. Pavlova (2025), who conceptualised lecturers' digital competence as a prerequisite for the meaningful implementation of educational technologies rather than merely a technical skill. The analysis of model and educational professional development programmes demonstrated that digital and blended learning formats are used not only as modes of delivering professional learning but also as means of developing digital competence, promoting the effective use of electronic resources, addressing learning loss, and implementing innovative educational technologies (Institute of Education Content Modernization, n.d.; Order of Ministry of Education and Science of Ukraine No. 904, 2022). Consequently, the digital component of postgraduate education should be integrated into the broader process of competency-based and practice-oriented professional renewal.

Thus, the content of the continuing professional development of teaching staff within postgraduate education encompasses institutionally organised learning, formal and non-formal educational practices, self-directed learning, reflective practice, competency renewal, the development of professional identity, and the practical enhancement of teaching practice. The content analysis of the regulatory and programme framework clarified that these components are institutionally and programmatically reflected through the regulations governing professional development, the activities of the Centres for the Professional Development of Teaching Staff, the Professional Standard for Teachers, and the model and educational professional development programmes. Within this framework, postgraduate education functions as a system of professional support for teachers that should provide for the assessment of professional learning needs, the development of individual learning pathways, access to diverse learning formats, support for implementing new pedagogical practices, and the evaluation of meaningful changes in teachers' professional practice. Continuing professional development should therefore be understood as a broader concept than professional development alone, as it integrates structured learning, professional experience, self-directed development, and the reflective renewal of teaching practice throughout a teacher's career.

Organisational framework of the principal models of teachers' professional development

Models of teachers' professional development differ not only in their learning formats but also in how they define the teacher's role, the source of professional renewal, the organisation of learning, the mechanisms of support, and the expected professional outcomes. Within the postgraduate education system, a professional development model may be understood as an organisational and conceptual framework that determines the logic of teachers' learning, ranging from formally organised professional development to personalised, digital, network-based, or supervision-oriented approaches. The identification and comparison of these models were based on the following criteria: the teacher's role in the learning process, the organisation of learning, the degree of individualisation, support mechanisms, expected professional outcomes, and the potential for implementation within the postgraduate education system. These criteria formed the basis for the comparative analysis of the models presented in Table 2.

Table 2. *Organisational framework of models of teachers' professional development*

Model	Conceptual basis	Function	Potential / conditions for implementation in postgraduate education	Limitations
Course-based	Institutionally organised learning	The structured updating of knowledge and skills	Delivery of compulsory and optional programmes, thematic modules, and certified professional learning activities	The risk of a merely formal completion of professional development courses
Competency-based	Professional competencies and outcomes	A focus on measurable professional change	Programme design based on the professional standard, competencies, and assessment criteria	Excessive standardisation
Andragogical	The experience and autonomy of the adult learner	Promoting teachers' agency	Recognition of teachers' professional experience, learning needs, motivation, and participation in determining learning objectives	The need for high levels of motivation
Personalised	An individual earning pathway	Adapting learning to professional needs	Assessment of professional learning needs, flexible selection of modules, individual learning planning, and advisory support	The complexity of needs assessment and ongoing support
Network-based	Professional learning communities and collegial collaboration	The exchange of experience and collaborative decision-making	Organisation of professional learning communities, subject networks, inter-school networks, and collegial post-course support	Dependence on the quality of professional interaction
Digital	Online learning environments and digital resources	Flexibility, accessibility, and modularity of learning	Delivery of online and blended programmes, microlearning, e-learning courses, and electronic portfolios	The risk of technical formalism
Mentoring and supervision	Mentoring, supervision, and feedback	Supporting the transfer of learning into professional practice	Post-course support, analysis of professional situations, expert feedback, and support for the implementation of change	Resource intensity and the need for appropriately trained specialists

Source: *compiled by the author on the basis of a theoretical analysis of models of teachers' professional development of R. Williams (2020), P. Meesuk et al. (2021), L. Tymchuk et al. (2021), R. Toh et al. (2022), J. Fairman et al. (2022), T. Phuong & B. Duong (2022), P. Chaipidech et al. (2022), K. Hinon et al. (2024), C. Marcelo et al. (2025)*

The course-based model is founded upon institutionally regulated teacher learning delivered through professional development programmes, thematic modules, seminars, and other formally organised educational activities. This model is characterised by a structured curriculum, specified duration of study, documented learning outcomes, and formal certification of teachers' participation (Kaminska, 2018; Fairman *et al*., 2022). Its potential lies in the organisation of compulsory and elective professional development programmes, thematic modules, and accredited training activities. The finding concerning the risk of formalisation within the course-based model is further supported by the conclusions of R. Ahmad Zaky El Islami *et al*. (2022), who argued that strategies for teachers' professional development should be aligned with genuine professional needs rather than merely reflecting the organisational availability of training programmes. This suggests that the course-based model retains its value within postgraduate education only when its content is methodologically relevant, practice-oriented, and capable of informing subsequent professional practice. Its principal limitation is the risk of formal participation, whereby the completion of accredited training is not accompanied by meaningful changes in teachers' professional practice.

