

Innovative Approaches to Training Future Specialists in Preschool Education in Crisis Situations

Maryna Yepikhina^{a,*}, Svitlana Bader^b, Svitlana Makarenko^c, Hanna Zazharska^d, Liudmyla Varianytsia^e

Received : 2 April 2025
 Revised : 28 August 2025
 Accepted : 28 September 2025
 DOI : 10.26822/iejee.2025.409

^{a,*} **Corresponding Author:** Maryna Yepikhina, State Institution Luhansk Taras Shevchenko National University, Ukraine.

E-mail: dewdrop@ukr.net

ORCID: <https://orcid.org/0000-0003-0199-8186>

^b Svitlana Bader, State Institution Luhansk Taras Shevchenko National University, Ukraine.

E-mail: svetmira23@meta.ua

ORCID: <https://orcid.org/0000-0002-9225-423X>

^c Svitlana Makarenko, Mariupol State University, Ukraine.

E-mail: msi.osv@gmail.com

ORCID: <https://orcid.org/0000-0001-8933-9681>

^d Hanna Zazharska, State Institution Luhansk Taras Shevchenko National University, Ukraine.

E-mail: anna.zazharskaya@gmail.com

ORCID: <https://orcid.org/0000-0002-0732-8610>

^e Liudmyla Varianytsia, State Institution Luhansk Taras Shevchenko National University, Ukraine.

E-mail: luda.varaniza@gmail.com

ORCID: <https://orcid.org/0000-0002-4355-1529>

Abstract

In the context of crisis situations, making use of the most recent opportunities for future educators' training is a pertinent issue. The purpose of the suggested article is to evaluate how cutting-edge technologies might help train future preschool education specialists and assess how well they work in emergency scenarios. In order to accomplish this, scientific survey methods were used, and regression correlation and Pearson correlation were used to analyse the results. The findings show that the average score significantly increased as a result of the utilization of innovations in the educational process. The average level of professional reflection and motivation rose once the experiment started. According to Pearson's correlation, university students were far more motivated to study and utilized this advantage to pass the test. Additionally, the regression analysis showed that even one variable (in the proposed study, motivation) significantly impacts another (in our case, test results). The STEM approach showed the most significant growth results, slightly outperforming the flipped learning opportunities. The conclusions recommend using innovative methods of flipped learning and the STEM approach.

Keywords:

Innovations, Education, Surveys, STEM Approach, Crises.

Introduction

Crisis affect the professional formation and development of an individual. Military conflicts, pandemics and economic instability affect all spheres of social life, including education. Thus, the qualification of future specialists in preschool education requires flexibility, adaptation and implementation of the latest technologies to meet modern challenges. In addition, the scientific literature proves that in crisis conditions, traditional approaches to teaching may not be practical enough, so it becomes essential to develop and implement innovative teacher training methods.

However, a significant challenge is that current crises impact resource constraints, lack of practical experience among teachers, and psychological stress among students and teachers. In addition, the need for rapid adaptation to new learning formats is also a serious challenge. This calls



www.iejee.com
 ISSN: 1307-9298

2025 Published by KURA Education & Publishing.
 This is an open access article under the CC BY-NC-ND license. (<https://creativecommons.org/licenses/by/4.0/>)

into question the effectiveness of traditional methods of training specialists in early childhood education and requires the search for new approaches, which determines the relevance of this study. Thus, given the preceding considerations, the main research problem is identifying important aspects of preschool teacher training that need improvement. Attention should be paid to identifying the main innovative methods influencing teaching effectiveness in these conditions.

This study differs from the previous ones in that it focuses on the study of the leading innovative approaches by conducting a cross-sectional study among students and teachers. In addition, it aims to determine the impact of digital technologies, adaptive methods and distance learning in crises. Therefore, the study focuses on determining the importance of innovative methods in training future specialists in preschool education.

The purpose of this work is to analyse the role of innovative technologies in the system of training future specialists in preschool education and to determine their effectiveness in crises. The main tasks are as follows:

1. To analyse the empirical materials obtained through testing before and after using innovative training of future teachers.
2. To determine the effectiveness of various innovative methods.
3. To formulate recommendations for improving the system of preschool teacher training.

For this purpose, a hypothesis has also been formed that needs to be proved:

1. Using digital technologies and adaptive learning strategies will improve the professional training of future teachers in crises.
2. STEM education methods and a project-based learning approach contribute to improving the professional training of students.

Literature review

The importance of innovations in the training of preschool education specialists

Modern scholars have drawn attention to the importance of innovations in training preschool education specialists. Dychkivska and Uliukaeva (2021) analyse various innovations used in the pedagogical models of France, Germany, Sweden and other countries. The authors pointed out that the experience of pedagogical support in France and the UK should be considered an innovative technology for the professional training of future preschool teachers.

In the UK, tutoring systems are actively developing, i.e., teachers' assignments to students to teach them to act and think independently. In France, support is being developed, which involves the professional development of young teachers.

