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CONCEPTUAL MODEL OF DIGITAL SKILLS DEVELOPMENT FOR FUTURE TEACHERS OF VOCATIONAL EDUCATION INSTITUTIONS

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Abstract

Relevance. Since 2022, the Ukrainian vocational education system has been functioning under war conditions characterized by powerful information attacks and mass displacement of staff and learners. This requires the development of new models for training educators with developed digital skills, capable of ensuring high-quality professional training of personnel for the future recovery of Ukraine and its European integration.

Objective: The theoretical substantiation and description of a conceptual model for the development of digital skills of future teachers of vocational education institutions.

Methods: Theoretical analysis of sources – to study the state of scientific elaboration of the problem and generalize the methodological foundations of digital skills development for future vocational education teachers; comparison and generalization – to study approaches to forming modern models of teachers' digital growth; systemic-structural analysis – to substantiate the architectonic structure of the model; modeling – to visualize the structure of the model of digital skills development for future teachers of vocational education institutions and the author's *MindMupsProfi* digital ecosystem used within it.

Results: A conceptual model for the development of digital skills of future teachers of vocational education institutions is proposed. It integrates 33 innovative tools (MindMup, Canva, Miro, Padlet, Jamboard, Google Workspace, ChatGPT, Copilot, etc.), structured by didactic levels (diagnostic, formative, analytical, reflective, updating), and utilizes the author's digital ecosystem *MindMupsProfi* (which facilitates continuous content updates, diagnostics, analytics, and automated certification of the results of educators' digital skills development).

Conclusions: The conceptual model for the development of digital skills of future teachers of vocational education institutions is presented as a flexible, structurally ordered system that integrates four interconnected concepts, is supported by the author's digital ecosystem *MindMupsProfi* with the "live" *PROFI* web-smart-advisor, and can serve as a platform for developing digital culture, pedagogical resilience, and innovative thinking of educators in the field of vocational education in Ukraine; the architectonic-structural orderliness, cross-cutting adaptability, and analytical manageability of the model will contribute to achieving the expected pedagogical effect (resilience and viability of the system under conditions of constant change, enhancement of the potential of Ukraine's vocational education, its harmonization with European standards (DigCompEdu), and the training of teachers capable of leading digital modernization processes both during the war and post-war recovery period, as well as in the conditions of future peaceful progress).

Keywords: *vocational education, future teachers of vocational education institutions, conceptual model, digital skills, innovative tools.*

Introduction. The digitalization of vocational education in Ukraine is gradually evolving from a technological phenomenon into a systemic factor for renewing pedagogical activity, modernizing the content of learning, and training specialists. It determines the methods of organizing the educational process, criteria for learning effectiveness, and innovative approaches to professional training. Today, a teacher at a vocational education institution is expected to possess not only methodological competence but also the capacity for digital creativity, analytics, working with intelligent services, and integrating digital tools into the content of educational programs. The training of such educators is a prerequisite for the recovery and sustainable development of vocational education in Ukraine, which is undergoing a stage of digital transformation and integration into the European educational space of open education.

Sources. The search for effective models of teachers' digital growth is the subject of an active international scientific dialogue, within which researchers view vocational education as a space of continuous interaction between technologies, pedagogical strategies, and humanistic values. The methodological foundation of this study was formed by the works of foreign scholars who analyzed the specifics of digitalization in the training of vocational education teachers, the development of digital skills, and the application of innovative tools in professional training (Mikeladze, & Gogmachadze, 2024; Pratiwi, Wulandari, & Sari, 2025; Gurtner, Schmid, & Häuptle, 2025; Liu & Du, 2024; Masoumi, 2025; Amemasor, & Brown, 2025). These studies emphasized the relationship between the digital mastery of a vocational education teacher and the quality of the educational process. Research devoted to digital portfolios as a tool for developing teachers' digital skills (Pratiwi et al., 2025), the role of professional communities in improving educators' digital mastery (Liu, & Du, 2024), and the impact of teachers' digital skills on the quality of professional training of learners (Stevens et al., 2024; Bussesund et al., 2024) has gained significant importance. The instrumental component of the model relies on pedagogical innovations described in the works of

scholars who investigated the use of digital technologies in the professional training of technical and economic specialists (Didi, 2024; Huang et al., 2025; Wulan et al., 2023; Kaihlänen et al., 2024).

