Zhytomyr Ivan Franko State University Journal. Pedagogical Sciences. Vol. 4 (123)

Вісник Житомирського державного університету імені Івана Франка. Педагогічні науки. Вип. 4 (123)

ISSN (Print): 2663-6387
ISSN (Online): 2664-0155

UDC 37.013.74:377:004.85
DOI 10.35433/pedagogy.4(123).2025.9

THEORETICAL FOUNDATIONS FOR IMPLEMENTING MODERN MODELS OF PROFESSIONAL TRAINING FOR FUTURE IT SPECIALISTS

R. V. Diadiushkin*

The article presents a systematic theoretical analysis, classification, and comparative characterization of contemporary global and national pedagogical models of professional training for IT specialists, based on identifying vectors of their integration and digitalization amid the growing qualification gap. The study of these models is critically important for ensuring that graduates' professional training aligns with current industry requirements.

A multi-level classification of IT training models is substantiated, highlighting the paradigmatic foundations of competency-based learning, the operational effectiveness of project-based learning, and the TPACK framework. The organizational-integrative model of Work-Integrated Learning (WIL)/Dual Education is analyzed in the context of addressing Ukraine's workforce needs. It is demonstrated that the optimal pathway for professional training is the transition to the hybrid Agile CBE (Agile Competency-Based Education) model, which combines the flexibility of iterative methodologies with a strong focus on skill mastery.

A structured classification of models based on paradigmatic, operational, and integrative approaches is provided. The necessity of integrating Agile principles into a Competency-Based Learning environment for the effective development of transversal (soft) skills is substantiated. For the first time, the role of universal IT toolsets as a key platform for the successful implementation of dual education within Ukraine's vocational education system is examined in detail.

The results may be used by higher education institutions to enhance curricula, develop synergistic educational programs aligned with the needs of the IT industry, and implement standardized, transparent mechanisms for assessing competencies.

Keywords: *competency-based approach, dual education, project-based learning, TPACK, agile pedagogy, qualification gap, digital competencies.*

ТЕОРЕТИЧНІ ЗАСАДИ ВПРОВАДЖЕННЯ СУЧАСНИХ МОДЕЛЕЙ ПРОФЕСІЙНОЇ ПІДГОТОВКИ МАЙБУТНІХ ІТ-ФАХІВЦІВ

Р. В. Дядюшкін

У статті проведено системний теоретичний аналіз, класифікацію та порівняльну характеристику сучасних світових та вітчизняних педагогічних моделей професійної підготовки ІТ-фахівців на основі визначення векторів їхньої інтеграції та діджиталізації в

* Postgraduate Student
(Zhytomyr Ivan Franko State University)
rd.rd.2250@gmail.com
ORCID: 0009-0001-9245-1479

умовах зростаючого кваліфікаційного розриву. Вивчення цих моделей є критично важливим для забезпечення відповідності професійної підготовки випускників сучасним вимогам індустрії.

Обґрунтовано багаторівневу класифікацію моделей підготовки ІТ-фахівців, виділено парадигмальні основи компетентнісно-орієнтованого навчання, операційну ефективність проєктно-орієнтованого навчання та фреймворку TPACK. Проаналізовано організаційно-інтеграційну модель Work-Integrated Learning (WIL)/Дуальної освіти в контексті подолання кадрових потреб України. Доведено, що оптимальним шляхом професійної підготовки є перехід до гібридної моделі Agile CBE (Agile Competency-Based Education), яка поєднує гнучкість ітеративних методологій з акцентом на набуття майстерності.

Систематизовано класифікацію моделей на основі парадигмальних, операційних та інтеграційних підходів. Обґрунтовано необхідність інтеграції Agile-принципів у Компетентнісно-орієнтоване середовище для ефективного розвитку трансверсальних навичок (Soft Skills). Вперше детально проаналізовано роль універсального ІТ-інструментарію як ключової платформи для успішного впровадження дуальної освіти в українській системі професійної освіти.