The study by Damayanti et al. (2024) provides a critical comparative analysis of the dynamics of early childhood education. The author identified a complex interaction between traditional and innovative pedagogical approaches. In general, the study points to the importance of introducing case and person-centred approaches as important innovative methods. Gavrilas et al. (2024) identified the importance of using robotic technology but indicated that not all teachers can cope with using robotic systems. This suggests better support for professionals in the future. Herut and Setlhako (2025) analysed modern preschool teacher training programmes to improve future teachers' pedagogical skills.

The authors' findings confirmed a strong and effective preservice teacher education programme that develops preservice teachers' pedagogical competencies (Artipah et al., 2024; Kozak et al., 2024). However, the authors also pointed to some limitations, including the problem of material resources and limited practical impact. Jing (2024) determined that modern preschool education has undergone a significant development evolution, and that its further development requires the involvement of new innovative solutions. Yang et al. (2023) identified the critical role of STEM education technologies in training future teachers. At the same time, Jin et al. (2023) also pointed out the importance of introducing modern innovative trends in training specialists. Modern education actively uses game modelling (Baikulova et al., 2024).

According to researchers, the use of game technologies in teacher training improves their ability to adapt the learning process to children's needs (Li et al., 2024; Lu et al., 2024; Mikrouli et al., 2024). In addition, a few studies have shown that flipped learning is one of the key technologies used in teacher training (Chen & Chen, 2014). According to the research, this methodology involves preliminary acquaintance of students with theoretical material through video lectures or interactive resources.

At the same time, classroom work focuses on the active application of knowledge (Lu et al., 2024; Kavanagh et al., 2017). Rapti et al. (2024) identified the importance of using virtual reality technologies to train the specialists of the future. The study of other authors showed the importance of introducing game modelling and project-based learning in teacher training (Martínez-Bello et al., 2023). The study by Zhufeng and Sitthiworachart (2023) presents the main results of the introduction of augmented reality in

training future preservice teachers. Luo et al. (2023) pointed out the negative side of AI involvement in teacher training and identified the negative role of AI chats.

However, modern authors also noted that these innovations are challenging to implement in education, as they require exceptional material support and appropriate professional qualifications of teachers and experts themselves (Kasioura et al., 2025; Kurniawati et al., 2024; Zubalii et al., 2024). These studies have highlighted the significant need to improve mechanisms for supporting and developing students' practical skills.

Teacher education in times of crisis and martial law

Modern crises affect the introduction of various innovative methods in the training of specialists (Tsekhmister et al., 2023). In the context of martial law, higher education must strengthen the formation of professional skills, because at this time everyone must perform their professional duties to the best of their ability. The study by Dychkivska and Kozliuk (2023) describes the main components of the training of masters in the speciality 'Preschool Education'.

The authors determined that in the content of modern disciplines provided by the master's educational and professional programme 'Preschool Education', applicants are provided with specialised knowledge and skills that affect the creation of safety and assistance in emergency and crises. Other authors have pointed out that in times of crisis, the content of courses involves both theoretical knowledge and practical skills that should influence the effective management of the educational process (Kozak et al., 2024; Nechyporenko et al., 2024; Vainola, 2024).

The study by Dychkivska & Kozliuk (2023) indicates that such modern courses as 'Organisation and Management of Preschool Education' and 'Psychology of Management' allow students to get acquainted with the regulatory framework for the organisation of the work of preschool education institutions with the provision of preschool education in the context of the crisis in Ukraine. In addition, students are introduced to the key aspects of crisis management. This area is now essential for making quick and effective decisions in the governance of preschool educational institutions. Bogush et al. (2024) identified the dual education system's role on teachers' professional development in crises. At the same time, several studies point to professional mental support for all applicants during the crisis period (Bilbrey et al., 2022; Kosenchuk & Tarnavska, 2024; Lowery, 2024).

The study by Ilichuk et al. (2024) describes the main measures to ensure the quality and accessibility of education for all participants in the educational process in war. Other scholars have also addressed

the issue of creating a quality learning space in times of war, emphasising the role of innovative solutions (Shynkar et al., 2025; Nissim & Naifels, 2024; Salha et al., 2024). At the same time, despite the considerable interest in providing preschool education in crisis conditions, several gaps should be addressed. First, there is not much empirical research on the impact of innovations in preschool teacher training.

Most existing work focuses on analysing policy and international initiatives but lacks a detailed analysis of their effectiveness. In addition, not many studies systematically examine the role of different innovative solutions. This study will fill these gaps and identify and indicate the role of innovative technologies in training future preschool education specialists.

Materials and Methods

Research design

The study employed a quasi-experimental pre-test/post-test design to examine the impact of innovative approaches (game modelling, flipped learning, project-based learning, case study, and the STEM approach) on the professional development of future preschool teachers. This research design was chosen as it allows for the comparison of student performance before and after the implementation of the selected teaching methods, thus enabling the assessment of their effectiveness. The intervention and data collection were conducted between September 2024 and December 2024. This period was selected to allow sufficient time for the application of innovative approaches and the subsequent analysis of their effects.