The competency-based model shifts the emphasis from participation in learning activities to the development of specific professional competencies. The analysis of the literature demonstrated that, within this model, professional development is evaluated through improvements in methodological, digital, communication, assessment, managerial, and reflective competencies rather than solely by the number of professional development hours completed (Phuong & Duong, 2022; Açıkgöz & Babadogan, 2021). This conclusion is reinforced by B. Wolde (2021), who highlighted the importance of continuing professional development for strengthening teaching and learning competencies in the context of educational quality. Similarly, L. Holubnycha *et al*. (2022) described the competency-based approach as an orientation towards the ability to act effectively rather than simply the acquisition of knowledge. Within this model, the content of professional development may be aligned with the Professional Standard for Teachers, intended learning outcomes, and indicators of professional competence. Consequently, the competency-based model provides a substantive framework for renewing teaching practice but may become excessively standardised if it fails to take account of teachers' professional contexts and individual learning needs.

The andragogical model is based on the premise that teachers participating in postgraduate education are adult learners possessing established professional experience, value orientations, educational aspirations, and a need for autonomy. This model assumes teachers' active involvement in defining learning objectives, analysing professional situations, selecting learning approaches, and evaluating their own professional progress (Tymchuk *et al*., 2021; Anishchenko, 2022).

The finding concerning teachers' active role within the andragogical model is further clarified by S. Maspupah *et al.* (2025), whose approach to andragogical placements emphasises the acquisition of professional experience through immersion in authentic educational settings rather than passive engagement with learning materials. This supports the view that teachers' learning should build upon prior professional experience, authentic professional tasks, and opportunities to apply newly acquired knowledge directly in practice. The distance-learning dimension of the andragogical model has also been elaborated through analyses of the preparation of adult educators within digitally mediated learning environments (Solohub & Humeniuk, 2022). In practice, this model is implemented by drawing upon teachers' professional experience, educational needs, motivation, and authentic teaching situations. Rather than replicating the course-based model, it redefines the teacher's position: teachers are not passive recipients of instruction but active participants who jointly determine the goals, methods, and directions of their own professional development.

The personalised model is centred on the development of an individual learning pathway that reflects teachers' professional needs, level of preparation, experience, educational context, and professional development goals. The analysis of the literature demonstrated that, within this model, the content of learning is not prescribed uniformly for all participants but is adapted to individual professional gaps, interests, and the specific demands of teaching practice (Chaipidech *et al.*, 2022; Marcelo *et al.*, 2025). The finding concerning the adaptation of learning to teachers' individual needs is further reinforced by J. Koay (2023), who argues that self-directed professional learning activities enable teachers to determine their own directions for professional development and select appropriate means of achieving them. Accordingly, the personalised model should not be limited to the formal selection of professional development courses but should provide teachers with genuine autonomy in planning their professional growth. The motivational dimension of personalised professional development was further explored by X. Zhang *et al.* (2021), who demonstrated that participation in continuing professional development is influenced by both individual and school-related factors. The potential of the personalised model lies in combining the assessment of professional learning needs, the flexible selection of learning modules, individual planning, motivational support, and ongoing guidance throughout teachers' individual learning pathways.

The network-based model of professional development is founded upon professional collaboration, collegial learning, the exchange of experience, and the joint resolution of professional challenges. Its organisational logic is characterised by a shift from the vertical transmission of knowledge towards horizontal interaction within professional learning communities, methodological networks, and collaborative learning environments (Meesuk *et al.*, 2021; Haruna *et al.*, 2025). In a similar vein, M. Irshad (2025) demonstrated that non-formal and self-directed professional development frequently takes place beyond the boundaries of traditional educational provision. Likewise, V. Sydorenko *et al*. (2020) emphasised the importance of integrating formal and non-formal education in supporting the continuing professional development of educational professionals. The network-based model may be implemented through professional learning communities, methodological working groups, inter-school networks, online communities, and collegial forms of post-course support. Its application extends postgraduate education beyond individual course-based learning; however, the effectiveness of such collaboration depends upon the quality of communication, mutual trust among participants, and the capacity of professional communities to generate pedagogically meaningful solutions.