Результати можуть бути використані закладами вищої освіти для покращення навчальних планів, розробки синергетичних навчальних програм, які відповідають вимогам ІТ-індустрії, та впровадження стандартизованих, прозорих механізмів оцінювання компетенцій.

Ключові слова: *компетентнісний підхід, дуальна освіта, проєктно-орієнтоване навчання TPACK, agile-педагогіка, кваліфікаційний розрив, цифрові компетентності.*

Introduction of the issue. The rapid development of information technologies and global digitalization require the higher education system to radically transform its approaches to the professional training of future IT specialists. In conditions where technological stacks are changing at a speed that significantly exceeds the rate of updating curricula, it is critically important to ensure that graduates develop not only relevant technical knowledge (Hard Skills), but also high adaptability and skills that allow them to work effectively in a dynamic environment. These transversal skills (Soft Skills), including critical thinking, teamwork, communication and creativity, are recognized by the industry as equally valuable, and sometimes more important, than purely technical ones.

The Ukrainian higher education system, guided by global trends of globalization and continuity of education, faces an acute problem of the qualification gap (Qualification Gap). Labor market studies show that despite the availability of specialists with higher education, they often do not meet the current requirements of employers, which leads to a shortage of qualified personnel [6: 71-72]. This situation emphasizes the structural mismatch between the educational outcomes provided by the traditional model and the needs of the IT industry, where flexible and iterative (Agile) methodologies dominate. Therefore, updating the content of curricula should be accompanied by changes in pedagogical models and mechanisms for integrating education with production.

Current state of the issue. The problem of professional training of future IT specialists is examined in scholarly works within both Ukrainian and international research domains. At the general theoretical level, issues of professional and pedagogical training in the context of digitalization have been analyzed by M. Chernenko, Ya. Honcharenko, A. Prokopenko, S. Semerikov, V. Shcherbak, K. Striuk, T. Vakaliuk, among others.

Foreign studies pay considerable attention to practice-oriented learning models such as Project-Based Learning (PjBL), Problem-Based Learning (PBL), Competency-Based Education (CBE), as well as the need to develop soft skills in technical fields (S. Gharbavi, S. Shishov, O. Yalcinkaya, M. Zarour, etc.). Conceptual aspects of dual education and the qualification gap in the Ukrainian context have been analyzed by V. Ostapchuk, H. Sliusarenko, and L. Strashynska.

Thus, the research landscape demonstrates a wide range of models – from competency-based and technological to integrative – yet lacks a comprehensive theoretical synthesis that would merge these approaches into a coherent system of professional training adapted to Ukrainian specifics.

Aim of the research. To identify, analyze, and systematize key global models of professional training for IT specialists, substantiate their methodological value for the Ukrainian higher education system, and determine optimal vectors for integration through the development of hybrid pedagogical models.

Results and discussion. The professional training of IT specialists is the subject of active scholarly investigation, within which several fundamental methodological directions have emerged that shape contemporary approaches to organizing the educational process.

Competency-Based Education (CBE), initiated in the works of R. Boyatzis, is understood as an instructional approach focused on mastery rather than the duration of learning. Current research concentrates on developing instruments for standardized competence assessment, including the use of artificial intelligence (SmartRubrics [5: 16-17]) for measuring soft skills.

The TPACK framework (P. Mishra, M. Koehler) represents a key model for integrating technology into education [9]. Empirical studies emphasize that TPACK development requires an organic combination of theoretical instruction and its practical implementation [8: 166-167].

Practice-oriented learning formats such as Project-Based Learning (PjBL) and Problem-Based Learning (PBL) hold a leading position in modern IT education, as they enable modelling of real engineering challenges and the development of managerial skills. In this context, the CDIO approach (Conceive, Design, Implement, Operate), proposed by E. Crawley, provides a holistic cycle of engineering activity [2].

There is increasing interest in the implementation of Agile pedagogy, which adapts the educational process to the industrial logic of iterativity and flexibility [16: 272].

Work-Integrated Learning (WIL) models are viewed as one of the most effective mechanisms for integrating formal education with workplace practice, particularly in the conditions of a digital economy [7].