Sample and participants

The study used a purposive sampling of participants. The criteria for inclusion in the study included studying in the field of preschool education and readiness to participate in the study. Participants had to voluntarily agree to participate in the study and complete all the proposed tasks. An important criterion was the lack of previous experience using the study methods. Therefore, students who had previously studied using the methods (flipped learning, STEM, etc.) were not included in the sample. This was done to avoid the influence of previous experience. In addition, regular attendance at classes was an important criterion, meaning that only those students who attended at least 85% of classes during the study period were included.

Thus, 38 preschool teacher training programme students were selected for the study. Depending on the methodology, students were divided into 5 groups of 7-8 people. Table 1 shows the main groups, and the current methods used.

Table 1

Number of students in groups and adopted approaches

Name of the group	The name of approach	Number of students
Group 1	Game simulation	7 students
Group 2	Flipped learning	8 students
Group 3	Project training	8 students
Group 4	Case-study	7 students
Group 5	STEM approach	8 students

Source: author's development

Instruments and Procedure

The main instrument in the study was a knowledge assessment test. The authors developed special tests to assess the level of pedagogical training. These tests took place before and after implementing the methods (maximum score - 100). The tasks consisted of theoretical questions and situational tasks that required the identification of practical skills of students (see Appendix 1). The study also used a motivation questionnaire consisting of 10 questions that required a score from 1 to 5 (the so-called Likert Scale). This questionnaire allowed students to assess their level of knowledge, motivation to learn and interest (see Appendix 2).

The research procedure included pre-testing, which consisted of test tasks to assess knowledge and pedagogical training. The training phase lasted 3 months. At this stage, each group had the opportunity to be trained according to the appropriate methodology (game modelling, flipped learning, case studies, project-based learning, STEM approach). An essential criterion for the students was their mandatory attendance at seminars. After completing 3 months of training, all participants completed a final test and a questionnaire to assess their motivation. It should be noted that the psychometric properties (reliability and validity) of the developed instruments were not formally tested. While the content of the test and questionnaire was reviewed by a panel of three experts in pedagogical methodology to ensure content relevance, no statistical validation was performed. This lack of formal validation is acknowledged as a limitation of the study and should be considered when interpreting the results.

Data analysis

Several scientific methods were used to process the data. In particular, the use of descriptive statistics was important. The average scores before and after implementing the methods were determined to assess the changes in knowledge and motivation, i.e., the average values were calculated. The growth was also calculated. The following formula was used for this purpose:

$$\text{Increase} = \frac{\text{GPA after} - \text{GPA before}}{\text{GPA before}} \times 100\% \quad (1)$$

Using this formula, the effectiveness of each method was determined and compared. The study also used correlation analysis to determine the level of motivation and test score gains. Pearson's correlation coefficient (r), known in science, determines the strength and direction of the relationship between the variables. The paper uses the method of multiple linear regression analysis to determine the impact of each methodology on test results. The following formula was used for this purpose:

$$\beta_0 + \beta_1 (\text{Game modelling}) + \beta_2 (\text{Flipped learning}) + \beta_3 (\text{Project-based learning}) + \beta_4 (\text{Case study}) + \beta_5 (\text{STEM}) + \varepsilon \quad (2)$$

The ε indicates the error (residual term) of the regression model. It indicates that certain factors that may affect the test are considered but are not included in the model. These include the individual characteristics of test takers and random errors. Such an indicator makes the regression model more realistic, as no mathematical formula can ideally account for variations in the results. After that, the method of comparative analysis was used to compare the data obtained with the data of other scientists.

Results

Unfortunately, the emergence of modern crisis realities has profound consequences in the formation of social, economic and military challenges, which will require qualitatively new approaches to the training of students in the field of preschool education to overcome (Tsekhmister, 2024; Zahorodnia et al., 2023).

In such circumstances, innovative methods have become a key tool in developing the necessary competencies required for further work in the fluid conditions of general political or socio-economic instability and gradual adaptation to possible rapid changes. From this point of view, it is essential to analyse the use of the latest educational technologies, to trace the vectors of their impact on the professional readiness of future teachers.

The main difficulties remain problematic, as they will undoubtedly be formed using innovative approaches. Considerable attention is paid to assessing the effectiveness of using such methods by reviewing the opinions of students and teachers, in particular, to identify further prospects for improving the use of pedagogical systems in teaching.

The purpose of the proposed survey is to study and empirically measure the assessments and practical experience of students and teachers using innovative digital methods to train future specialists in preschool education.

The survey made it possible to establish the level of effectiveness of the use of the latest approaches, to conduct a professional assessment of readiness to perform professional duties in times of socio-political and military crisis, and to identify the main obstacles to establishing the educational process faced by all participants in the training.

The obtained results provide an essential empirical basis for further use in improving both existing educational practices and adjusting or developing fully independent recommendations for the future improvement of the quality of education of students in the field of preschool education (Maksymchuk et al., 2019).