The digital model of professional development is based upon the use of online platforms, distance learning courses, electronic resources, digital tools, analytical systems, and technology-supported learning environments. This model provides flexibility, accessibility, modularity, and opportunities for self-paced learning, but it requires pedagogically sound digital design (Williams, 2020; Rasdiana *et al*., 2024). The finding concerning the need for pedagogically informed digital design is further supported by the work of E. Garzón-Artacho *et al.* (2021), who conceptualised digital competence as an integral component of lifelong learning. This perspective demonstrates that the digital model of professional development should facilitate not merely the one-off acquisition of digital tools but the gradual development of teachers' capacity to select, adapt, and apply digital resources in pedagogically appropriate ways. The importance of digital competence for the meaningful implementation of educational technologies is further emphasised by V. Pavlova (2025), reinforcing the distinction between the digital model and conventional distance learning. The digital model may be implemented through online and blended learning programmes, microlearning, electronic courses, digital portfolios, and support for teachers' individual pace of professional development.

The mentoring and supervision model is based on mentoring, professional supervision, coaching support, expert feedback, and the analysis of professional situations. The organisational logic of this approach lies not so much in the transmission of learning content as in supporting teachers while they apply new approaches in professional practice (Toh *et al*., 2022; Hinon *et al*., 2024). This perspective may be compared with the conclusions of R. D'Agostino & E. Pace (2025), who examined teachers' professional identity through a

conceptual understanding of the pedagogical role. Likewise, D. Mayer & M. Mills (2021) demonstrated that teacher professionalism entails both responsibility and the capacity to act appropriately within the educational context. The mentoring and supervision model provides post-course support, the analysis of professional situations, expert feedback, and assistance in implementing new pedagogical approaches in practice. This approach is valuable not only for supporting early-career teachers but also for facilitating the professional development of experienced practitioners. Its principal limitation lies in its resource-intensive nature and the need for well-prepared mentors and supervisors.

The synthesis of the models examined demonstrates that no single model is capable of independently providing the full cycle of continuing professional development for teaching staff. The course-based model establishes the organisational foundation; the competency-based model defines the expected professional outcomes; the andragogical model acknowledges the experience of the adult learner; the personalised model supports individual learning pathways; the network-based model promotes collegial collaboration; the digital model enhances accessibility and flexibility; and the mentoring and supervision model facilitates the transfer of learning outcomes into professional practice. Consequently, within the postgraduate education system, the emphasis should not be placed on selecting a single model but on integrating these approaches in accordance with teachers' professional needs, the resources of educational institutions, opportunities for post-course support, levels of digital readiness, conditions for personalised learning, and the expected changes in teaching practice.

Effective forms of professional development for teaching staff

Effective forms of professional development for teaching staff should be understood as practical means of organising learning interactions, professional experimentation, and post-course support. Unlike professional development models, which establish the overall organisational framework, professional development formats define the specific mechanisms through which teachers engage in learning, including courses, modules, training programmes, workshops, professional learning workshops, webinars, online courses, professional learning communities, mentoring, supervision, placements, electronic portfolios, practice-oriented projects, and microlearning. Their effectiveness cannot be assessed solely on the basis of duration, the number of participants, or the award of certificates. Within postgraduate education, the crucial consideration is whether the chosen format enables teachers' active participation, engagement with authentic professional tasks, constructive feedback, documentation of learning outcomes, and the subsequent application of newly acquired knowledge and experience in professional practice.

The content analysis of the Model Programme for Teachers' Professional Development (Order of Ministry of Education and Science of Ukraine No. 904, 2022) and the educational programmes published by the Institute of Education Content Modernisation (Institute of Education Content Modernization, n.d.) demonstrated that the most frequently employed formats include courses, thematic modules, webinars, online courses, training programmes, workshops, and practice-oriented activities. These forms are primarily intended to update teachers' methodological, digital, assessment, and communication competencies, while also introducing new educational approaches, tools, and regulatory requirements. However, considerably less attention is devoted to components related to the assessment of individual professional learning needs, sustained post-course support, mentoring, supervision, documenting changes in teaching practice, and evaluating the long-term outcomes of professional development. In most programmes, learning outcomes are defined in terms of participation, the completion of assignments, or the award of a certificate, whereas the mechanisms for evaluating how newly acquired knowledge and skills are applied in teachers' professional practice after completing the programme are described less consistently.

