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Modernization of Future Educators' Professional Training in the Context of Education for Sustainable Development

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ABSTRACT :
Modernization of professional training of future teacher education specialists is of particular relevance in the context of digitalization of the educational space, globalization of the labor market and growing demands on the professional competencies of teachers. Integration of innovative technologies, strengthening of practice-oriented learning and ensuring continuous professional development are key tasks of modern teacher education. This study aims to examine the existing conditions, prevailing trends, and future directions for updating the professional preparation of prospective teacher educators in both Ukraine and the global context. Methodologically, the research relied on comparing, systematizing, and synthesizing information from international reports, alongside analyzing scientific literature and regulatory acts. It also incorporated a secondary review of findings from global comparative assessments of teacher education quality. The research revealed that significant directions in updating teacher preparation include adopting a competency-based framework, enhancing digital skills, applying adaptive learning systems and VR/AR tools, and fostering stronger partnerships with employers as well as international educational organizations. Special emphasis is placed on developing intercultural competence and preparing educators to operate effectively in multilingual settings.
It is proved that effective modernization requires an integrated approach that combines digital transformation, development of practical skills and creation of a system of continuous professional growth. . It is substantiated that teacher education for sustainable development is not only knowledge, but also the formation of a new culture of thinking and responsible behavior, which is a necessary condition for building a sustainable future. The practical value of the findings is reflected in their potential to inform the renewal of higher education curricula, enhance the substance and methodology of teacher preparation, shape a national strategy for advancing teacher education, and establish conditions for training competitive professionals capable of thriving in today's digital learning environment.

Keywords: professional training, digitalization of education, competency-based approach, teacher education, innovative technologies, intercultural competence, VR/AR, adaptive learning, international cooperation, pedagogical competencies, sustainable development education, environmental competence.

1. Introduction

One of the aspects of securing the quality of the educational process and competitive human capital formation in the circumstances of dynamic socio-economic

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transformations is the professional training of future teachers. The existing problems of digitalisation of society, globalisation of the educational area, and fast evolution of artificial intelligence demand a review of the contents of teacher training, methods of teacher training and forms of teacher training. Education is no longer a system that can be considered as frozen: it is rather a dynamic adaptive platform which can change fast and integrate the recent technologies into the educational process. The empirical research is important in terms of modernizing the system regarding professional training of the future teachers corresponding to the demands of the information society and knowledge economy. Preparing a teacher of the XXI century requires not only strong professional knowledge, but also developed digital, communicative, intercultural competencies, readiness to work in conditions of rapid technological change, multilingual and multicultural environment. Of particular importance is the development of the ability to reflect, to search for information independently, to think critically, and to continuously improve one's professional skills (Benade, 2017).

The significance of the scientific notes and contributions is the generalization and systematization of the existing tendencies and the best directions on modernization of teacher training within the framework of the global and national challenges. The research allows tracking the returning transformations in the structure, material, and management model of teacher training in countries of the world, the infiltration of innovative technologies into the educational process, and the ratio of fundamental training and practice-oriented training. The theoretical value of the work lies in disclosing the nature and the way of a competency-based approach implementation, digitalization of the educational process, and continuity of the professional growth of future teachers. Practical value of work consists in setting the recommendations on updating the content, methods and technologies of training future teachers in Ukraine with regard to the best European and world practice.

Although the issue of systematic integration of digital technologies into the preparation of future teachers and the development of adaptive educational pathways and the guaranteed maintenance of a sustainable motivation of professional self-formation through life cannot be ignored (Bakhmat et al. , 2022; Liubarets, 2019; Yuzyk et al., 2024), it is a little studied topic because of a vast amount of scientific publications devoted to some of the components of teacher education (Guillén-Gámez et al., 2024). Meanwhile, the question of shaping the digital culture of educators and creating efficient quality monitoring mechanisms of their professional training should be expanded (Fissore et al., 2024; Batsurovska et al., 2024).

The objective of the study will be to examine the existing situation, tendencies and opportunities to re-organize the professional training of future teacher educators regarding the digitalization and globalization of education space.