The Ukrainian context of the research is represented by modern works that have highlighted digital transformations of the educational space, the impact of digital skills on the competitiveness of specialists, and the role of innovations in the development of pedagogical activity (Shaposhnikov & Zhavoronok, 2025; Hedikov, 2025; Hbur, 2024; Haiovych & Rozlutska, 2024). They have proven that forming the digital culture of a vocational education teacher is a key condition for the sustainable development of the vocational training system in Ukraine and its integration into the European educational space. The construction of the concept took into account the analytical conclusions of the Institute of Vocational Education of the NAES of Ukraine (Radkevych & Pryhodii, 2025), which summarized the domestic experience of the digital transformation of vocational education. The foundation relies on the provisions of the European DigCompEdu framework, which outlined the levels of digital maturity of vocational training educators and provided guidelines for the development of digital skills for future teachers of vocational education.

The purpose of the article is the theoretical substantiation and description of a conceptual model for the development of digital skills of future teachers of vocational education institutions.

Research methods. A complex of interconnected methods was applied in the research process: theoretical analysis of sources – to study the state of scientific elaboration of the problem and generalize the methodological foundations of digital skills development for future teachers of vocational education institutions; comparison and generalization – to identify common trends of digitalization in global and Ukrainian vocational education; systemic-structural analysis – to determine the conceptual foundations of the model; modeling – to construct the architectonic structure of the conceptual model of digital skills development and to illustrate the author's digital ecosystem *MindMupsProfi*.

Results and discussion. Sharp shifts in the Ukrainian system of vocational education, caused by war conditions, digital re-equipment of the educational process, and the integration of European standards, reveal the heterogeneity of digital skills among master's students of specialty A5 "Professional Education (by specializations)." Despite the intensive use of digital platforms in higher education institutions (HEIs), the basic and operational digital skills of future vocational education teachers are formed unevenly and nonsystematically. Future educators often demonstrate a sufficient level of self-esteem and high activity in using AI tools; however, their real operational readiness to work in digital environments (LMS, interactive platforms, cloud services, multimedia) remains low. This creates a contradiction between the external figurative sense of "digitalization" and the level of actual digital skills for the professional application of innovative tools in future teaching activities. There are also structural barriers – technical, organizational, methodological, and didactic-psychological – which indicate that the training of vocational education teachers requires not spot digitalization, but a holistic pedagogical system capable of simultaneously organizing, supporting, and assessing the development of digital skills throughout the entire period of study. This requires the substantiation of a modern conceptual model for the development of digital skills of future teachers of vocational education institutions.

It is obvious that the development of digital skills of future vocational education teachers cannot be ensured solely by increasing the number of innovative tools or changing the forms of classes. The revealed fragmentation of digital actions and the superficial use of digital services in the educational process required an integrated solution that would not only form the content but also regulate the logic of transition from goals to operations, from

operations to measurements, and from measurements to analysis and correction.

The proposed model is designed as a closed pedagogical system in which the architectonic structure ensures the sequence and interconnectedness of concepts, while the adaptive nature determines the system's ability to restructure itself according to the conditions of the educational environment.

Architectonics determines the internal logic of the model: each concept generates the next and simultaneously supports the previous one, creating a holistic learning cycle. Goals form content, content sets the character of digital actions, digital actions generate analytical data, and data returns to the first concept, enriching the setting of new goals. In this way, the sequence, interdependence, and self-development of all model components are ensured.