Courses and modular programmes remain appropriate when they provide not only a structured progression through the content but also culminate in a practical outcome. A professional learning programme has practical value when it addresses teachers' actual needs rather than merely adhering to the formal organisation of a training course (Fairman *et al*., 2022; Ahmad Zaky El Islami *et al*., 2022). Teachers' engagement in continuing professional development is strengthened when learning aligns with their professional expectations and offers accessible opportunities for participation, as emphasised by M. Njenga (2023). Personal professional goals, support from the school, and clear benefits for everyday teaching practice also enhance teachers' motivation for professional development, as demonstrated by X. Zhang *et al.* (2021). Thus, courses and modules should not consist of a standardised set of topics but should function as flexible learning formats that include needs assessment, the selection of relevant content blocks, the completion of a practical task, and the subsequent application of the outcomes in professional practice.

Training sessions, masterclasses, and pedagogical workshops are effective when they are designed to develop specific teaching practices. Unlike traditional course-based formats, these approaches emphasise the simulation of professional situations, practical exercises, case analysis, trial implementation of teaching methods, and collaborative reflection on outcomes, which is consistent with the concept of immersive professional

learning for teachers (Maspupah *et al*., 2025). The importance of aligning learning with authentic socio-pedagogical challenges was substantiated by O. Budnyk (2021). In the context of continuing professional development, this means that a training session or masterclass should be organised around a specific challenge in educational practice rather than a general presentation of experience. The reflective stage of such activities enhances learning effectiveness because it enables teachers to evaluate not only the correctness of a particular technique but also the conditions for its application within their own classrooms, as highlighted by S. Efu (2023). Consequently, a pedagogical workshop should conclude with a methodological product, an implementation plan, or a reflective conclusion rather than merely a discussion of observed practices.

Webinars, online courses, and distance learning programmes make continuing professional development more accessible; however, the effectiveness of these formats depends on well-designed pedagogical planning. An analysis of online professional development for teachers demonstrated that effective provision requires a clear structure, meaningful interaction, participant support, a carefully designed learning environment, and opportunities to apply acquired knowledge in practice (Bragg *et al*., 2021). This conclusion does not simply reiterate the general concept of the digital model but specifies the requirements for online learning formats: a webinar or online course should include practical tasks, discussion, feedback on completed work, and opportunities to revisit learning materials. R. Williams (2020) likewise emphasised that technology-supported professional learning requires sound pedagogical design rather than merely a digital platform. Thus, online courses and webinars can be effective within postgraduate education when they function as interactive learning environments rather than as channels for the one-way transmission of information.

Microlearning is an effective approach when teachers require brief, targeted, and immediately applicable development of a specific professional skill. This format consists of small learning units focused on a single tool, teaching strategy, digital resource, or method of organising learning activities (Kohnke *et al*., 2024; Prihatin *et al*., 2025). The practical value of microlearning lies in its capacity to facilitate the rapid development of an individual professional practice; however, it does not encompass the entire cycle of pedagogical change. The importance of high-quality design in online professional development, participant support, and opportunities to apply learning in teaching practice was demonstrated by L. Bragg *et al.* (2021), providing grounds for viewing microlearning not as an isolated digital component but as part of a carefully designed learning pathway. Consequently, microlearning is most appropriately used for the targeted development of specific skills, while being combined with courses, training sessions, mentoring, or practice-oriented projects when comprehensive changes in teaching practice are required.

Professional communities, subject-based methodological groups, and collaborative networks support continuing professional development through interaction among teachers, the joint analysis of challenges, and the collaborative development of pedagogical solutions. These formats facilitate post-course collaboration in which teachers not only exchange experience but also jointly plan, trial, and refine educational practices (Meesuk *et al*., 2021; Haruna *et al*., 2025). The value of these approaches extends beyond the mere existence of collegial communication. The complementarity of formal and non-formal education, demonstrated by V. Sydorenko *et al*. (2020), confirms the value of integrating professional learning communities with courses and training programmes rather than viewing them as alternatives. Furthermore, the findings of L. Kohnke *et al*. (2024) concerning flexible professional development in online and blended environments highlight the digital potential of such communities, as collaborative interaction can be supported through short online modules, shared digital resources, and asynchronous discussion of practical tasks. A professional learning community is effective when it extends beyond the exchange of ideas and culminates in a shared product, such as a methodological resource, a bank of teaching activities, an assessment framework, a pupil support plan, or a project for improving educational practice.