1.1 Analysis of the latest research and publications

Current research focuses on the modernization of teacher training in the context of digitalization, globalization, and competency-based approach (Guillén-Gámez et al., 2024; Fissore et al., 2024; Liu, 2024; Symeonidis et al., 2024). Much attention is paid to the introduction of innovative educational technologies, including VR/AR, adaptive platforms, and artificial intelligence to personalize learning (Bakhmat et al., 2022; Angelini

et al., 2024). Researchers also emphasize the need to develop the digital and intercultural competencies of future teachers (Lasagabaster & Fernández-Costales, 2024; Ceballos-Hernández et al., 2024; Yuzyk et al., 2024). The issues of practice-oriented teacher training, strengthening of pedagogical practice and cooperation with employers are highlighted separately (Keller-Schneider & Schneider Boye, 2025; Rutkiene, 2023; Koval & Petryk, 2020). Comparative research has increasingly focused on European and global tendencies in teacher education reform, especially regarding the promotion of academic mobility, the establishment of mentoring frameworks, and the incorporation of inclusive practices (Symeonidis et al., 2024; Sablić et al., 2023; Gümüş, 2022).

Ukrainian research focuses on the problems of low digital readiness of pedagogical HEIs, the inconsistency of curriculum content with modern challenges, and the need to improve the level of digital literacy of teachers (Liubarets, 2019; Liubarets & Yavoska, 2023; Onyshchenko & Lykhovyd, 2020; Batsurovska et al., 2024). In particular, the importance of integrating open educational resources, digital libraries, and online platforms into the teacher training process is emphasized (Batsurovska et al., 2021; Kashyna et al., 2024; Aparicio-Herguedas et al., 2023). To summarize, researchers are unanimous about the need for comprehensive reform of teacher education through a combination of innovative technologies, practice-oriented approaches, international cooperation, and the development of a competency-based training model (Nurullaeva et al., 2021; Symeonidis et al., 2024; Keller-Schneider & Schneider Boye, 2025). At the same time, taking into account the national context and adapting the best European practices are important prerequisites for the effective modernization of teacher training in Ukraine (Yuzyk et al., 2024; Liubarets & Yavoska, 2023; Koval & Petryk, 2020).

Along with the digitalization, the formation of pedagogical skills is becoming an essential part of contemporary professional preparation, especially in a situation related to the STEAM education, thinking, and creativity (Liu, 2024; Kashyna et al., 2024). The acquisition of reflective skills, personal developments and pedagogical leadership is of great concern to researchers and is increasingly becoming a driver in the successful professional practice when it comes to change (Sablić et al., 2023; Gümüş, 2022). Researchers pay considerable attention to the development of reflective skills, self-development and pedagogical leadership, which is becoming a key factor in effective professional activity in the face of change (Sablić et al., 2023; Gümüş, 2022)

The role of partnerships between educational institutions, employers, and international organizations in creating effective models of practice-oriented learning and continuous professional development of teachers is also emphasized (Koval & Petryk, 2020; Rutkiene, 2023). Comparative studies show that successful reforms of teacher education in the EU and the US are based on a systematic approach that includes updating curriculum content, developing digital infrastructure, and creating inclusive educational environments (Symeonidis er al., 2024; Keller-Schneider & Schneider Boye, 2025; Yuzyk et al., 2024). At the same time, scientific publications emphasize that excessive unification of teacher education can reduce the effectiveness of training due to the loss of unique national characteristics and regional educational needs (Keller-Schneider & Schneider Boye, 2025; Sablić et al., 2023).

Unsolved problems are the partial lack of a whole system for the monitoring of the quality of teaching education in Ukraine, and insufficient involvement in educational

practices of modern digital technologies. (Onyshchenko & Lykhovyd, 2020; Liubarets, 2019).

2. Research Methods

It is a study founded on an in-depth investigation of sources related to scientific journals, international reports, regulations, and statistics on the professional training of future practicing pedagogues in the issue of digitalization and globalization of the educational space. The work has been conducted in the context of an analytical and comparative investigation of the world and Ukrainian experience of modernizing the professional training of teachers that the author was carrying out in 2023-2024. International organizations' reports (UNESCO, OECD, European Commission), results of international comparative studies on teacher education quality (TALIS, Eurydice and World Bank Reports) and well-known publications of Ukrainian and foreign scientists were used as the main materials for the study. This goal was achieved by using the methods of comparison, content analysis, systematization and generalization. The special attention was given to the study of practices of entering the digital technologies into teachers' education, its competency-oriented action, and the ways to evaluate effectiveness of the modern models of interaction of the higher education institutions with employers and foreign structural units. The application of the interdisciplinarity allowed us to establish the main trends, problems and prospects of modernisation of professional training of the future teachers in Ukraine and the world. A limitation of the present study is the absence of original empirical data obtained directly from Ukrainian pedagogical institutions. While the research relies on a comprehensive synthesis of secondary sources, future investigations should include primary evidence such as teacher surveys, interviews, and institutional case studies to provide deeper contextual understanding. Such empirical input would enrich the analysis, strengthen the practical relevance of conclusions, and allow for more targeted recommendations adapted to specific national circumstances.