The Ukrainian scholarly tradition actively incorporates these global trends. Researchers such as K. Striuk, S. Semerikov, T. Vakaliuk and others focus on the development of information and communication competencies and the enhancement of project-based skills. Studies on dual education tailored to the needs of the IT industry are also gaining prominence.

The synthesis of these findings allows for the identification of three groups of models – paradigmatic, operational, and organizational-integrative – which collectively form a coherent system of modern IT training and create a foundation for the development of hybrid pedagogical models relevant to the Ukrainian context.

Paradigmatic foundations. Competency-Based Education (CBE) is a fundamental paradigm that ensures direct alignment of learning outcomes with the requirements of the IT industry. Unlike traditional education, which is oriented toward the amount of time spent in an educational institution, CBE focuses on the demonstration of mastery and the successful acquisition of a clearly defined set of knowledge and skills [1: 7].

A key argument in favor of CBE is the need to bridge the qualification gap. While the traditional system guarantees only the time devoted to learning, CBE requires proof that a student is capable of performing tasks relevant to their future profession. This is particularly critical in IT, where mastery of technical skills (such as mathematical and computer modelling) must be complemented by highly developed transversal competencies.

An analysis of industry requirements clearly shows that soft skills (communication, critical thinking, stress management) are just as essential for individual and team success as technical knowledge. Moreover, employers frequently note a lack of these skills among early-career professionals [11: 15, 14: 10]. Competency-based learning inherently requires the inclusion of these competencies in learning objectives and their mandatory assessment.

One of the key challenges in implementing CBE is the development of reliable and standardized methods for assessing such complex competencies. Contemporary studies highlight the potential of AI-based tools, which can provide automated generation and evaluation of tasks, thereby enhancing standardization and objectivity in IT education [5: 16-17].

A comparison of the underlying principles demonstrates the need for a methodological transition from the traditional model toward a competency-based one, focused on measurable outcomes, the development of flexible skills, and the enhancement of learner autonomy.

Table 1

Comparison of Competency-Based and Traditional Models of IT Specialist Training

Comparison parameter	Competency-Based Model	Traditional Model
Progress focus	Demonstration of mastery and skills	Number of classroom hours
Unit of measurement	Set of acquired competencies	Completed courses or subjects
Assessment requirements	Comprehensive assessment of competencies and soft skills (SmartRubrics, portfolio)	Knowledge-based assessment (exams, tests)
Role of the educator	Coach, facilitator, experience designer	Lecturer, transmitter of knowledge

An equally important paradigmatic foundation is the Technological, Pedagogical, and Content Knowledge (TPACK) model, which is fundamental for ensuring the effective integration of ICT into the didactic process. The model identifies three domains of knowledge that must converge to enable successful teaching: technological, content, and pedagogical knowledge [9].

Technological knowledge (TK) encompasses mastery of the tools and technologies required for the future specialist's professional activity. Content knowledge (CK) refers to a deep understanding of the instructional content (for example, software architecture or algorithms). Pedagogical knowledge (PK) involves proficiency in instructional methods, strategies, and teaching processes [9].

In the field of IT education, where instructors often possess a high level of TK and CK, special attention must be paid to the development of pedagogical knowledge (PK), particularly the ability to effectively use mobile ICT tools to teach informatics-related subjects.

Studies emphasize that TPACK develops most successfully when instructors not only undergo training but also have the opportunity to immediately apply the acquired knowledge in real teaching contexts. However, a widely recognized barrier to effective professional development is the lack of time and

financial incentives for educators. This creates a paradox: although the need to enhance TPACK is high due to the rapid evolution of technology, institutional barriers slow down this process, negatively affecting the quality of digitalization in education [8: 178].

In summary, competency-based education and the TPACK model form a complementary foundation for modernizing the training of future IT specialists. CBE ensures a focus on measurable outcomes and relevant professional competencies, while TPACK defines the conditions necessary for high-quality integration of digital technologies and improved pedagogical mastery. Together, these paradigms set a strategic direction for updating educational programs in alignment with industry needs, the development of soft skills, and effective digitalization of the educational process.

