

Transforming Pre-Service Teacher Education in Early Childhood and Special Education: A Comparative Study of Training Models and Professional Competency Development

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Abstract

Changes in modern teacher education programs have made it necessary to search for effective models of training future teachers who can work in a digital and inclusive educational environment. This study aimed to compare the effectiveness of traditional and innovative models of training future teachers in developing their professional competencies. The study was conducted using a quasi-experimental design with pre- and post-testing. 176 students of pedagogical programs participated in it, who were divided into a control group ($n = 88$) and an experimental group ($n = 88$). The innovative training model consisted of the components of practice-oriented learning, the use of digital educational platforms, and AI-supported scaffolding. In results it is shown, that the largest intervention effect was determined for digital pedagogical competence ($\eta^2 = 0.17$) and inclusive pedagogical competence ($\eta^2 = 0.13$). The results highlight the importance of integrating digital technologies and innovative pedagogical approaches into teacher education programs. The results of this study will be important for future teacher education curriculum updates.

Keywords: pre-service teacher education, professional competencies, competency-based teacher training, AI-supported scaffolding, digital pedagogical competence, quasi-experimental design

1. Introduction

1.1 Introduce the Problem

The modern system of training future teachers is in a period of change, which is caused by the transformation of the requirements for the professional activity of teachers, the spread of inclusive education and the rapid development of digital technologies. These changes are especially noticeable in the field of preschool and special education, in which a teacher must possess a range of professional competencies: pedagogical, inclusive, psychological, communicative and digital (Ari et al., 2022; Rudrabhatla et al., 2024). In such conditions, traditional models of training future teachers, which are based on the lecture-seminar system of education and limited pedagogical practice (Sitovskyi et al., 2019), are criticized for their insufficient effectiveness in the formation of practically oriented abilities.

However, in parallel with this, innovative models of training are actively developing in pedagogical education, which involve the use of practice-oriented learning, reflective methods and digital platforms. These models are aimed at developing in future teachers the ability to self-regulated learning, professional reflection, work in an inclusive environment, which are relevant in the modern professional world (Maksymchuk et al., 2018; Maksymchuk et al., 2019).

However, in the modern scientific literature, there is still a lack of empirical studies that would compare the effectiveness of different models of training future teachers, and importantly, prove the effectiveness of innovative and new models. This is especially true for teacher training programs for preschool and special education, in which the requirements for professional competence are multidimensional. In this regard, there is a need for research that will allow assessing the impact of educational models on the development of professional competences of future teachers. In view of the above, an important scientific task is a comparative analysis of the effectiveness of traditional and innovative models of training future teachers within the framework of the formation of their professional competences.

1.2 Explore Importance of the Problem

The issue of improving the quality of training of future teachers is one of the important and debatable issues in the modern educational policy of many countries. Changes in the socio-cultural environment, the growth of diversity of student groups have influenced the formation of new requirements for the professional activities of teachers.

For specialists in the field of preschool and special education, this problem is even more relevant. Teachers who actively interact with children of early age or with special educational needs must possess general pedagogical knowledge and special competencies related to inclusive practice and differentiated learning.

However, there is some disagreement in scientific research regarding which approaches to teacher training are the most effective. Some authors have emphasized the effectiveness of traditional academic models of training, which provide a theoretical basis for professional activity (Chen, 2024; Zhang et al., 2021). Other scientists have pointed out the importance of the transition to practice-oriented and competency-based models of training (Ritter et al., 2019; Tarraga et al., 2021). Some scholars advocate the development of new innovative models that integrate real pedagogical practices (Kichuk et al., 2024; Tomczyk, 2024; Colonna, 2025). At the same time, the scientific literature also supports the idea of the effectiveness of e-learning or blended forms (Tomczyk, 2024).

Thus, there is a need for research that would empirically compare the results of different models of teacher training in the field of forming professional competencies of future teachers.