3. Research Results

The professional preparation of future educators is currently shaped by profound transformative processes driven by both global and national challenges. In line with the rapid process of education digitalization, globalization of the labour market and competency based learning, training for future teachers must consider new it is required for, professional competencies, technological literacy, work readiness in a multicultural environment (Guillén-Gámez et al., 2024). It is going to be one of the key challenges to make sure that content and teaching methods are in conformity with the demands of the digital age. This applies to the mastery of the modern systems of information transmission and communication and to the shaping of the future teachers' digital culture (Liu, 2024). In particular, we focus on the development of teachers' skills in dealing with digital platforms, changing the teaching materials to meet the requirements of the online environment and applying artificial intelligence in the learning process (Fissore et al., 2024).

Besides the state, national challenges related to teacher training in Ukraine include a need to change the content of education in the framework of European integration

processes, to improve the quality of pedagogical practice, to provide conditions for a continuous professional development of teachers, and to create conditions for sustainable motivation of teachers' self education (Koval & Petryk, 2020). In particular, we are interested in that learning which will help to shape professional competences of future teachers, in particular, the competence to work in the environment of the modern educational institution and employ innovative means of education (Bakhmat et al., 2022). One of the global challenges includes educational adaptation, new learning models that provide flexible educational path, individualized learning, and can incorporate the forms of blended learning (Carvalhais & Azevedo, 2024). We, as well, have to consider the increased need of intercultural competence and the willingness to work in a multicultural environment, which is applicable regarding migration processes and internationalization of the education (Lasagabaster & Fernandez-Costales, 2024).

Conversely, Ukraine's vocational and general teacher training systems are experiencing a crisis, stemming from the mismatch between theoretical preparation and the practical demands of education, limited proficiency in using innovative teaching technologies, and inadequate incorporation of international best practices in specialist training (Onyshchenko & Lykhovyd, 2020). Because of these factors, further modernization of the content, forms and ways of professional training, in particular on the basis of enhancing the cooperation with the European educational institutions, intensifying academic mobility, and introducing a system of independent assessment of pedagogical competencies (Symeonidis et al., 2024) will be required. Therefore, the current condition of professional training of future teacher educators connotes an active search for the ways in which it can improve its effectiveness, incorporate the newly developed innovations and comply with the current educational trends at the global and the national educational traditions and values.

One major factor in the shaping of an environmentally conscious society is education of teachers towards sustainable development. It consists of educating the teachers to provide them with the knowledge, skills and values needed to incorporate the principles of sustainable development into the children education process in order to develop responsible people. The education of future teachers about sustainable development is supposed to create a new environmental awareness, establish skills of critical thinking, promote responsibility, and create skills of sustainable living. The modernization of professional training of prospective teachers within the framework of education on sustainable development includes the training of environmentally responsible specialists with honed critical thinking, decision-making skills to guarantee harmonious coexistence of man and nature. Sustainable development education takes into account environmental, social and economic factors and entails the following major principles: integration, interdisciplinarity, dialogue and cooperation, practical orientation, value formation, critical thinking. Education to sustainable development is the adoption of initiatives, which can propose programs and projects aimed at forming the ecological culture, preservation of natural resources, and it is one of the most important means to the UN Sustainable Development Goals that consider a broad scope of social, economical, and ecological issues.

Future teachers training technologies within the common concept of education on sustainable development need a reasonable balance between traditional and innovative

means modelling and simulating the real situations in everyday and professional life. The use of specially designed tasks makes it possible to consolidate the theoretical knowledge obtained through exercises, in order to make professionally sound decisions in the context of sustainability. Extracurricular social and developmental activities are distinguished by significant effectiveness, stimulating the acquisition of experience and motivation by future teachers for active sustainable practice within the framework of professional activities, focused on long-term positive results for the environment and society.

To effectively implement education for sustainable development in pedagogical practice, it is necessary to improve the qualifications of teachers by organizing trainings, seminars and other events aimed at deepening teachers' knowledge in the field of sustainable development. It is also necessary to include sustainable development issues in curricula and programs, create new educational materials, and provide conditions for practical activities to solve environmental and social problems.