Adaptability means the model's ability to promptly restructure goals, content blocks, and digital actions according to the real conditions of the functioning of vocational education institutions: military threats, blackouts, changes in learning formats, multi-level preparation of students, and fluctuations in personnel and resources. This is not a simplification of learning material, but the intellectual flexibility of a system that supports the sustainability of digital skills development even under conditions of uncertainty. In such logic, the conceptual model appears as a flexible yet structurally ordered system capable of withstanding changes in external conditions, maintaining the continuity of the pedagogical process, and ensuring the gradual development of digital skills of future teachers of vocational education institutions.

Thus, the conceptual model is constructed as an architectonic structure of an adaptive nature, capable of functioning effectively under conditions of uncertainty, uneven digital readiness of higher pedagogical education learners, and instability of the Ukrainian infrastructure due to the current war in Ukraine (Fig. 1).

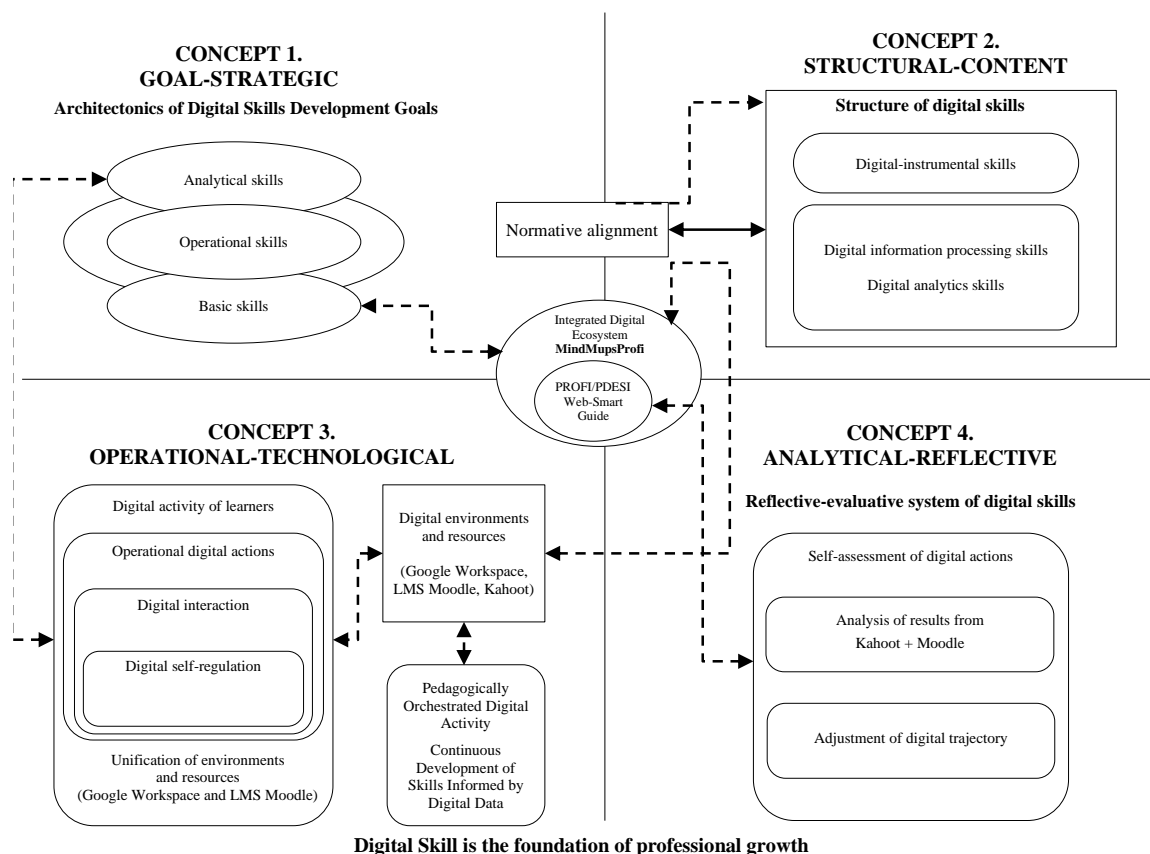


Fig. 1. Conceptual model of digital skills development
Source: author's visualization