1.3 Describe Relevant Scholarship

The issue of training future teachers and the development of their professional competencies is actively studied in modern pedagogical science. The authors indicated that the effectiveness of pedagogical education largely depends on the system of curricula, teaching methods and the level of integration of practical experience into the process of training future teachers (Alvarez-García et al., 2018; Jeon et al., 2021). In particular, Alsolami (2022) and Wang et al. (2025) identified the importance of the transition from the knowledge paradigm of pedagogical education to a competency-based approach. Other authors have proven the importance of practice-oriented models, which are focused on the formation of the ability of future teachers to act effectively in complex professional situations (Zabeli & Gjelij, 2020; Borysiuk et al., 2022).

A separate area of research is related to the development of combined practice-oriented with theoretical models of pedagogical education, which involve the integration of pedagogical practice and mentoring. In addition, the authors indicated that early involvement of students in the real educational environment can affect the effective combination of theoretical knowledge and practical skills (Gauvreau et al., 2019; Lei et al., 2025; Chang et al., 2024).

In the area of inclusive education, considerable attention is paid to the formation of inclusive pedagogical competence, which involves knowledge of the development characteristics of children with different educational needs, the ability to adapt educational materials to different needs (Melnik et al., 2021). At the same time, the authors indicated that traditional pedagogical education programs cannot always provide a sufficient level of training for future teachers to work in an inclusive environment (Bondar et al., 2021; Peterson-Ahmad et al., 2018).

A separate direction in modern literature, which is actively studied, is the involvement of digital technologies and hybrid learning formats. The authors drew attention to the role of digital technologies and innovative educational tools in teacher training (Badanbekkyzy et al., 2025). Digital platforms, online resources, interactive teaching methods are determined by important factors in increasing the effectiveness of pedagogical education (Moreira-Choez et al., 2024; Rets et al., 2020). Such approaches make it possible to develop digital pedagogical competence in learners and form self-reflection in applicants.

Despite the significant amount of research in this area, there is a noticeable lack of empirical comparative studies in the scientific literature that would directly determine the effectiveness of different models of training future teachers. Most of the existing works are theoretical in nature or focus on individual aspects of teacher education. Therefore, there is a need for studies that would allow comparing the results of different educational models and determine their impact on the formation of professional competencies of future teachers in the field of preschool and special education.

1.4 State Hypotheses and Their Correspondence to Research Design

The purpose of the study is to conduct a comparative analysis between traditional and innovative models of training future teachers in the field of preschool and special education from the point of view of developing their professional competencies. To solve the identified scientific problem, this study used a comparative quasi-experimental design.

The main hypothesis of the study was that an innovative model of training future teachers can affect the development of professional competencies more significantly compared to the traditional model of training.

The following research assumptions follow from this hypothesis:

H1. Students who study according to an innovative training model will have a higher level of development of general pedagogical competencies than applicants to a traditional program.

H2. An innovative training model will contribute to the effective development of inclusive pedagogical competence in future teachers.

H3. The use of innovative practice-oriented and digital educational tools in the process of training teachers will positively affect the formation of their professional skills and ability to pedagogical reflection.

2. Method

2.1 Research Design

The study was conducted within the framework of a quantitative empirical approach and using a comparative quasi-experimental design of the pre-test–post-test type with nonequivalent groups. This design made it possible to evaluate models of pedagogical training for the development of professional competencies of future teachers.

The study compared two models of training of future teachers in the field of Early Childhood Education and Special Education: a traditional model of training, based mainly on lecture-seminar organization of training and standard pedagogical practice;

An innovative model of training, which involved the integration of practice-oriented learning, reflective methods, the use of digital educational platforms and AI-supported scaffolding.

The innovative model involved the use of various digital educational environments (learning management systems, collaborative platforms, digital reflection tools), as well as AI-supported scaffolding. The latter was actively used to support educational planning, analysis of pedagogical situations and reflection of students.