Mentoring, supervision, and coaching provide ongoing support for teachers as they implement new approaches in practice. The analysis of the literature demonstrated that mentoring is valuable not only for novice teachers but also for experienced practitioners who are modifying established ways of working or adopting new pedagogical approaches (Morcom & MacCallum, 2022). The coaching dimension of professional learning further refines this perspective, as coaching is viewed as a means of supporting teachers in improving their pedagogical practice (Hope *et al*., 2022). The importance of sustained post-training support was further confirmed by A. Saunders *et al*. (2024), who demonstrated that the implementation of evidence-informed practice requires not a single consultation but continuous guidance, feedback, and refinement of professional practice. Thus, within postgraduate education, mentoring, supervision, and coaching should be used as extensions of courses and training programmes, enabling teachers to identify implementation challenges, refine their practice, and consolidate professional change.

Placements, practice-oriented projects, and electronic portfolios enable a shift from evaluating participation to evaluating professional outcomes. A practice-oriented approach to continuing professional development requires teachers to create or trial a tangible educational product, such as a lesson segment, a digital resource, a methodological case study, an

assessment tool, a set of learning activities, a plan for working with pupils, or a support programme for a particular group of learners (Budnyk, 2021). This finding may be further extended through the concept of personalised digital learning, as P. Chaipidech *et al.* (2022) demonstrated the potential of individualised professional tasks for developing teachers' technological, pedagogical, and subject-specific knowledge. Likewise, C. Marcelo *et al.* (2025) highlighted the significance of individual learning pathways in professional development, supporting the use of an electronic portfolio as a means of documenting a teacher's personal professional journey. In this context, an electronic portfolio should contain not only certificates but also evidence of the practical application of learning outcomes, including teaching materials, trialled methodological approaches, and reflective records.

A distinct place among effective forms of continuing professional development is occupied by short courses, training sessions, webinars, and pedagogical workshops aimed at updating teachers' assessment and digital practices. Their effectiveness depends on whether familiarity with a digital tool results in changes to formative assessment methods, the provision of feedback, and support for pupils' learning progress (Zhorova *et al*., 2022). The principles of high-quality online professional development, participant interaction, and ongoing support identified by L. Bragg *et al*. (2021) further clarify the conditions under which such formats move beyond simply reviewing materials or providing technical instruction. Consequently, a short course, training session, or workshop on digital formative assessment should conclude with the creation of an assessment tool, its practical implementation, analysis of the outcomes obtained, and subsequent refinement of the teacher's practice.

The effectiveness of professional development for teaching staff is determined by several interrelated conditions. The form of professional learning should correspond to a specific professional need rather than merely reflecting the general theme of the programme. Learning should involve teachers' active engagement through completing practical tasks, analysing professional situations, creating educational products, discussing solutions, or trialling new approaches. Feedback and post-course support remain essential, as without them learning outcomes often fail to translate into professional practice. Effectiveness should be evaluated not by the number of training hours completed or certificates obtained, but by measurable changes in methodological decision-making, digital practice, assessment approaches, communication with learners, and the organisation of the educational process. It is therefore not the particular format of professional development that determines its value, but its capacity to facilitate progression from learning content to professional action, from participation to demonstrable outcomes, and from one-off training events to sustained professional development.

Directions for implementing the integrated model of teachers' professional development

The implementation of an integrated model of professional development within the postgraduate education system requires a shift from isolated training activities to a continuous process of professional support for teachers. This approach integrates the assessment of professional learning needs, individual learning pathways, modular learning, face-to-face, online, and blended learning formats, practice-oriented tasks, professional learning communities, mentoring, supervision, electronic portfolios, and the evaluation of changes in teaching practice. It involves not the mechanical addition of new courses or digital resources to the existing system, but the organisation of a continuous cycle in which each stage builds upon the previous one and culminates in a specific professional action, an educational product, a reflective conclusion, or a measurable change in professional practice. The sequence of this implementation process is presented in Figure 1.