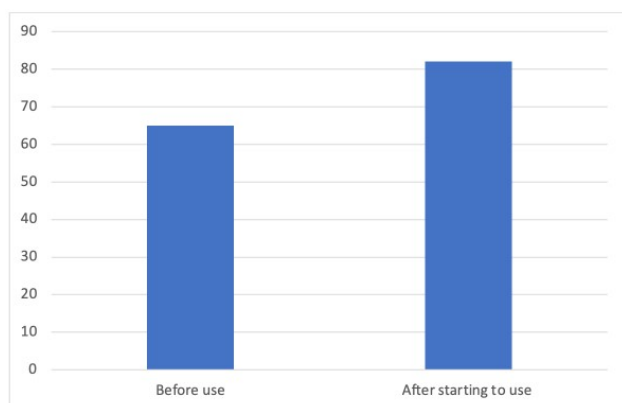
The test results were based on both answers to theoretical questions (finding the correct answer) and situational tasks. In particular, the average test score was determined, as well as the assessment of knowledge (see Figure 1).

The test showed a significant increase in the average score because of using innovations in the educational process. The scores increased by more than 17 points, more than 26%. This makes it possible to discuss the experiment's somewhat tangible educational success.

A survey based on the Likert scale revealed an average level of motivation, which was 3.2 points before the experiment, while after the experiment it was 4.1.

The level of professional reflection has also increased. Before the active use of innovative education methods, self-analysis scores were 2.8 points; after active use of innovative approaches, this level increased to 3.9 points.

Figure 1.
Average score according to the test to assess the level of pedagogical training



Source: author's development

Positive dynamics in assessment and self-assessment also increased the percentage of higher education students who support using innovative methods. The increase was from 45% to 78%.

Obtaining digital values made it possible to determine the correlation between motivation and test results, i.e. to determine the Pearson coefficient. The calculations showed that before using innovative approaches, the coefficient was $r = 0.45$ (indicating a weak relationship), while after the application, the coefficient was $r = 0.72$ (i.e., a strong relationship). The regression analysis showed the following indicators: before the experiment, motivation explained 25% of the variations in performance, while after the active use of innovative methods, motivation can explain 50% of the variation in performance.

Thus, the correlation demonstrated how strongly the two variables are related. Analysing the relationship between student motivation and test results; before using innovative methods, the indicator was found $r = 0.45$ (i.e., a relatively positive relationship was demonstrated). In practice, this led to the fact that higher education students were much more motivated to study and used their positive impact to pass the test (demonstrated better results when answering questions).

However, the impact of motivation can still be considered insignificant. At the same time, after the application of modern methods, the indicator was $r = 0.72$ (a strong positive correlation was proved), which, after the introduction of innovative methods, determined a much higher level of motivation, which began to have a much more significant impact on test results. Accordingly, higher education students had a much greater interest and engagement in learning and were sufficiently motivated to improve their results.

Also, the regression analysis showed that even one variable (motivation in the proposed study) significantly impacts another (in our case, test results). Thus, before introducing innovative teaching methods, motivation could explain approximately 20% of the variation in performance ($R^2 = 0.20$). Based on this, it can be argued that the level of students' motivation before the experiment had a weak impact on learning outcomes.

After introducing progressive methods, motivation can explain half of the variation in performance ($R^2 = 0.50$). This indicator also indicates that the level of motivation began to have a significant impact on learning outcomes. The results of the correlation and regression analyses can be found in Tables 2-4.

Table 2.
Comparison of mean values

Indicator	Before implementation	After implementation
Average test score	65	82
Motivation level (1–5)	3.2	4.1
Professional reflection level (1–5)	2.8	3.9
Support for innovative methods (%)	45%	78%

Source: author's development

Table 3.
Conducting correlation analysis (determining Pearson's coefficient)

A pair of variables	Before implementation (r)	After implementation (r)
Motivation - Test results	0.45	0.72

Source: author's development

Table 4.
Regression analysis (the impact of motivation on results)

Indicator	Before implementation	After implementation
R ² (proportion of explained variation)	0,20 (20%)	0,50 (50%)

Source: author's development

The study also describes some methods used because of innovations that have demonstrated their benefits.

The measurements demonstrated the acquisition of specific theoretical knowledge, making it possible to improve the educational process and make certain adjustments.

In particular, the calculation mechanism involved dividing 38 students into 5 groups, each of which can be compared to the degree of improvement in learning outcomes (see Table 5).

Table 5.
Degrees of improvement in learning outcomes as a result of innovative methods

Method	Average score to	Average score after	Growth (%)
Game modelling	64	78	+21,9%
Flipped learning	66	85	+28,8%
Project-based learning	65	79	+21,5%
Case studies	63	77	+22,2%
STEM approach	62	80	+ 29,0%

Source: author's development

Therefore, the calculations showed that the STEM approach showed the highest growth results, which amounted to +29%, which is not much, but higher than the best results in test scores, slightly ahead of the flipped learning opportunities (+28.8%).

We also propose a definition for assessing changes in motivation (see Table 6).

Table 6.
Evaluation of changes in motivation

Methodology	Average level of motivation to	Average level of motivation after	Increase
Game modelling	3,1	4,0	+0,9
Flipped learning	3,2	4,5	+1,3
Project-based learning	3,3	4,2	+0,9
Case studies	3,0	4,1	+1,1
STEM approach	3,1	4,6	+1,5

Source: author's development

As a result of the correlation, it was determined that using the STEM approach is most important for the best increase in motivation (+1.5). This indicates the effectiveness of its use in individual test tasks, increasing the motivational component, engaging students in learning, etc. Accordingly, this made it possible to summarise the role of STEM methods in further education.