The intervention lasted one academic semester. This time was chosen to provide a sufficient period for the formation and measurement of changes in the professional competencies of the participants.

To assess the effectiveness of the training models, a two-stage data collection procedure was used: pre-test (T1) - at the beginning of the semester; post-test (T2) - after the completion of the training module.

2.2 Participant (Subject) Characteristics

The study involved 176 students of pedagogical specialties who studied in educational programs related to the training of specialists in the field of preschool and special education.

The sampling was carried out according to the principle of purposive selection, since participation in the study required compliance with the specified inclusion criteria. The sample included students who: are studying in pedagogical education programs; are undergoing training in the field of Early Childhood Education or Special Education; participated in training courses aimed at developing professional competencies of teachers; provided voluntary consent to participate in the study.

Participants were divided into two comparable groups: control group (CG) - 88 students who studied in the traditional training model; experimental group (EG) - 88 students who studied in the innovative training model (see Table 1).

Table 1. Demographic characteristics of participants

Variable	Control Group (CG) n=88	Experimental Group (EG) n=88	Total (n=176)
Mean age (SD)	20.9 (1.8)	21.1 (1.7)	21.0 (1.8)
Gender – Female	67	69	136
Gender – Male	21	19	40
Study level – Bachelor	70	72	142
Study level – Master	18	16	34
Program –	48	46	94
Early Childhood Education			
Program –	40	42	82
Special Education			

2.3 Instruments and Measurements

To determine the general level of formation of professional competencies of future teachers, survey-type instruments were used. Such instruments made it possible to assess the components of professional training of students in the field of preschool and special education. The research instrument was developed on the basis of modern international competency frameworks for teacher training, in particular approaches to the formation of pedagogical, inclusive and digital competencies of a teacher.

The main measuring instrument was the Professional Competency Questionnaire for Pre-Service Teachers. This questionnaire consisted of several thematic scales it included 4 domains of professional competence:

Pedagogical Competence – the ability to plan the educational process, apply different pedagogical methods

Inclusive Competence – the ability to work with children with different educational needs

Psychological and Communication Competence – the ability to effectively interact with children, parents and the pedagogical team,

Digital Pedagogical Competence – the ability to use digital educational platforms, interactive tools

All statements were assessed on a five-point Likert scale (1 – completely disagree; 5 – completely agree). Higher index values indicated a higher level of formation of the corresponding competence (See Appendix A).

To obtain an integral indicator, the Professional Competency Index was calculated, which was determined as the average value of the indicators of all scales.

The reliability of the tool was assessed using the Cronbach's alpha internal consistency coefficient, which allowed us to confirm an acceptable level of reliability of the measurement scales (See Appendix B).

Exploratory factor analysis (EFA) was used to confirm the construct validity of the instrument. The results confirmed the validity of the questionnaire, which corresponded to the four defined domains of professional competence. Factor loadings ranged from 0.52 to 0.84; items with loadings below 0.40 were excluded at the stage of questionnaire development. The selected four-factor model explained 61.3% of the total variance. Interscale correlations ranged from 0.38 to 0.61. This state of affairs demonstrated a sufficient level of validity while maintaining the integrity of the survey.

2.4 Procedure

The experiment was conducted over one academic semester and included several stages of data collection and analysis. At the initial stage, participants were informed about the purpose of the study, the conditions of participation, and the principles of confidentiality. All students provided voluntary informed consent to participate in the study.

At the beginning of the semester, a pre-test was conducted. At this stage, the initial level of students' professional competencies was determined. Participants in both groups completed a questionnaire on professional competencies. In this way, the authors obtained baseline indicators of pedagogical, inclusive, communicative, and digital competencies.

After the pre-test, the implementation of the corresponding training models began.

In the control group, training was carried out according to the traditional model of pedagogical training. This model included lecture and seminar classes, analysis of theoretical materials, and standard forms of pedagogical practice. The use of digital tools in this group was limited and did not require specially organized methods of supporting professional development.