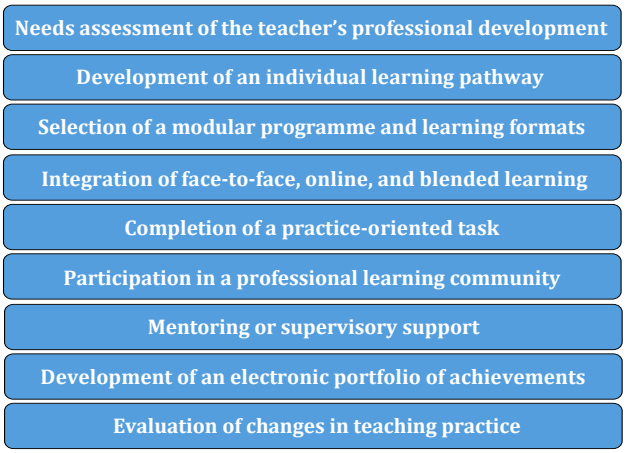

Figure 1.*Stages in the implementation of the integrated model of teachers' professional development*

Source: *developed by the author on the basis of theoretical analysis, content analysis of regulatory and programme documents, the synthesis of scholarly approaches, and pedagogical modelling*

The implementation of the stages presented in Figure 1 requires the involvement of several groups of institutional stakeholders. The diagnosis of professional needs, the development of an individual learning pathway, and the selection of a modular programme are carried out with the participation of the teacher, methodologists, Centres for the Professional Development of Teachers, and institutions of postgraduate teacher education. The organisation of face-to-face, online, and blended learning, the completion of practice-oriented tasks, and the development of an electronic portfolio are supported by programme instructors, tutors,

methodologists, and the teacher. Participation in professional learning communities, mentoring, supervision, and the evaluation of changes in teaching practice require the involvement of mentors, supervisors, school leaders, professional communities, and the administration of educational institutions. This distribution of responsibilities clarifies the organisational mechanism for implementing the integrated model within the postgraduate education system.

The proposed framework illustrates a sequential process for implementing the integrated model, in which the starting point is not the selection of a ready-made course but the diagnosis of the teacher's professional needs. This approach makes it possible to identify which aspects of professional practice require improvement, including methodological decision-making, digital practices, assessment approaches, communication with learners, the organisation of group work, or support for learners' academic progress. The impact of in-service teacher education programmes on professional development was examined by R. Qaisra & S. Haider (2023), confirming the importance of aligning postgraduate learning with the realities of school teaching. Within the integrated model, this means that diagnosis should fulfil not merely a formal function but a substantive one, as it determines the individual learning pathway, the selection of modules, and the expected professional outcomes.

The second stage of the framework involves the development of an individual learning pathway that combines compulsory and elective components of professional development. Such a pathway may include a core module, short thematic learning units, digital resources, a practical assignment, participation in a professional learning community, supervisory support, and a final portfolio. Changes in teachers' perceptions of postgraduate education and its role in professional development were analysed by G. Singh *et al.* (2024). These findings are particularly relevant to the integrated model, as postgraduate education should be perceived by teachers not as an administrative requirement but as a resource for professional growth. Accordingly, the individual learning pathway should reconcile institutional requirements, teachers' professional expectations, their readiness for change, and the actual conditions of work within educational institutions.

Within the framework, the modular structure of programmes serves as the organisational link connecting different forms of professional learning. One module may provide theoretical updating, another may focus on digital competence, a third may involve a practical task, a fourth may include a supervisory discussion, and a fifth may document learning outcomes in the portfolio. A mobile-oriented framework for teacher professional development and certification was proposed by N. Dahri *et al*. (2023), confirming the potential of digital technologies to support structured, accessible, and well-monitored professional learning. Within the integrated model, the digital platform should perform more than an informational function. It can facilitate the registration of professional learning needs, provide access to learning modules, support communication with mentors, deliver feedback, store portfolio materials, and monitor the completion of practical tasks.

The combination of face-to-face, online, and blended learning within the framework reflects the different functions these modes perform in postgraduate education. Face-to-face sessions are particularly appropriate for training workshops, pedagogical workshops, supervisory meetings, and collaborative analysis of professional situations. Online learning can provide access to learning materials, micro-modules, webinars, digital tools, and independent learning activities. Blended learning combines direct interpersonal interaction with the flexibility of digital environments. The choice of learning mode should be determined not by organisational convenience but by pedagogical purpose: an online module is appropriate for acquiring knowledge, a training workshop for practising specific professional skills, and mentoring or supervision for supporting the implementation of new approaches in professional practice.

Practice-oriented tasks constitute the central element of the integrated model because they translate learning content into professional action. Such tasks may involve developing a lesson segment, a digital resource, a formative assessment tool, a methodological case study, a set of learning activities, a plan for interaction with learners, or a support programme for a particular group of learners. The effectiveness and challenges of implementing a professional development programme focused on formative assessment were analysed by F. Berisha *et al*. (2024). This example demonstrates that changes in teaching practice require not only training but also sufficient time for implementation, analysis of barriers, ongoing support, and the refinement of subsequent actions. Thus, the practice-oriented component of the integrated model should culminate not in a report confirming participation but in a tangible educational product or a documented change in professional practice.