A qualitative regression analysis was also conducted. It identified the main factors that directly impacted the test results. The model was used for the regression analysis:

$$\text{Test Results} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon \quad (3)$$

In this model: X₁X₁ - use of game simulation, X₂X₂ - use of flipped learning, X₃X₃ - project-based learning, X₄X₄ - case study method used, X₅X₅ - use of STEM approach, β_iβ_i - coefficients of influence of each methodology, εε - random error.

The calculation of the regression coefficients based on the increase in test scores and the level of motivation showed the following results (see Table 7).

Table 7.
Analytical data for calculations

Methods	Test score increase (%)	Increased motivation
Game modelling	21.9%	+0.9
Flipped learning	28.8%	+1.3
Project-based learning	21.5%	+0.9
Case studies	22.2%	+1.1
STEM approach	29.0%	+1.5

Source: author's development

Regression analysis was also applied, demonstrating certain advantages of the applied innovative methods in the training organisation. The results of the regression analysis are shown in Table 8.

The efficiency of five different teaching strategies was assessed using a multiple linear regression analysis, with the dependent variable being the post-testing outcomes of the students. The reference category was the control group (conventional instruction), and dummy variables were made for each of the five approaches (1 = method utilized; 0 = otherwise) because each student had only ever used one method. Notably, there were 38 participants in the entire sample, with rather modest subgroup sizes ($n = 6-8$ per method). The statistical power and generalizability of the results are hampered by the small sample size, even though regression analysis was utilized to find broad trends.

Despite being encouraging, the effect sizes for case studies and game models fell short of statistical significance ($p > 0.05$), suggesting only moderate or ambiguous efficacy. The least effective and non-statistically significant was project-based learning.

These findings should be regarded cautiously due to the small sample size. However, the analysis indicates that the STEM approach and flipped learning may have the most potential to improve pedagogical outcomes and ought to be taken into consideration for broader adoption in teacher training. To validate these patterns and draw trustworthy statistical inferences, more studies with bigger sample sizes are required.

The regression model yielded the following coefficients (β): flipped learning (+8.23), STEM approach (+8.43), case studies (+1.63), game modelling (+1.33), and project-based learning (+0.93). Among them, only flipped learning and the STEM approach demonstrated statistically significant effects ($p < 0.05$), indicating a strong association with improved test outcomes.

It has been demonstrated that game modelling and the case study method showed a relatively moderate impact (1.33 and 1.63, respectively), demonstrating their tangible effectiveness, but not as significant as using the STEM approach or flipped learning. Accordingly, a recommendation can be made to deepen the training of future teachers using innovative methods of flipped learning and the STEM approach, as these methods have demonstrated perhaps the best results.

Discussion

Times of political and economic instability have a significant impact on the formation of educational policy and the effectiveness of innovative technologies. The purpose of this paper is to analyse

the role of innovative technologies in the system of training future specialists in preschool education and to determine their effectiveness in crises.

The realisation of this goal involves several tasks, in particular, to analyse empirical materials obtained as a result of testing before and after the use of innovative training of future teachers; to determine the effectiveness of various innovative methods; to formulate recommendations for improving the system of training of preschool teachers.

The following scientific hypotheses needed to be proved: using digital technologies and adaptive learning strategies will improve the professional training of future teachers in crises; STEM education methods and project-based learning will improve the professional training of students (Pavlenko et al., 2024). The proposed results show that the testing demonstrated a significant increase in the average score because of the application of innovations in the educational process: the indicators increased by more than 17 points, more than 26%.

The Likert scale survey determined the average level of motivation, which increased after the start of the experiment. The level of professional reflection has also increased. Pearson's correlation showed that higher education students were more motivated to learn and used their positive impact to pass the test (they showed better results when answering questions) (Bondar et al., 2021). However, the impact of motivation can still be considered insignificant. In addition, the regression analysis showed that even one variable (in the proposed study, motivation) significantly impacts another (in our case, test results). This indicator also indicates that the motivation level has significantly impacted learning outcomes.

The results confirm the findings of other researchers who consider the motivational factor one of the main advantages of using innovative teaching methods for future teachers (Bielienka, 2021; Storozhyk, 2024). Researchers rightly point out the importance of this aspect, and empirically prove the link between students' interest in new innovative teaching methods and the increase in grades (Koshil, 2018; Telychko, 2020).

Previous studies have highlighted the importance of implementing innovative teaching methods from the early stages of teacher education (Racu et al., 2017), as such approaches may support the modernisation of educational processes. The present findings provide tentative support for the hypothesis that digital technologies and adaptive learning strategies can contribute to improving the professional training of future teachers, particularly in crisis conditions.

The data suggest that the STEM approach and flipped learning were associated with comparatively higher gains in test scores and learner motivation. However, these conclusions must be interpreted with caution due to the limited sample size ($n = 38$), with only 7–8 participants per group. Such a small sample substantially limits the statistical power of the analyses and weakens the reliability of inter-group comparisons.