The experimental group used an innovative training model consisting of practice-oriented learning, reflective pedagogical practices, and the use of digital educational tools. During one semester, students worked with pedagogical cases, performed tasks on modeling educational situations in preschool and inclusive educational environments. Participants also participated in microteaching and group discussions.

An important component of the innovative model was the use of digital platforms and AI-supported scaffolding tools. Digital environments were used to organize educational interaction, work together on tasks, and receive feedback. AI-tools were used to support lesson planning and analysis of pedagogical situations. At the same time, they performed the role of cognitive support.

At the end of the semester, a final test (post-test) was conducted using the same tools. This allowed us to determine changes in the level of professional competencies of students and compare the results of the control and experimental groups.

The obtained data were anonymized, coded, and prepared for further statistical analysis.

2.5 Data Analysis

Statistical data analysis was carried out based on standard quantitative data processing methods, which were aimed at assessing changes in the level of professional competencies of students and comparing the results between the control and experimental groups.

At the first stage, descriptive statistics were performed for the main study variables, including mean values (M), standard deviations (SD), as well as minimum and maximum values.

Before conducting the main analysis, the data were checked for compliance with key statistical assumptions, in particular, the normality of the distribution of variables and the absence of significant outliers. For this, asymmetry and kurtosis indicators were used.

The main method of analyzing the effectiveness of the intervention was analysis of covariance (ANCOVA). This tool made it possible to compare post-test indicators of professional competencies between the experimental and control groups, considering the initial values. The use of ANCOVA made it possible to reduce the influence of possible starting differences between the groups.

In addition, t-tests for dependent samples were used to analyze changes within each group.

Independent samples t-tests were also used to determine the increase in scores between groups. At the same time, the effect size, partial eta squared (η^2), was calculated for ANCOVA analysis to assess the practical significance of the results.

All statistical tests were performed using a statistical significance level of $p < .05$.

3. Results

At the first stage, descriptive statistics analysis of professional competence indicators in the control (CG) and experimental (EG) groups at the pre-test (T1) and post-test (T2) stages was carried out. Analysis of mean values indicated that at the beginning of the study, the level of professional competence in the groups was similar. After the end of the academic semester, an increase in indicators in both groups became noticeable, however, a more pronounced increase was noted in the experimental group, which studied according to an innovative model using digital platforms and AI-supported scaffolding (see Table 2).

Table 2. Descriptive statistics for professional competency outcomes (T1–T2)

Outcome measure	Group	Pre-test (T1) M (SD)	Post-test (T2) M (SD)
Professional Competency Index	CG (n=88)	3.18 (0.41)	3.42 (0.44)
	EG (n=88)	3.21 (0.39)	3.86 (0.46)
Pedagogical competence	CG (n=88)	3.24 (0.48)	3.46 (0.50)
	EG (n=88)	3.26 (0.45)	3.92 (0.47)
Inclusive teaching competence	CG (n=88)	3.05 (0.52)	3.28 (0.53)
	EG (n=88)	3.07 (0.50)	3.74 (0.51)
Psychological & communication competence	CG (n=88)	3.34 (0.47)	3.55 (0.49)
	EG (n=88)	3.36 (0.46)	3.95 (0.48)
Digital pedagogical competence	CG (n=88)	3.10 (0.55)	3.32 (0.56)
	EG (n=88)	3.12 (0.53)	3.91 (0.50)

Therefore, these data indicated that at the pre-test stage, the differences between the groups were minimal. This confirmed the comparability of the samples at the beginning of the study. After the intervention, there was a noticeable increase in the indicators in the experimental group, especially the indicators of digital pedagogical competence and inclusive teaching competence. This is clearly related to the use of digital platforms and AI-supported scaffolding in the training process (see Figure 1).