Participation in a professional learning community within the framework ensures the continuation of learning after the completion of a module or course. Such communities can facilitate collaborative analysis of professional challenges, discussion of implementation outcomes, dissemination of methodological solutions, peer consultation, and support for teachers introducing new approaches. Within the integrated model, however, a professional learning community should not remain merely a space for unstructured exchange of opinions. Its effectiveness is demonstrated when collaboration results in methodological materials, assessment frameworks, digital resources, learner

support plans, or projects aimed at improving educational practice. In this way, the professional learning community transforms the individual outcomes of professional development into a collective resource for the educational institution.

Mentoring or supervisory support is positioned in the framework after the practice-oriented task and participation in the professional learning community because this is the stage at which teachers most frequently encounter implementation challenges. Mentoring as a pathway to professionalisation was examined by S. Pandey & M. Sharma (2022), allowing it to be interpreted not only as support for novice teachers but also as a mechanism for sustained professional growth. Within the integrated model, mentors or supervisors should support specific professional actions, such as implementing a new teaching method, revising assessment practices, organising collaborative learning, developing a digital resource, or adapting learning activities. In this context, mentoring does not duplicate the course itself but facilitates the transfer of learning outcomes into authentic teaching practice.

The electronic portfolio serves as a tool for evidence-based documentation of the outcomes of the integrated model. It should not be developed merely as a repository of certificates but as a structured collection of materials demonstrating the teacher's professional development. The portfolio may include the results of the professional needs assessment, the individual development plan, completed assignments, teaching materials, digital resources, assessment tools, mentor feedback, evidence from implementation, reflective accounts, and documentation of changes in teaching practice. In this form, the portfolio integrates learning, support, and evaluation within a single coherent system. Its value lies in demonstrating the outcomes of postgraduate education not through the number of completed hours but through evidence of the application of new approaches in professional practice.

The final stage of the framework involves evaluating changes in teaching practice. The evaluation of the effectiveness of the integrated model should focus not on the number of completed courses but on the specific changes that have occurred in teachers' professional practice following participation. Such changes include the improvement of methodological approaches, the use of digital technologies, the enhancement of formative assessment practices, changes in feedback strategies, the development of educational resources, more active participation in professional learning communities, increased reflective capacity, and the ability to plan further professional development independently. For this reason, the integrated model should assess not merely participation but professional impact, including the educational products created, the implementation of new professional practices, reflective conclusions, documented changes in teaching practice, and the teacher's capacity to sustain professional growth beyond the completion of the programme.

Thus, the possibilities for implementing an integrated model of professional development within the postgraduate education system are linked to the organisation of a sequential cycle of professional support for teachers: from needs assessment, the design of individual development pathways, and modular and blended learning, to practice-oriented tasks, participation in professional communities, mentoring, supervision, the creation of an electronic portfolio and the assessment of changes in teaching practice. The analysis carried out has shown that the continuous professional development of teaching staff should be viewed as a holistic process of professional renewal, in which the content, models, forms and mechanisms of implementation are interlinked. Within such a system, postgraduate education is not merely a mechanism for periodically undertaking courses, but an institutional environment that provides learning, support, testing, reflection and evidence-based presentation of the results of professional development.

Conclusions

The analysis of the substantive components of teachers' professional learning demonstrated that postgraduate education should not be limited solely to professional development. Its essence lies not merely in attending courses or accumulating certificates, but in the continuous renewal of competencies, pedagogical thinking, digital readiness, reflective practice, and the capacity for self-directed professional growth. In this context, postgraduate education performs both educational and supportive functions by creating conditions for individual learning pathways, professional collaboration, and the practical enhancement of teachers' professional practice. The analysis of professional development models demonstrated that the course-based, competency-based, andragogical, personalised, network-based, digital, and mentoring and supervision models each perform distinct functions within the postgraduate education system. The course-based model provides organisational coherence for learning, the competency-based model focuses on professional outcomes, the andragogical model recognises the experience of the adult learner, the personalised model supports individual learning pathways, the network-based model strengthens collegial collaboration, the digital model enhances accessibility and flexibility, while the mentoring and supervision model provides support for implementing new approaches in practice. Consequently, effective professional development depends not on selecting a single model but on combining these approaches in accordance with teachers' professional needs.