The training of future teachers is dramatically changing its approaches in the processes of digitalization, globalization, and rapid development of the information technology. The constantly growing proportion of educational process based on digital platforms, online courses, blended learning, etc., gives a rise to the necessity of corresponding update of the content, the forms and methods of making those who go about it to professionals. Adaptive learning trajectories, augmented and virtual reality elements, artificial intelligence, personalized educational process and monitoring of educational achievements are becoming relevant (Fissore et al., 2024).

In this context, it is essential to systematize the prevailing trends and strategic directions in teacher training reform to ensure that education can effectively respond to the demands of the twenty-first century. Table 1 outlines the key developments and approaches in updating the content, formats, and methodologies of teacher preparation within the framework of digitalization and the adoption of innovative technologies.

Table 1: The main trends and directions of modernization of the content, forms and methods of professional training of teachers in the context of digitalization and integration of innovative technologies

Trend / Direction of modernization	**Characteristics and features**
Competency-based training model	Focusing on the development of comprehensive professional, digital, communication and intercultural competencies of teachers (Guillén-Gámez et al., 2024).
Integration of digital technologies	Using LMS platforms, online simulations, and mobile applications to develop practical skills and provide continuous access to learning materials (Angelini et al., 2024).
Blended learning	Combining traditional and online forms of learning with an emphasis on practice-oriented tasks and project activities (Carvalhais & Azevedo, 2024).
Personalization of training	Customizing learning pathways to align with each student's specific needs and preferences through the application of digital technologies and artificial intelligence (Fissore et al., 2024).

Use of VR/AR technologies	Modeling pedagogical situations in the virtual space to develop professional skills in a safe environment (Bakhmat et al., 2022).
Integration of STEAM education	Establishing cross-disciplinary links and fostering critical thinking, creativity, and collaborative skills by engaging students in STEAM-based projects (Liu, 2024).
International cooperation	Participation in academic mobility programs, joint educational projects with European universities, and exchange of experience (Symeonidis et al., 2024).
Formation of digital culture	Preparing teachers to work with open educational resources, digital libraries, interactive platforms for collaboration with students and colleagues (Batsurovska et al., 2024).

Source: constructed by the author based on Angelini et al. (2024), Bakhmat et al. (2022), Batsurovska et al. (2024), Carvalhais & Azevedo (2024), Fissore et al. (2024), Guillén-Gámez et al. (2024), Liu (2024), Symeonidis et al. (2024).

Therefore, updating the content, formats, and methodologies of future teachers' professional preparation is intrinsically connected with digitalization, globalization, and the increasing need for educators to demonstrate professional mobility and adaptability. The integration of innovative technologies allows to ensure the practice-oriented nature of training, improve its quality and accessibility, creating conditions for the formation of a modern, competitive specialist capable of working effectively in a digital educational environment. However, the feasibility of implementing such technologies depends on multiple institutional and contextual factors. Key barriers include insufficient technical infrastructure, particularly in rural institutions, uneven access to high-speed Internet, and significant disparities in funding allocations. Teacher readiness also remains a challenge, as many educators require targeted professional development to effectively use VR/AR tools, artificial intelligence applications, and adaptive learning platforms. Addressing these issues through state-supported modernization programs, equitable resource distribution, and capacity-building initiatives can help bridge the digital divide between urban and rural institutions, ensuring scalability and inclusivity of modernization strategies.

Digital technologies and information and communication tools (ICTs) play a leading role in advancing the modernization of future teacher training systems. Their widespread use contributes to increasing accessibility of education, personalizing the educational process, developing digital competence, creating interactive learning environments, and ensuring effective control and monitoring of learning achievements. In modern conditions, digital technologies not only complement traditional teaching methods but also become a basic tool for implementing innovative pedagogical approaches (Bakhmat et al., 2022; Guillén-Gámez et al., 2024). ICTs allow preparing future teacher educators to work in the digitalized educational space, develop their skills in using electronic resources, working with virtual learning environments, and form critical thinking, creativity, and self-education (Liu, 2024). Table 2 presents a structured overview of the key applications of digital technologies within teacher education.