The presented model is a holistic architectonic construction of four interconnected concepts that function in a closed pedagogical cycle. They are united by a core – the author's digital ecosystem *MindMupsProfi* with the "live" web-smart-advisor *PROFI* (Personal Development of Educational Professional Innovations). This advisor is constantly updated, maintaining relevant innovative tools (currently 33), automatically removing outdated ones and adding new ones, preserving relevance to the times, educational technologies, and professional requirements.

The conceptual model forms a pedagogical spiral of digital maturity for future teachers of vocational education institutions:

goals → content → digital action → analysis → new goals →..., where each subsequent cycle is a higher turn compared to the previous one.

Concept 1.

Target-Strategic Level

This concept defines "what for" the development of digital skills takes place. At this

level, a strategic vision of the digital activity of future vocational education teachers is formed, which aligns with standards, ethical norms, safety requirements, and the logic of professional training.

Functions of Concept 1:

- defining the strategic goal of digital development (not tools for the sake of tools, but digital skills as a condition for quality teaching);
- building a hierarchy of digital skills: from basic → to operational → to analytical;
- normative alignment: safety, integrity, compliance with vocational education standards.

Given the architectonic construction of the conceptual model, it is advisable to order digital skills according to a structure that ensures a logical transition from basic operations to analytical and reflective actions. Therefore, the array of content elements is organized into a multi-level system (Table 1), which allows tracing internal connections between groups of digital skills of future vocational education teachers and integrating them into the environment of the author's digital ecosystem *MindMupsProfi*, where the educational process in

specialty A5 "Professional Education (by specializations)" takes place engagingly, interactively, and without routine actions thanks to

the constant use of the web-smart-advisor *PROFI* (Personal Development of Educational Professional Innovations).

Table 1

Hierarchy of Digital Skills in the Target-Strategic Concept

Level	Content of Skills	Example of Practical Task
Basic	digital-instrumental actions	creation and shared access to a Google Doc
Operational	organization of a digital class	setting up a course in Moodle
Analytical	data interpretation and decision making	analysis of a Moodle report and correction of tasks

Source: author's systematization

Such a division has a cross-cutting logic for the development of digital skills of future vocational education teachers: from simple actions of creating materials to complex processes of analytics, collaboration, and digital self-regulation. At the same time, each group of skills is not a separate module but a part of a single pedagogical system functioning in interdependence with the goals of the conceptual model, operational actions, and the analytic-reflective cycle.

The first concept determines the strategic direction of the model's development and serves as the foundation for its other elements. In the structure of architectonics, it simultaneously launches the system and acts as a point of return after each analytical cycle, when goals are subject to refinement. The model's adaptability allows adjusting expected results according to changes in learning conditions – internet availability, variability of educational load, and the transition of learners of the second (master's) level of higher education in specialty A5 "Professional Education (by specializations)" to a mixed or distance format.

Thanks to this, the first concept forms a flexible construction that preserves the internal equilibrium of the entire conceptual model.

Concept 2.

Structural-Content Level

At this level, the content of digital skills is formed: their groups, subgroups, interconnections, and benchmarks for assessment. *MindMupsProfi* uses a nine-component structure that provides clear semantic filling for the conceptual model.

To ensure the integrity of the model, quantitative indicators have been integrated to objectify the change in digital skills in dynamics. Key metrics of the Kahoot and Moodle tools, which form the digital footprint of diagnostics and testing of the digital skills level of vocational education master's students, are systematized in a comparative format (Table 2). This made it possible to directly link preliminary, intermediate, and final results with individual trajectories, *MindMupsProfi* recommendations, and the correction of methodological and didactic decisions.