Operational models provide the mechanisms through which competency-based education is implemented in practice. In international academic discourse, two core models are distinguished: Problem-Based Learning and Project-Based Learning. Both are active learning formats, yet their end goals and areas of focus differ.

PBL (Problem-Based Learning) is centered on developing critical thinking and decision-making skills through the analysis and resolution of complex, "unstructured", or "ill-defined" problems. Its goal is to teach students to analyze a situation, formulate a problem, and generate possible solutions [4].

PjBL (Project-Based Learning) focuses on learning through direct experience in completing real-world projects. The primary outcome of PjBL is the creation of a final functional product (software, system, or solution). PjBL effectively increases motivation, develops collaboration skills, and enables the application of theoretical knowledge in a relevant context [15: 110-111]. Ukrainian scholars actively study the use of PjBL, particularly for developing IT project management competencies by using ICT and online courses.

The key differences between these models are summarized in Table 2.

Table 2

Differentiation of Project-Based Learning (PjBL) and Problem-Based Learning (PBL) Models

Characteristic	Problem-Based Learning (PBL)	Project-Based Learning (PjBL)
Primary goal	Development of critical thinking and the ability to solve complex problems	Creation of a final product
Duration	Short-term (focused on a single problem)	Long-term (covers a broader set of concepts)
Task type	Solving an "unstructured" problem	Completing a real or simulated project
Key skills	Analysis, diagnosis, scientific inquiry	Planning, teamwork, project management

For engineering education and the IT sector, PjBL can be effectively structured using the CDIO framework (Conceive, Design, Implement, Operate), an initiative launched at the Massachusetts Institute of Technology. CDIO provides training across the full product life cycle – from idea conception to implementation and operation – which increases the practical orientation of the educational process and aligns it more closely with real production conditions [18].

The success of project-based learning is directly linked to the methodologies

widely used in the information technology industry. Existing research indicates that traditional approaches, including the "waterfall" model, are insufficiently effective for long-term knowledge retention and the development of sustainable competencies. In contrast, Agile pedagogy offers a flexible and iterative approach focused on learner needs and the dynamic nature of instructional content. Its key principles revolve around iterativity, which involves frequent cycles of learning interaction with systematic feedback, and value orientation, where course content is structured according to its priority and relevance for the learner. Within this approach, students first articulate the desired outcome and only then take steps to achieve it, which contributes to a better understanding of learning goals [16: 272]. A systematic review confirms that Agile methodologies can be effectively applied both for studying Agile practices themselves and as a general pedagogical approach to mastering non-Agile content, enhancing the relevance and practical orientation of information systems in education.

PBL, PjBL, CDIO, and Agile pedagogy form an integrated system of operational models that ensure the practical implementation of the competency-based approach in IT education. PBL develops intellectual and analytical competencies; PjBL provides experience in professional activity and product creation; CDIO structures this experience within the logic of the engineering life cycle; and Agile pedagogy adds flexibility and alignment with contemporary industry practices. Together, they constitute a balanced methodological foundation capable of preparing competitive IT professionals in a dynamic digital environment.

Organizational-integration models play a crucial role in bridging theoretical learning with real professional experience. In global practice, one of the most effective approaches is Work-Integrated Learning (WIL), a model aimed at the deep integration of academic training and practical activity within the contemporary digital economy [7]. Its key objective is to create a learning environment in which students can systematically apply their acquired knowledge to real production situations.

In Ukraine, WIL is implemented through dual education, which combines theoretical learning in higher education institutions with practical employment at an enterprise. Pilot projects on dual education were launched by the Ministry of Education and Science of Ukraine in 2015-2017, demonstrating high employment rates and improved quality of professional training [3].

Despite the active discussion of development pathways for training future IT specialists in Ukrainian academic discourse, the main barrier to the full implementation of dual education – especially in institutions of professional pre-higher education – is the limited resource base, including insufficient funding and a shortage of specialists proficient in modern information technologies at a professional level.

To overcome these constraints, it is necessary to create a unified digital educational space that ensures active and continuous interaction between educational institutions and the enterprise. Such an integrated digital environment would allow leading IT professionals to participate in key educational processes, such as designing and updating curricula, delivering instruction, or participating in the evaluation of final and qualification projects [10].