Regression and correlation analyses indicated that the STEM approach had the strongest relationship with both academic improvement and motivational outcomes, followed closely by flipped learning. Nonetheless, the strength of these associations cannot be generalised beyond the study sample. The observed trends require further investigation and replication using larger, more representative participant groups.

The results partially support the second hypothesis, which proposed that STEM education and project-based learning contribute to enhancing the professional preparation of students (Gumenyuk et al., 2021). While project-based learning showed lower effectiveness, flipped learning demonstrated outcomes close to those of the STEM approach. However, due to the methodological constraints of the study (particularly the small sample size) these findings remain preliminary.

The conclusions drawn align with those reported in other empirical studies on the impact of innovative teaching methods in teacher education (Brenneman et al., 2018; Dönmez & Gülen, 2024; Wan et al., 2020; Zhazira et al., 2024). Some researchers have also noted that outcomes may depend on the specific characteristics of participants and contextual factors (Arasomwan & Mashiy, 2021; Ozcinar et al., 2021), which further supports the need for careful interpretation.

Considering the small sample size, the findings of this study should not be considered definitive. Future research should be conducted with larger samples to strengthen the validity and generalisability of the results. Until then, any recommendations for the use of specific methods such as flipped learning or the STEM approach should be treated as exploratory rather than conclusive. It should also not be ruled out that the use of specific methods and their effectiveness depend on the pedagogical skills of teachers, which has also been emphasised by some scholars (Desnenko et al., 2021; Halachev, 2024). Considering these aspects will also require a broader justification in future studies.

The study's methodology has limitations, which should be considered when further processing the results. First, the proposed Likert scale contains certain limitations that may be subjective. For example, respondents may have found it difficult to determine the exact difference in scores, and their characterisation of good and satisfactory (for example) may have been

based solely on their own experience. The use of regression analysis in this study is limited by the small sample size, which reduces the robustness of statistical conclusions.

It should be noted that testing is also a method that may have some subjective characteristics of the students themselves, who may have found some tasks more straightforward than others. At the same time, this does not deny that innovative methods directly impact training future teachers in crisis conditions.

Conclusions

The use of innovative methods in the training of students of pedagogical specialties is a promising direction, especially in the conditions of modern political and economic instability. Within the framework of this study, conducted on a relatively small sample, a positive dynamic of the average academic score was recorded after the implementation of innovative educational approaches: the indicators increased by more than 17 points, or over 26%.

An increase in the level of academic motivation and professional reflection of students was also observed. Pearson correlation analysis showed that more motivated students achieved higher results in completing test tasks. At the same time, the influence of motivation on the results should be considered statistically significant but limited. Regression analysis confirmed that even one variable (motivation) can have an impact on another (test results).

The best results were recorded when using the STEM approach, which slightly surpassed the flipped learning method in terms of effectiveness. Correlations indicate that it was the STEM methodology that contributed the most to the increase in motivation, which indicates its potential effectiveness not only in performing test tasks, but also in forming a general positive attitude towards learning.

Regression analysis confirmed these trends: students who studied using the STEM approach and flipped learning showed the greatest increase in knowledge.

However, it is worth emphasizing that the results obtained are specific to this sample and cannot be automatically generalized to wider populations. Although the conclusions look promising, they are preliminary. Further research using larger and more representative samples is needed to verify the reliability of the identified trends and to form more substantiated recommendations. Accordingly, future research should be devoted to the application of innovative methods in the training of students of pedagogical specialties based on the involvement of many respondents. This will allow us to confirm the effectiveness of innovations.