Table 2: The Role of Digital and Information and Communication Technologies in Improving the Effectiveness of Professional Training of Future Specialists in Teacher Education

The direction of ICT use	Characteristics and examples
Organization of online and blended learning	Use of Moodle, Google Classroom, Microsoft Teams platforms to provide distance and hybrid learning, expand access to educational materials (Angelini et al., 2024).
Formation of digital competence	Teaching future teachers to work with digital libraries, digital laboratories, online testing, and electronic portfolios (Guillén-Gámez et al., 2024).
Interactive teaching methods	Use of interactive exercises, video cases, online quests, and virtual excursions to build practical skills and develop critical thinking (Batsurovska et al., 2024).
Use of augmented and virtual reality (AR/VR)	Creation of educational simulators of pedagogical situations, modeling of classes in a virtual classroom (Bakhmat et al., 2022).
Personalization of learning	The use of adaptive learning platforms with individualized learning paths based on the analysis of current assessment results (Fissore et al., 2024).
Involvement in international educational communities	Participation in webinars, online conferences, joint international projects on teacher training through digital platforms (Symeonidis et al., 2024).
Digital monitoring and evaluation	Using automated systems to assess learning outcomes, analyze learning progress, and identify students' educational needs (Liu, 2024).

Source: created by the author based on Angelini et al. (2024), Bakhmat et al. (2022), Batsurovska et al. (2024), Fissore et al. (2024), Guillén-Gámez et al. (2024), Liu (2024), Symeonidis et al. (2024)

In this way, digital and information and communication technologies are finding their way into becoming part and parcel of professional education of future teachers. They help to broaden the access to good educational materials, establish modern interactive environment of learning, enhance the desire of students to study, and give constructive feedbacks. Future teachers due to the use of innovative digital technologies can obtain the required competencies to work in the environment of digitalizing the learning process and global challenges of the twenty-first century.

The processes of teacher education reform in the world and Europe are predetermined by the world trends related to digitalization, competency-based approach and the lifelong learning concept. Standardized methods of pedagogical competencies formation development, intensification of the practical aspect of the training of future teachers, the growth of academic mobility, and the availability of digital technologies in the educational process are the active measures of European countries (Symeonidis et al., 2024). As the international experience has shown, the most important priorities of the reforms are to enhance the role of the teacher as the facilitator of the educational process, advance the inclusive approaches to learning, and design the flexible educational program which is adjusted to the dynamically evolving needs of the society (Keller-Schneider & Schneider Boye, 2025). The analysis of this experience and its contextualization in the Ukrainian

environment is able to promote modernization of the national system of teacher education to the requirements of modern tendencies (Table 3).

Table 3: European and world experience in reforming teacher education and possibilities of adaptation to the national system

Country / region	Key areas of reform	Opportunities for adaptation in Ukraine
Finland	Competency-based programs, emphasis on pedagogical practices, high requirements for entry into the profession (Symeonidis et al., 2024)	Increasing the requirements for admission to pedagogical specialties, expanding pedagogical practice and mentoring
Germany	Two-stage training system: academic education + practical training, integration of digital technologies (Keller-Schneider & Schneider Boye, 2025)	Introduce mandatory postgraduate internships at schools and create digital pedagogical laboratories
Poland	Integration of ICT, development of interdisciplinary competencies, emphasis on working with children with SEN (Yuzyk et al., 2024)	Include courses on inclusive education and digital technologies in basic teacher training programs
Lithuania	Focus on lifelong learning, continuous retraining of teachers, partnership with employers (Rutkiene, 2023)	Creating a system of postgraduate support and development of career paths for teachers
USA	Practice-oriented programs, development of teachers' leadership competencies, significant autonomy of higher education institutions	Introduction of individual training trajectories based on the profile of the institution and regional needs
Spain	Two-stage training model, emphasis on pedagogical reflection, development of language competencies (Lasagabaster & Fernández-Costales, 2024)	Introduce compulsory courses in intercultural communication and academic writing
Switzerland	Development of pedagogical research, increased attention to psychological and pedagogical support of students (Keller-Schneider & Schneider Boye, 2025)	Introduction of psychological support services for students of pedagogical specialties

Source: Created by the author based on Keller-Schneider & Schneider Boye (2025), Lasagabaster & Fernández-Costales (2024), Rutkiene (2023), Symeonidis et al. (2024), Yuzyk et al. (2024).

An analysis of European and global experience in reforming teacher education shows that the key trends are to strengthen the practical training of future teachers, develop interdisciplinary and digital competencies, and introduce mentoring and lifelong learning systems. For Ukraine, a comprehensive reform of the content, forms, and methods of teacher training using the best international practices, while taking into account

national peculiarities and the needs of the educational system development, is promising. Future research could benefit from a comparative analysis of post-reform outcomes across different Ukrainian regions, with a focus on variations in institutional capacity, resource allocation, and pedagogical practices. Particular attention should be paid to how digital training components, including AI-assisted learning pathways, influence the long-term pedagogical effectiveness of teachers. Such studies would not only provide valuable evidence for refining national reform strategies but also contribute to the international discourse on sustainable digital teacher training reforms.