Table 2

Groups of Digital Skills in MindMupsProfi

No.	Skill Group	Simple Explanation	Example of Activity
1	Digital-instrumental	work with documents and clouds	formatting instructions in Drive
2	Information search	search, selection, verification	creating a curated collection in Wakelet
3	Editing and documenting	preparation of structured materials	PDF instruction with links
4	Visualization	schemes, infographics, maps	process infographic in Canva
5	Multimedia	video recording and editing	video instruction (3-5 min)
6	Collaboration	online teamwork	group project in Trello
7	Analytics	work with learning data	interpretation of Kahoot report
8	Safety and ethics	ethical and safe digital behavior	risk analysis and 2FA setup
9	Self-regulation	planning, self-assessment	individual digital trajectory

Source: author's systematization

Comparative dynamics testified: the increase in effectiveness is not a consequence of one-time actions but reflects the systemic influence of the conceptual model, its closed nature, and the constant circulation of data between all concepts. Thus, metrics perform the function of quality indicators, which record not only the level of digital skills development of future vocational education teachers but also the effectiveness of the methodology and didactics implemented in the environment of the author's digital ecosystem *MindMupsProfi*.

The second concept forms the content orderliness of the model and sets the sequence of transition from defined goals to specific pedagogical actions. The architectonic structure of the conceptual model looks like a multi-level hierarchy: each group of digital skills of future vocational education teachers has internal subgroups connected to corresponding operational actions and types of assessment. Adaptability ensures the possibility of quickly adding new tools (when technologies update) or removing those that have lost relevance. It is precisely through the combination of structural orderliness and content flexibility that *MindMupsProfi* remains modern and effective in the unstable conditions of wartime.

Concept 3.

Operational-Technological Level

Within the third concept of the model, "digital action" takes place, i.e., the real activity of vocational education master's students, which combines LMS, interactive innovative tools, the creation of digital products, multimedia materials, and the execution of group tasks. This component of the model is not reduced merely to a set of technical operations. It is a managed pedagogical sequence in which each action is subordinate to the logic of the author's digital ecosystem *MindMupsProfi* and performs the function of developing specific digital skills of future vocational education teachers.

The structure of the digital activity of vocational education master's students is organized as a continuous pedagogically managed cycle, which includes:

- a preliminary diagnostic cross-section of master's students' digital skills using Kahoot and Moodle, which records starting indicators and forms an "entry" digital certificate;

- purposeful execution of exercises, simulators, and practical tasks in the *MindMupsProfi* digital ecosystem, which accompanies the educational process, reinforces the mastery of discipline content, and facilitates the constant development of master's students' digital skills;

- repeated passage of Kahoot and Moodle after working in the *MindMupsProfi* environment, which provides an "exit" certificate and allows assessing the dynamics of digital skills growth;

- fixation of the digital footprint and pedagogical interpretation of results, which ensures the return of analytical data into the conceptual model, refinement of individual goals, and formation of a further adaptive trajectory for the development of digital skills of future vocational education teachers.

The third concept ensures the practical implementation of all other model concepts, integrating educational goals with specific digital actions in the environment of the author's digital ecosystem *MindMupsProfi*. The architectonic structure and adaptive nature support the continuous development of digital skills of vocational education master's students, constantly updating innovative tools and didactic-methodological approaches according to current educational needs.

Concept 4.

Analytic-Reflective Level

This is the level of assessment, self-assessment, data interpretation, and correction of student trajectories. It returns results to the system and launches the next turn of the development spiral.

Functions of Concept 4:

- analysis of Kahoot and Moodle results;
- construction of analytical reports;
- individual reflection;
- correction of digital trajectories.

To ensure a holistic pedagogical cycle, it is important not only to structure digital actions but also to set a transparent system for tracking changes. That is why the analytical block of the model is concretized in the form of clear measurement parameters, grouped in the format of analytical metrics (Table 3). Their introduction allows synchronizing the results of educational activity with initial and intermediate goals, and also creates the basis for automated correction of individual trajectories.