References

- Arasomwan, D. A., & Mashiy, N. J. (2021). Early childhood care and education educators' understanding of the use of music-based pedagogies to teach communication skills. *South African Journal of Childhood Education*, 11(1). <https://doi.org/10.4102/sajce.v11i1.896>
- Artipah, A., Sain, Z. H., Asfahani, A., & Sa'diyah, S. (2024). Early Childhood Education Reform in Pakistan: Challenges, Innovations, and Future Prospects. *Absorbent Mind*, 4(1), 57–64. https://doi.org/10.37680/absorbent_mind.v4i1.4903
- Baikulova, A., Akimbekova, S., Kerimbayeva, R., Arzymbetova, S., & Moldagali, B. (2024). Leveraging digital interactive didactic games to enhance cognitive development in preschool education. *E-Learning and Digital Media*. <https://doi.org/10.1177/20427530241261294>
- Bielienka, H. (2021). Preparation of future preschool teachers: Vectors of eurointegration. *Pedagogical Education: Theory and Practice. Psychology. Pedagogy*, (35), 30–35. <https://doi.org/10.28925/2311-2409.2021.354>
- Billbrey, J. B., Castanon, K. L., Copeland, R. B., Evanshen, P. A., & Trivette, C. M. (2022). Primary early childhood educators' perspectives of trauma-informed knowledge, confidence, and training. *The Australian Educational Researcher*, 51, 67–88. <https://doi.org/10.1007/s13384-022-00582-9>
- Bogush, A., Naida, R., Malinovska, N., Durmanenko, Y., & Bubin, A. (2024). The Impact of a Dual Education System on the Professional Training of Future Preschool Teachers in Higher Education Institutions. *Revista EDaPECI*, 24(1), 172–184. <https://doi.org/10.29276/redapeci.2024.24.119940.172-184>
- Bondar, I., Humeniuk, T., Batchenko, L., Horban, Y., & Honchar, L. (2021). State regulation of the development of educational and scientific process in higher education institutions. *Journal of Management Information and Decision Sciences*, 24(2), 1-10. <https://www.abacademies.org/articles/state-regulation-of-the-development-of-educational-and-scientific-process-in-higher-education-institutions-10158.html>
- Brenneman, K., Lange, A., & Nayfeld, I. (2018). Integrating STEM into Preschool Education; Designing a Professional Development Model in Diverse Settings. *Early Childhood Education Journal*, 47(1), 15–28. <https://doi.org/10.1007/s10643-018-0912-z>
- Chen, M., & Chen, S. (2014). Empirical Study on Flipped Classroom Based on Understanding. In *2014 International Conference of Educational Innovation through Technology (EITT)*. IEEE. <https://doi.org/10.1109/eitt.2014.24>
- Damayanti, E., Djollong, A. F., Asfahani, A., et al. (2024). Dynamics of Early Childhood Education in Taiwan: A Comparative Study of Traditional and Innovative Approaches. *Absorbent Mind*, 4(1), 65–75. https://doi.org/10.37680/absorbent_mind.v4i1.4904
- Desnenko, S., Pakhomova, T., Starostina, S., & Tokareva, J. (2021). Gamification in the formation of digital skills of future teachers. *E3S Web of Conferences*, 273, 12118. <https://doi.org/10.1051/e3sconf/202127312118>
- Dönmez, İ., & Gülen, S. (2024). Trends, Opportunities, and Pipelining in Preschool STEM Education: A Scoping Review. *Kuramsal Eğitim Bilim*, 17(1), 28–56. <https://doi.org/10.30831/akukeg.1295046>
- Dychkivska, I., & Uliukaeva, I. (2021). Innovative trends in the professional future preschool education specialist training: Domestic and European experience. *Ukrainian Professional Education*, (9-10), 103–112. <https://doi.org/10.33989/2519-8254.2021.9-10.263614>
- Dychkivska, I., & Kozliuk, O. (2023). Professional Training of Future Masters in Preschool Education in Conditions of Martial Law. *Theoretical and Methodical Problems of Children and Youth Education*, 27(1), 165–178. <https://doi.org/10.32405/2308-3778-2023-27-1-165-178>
- Gavrilas, L., Kotsis, K. T., & Papanikolaou, M.-S. (2024). Assessing teacher readiness for educational robotics integration in primary and preschool education. *Education 3-13*, 1–17. <https://doi.org/10.1080/03004279.2023.2300699>
- Gumenyuk, T., Kushnarov, V., Bondar, I., et al. (2021). Transformation of Professional Training of Students in the Context of Education Modernization. *Studies of Applied Economics*, 39(5). <https://doi.org/10.25115/eea.v39i5.4779>
- Halachev, P. (2024). Gamification as an e-learning tool: A Literature Review. *E-Learning Innovations Journal*, 2(2), 4–20. <https://doi.org/10.57125/elij.2024.09.25.01>
- Herut, A. H., & Setlhako, M. A. (2025). Shaping future preschool teachers in Ethiopia: A qualitative evaluation of pedagogical competence development mechanisms. *Social Sciences & Humanities Open*, 11, 101218. <https://doi.org/10.1016/j.ssaho.2024.101218>