Examining European and global practices in teacher education reform is essential for enhancing Ukraine's national system of teacher preparation. The methodological basis of the study was a comparative analysis, systematization and generalization of data from international reports (UNESCO, OECD, European Commission), as well as statistical indicators on the implementation of innovative approaches to teacher training in different countries (Symeonidis et al., 2024). To obtain an objective picture, the method of content analysis of scientific publications and regulatory documents, as well as secondary analysis of data from international comparative studies of the quality of teacher education (TALIS, Eurydice, World Bank Reports) was used. Particular attention is paid to identifying trends in the digitalization of teacher education and the integration of innovative technologies in the training of future teachers.

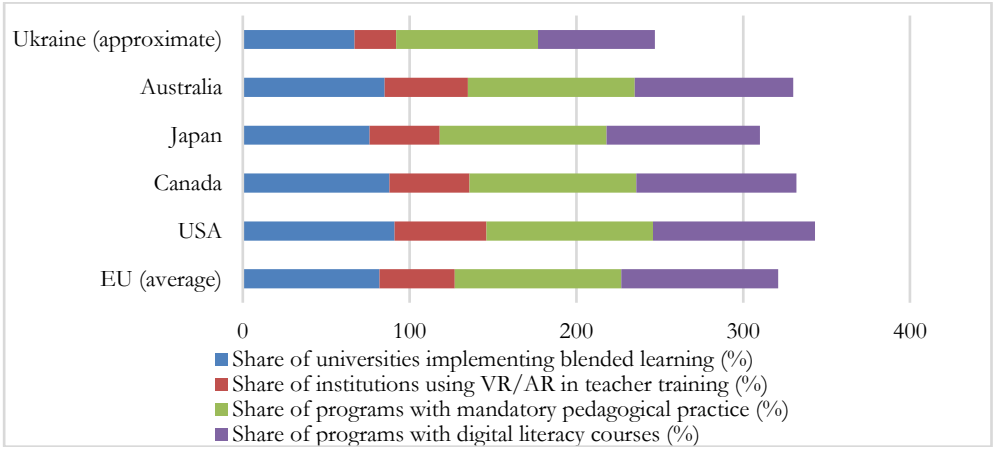

Figure 1: *Implementation of blended learning, AR and VR, programs with mandatory pedagogical practice, and digital literacy courses in selected countries and in the EU*

Source: created by the author on the basis of generalized data from open reports of UNESCO, OECD, European Commission, World Bank (2023-2024), as well as analytical reviews (Symeonidis et al., 2024; Keller-Schneider & Schneider Boye, 2025; Yuzyk et al., 2024).

The highest rates of blended learning implementation in teacher education are recorded in the United States (91%) and Canada (88%). This is connected with the organized implementation of hybrid educational technologies that integrate online courses and so-called face-to-face classes offered on the territory of classrooms, establishing the flexible environment of the development of professional competencies. Meanwhile, the

mean rate in the European Union is 82%, which shows a high yet not as intense pace of the blended learning realization compared to the United States and Canada. This could be attributed to a various way of arranging the educational process, such as arrangements of maintaining the classical model of classroom learning instruction stage in those countries that have strong traditional classical pedagogical background (Symeonidis et al., 2024).

The use of VR/AR technologies varies significantly. In the United States, the share of institutions that use virtual and augmented reality in teacher training is 55%, while in Ukraine this figure does not exceed 25%. This indicates the limited technical support of Ukrainian pedagogical institutions and the lack of readiness of teachers to use such technologies (Bakhmat et al., 2022). European countries have an average level of 45%, which demonstrates the gradual introduction of VR/AR within the framework of individual innovative projects (Yuzyk et al., 2024). Interestingly, all the countries studied show high rates of mandatory pedagogical practice - from 85% in Ukraine to 100% in most European countries and the United States. This confirms the general trend towards increased practice-oriented teacher education worldwide (Keller-Schneider & Schneider Boye, 2025). However, there are significant differences in the level of integration of digital literacy courses into teacher education programs. While in the US this figure reaches 97%, in the EU - 94%, in Ukraine only 70% of programs have such courses. This indicates the need to modernize the content of domestic educational programs with a greater focus on the development of digital competencies (Guillén-Gámez et al., 2024).