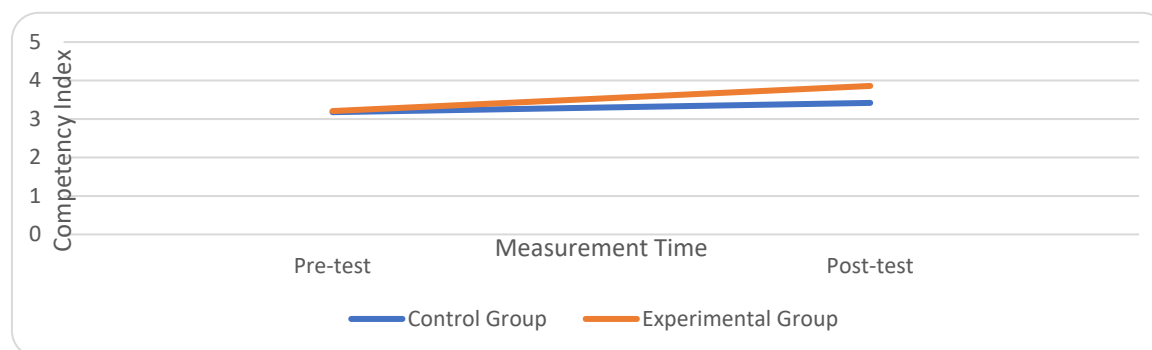


Figure 1. Changes in Professional Competency Index (Pre-Post)

Before the main analysis, the data were checked for compliance with the main statistical assumptions that were important for the application of covariance analysis. In particular, the normality of the distribution of variables, the linearity of the relationship between the covariate (pre-test) and the dependent variable (post-test), as well as the homogeneity of variances between groups were analyzed.

The analysis of the asymmetry and kurtosis indicators showed that the values of all variables are within acceptable intervals. Additionally, Levene's test was performed, which did not reveal statistically significant differences in variances between groups ($p > .05$).

In addition, the assumption of homogeneity of regression slopes between pre-test and post-test indicators in different groups was tested. The results did not reveal a significant interaction between group and covariate ($p > .05$). Such

indicators made it possible to apply ANCOVA for further analysis.

Thus, all statistical assumptions were met. This confirmed the correctness of using covariance analysis to assess the effect of the innovative training model.

It was important to determine the impact of the training model on the development of professional competencies. In the analysis, post-test competency scores were the dependent variables, the type of training model (traditional or innovative) was the independent variable, and pre-test scores were used as a covariate. The results of the analysis indicated that the training model had a significant impact on the level of professional competencies of students after the end of the academic semester. After controlling for initial values, the experimental group had higher results in all studied competency domains. The most pronounced effect was recorded for digital pedagogical competence. Thus, the impact of using digital platforms and AI-supported scaffolding on the development of students' digital pedagogical skills became noticeable. Significant differences were also found for inclusive teaching competence and pedagogical competence.

Table 3. ANCOVA results for post-test competency scores

Outcome variable	F	p	Partial η^2
Professional Competency Index	29.84	< .001	.15
Pedagogical competence	24.17	< .001	.12
Inclusive teaching competence	26.92	< .001	.13
Psychological & communication competence	18.45	< .001	.10
Digital pedagogical competence	34.56	< .001	.17

To determine the changes in the level of professional competencies within each group, paired samples t-tests were conducted. These tests made it possible to compare the pre-test (T1) and post-test (T2) indicators.

The results indicated that the control group showed a significant but moderate increase in professional competencies. However, in the experimental group, the increase in indicators was greater in all studied domains.

The largest changes in the experimental group were recorded for digital pedagogical competence. Such indicators may be associated with the active use of digital platforms and AI-supported scaffolding in the learning process. A significant increase is also noticeable in the inclusive teaching competence indicator. This situation indicated the effectiveness of practice-oriented methods and case analysis in preparing future teachers for work in an inclusive educational environment.