The identification of effective forms of professional development showed that the effectiveness of courses,

training programmes, workshops, online courses, professional learning communities, mentoring, supervision, placements, electronic portfolios, practice-oriented projects, and microlearning depends on teachers' active participation, engagement with authentic professional tasks, the creation of educational products, constructive feedback, and sustained post-course support. The content analysis of professional development programmes revealed the predominance of courses, thematic modules, webinars, online courses, training programmes, workshops, and practice-oriented activities, whereas the assessment of individual professional learning needs, long-term support, mentoring, supervision, the documentation of changes in teaching practice, and the evaluation of long-term outcomes were addressed less consistently. The rationale for implementing an integrated model demonstrated that postgraduate education should operate as a continuous cycle of professional support: from needs assessment, the development of an individual learning pathway, and modular and blended learning to practice-oriented tasks, participation in professional learning communities, mentoring or supervision, the development of an electronic portfolio, and the evaluation of changes in teaching practice. Implementing this cycle requires a clear distribution of responsibilities among teachers, educational advisers, centres for the professional development of teachers, postgraduate teacher education institutions, mentors, supervisors, school leaders, and professional learning communities. Such integration makes it possible to move from periodic professional development towards a systematic model of teachers' continuing professional development. Future research should focus on the empirical evaluation of the effectiveness of the integrated model of teachers' professional development, particularly through examining the impact of individual learning pathways, mentoring, supervision, digital platforms, and electronic portfolios on measurable changes in teaching practice.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Організація професійного навчання педагогів у системі безперервної освіти

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■ **Анотація.** Мета статті полягала в теоретичному узагальненні моделей неперервного професійного розвитку педагогів, ефективних форм підвищення кваліфікації та можливостей їх застосування в післядипломній освіті. Методологія дослідження ґрунтувалася на теоретико-аналітичному підході й передбачала поєднання теоретичного аналізу наукових джерел, контент-аналізу нормативно-програмних матеріалів, порівняльного методу, систематизації, узагальнення та педагогічного моделювання, що забезпечило аналіз 64 джерел за 2018-2025 рр., зіставлення моделей професійного розвитку педагогів, упорядкування форм підвищення кваліфікації та обґрунтування логіки інтегрованої моделі для системи післядипломної освіти. Результати дослідження показали, що неперервний професійний розвиток педагогічних працівників у післядипломній освіті постає як цілісний процес професійного оновлення, що охоплює не лише підвищення кваліфікації, а й самоосвіту, рефлексію, цифрову готовність, професійну взаємодію та практичне вдосконалення педагогічної діяльності. Моделі професійного розвитку виконують різні функції: курсова забезпечує організаційну впорядкованість, компетентнісна орієнтує на професійні результати, андрагогічна враховує досвід дорослого учасника, персоналізована підтримує індивідуальну траєкторію, мережева посилює колегіальну взаємодію, цифрова розширює доступ до навчання, а менторсько-супервізійна забезпечує супровід упровадження змін у практику. Ефективність форм підвищення кваліфікації визначається не їхньою назвою, а здатністю забезпечити активну участь педагога, виконання практичного завдання, створення освітнього продукту, зворотний зв'язок, післякурсовий супровід і оцінювання змін у професійній діяльності. Інтегрована модель професійного розвитку має впроваджуватися як послідовний цикл, що поєднує діагностику потреб, індивідуальну освітню траєкторію, модульне й змішане навчання, професійну спільноту, наставництво, супервізію, електронне портфоліо та оцінювання змін у педагогічній практиці

■ **Ключові слова:** рефлексія; компетентність; самоосвіта; наставництво; супервізія; мікронавчання

Науковий журнал

«ПРОФЕСІЙНА ОСВІТА: МЕТОДОЛОГІЯ, ТЕОРІЯ ТА ТЕХНОЛОГІЇ»

Том 12, № 1
2026

Відповідальний редактор:
Н. Сердюк

Підписано до друку з оригінал-макета 12.05.2026
Ум. друк. арк. 15,1
Тираж 100 примірників

Видавництво:
Університет Григорія Сковороди в Переяславі
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Scientific Journal

"PROFESSIONAL EDUCATION: METHODOLOGY, THEORY AND TECHNOLOGIES"

Volume 12, No. 1
2026

Managing Editor:
N. Serdiuk

Signed to the print with the original layout 12.05.2026
Conventional Printed Sheet 15.1
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