An examination of international data reveals that Ukraine significantly trails behind leading nations in both the digitalization of teacher education and the adoption of innovative technologies. At the same time, the high level of implementation of pedagogical practice and focus on the competency model provide the basis for effective adaptation of the best European and international practices. To reduce this gap, it is necessary to strengthen the technical support of pedagogical institutions, expand the training of teachers to work with digital tools, and introduce mandatory courses on digital literacy in all educational programs for future teachers.

Modernization of the professional training of future teachers is one of the priority areas of educational policy in Ukraine and many other countries. Increasing requirements for the quality of teacher education are driven by global challenges, digitalization, and the need to ensure that educational programs are inclusive and relevant to modern socio-economic realities. At the same time, being accompanied by a number of problems and barriers, the modernization process is inhibiting the implementation of qualitative changes. The systematization of these problems as well as the prospects for overcoming them are an important condition for increasing the effectiveness of teacher education and its conformity to European and international standards (Symeonidis et al., 2024; Bakhmat et al., 2022). Table 4 outlines the challenges, obstacles, and potential pathways for advancing the modernization of teacher training to ensure the quality of teacher education.

Table 4: Problems, Barriers and Prospects for Further Modernization of Teacher Training in the Context of Ensuring the Quality of Teacher Education

Category	Contents	Examples and comments
Institutional problems	Absence of a coherent framework for teacher education development, disjointed reform efforts, and inadequate coordination between relevant agencies	Education policy is often changed without taking into account previous experience, which complicates systemic change (Onyshchenko & Lykhovyd, 2020).
Content barriers	Mismatch of the content of educational programs with modern challenges, poor integration of digital technologies and practice-oriented methods	Many educational institutions are still dominated by the traditional lecture form of work with minimal use of interactive platforms (Bakhmat et al., 2022).
Technological limitations	Insufficient technical equipment of educational institutions, low digital literacy of teachers	There is a dependence on the use of VR/AR and modern technology, as well as digital skills of the teachers, when working with distance learning platforms. (Guillén-Gámez et al., 2024).
Socio-economic factors	Low prestige of the teaching profession, insufficient level of remuneration, and growing migration sentiments among young teachers	Young professionals often see no prospects for career growth and stability (Keller-Schneider & Schneider Boye, 2025).
Psychological and pedagogical challenges	Limited preparedness of educators to operate effectively within digitalized and inclusive learning environments	Teachers need systematic professional development in digital pedagogy and work with children with SEN (Batsurovska et al., 2024).
Prospects for development	Formulating a comprehensive national strategy for teacher education, integrating advanced educational technologies, and enhancing the social status of the teaching profession	Active cooperation with European educational institutions, creation of conditions for academic mobility and implementation of mechanisms for independent assessment of the quality of teacher education (Symeonidis et al., 2024).
Innovative approaches	Use of adaptive platforms, digital simulators, and artificial intelligence to personalize educational trajectories	Integration of elements of blended and distance learning to increase the flexibility and accessibility of education (Fissore et al., 2024).

Source: created by the author based on Bakhmat et al. (2022), Batsurovska et al. (2024), Fissore et al. (2024), Guillén-Gámez et al. (2024), Keller-Schneider & Schneider Boye (2025), Onyshchenko & Lykhovyd (2020), Symeonidis et al. (2024).

Modernization of teacher education requires a comprehensive approach that takes into account global and national challenges, modern technological capabilities, and

socioeconomic realities. Overcoming the existing problems and barriers is possible only if a comprehensive strategy for the development of teacher education aimed at improving its quality and compliance with international standards is developed. Important areas include strengthening the practice-oriented nature of the educational process, creating conditions for digitalization of education, raising the prestige of the teaching profession, and creating a modern educational environment that will promote the professional development of future teachers.

4. Discussion

These outcomes of the research proved the idea that modern professional education of future teachers is experiencing drastic changes under the impact of global challenges, among which the digitalization of the education process, the rise in the scope of intercultural interactions, and the development of new skills and abilities may be noted. Simultaneously, the analysis of the information reveals the fact that the modernization of the educational process in Ukraine is hampered by weighty barriers that slow down the process in question, such as the disunity of reforms, poor incorporation of digital technologies, and the adherence to habitual forms of education. Scholars who study current trends in teacher education demonstrate a certain polarity of views on the key areas of its reform. For example, Symeonidis et al. (2024) emphasize the need to fully harmonize national teacher education systems with European standards, in particular by increasing student and teacher mobility, introducing common assessment criteria, and creating common digital educational platforms. On the other hand, Keller-Schneider and Schneider Boye (2025) note that excessive unification can lead to the loss of national specificity of teacher education, including consideration of regional educational needs and the peculiarities of each country's school system.