Table 4. Paired samples t-tests for within-group changes (T1–T2)

Outcome variable	Group	t	p	Cohen's d
Professional Competency Index	CG	4.12	< .001	0.44
	EG	9.63	< .001	1.02
Pedagogical competence	CG	3.85	< .001	0.41
	EG	8.74	< .001	0.93
Inclusive teaching competence	CG	3.67	< .001	0.39
	EG	9.11	< .001	0.97
Psychological & communication competence	CG	3.21	.002	0.34
	EG	7.58	< .001	0.81
Digital pedagogical competence	CG	3.94	< .001	0.42
	EG	10.42	< .001	1.10

Therefore, as can be seen from Table 4, the innovative training model provided a greater increase in professional competencies compared to the traditional training model. Cohen's d values indicated a large effect in the experimental group. This is noticeable in the indicators of the development of digital pedagogical competence and inclusive pedagogical practice.

An important part of the study was to determine which components of the innovative training model had the greatest impact on the development of professional competencies of future teachers. For this, a multiple regression analysis was conducted. The dependent variable was the increase in the integral indicator of professional competence, which was calculated as the difference between the post-test (T2) and pre-test (T1) indicators.

The model included as predictors the intensity of use of the main digital components of the innovative training model: AI-supported scaffolding, collaborative digital platforms, which provided joint work of students on tasks, learning management systems (LMS), which were used to organize the educational process, access to educational materials; and digital assessment tools, which were used for formative assessment and self-assessment of students' learning outcomes.

The results of the regression analysis indicated that all included variables had a statistically significant positive impact on the increase in students' professional competencies. However, as can be seen from Table 5, the strongest predictor was the use of AI-supported scaffolding. This indicates that intellectual learning support tools played a particularly important role in the development of pedagogical competencies of future teachers.

Table 5. Multiple regression analysis predicting professional competency gain

Predictor	B	SE	β	t	p	VIF
AI-supported scaffolding	0.42	0.07	.41	6.28	< .001	1.42
Collaborative digital platforms	0.26	0.07	.26	3.74	< .001	1.36
Learning management system (LMS) usage	0.18	0.06	.18	2.91	.004	1.28
Digital assessment tools	0.11	0.05	.12	2.05	.042	1.19

Note: $R^2 = .39$; Adjusted $R^2 = .37$; $F(4, 171) = 27.48$, $p < .001$

The results of multiple regression analysis indicated that the digital components included in the model explained 39% of the variation in the increase in students' professional competencies. The largest contribution to explaining the changes is made by AI-supported scaffolding ($\beta = .41$, $p < .001$). This indicated the important role of intellectual support for learning in the formation of pedagogical competencies of future teachers. Collaborative digital platforms ($\beta = .26$, $p < .001$) also had a noticeable positive impact, which influenced the development of students' communicative and pedagogical skills. Besides, the indicators of learning management systems and digital assessment tools had a smaller, but significant impact (See Figure 2). These instruments played a supporting role in the structure of the innovative training model. Moreover, low VIF values indicated the absence of multicollinearity problems between predictors.