Moreover, dual education requires moving away from typical abstract assignments, instead offering students the opportunity to solve real technological problems of an enterprise or to engage in situational-practical tasks based on simulation technologies. This emphasis on pragmatism and real production challenges is a direct pathway to overcoming the structural qualification gap.

The analysis of various pedagogical models shows that IT training cannot rely on a single conceptual foundation, as high-quality educational practice requires the combination of paradigmatic

approaches, operational methodologies, and organizational structures. The synergy of competency-based education, project- or Agile-oriented learning, and industry-integrated models such as dual education makes it possible to provide balanced training in which theoretical acquisition, practical application, and professional socialization act as mutually reinforcing mechanisms. This integrated perspective explains why PjBL creates a context for applying knowledge through work on a real project, yet CBE ensures that the outcome of this process is verified mastery rather than merely the completion of a course. Similarly, WIL or dual education provides an authentic industrial environment [17: 393], but without the TPACK framework teachers cannot effectively integrate technological tools into the complex, long-term, multidimensional learning process that requires deliberate pedagogical management.

At the same time, the limitations of implementing these models – particularly in the Ukrainian context – are largely determined by organizational and staffing constraints. One of the key challenges is the assessment of soft skills: although the industry emphasizes their priority, standardizing procedures for their measurement remains extremely difficult. The implementation of CBE requires substantial investment in designing detailed educational programs and training methodologists capable of applying them correctly. Effective dual education demands close cooperation with industry, including joint curriculum development, which may conflict with instructors' desire to maintain autonomy in course design, while administrators focus on aligning content with employer demands. Finding a balance between these interests constitutes a complex managerial and political task that significantly influences the success of pedagogical innovation implementation.

Justification of the Hybrid Approach. For effective functioning within the dynamic IT environment, the modern system of professional training must transition from linear, "waterfall"-style schemes to flexible models capable of responding rapidly to technological changes and industry demands. It is precisely the need to overcome the structural mismatch between educational outcomes and professional standards that highlights the relevance of introducing the hybrid Agile CBE (Agile Competency-Based Education) model.

The traditional education model based on fixed curricula has proven insufficient for preparing specialists who must work in iterative, team-based, and high-demand development settings. In contrast, the hybrid Agile CBE model integrates three key components:

- The competency orientation of CBE, which ensures clarity, measurability, and evidence-based learning outcomes. A student demonstrates not merely course completion but the attainment of a defined level of mastery.
- The flexibility and cyclicality of Agile, which organize the educational process into short iterations (sprints) that include planning, execution, reflection, and continuous feedback. This makes learning adaptive to technological advances and promotes the development of team communication skills.
- The contextuality of PjBL and WIL, which immerse students in real projects and authentic production tasks. Using a unified digital environment, industry partners can integrate into the educational process, formulate tasks, participate in reviews, and monitor progress.

In this configuration, Agile defines the mode of organizing learning, CBE specifies the content and expected outcomes, while PjBL and WIL create the environment for authentic practice. Meanwhile, TPACK ensures pedagogical and technological coherence, without which digital tools cannot be effectively integrated into a complex, long-term, multidimensional learning process. Altogether, Agile CBE becomes not merely a set of methods but a systemic response to contemporary industry demands requiring a combination of flexibility,

practical relevance, and a high level of professional competence.

Since these pedagogical models perform different functions within the structure of the hybrid approach – content-related, procedural, techno-pedagogical, and contextual – it is essential to identify their key components and methodological distinctions. This makes it possible to understand how they complement one another within Agile CBE and which elements of each model are integrated into the shared framework.

The systematized characteristics of these models are presented in Table 3, allowing the underlying approaches, methods, and foundational principles to be traced and compared.