Analytical Metrics of MindMupsProfi

Metric	Source	What it Shows	Purpose
Kahoot Score	automatic test	operational knowledge	level of theory mastery
% of completed tasks	Moodle	responsibility and consistency of practice	assessment of digital skill formation
Completion time	Moodle/Kahoot	efficiency of self-regulation	optimization of tasks
Quality of digital products	portfolio	level of practical skills	comparison with goals of Concept 1
Self-assessment scale	MindMupsProfi	reflexivity	synchronization of expectations and results

Source: author's systematization

The presented metrics form the "analytical contour" of the conceptual model: they connect operational digital actions with strategic goals and also ensure the transition from fragmented observations to systemic pedagogical interpretation. Thanks to them, the model does not record one-time task completions but reproduces the development of digital skills – taking into account the pace, stability, and quality of digital results. That is why after each analysis cycle, the system returns to the first concept and refines the goals, content, and intensity of digital actions. Thus, the closed architectonic logic of the model is formed, where assessment is not a final but a restorative element.

In the fourth concept, the architectonic structure and adaptive nature of the model are manifested most fully: data are not only recorded but also transformed into a means of correcting goals, content, and methods of digital activity. Analytics allows responding to individual and group difficulties (Fig. 2), taking into account wartime conditions (loss of access to equipment, variability of schedules, change in educational load), offering personalized routes, and avoiding overload. This turns the model into a self-sustaining system capable of working over a long time horizon.

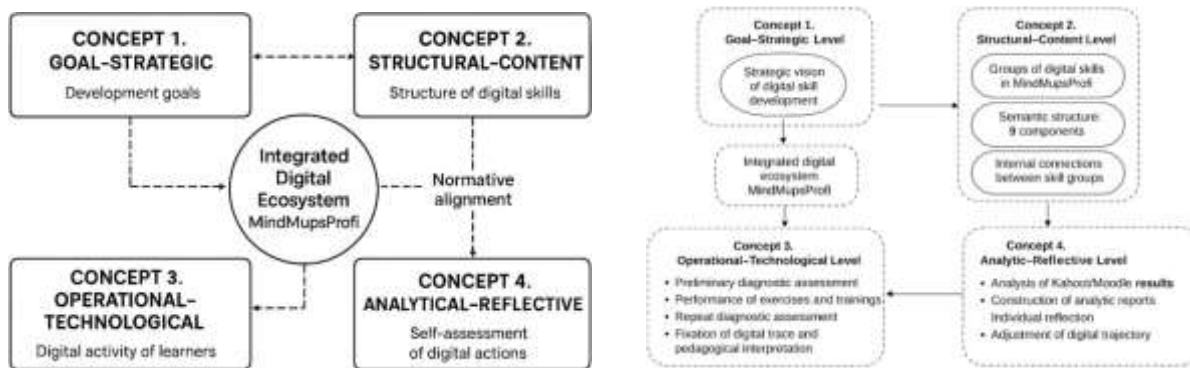


Fig. 2. Possible variations of the conceptual model by adaptive nature

Source: author's visualization

Summarizing the functionality of all four concepts, it is determined that the model ensures a holistic architectonics of digital skills development for future vocational education teachers: goals generate content, content → actions, actions → data, and data form new goals. Adaptability guarantees the viability of the model even in changing

conditions of the educational environment, particularly given the variability of access to technologies and the unequal level of digital readiness of vocational education master's students.

Conclusions. The conceptual model for the development of digital skills of future teachers of vocational education institutions is formed as a

flexible yet structurally ordered system that ensures the sequence and interdependence of strategic goals, content, digital actions, and analytical assessment. The model integrates four interconnected concepts and is supported by the author's digital ecosystem *MindMupsProfi* with the "live" web-smart-advisor *PROFI*. Its adaptive nature ensures the prompt restructuring of goals, content, and digital actions according to the real conditions of the educational environment, including military threats, blackouts, multi-level preparation of higher education learners, and personnel fluctuations. The model offers a convenient algorithm for raising the level of digital skills development of future vocational education teachers, ensuring the sequential integration of innovative tools. The achievement of the pedagogical effect is anticipated thanks to the continuity of digital skills development ("goals → content → digital actions → analysis → new goals

→ ..."), which guarantees the stability and viability of the system under conditions of constant change.