The position of Symeonidis et al. (2024) is partially supported by Bakhmat et al. (2022), who emphasize that the intensive introduction of digital technologies and open educational resources contributes to increasing the accessibility and quality of teacher education. At the same time, these authors note that digitalization without proper teacher training and institutional support can only widen the gap between leading institutions and regional universities, which is already observed in Ukraine. On the other hand, researchers such as Lasagabaster and Fernández-Costales (2024) emphasize the need to form pedagogical reflection, develop communicative and intercultural competencies of future teachers as an important component of quality training. At the same time, Guillén-Gámez et al. (2024) emphasize that digital technologies alone will not provide quality learning without methodological training of teachers in the use of ICT and without systematic integration of digital components into the structure of curricula.

The findings confirm that professional teacher training in Ukraine requires not only technical and methodological updates, but also a conceptual restructuring based on the principles of flexibility, practice-orientation, and digital transformation. Blended learning, the introduction of VR/AR elements, personalized learning paths, and the involvement of students in international educational projects can provide a new quality of training for future teachers. At the same time, limitations related to uneven digitalization, low motivation to innovate among some teachers, and insufficient adaptation of existing

educational programs to modern challenges should be taken into account. The data from Symeonidis et al.'s (2024) EU study proves teacher education modernization leads to better graduate quality, but Ukrainian universities lack proper alignment between policy declarations and actual higher education conditions. Teacher education development remains underdeveloped because Ukraine lacks a unified national plan while necessary funding remains insufficient for modernization (Onyshchenko & Lykhovyd, 2020). These findings align with global research emphasizing that insufficient infrastructure and uneven access to digital resources can deepen existing educational inequalities (Guillén-Gámez et al., 2024). The disparities observed in the integration of digital literacy programs across countries confirm the urgency of coupling digital initiatives with systemic institutional support. Addressing infrastructure gaps, ensuring equitable access to technology, and embedding digital literacy into national education strategies are critical steps for fostering both readiness and equity in teacher education.

Further research must be carried out to form integration models of European best practices Ukrainian teacher education programs and adapt the practice to Ukrainian context of education. Individual, institutional, technological and socioeconomic factors need to be addressed in detail to develop a quality monitoring system of teacher education. The study of digital technologies in connection with the shaping of the professional competencies of future teachers, analysis of the situation with the lack of digital literacy of teachers at higher educational establishments, and creation of models to enhance teacher digital literacy at higher educational establishments also could be considered as relevant.

5. Conclusions and Prospects for Further Research

The research showed that the current professional training of future teachers is experiencing a radical search of the compromise between the traditional methods of teaching with the new ones caused by the global digitalization and the rise in the quality requirements. One of the results of the study is defining the lack of implementation of advanced digital technologies into the body of teacher training and the approach to its conduct that precondition the possibility of creating new educational standards and programs. Among the primary proposals, there is the establishment of a single national registry to develop and certify digital competencies and to follow the quality of teacher education. An effective system with that may considerably boost institutional responsibility, promote consistent professional growth, and develop teacher flexibility towards technological change. Establishing an association between the digital competency evaluation and formal certification schemes, the platform would contribute to standardisation of requirements in the higher education sector of Ukraine as well as sustainable reform. The innovation of the investigation is in the finding of the intricate network of obstacles preventing modernization, such as low level of digital competence of certain educators, lack of consistent national strategy and insufficient material-technical base of many pedagogical establishments. Such issues will have to be mitigated through state policy coordination, infrastructure investments, and other systematic professional advancement programs. The next line of research is needed to find out the effect of national certification platforms on teacher flexibility, the long-term effectiveness of a pedagogical approach, and fair access to digital tools. From a practical standpoint, the

proposed reforms can be made more actionable by integrating applied pedagogical models, case-based examples, and adaptable training frameworks suitable for diverse educational contexts. Strengthening the empirical depth of future studies through primary data collection, alongside detailing concrete strategies for digital implementation, would align Ukrainian teacher education reforms with global academic standards. This approach would also reinforce the study's contribution to the field of comparative education by providing evidence-based, context-sensitive solutions.The detailed consideration of adaptive learning models, AI-guided pathways, and international mobility programs as the drivers of the improvement of professional identity and competency in Ukrainian teachers should be given.

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