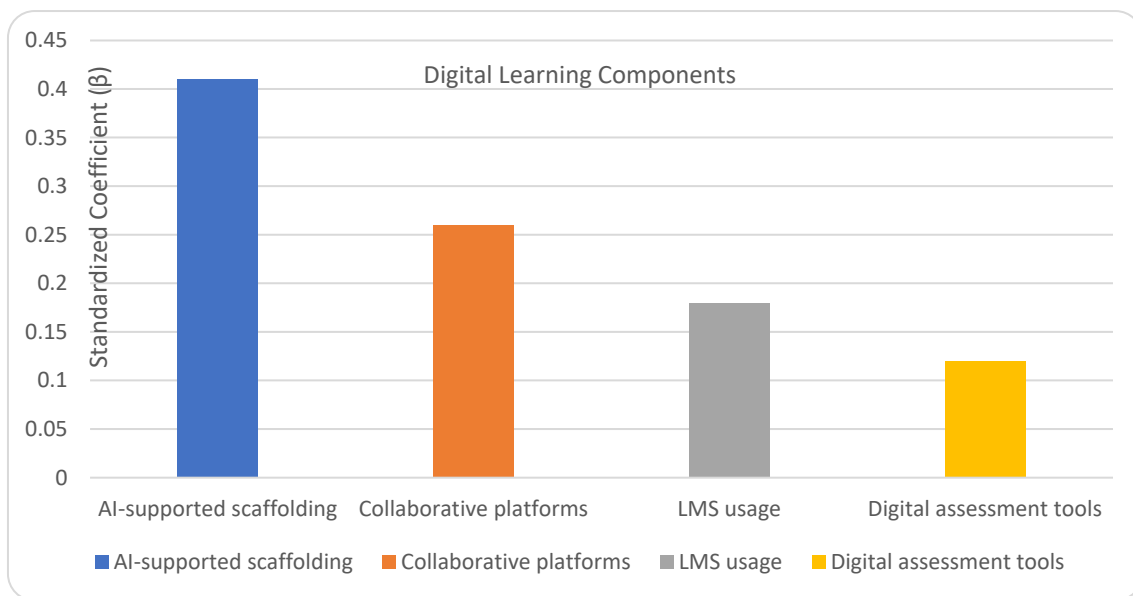


Figure 2. Contribution of Digital Platforms to Competency Gain

Overall, these data indicated that an innovative learning model incorporating digital platforms and AI-based learning tools was associated with higher levels of professional competence development.

4. Discussion

This study aimed to determine the effectiveness of traditional and innovative models of training future teachers in the field of preschool and special education. The results obtained indicated that the innovative model of training, which consisted of practice-oriented learning, reflective pedagogical practices and the use of digital platforms and AI-supported scaffolding, became more effective for the formation of professional competencies of future teachers.

First, the results indicated that students in the experimental group had a significantly higher increase in the integral indicator of professional competence compared to students in the control group. This confirmed the assumptions of other scientists that modern models of teacher education should combine theoretical training with active and practice-oriented forms of learning. Similar conclusions are consistent with the findings of previous studies that identified the importance of integrating practical experience and reflective learning in the training of future teachers (Daggubati, 2025; Hermansah et al., 2025; Awasthi & Gupta, 2025). Fildzah (2020) and Dollar & Mede (2016) emphasized that involving students in the analysis of pedagogical situations, modeling educational cases and microteaching can affect the better acquisition of professional skills.

Attention was paid to data related to the development of digital pedagogical competence. Accordingly, the study recorded the greatest increase in indicators in the experimental group. This can be explained by the active use of digital platforms and interactive educational tools in the learning process (Sysoiev et al., 2024). Moreover, modern research in the field of

educational technologies has also indicated that digital platforms can create important additional opportunities for interaction, joint learning, and feedback (Duque et al., 2021). Such a direction will contribute to a more effective formation of professional competencies of future teachers (Lander et al., 2025; Zhanarstanova et al., 2024).

An important result of the study was the identification of a significant impact of AI-supported scaffolding on students' professional competency growth. Regression analysis showed that it is this component of the innovative model that makes the greatest contribution to explaining changes in the level of competencies. This may be since artificial intelligence tools are able to provide individualized learning support, offer recommendations for lesson planning (Tsekhmister, 2023a; Tsekhmister, 2023b; Tsekhmister et al., 2024), and stimulate students' reflection on their own pedagogical activities (Lander et al., 2025; Ivanchuk et al., 2020). Thus, the use of AI technologies in teacher education should be recognized as a promising direction for the modernization of future teacher training programs (Cruz & Vieira, 2022; Huyen et al., 2025; Belhaj, 2025).