Table 3

Systematized Characteristics of Contemporary Models of Professional Training for IT Specialists

Model	Approaches	Methods	Principles
Competency-Based Education (CBE)	Competency-based; learner-centered; systemic (for structuring competencies).	Programmatic assessment of competencies; skills measurement in realistic environments; formative assessment through feedback.	Mastery-oriented education; priority of demonstrated outcomes over time spent; focus on complex competencies.
Project-/Problem-Based Learning (PjBL/PBL)	Activity-based; contextual; constructivist.	Project-based method; problem-based method.	Authenticity and relevance of tasks; fostering critical thinking; learning through collaborative inquiry and selection of optimal solutions.
TPACK	Technological-pedagogical; integrative approach; reflective approach.	Professional development of instructors; self-assessment across knowledge components (CK, PK, TK).	Convergence of three knowledge domains (technology, pedagogy, content); effective ICT integration into learning content; continuous professional development.
WIL/Dual Education	Integrative; social partnership; digitalization-driven.	Solving real technological problems of the enterprise; workplace-based practical training (internship).	Social partnership; provision of an authentic industrial context.

Conclusions and research perspectives. The theoretical analysis conducted confirms that the contemporary system of professional training for future IT specialists requires a comprehensive renewal of pedagogical approaches. The functioning of education under conditions of global digitalization

and the rapid growth of the qualification gap is possible only through the transition to integrated, practice-oriented, and flexible models of learning organization. The key methodological foundation of such renewal is competency-based education, which reorients professional training toward the achievement and demonstration of mastery and ensures the development of critically important soft skills that determine a specialist's competitiveness in the modern labor market.

The effectiveness of the educational process is strengthened through the combination of project-based learning and the principles of Agile pedagogy, which provide the necessary flexibility, iterativity, and adaptability of educational programs. This combination enables a prompt response to the dynamics of technological change, while allowing students to develop competencies relevant to the working conditions of IT companies that operate under iterative methodologies.

The integration of theoretical and practical components becomes particularly significant, especially within the framework of Work-Integrated Learning and dual education formats. In the Ukrainian context, where the material and technical resources of educational institutions are limited, the effectiveness of such models largely depends on the use of universal and open digital tools. These tools make it possible to create a holistic digitalized educational space and ensure sustainable cooperation between educational institutions and industry partners.

The generalization of the obtained results allows recommending a transition to hybrid pedagogical models, such as Agile CBE, which integrate the goals, processes, and contexts of professional training. Within this model, the competency-based approach defines the expected learning outcomes, Agile methodology provides a dynamic mechanism for achieving them, and project-based and industry-integrated learning create a practical environment for their realization. This approach is the most effective for preparing specialists capable of functioning in a highly dynamic, technologically saturated, and uncertain professional environment.

Future research perspectives include empirical verification of the effectiveness of hybrid models of professional training, the development of methodologies for assessing the formation of integrated competencies (both technical and soft) of IT specialists, as well as exploring the potential for scaling Agile pedagogy within formal and non-formal education.

REFERENCES (TRANSLATED & TRANSLITERATED)

1. Boyatzis, R.E. (2008). Competencies in the 21st century. *Journal of Management Development*, 27(1), 5-12. DOI: 10.1108/02621710810840730 [in English].

2. *CDIO Syllabus 3.* (n.d.). Worldwide CDIO Inititative. Retrieved from: https://www.cdio.org/content/cdio-syllabus-30 [in English].

3. *Dualna osvita [Dual education].* (n.d.). Ministerstvo osvity i nauky Ukrainy. Retrieved from: https://mon.gov.ua/osvita-2/profesiyno-tekhnichna-osvita/reforma-profesiynoi-osviti/derzhavno-privatne-partnerstvo-ta-dualna-osvita/dualna-osvita [in Ukrainian].

4. Erdem, C., Kaya, M., Toptaş, H.T., & Altunbaşak, I. (2025). Problem-based learning and student outcomes in higher education: A second-order meta-analysis. *Studies in Higher Education,* 1-22. DOI: 10.1080/03075079.2025.2498084 [in English].

5. Hochstetter-Diez, J., Negrier-Seguel, M., Diéguez-Rebolledo, M., Candia-Garrido, E., & Vidal, E. (2025). From mapping to action: SmartRubrics, an AI tool for competency-based assessment in engineering education. *Sustainability,* 17(13), 6098. DOI: 10.3390/su17136098 [in English].