The presented conceptual model demonstrates the potential for long-term use in the system of training vocational education institution teachers, as it combines architectonic-structural orderliness, cross-cutting adaptability, and analytical manageability. Its implementation will contribute to enhancing the potential of vocational education in Ukraine, harmonizing with European standards (DigCompEdu), and training teachers capable of leading digital modernization processes both during the war and post-war recovery period, as well as in conditions of future peaceful progress. The author's conceptual model is not only a didactic-methodological system but can also serve as a platform for developing digital culture, pedagogical resilience, and innovative thinking of educators in the field of vocational education in Ukraine.

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КОНЦЕПТУАЛЬНА МОДЕЛЬ РОЗВИТКУ ЦИФРОВИХ НАВИЧОК МАЙБУТНІХ ВИКЛАДАЧІВ ЗАКЛАДІВ ПРОФЕСІЙНОЇ ОСВІТИ

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Реферат:

Актуальність: після 2022 року українська система професійної освіти функціонує в умовах війни з потужними інформаційними атаками, масовим переміщенням кадрів і здобувачів освіти, що потребує вироблення нових моделей підготовки педагогів з розвиненими цифровими навичками, здатних забезпечити якісну професійну підготовку кадрів для майбутнього відновлення України та її європейської інтеграції.

Мета: теоретичне обґрунтування й опис концептуальної моделі розвитку цифрових навичок майбутніх викладачів закладів професійної освіти.

Методи: теоретичний аналіз джерел – для вивчення стану наукової розробленості проблеми, узагальнення методологічних засад розвитку цифрових навичок майбутніх викладачів професійної освіти; порівняння й узагальнення – для вивчення підходів до формування сучасних моделей цифрового зростання викладачів; системно-структурний аналіз – для обґрунтування архітектонічної структури моделі; моделювання – для унаочнення структури моделі розвитку цифрових навичок майбутніх викладачів закладів професійної освіти та використаної в ній авторської цифрової екосистеми MindMupsProfi.

Результати: запропоновано концептуальну модель розвитку цифрових навичок майбутніх викладачів закладів професійної освіти, що інтегрує 33 інноваційні інструменти (MindMup, Canva, Miro, Padlet, Jamboard, Google Workspace, ChatGPT, Copilot тощо), структуровані за дидактичними рівнями (діагностичний, формувальний, аналітичний, рефлексивний, оновлювальний), використовує авторську цифрову екосистему MindMupsProfi (сприяє проведенню безперервного оновлення контенту, діагностики, аналітики й автоматизованої сертифікації результатів розвитку цифрових навичок педагогів).

Висновки: концептуальна модель розвитку цифрових навичок майбутніх викладачів закладів професійної освіти представлена як гнучка структурно-впорядкована система, що інтегрує чотири взаємопов'язані концепти, підтримується авторською цифровою екосистемою MindMupsProfi з «живим» веб-смарт-порадником ПРОФІ і може бути платформою розвитку цифрової культури, педагогічної стійкості й інноваційного мислення педагогів у сфері професійної освіти України; архітектонічно-структурна впорядкованість, наскрізна адаптивність, аналітична керованість моделі сприятимуть досягненню очікуваного педагогічного ефекту (стійкість і життєздатність системи в умовах постійних змін, підвищення потенціалу професійної освіти України, її гармонізації з європейськими стандартами (DigCompEdu), підготовка викладачів, здатних очолювати процеси цифрової модернізації як у воєнний період і період повоєнного відновлення, так і в умовах майбутнього мирного поступу).

Ключові слова: професійна освіта, майбутні викладачі закладів професійної освіти, концептуальна модель, цифрові навички, інноваційні інструменти.

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