The results of the study also indicated the important role of collaborative digital platforms, which influenced the provision of opportunities for students to work together, discuss pedagogical cases, and exchange experiences. Modern authors have also proven that collaborative activities affect the development of communicative and social skills, which are important components of a teacher's professional competence (Deroncele-Acosta et al., 2023; Eftimie & Mărgărițoiu, 2022; Manasia et al., 2019; Miralles-Cardona et al., 2025). At the same time, the influence of learning management systems and digital assessment tools was less pronounced, but significant. This indicated their supporting role in the structure of an innovative training model (Adigun, 2021). Similar thoughts regarding management systems in hybrid forms of training are contained in other works (Allen et al., 2013; Cahyaningsih et al., 2025).

Therefore, the data obtained in the study allowed us to conclude that the hypotheses put forward were confirmed. Hypothesis H1, which predicted that the innovative training model would contribute to a higher level of development of professional competencies of future teachers compared to the traditional model, was confirmed by the results of covariance analysis. This analysis showed significant differences between the experimental and control groups. Hypothesis H2, which concerned the positive impact of the innovative training model on the development of inclusive pedagogical competence, was also empirically confirmed, as the applicants of the experimental group had a greater increase in the relevant indicators. In addition, hypothesis H3, according to which the use of digital educational tools contributes to the development of students' professional competencies, was confirmed. Data from the regression analysis indicated that digital components of training became important predictors of the growth of professional competencies of future teachers.

The results obtained have important theoretical and practical implications. From a theoretical point of view, the study made it possible to expand the understanding of the mechanisms of development of professional competencies of future teachers in a digital educational environment. It indicated that the effectiveness of innovative training models depends on the combination of several components: practice-oriented learning, digital educational platforms and intellectual support of the educational process.

From a practical point of view, the results of the study can be used to modernize teacher education programs. The integration of digital platforms, AI-supported scaffolding, and collaborative learning tools can contribute to a more effective development of the professional competencies of future teachers.

Thus, the results of the study indicated that the combination of practice-oriented pedagogical approaches and modern digital technologies can create important, favorable conditions for the development of professional competencies of future teachers.

Despite the significant results obtained, the study has certain limitations that need to be considered. A separate limitation of the study was the use of self-assessment tools to determine the level of professional competence development. Since the participants independently assessed their own level of competence, this could have led to an overestimation of the results. This effect should be paid attention to in future studies. The generalizability of the findings was limited by the specific educational context in which the study was conducted. The sample included students from a single higher education institution within a single national teacher education system. Therefore, differences in curricula, institutional resources, and cultural contexts may have had an impact on other countries and educational systems. Another limitation was the time horizon of the study. The measurements were only taken at the beginning and end of one academic semester. This made it impossible to determine whether the observed effect would be maintained in the long term.

5. Conclusions

This article aimed to compare traditional and innovative models of training future teachers in the field of preschool and special education. The results of the study showed that the innovative training model, which included practice-oriented learning, reflective pedagogical practices and the use of digital platforms and AI-supported scaffolding, became more

effective for the development of students' professional competencies.

In particular, it was found that students in the experimental group had a higher increase in the integral indicator of professional competence. Participants from this group also had higher results in individual domains of competence: pedagogical, inclusive, communicative and digital competence. Additional analysis showed that the use of digital educational tools was important for the development of professional skills of future teachers.

The results also indicated the importance of integrating modern digital technologies and innovative pedagogical approaches into future teacher training programs. At the same time, it has been proven that the combination of practice-oriented learning, collaborative digital platforms and intellectual support of the educational process can create important favorable conditions for the formation of professional competencies that are necessary for effective pedagogical activity in a modern educational environment. Thus, the study contributes to the development of modern approaches to pedagogical education and can be used as a theoretical and practical basis for further modernization of training programs for future teachers in the field of preschool and special education.

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Data sharing statement

No additional data are available.

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