6. Horoshkova, L., Sydorenko, V., & Grytsan, O. (2025). Qualification gap in the Ukrainian labour market in the context of war: Regional aspect. *Baltic Journal of Economic Studies,* 11(1), 68-77. DOI: 10.30525/2256-0742/2025-11-1-68-77 [in English].

7. International journal of work-integrated learning: Home. (n.d.). *International Journal of Work-Integrated Learning.* Retrieved from: https://www.ijwil.org/ [in English].

8. Jaipal-Jamani, K., & Figg, C. (2015). A case study of a TPACK-based approach to teacher professional development: Teaching science with blogs. *Contemporary Issues in Technology and Teacher Education,* 15(2), 161-200. Retrieved from: https://www.learntechlib.org/p/148462 [in English].

9. Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education,* 9(1), 60-70. Retrieved from: https://citejournal.org/volume-9/issue-1-09/general/what-is-technological-pedagogicalcontent-knowledge [in English].

10. Kukushkin, D.V., & Kolesnikova, V.V. (2022). Praktychni aspekty didzhytalizatsii dualnoi formy osvity u zakladakh fakhovoi peredvyshchoi osvity [Practical aspects of digitalization of the dual form of education in institutions of professional higher education]. *Elektronne naukove fakhove vydannia "Vidkryte osvitnie e-seredovyshche suchasnoho universytetu" – Electronic scientific professional publications "Open education e-environment of the modern university",* (12), 69-79. DOI: 10.28925/2414-0325.2022.126 [in Ukrainian].

11. Mohammed, F.S., & Ozdamli, F. (2024). A systematic literature review of soft skills in information technology education. *Behavioral Sciences,* 14(10). DOI: 10.3390/bs14100894 [in English].

12. Nosyrieva, O.V. (2023). Overview of theoretical foundations of IT specialists professional training at universities in Great Britain. *Innovate Pedagogy,* 2(65), 83-86. DOI: 10.32782/2663-6085/2023/65.2.17 [in English].

13. Petrenko, S. (2023). Problema profesiinoi pidhotovky maibutnikh IT-fakhivtsiv u retseptsiiakh vitchyznianykh naukovtsiv ostannoho desiatyrichchia [The problem of professional preparation of future IT specialists in the recipes of foreign sciences of the last decade]. *Pedahohichna nauka i osvita XXI stolittia – Pedagogical science and education of the XXI century,* (1), 115-129. Retrieved from: http://repository.rshu.edu.ua/id/eprint/14706 [in Ukrainian].

14. Pritchard, J. (2022). The Importance of Soft Skills In entry-level employment and postsecondary success: Perspectives from employers and community colleges. *Seattle Jobs Initiative.* Retrieved from: https://www.jtech.org/wp-content/uploads/2022/09/SJI_SoftSkillsReport_vFINAL_1.17.13.pdf [in English].

15. Ramadhan, D.L., & Nafisah, D. (2025). Project-Based learning vs. problem-based learning: Uncovering effective learning methods. *Journal of Technology, Education & Teaching (J-Tech),* 1(3), 108-114. DOI: 10.62734/jtech.v1i3.424 [in English].

16. Sharp, J., Mitchell, A., & Lang, G. (2020). Agile teaching and learning in information systems education: An analysis and categorization of literature. *Journal of Information Systems Education,* 31, 269-281 [in English].

17. Siddoo, V., Janchai, W., & Sawattawee, J. (2018). A systematic review of work-integrated learning for the digital economy. *International Journal of Work-Integrated Learning,* 9(2), 385-398. Retrieved from: https://www.ijwil.org/files/IJWIL_19_4_385_398.pdf [in English].

18. Zhong, X., Chiu, S., & Lai, F. (2021). Effects of the use of CDIO engineering design in a flipped programming course on flow experience, cognitive load. *Sustainability,* 13(3), 1381. DOI: 10.3390/su13031381 [in English].

Received: October 30, 2025
Accepted: November 24, 2025