- Jin, X., Kim, E., Kim, K.-c., & Chen, S. (2023). Innovative Knowledge Generation: Exploring Trends in the Use of Early Childhood Education Apps in Chinese Families. *Journal of the Knowledge Economy*, 15, 12253–12292. <https://doi.org/10.1007/s13132-023-01585-2>
- Jing, Z. (2024). The Evolution, Present Practices, and Future Directions of Early Childhood Education and Care in China. *European Journal of Education*, 60(1), e12880. <https://doi.org/10.1111/ejed.12880>
- Iliichuk, L., Tsiuniak, O., & Vorobets, O. (2024). Ensuring the Quality and Accessibility of Education in Times of War: Guidelines and Initiatives of the International Community. *Journal of Vasyl Stefanyk Precarpathian National University*, 11(1), 39–49. <https://doi.org/10.15330/jpnu.11.1.39-49>
- Kasioura, C., Plakias, S., Mousena, E., & Foti, P. (2025). A Grounded Theory on Creativity, Collaboration, and Innovation in Preschool Education. *The International Journal of Early Childhood Learning*, 32(2), 23–41. <https://doi.org/10.18848/2327-7939/cgp/v32i02/23-41>
- Kavanagh, L., Hadgraft, R., Reidsema, C., Smith, N., & McGrath, D. (2017). Case Study Framework. In *The Flipped Classroom* (87–93). Springer Singapore. https://doi.org/10.1007/978-981-10-3413-8_6
- Kosenchuk, O., & Tarnavska, N. (2024). Mental Health in Education for Crisis-affected Preschool Children: Multilevel Monitoring. *Mental Health: Global Challenges Journal*, 7(1), 95–117. <https://doi.org/10.56508/mhgcj.v7i1.235>
- Kozak, L., Popovych, O., Ivanova, V., Harashchenko, L., & Teslenko, S. (2024). Teaching professional competence in preschool education. *Revista Amazonia Investiga*, 13(73), 114–127. <https://doi.org/10.34069/ai/2024.73.01.9>
- Koshil, O. (2018). Features of formating the project competence for future teachers of preschool education. *Educological Discourse*, (1-2). <https://doi.org/10.28925/2312-5829.2018.1-2.9146>
- Kurniawati, A., Nurhayati, S., & Rukanda, N. (2024). Enhancing Early Childhood Education Teachers' Creativity through Professional Development Training Program. *Aulad: Journal on Early Childhood*, 7(1), 141–149. <https://doi.org/10.31004/aulad.v7i1.537>
- Li, M., Zhang, X., Wu, M., & Lv, Y. (2024). Collaborative governance in integrated preschool education: A quadrilateral evolutionary game model analysis. *Alexandria Engineering Journal*, 91, 516–534. <https://doi.org/10.1016/j.aej.2024.02.038>
- Lowery, C. L. (2024). Critical Educational Bricolage in Times of Prolonged Conflict. In *Challenges facing Education Leadership in the Shadow of War* (141–151). Routledge. <https://doi.org/10.4324/9781003571575-20>
- Luo, W., He, H., Liu, J., et al. (2023). Aladdin's Genie or Pandora's Box for Early Childhood Education? Experts Chat on the Roles, Challenges, and Developments of ChatGPT. *Early Education and Development*, 1–18. <https://doi.org/10.1080/10409289.2023.2214181>
- Lu, L., Sitthiworachart, J., & Petsangsri, S. (2024). Project-Driven Flipped Classroom Develop Digital Competences in Preschool Education Students. In *2024 12th International Conference on Information and Education Technology (ICIET)*. IEEE. 269–273. <https://doi.org/10.1109/iciet60671.2024.10542749>
- Maksymchuk, B., Melnyk, N., Bidyuk, N., Kalenskyi, A., Bakhmat, N., Matviienko, O., Matviichuk, T., Solovyov, V., Golub, N., & Maksymchuk, I. (2019). Models and organizational characteristics of preschool teachers' professional training in some EU countries and Ukraine. *Zbornik Instituta za Pedagoska Istrazivanja*, 51(1), 46–93. <https://doi.org/10.2298/ZIP1901046M>
- Martínez-Bello, V. E., Vega-Perona, H., Robles-Galán, P., Segura-Martínez, P., & Bernabé-Villodre, M. d. M. (2023). Pedagogical Content Knowledge of Movement Opportunities in Toddler Education: Perceptions of Early Childhood Educators and Student Teachers. *Early Childhood Education Journal*, 53, 161–174. <https://doi.org/10.1007/s10643-023-01578-5>
- Mikrouli, P., Tzafilkou, K., & Protogeros, N. (2024). Applications and Learning Outcomes of Game Based Learning in Education. *International Educational Review*, 25–54. <https://doi.org/10.58693/ier.212>
- Nechyporenko, V., Nikolenko, L., Nichuhovska, L., Omelchenko, M., & Bondarenko, Z. (2024). Mobile technologies as a tool to support inclusive learning in higher education institutions. *Periodicals of Engineering and Natural Sciences (PEN)*, 12(4), 651–660. <https://doi.org/10.21533/pen.v12.i4.69>

- Nissim, Y., & Naifels, E. (2024). Early childhood educators: anchors amidst chaos. Agility and adaptive leadership in Israel's October 7th war. *Journal of Early Childhood Teacher Education*, 1–22. <https://doi.org/10.1080/10901027.2024.2436355>
- Ozcinar, Z., Orekhovskaya, N. A., Svintsova, M. N., Panov, E. G., Zamaraeva, E. I., & Khuziakmetov, A. N. (2021). University Students' Views on the Application of Gamification in Distance Education. *International Journal of Emerging Technologies in Learning (iJET)*, 16(19). <https://doi.org/10.3991/ijet.v16i19.26019>
- Pavlenko, I., Boiko, O., Mykolaiets, D., Moskalenko, O., Shrol, T. (2024). Advancements in STEM education and the evolution of game technologies in Ukrainian educational settings. *Multidisciplinary Reviews*, 7, e2024spe007. <https://doi.org/10.31893/multirev.2024spe007>
- Racu, I., Lystopad, O., & Mardarova, I. (2017). The formation of future preschool teachers' competence required for using computer technology. *Science and Education*, 25(5), 23–26. <https://doi.org/10.24195/2414-4665-2017-5-5>
- Rapti, S., Sapounidis, T., & Tselegkaridis, S. (2024). Investigating Educators' and Students' Perspectives on Virtual Reality Enhanced Teaching in Preschool. *Early Childhood Education Journal*, 53, 1107–1118. <https://doi.org/10.1007/s10643-024-01659-z>
- Salha, S., Tlili, A., Shehata, B., Zhang, X., Endris, A., Arar, K., Mishra, S., & Jemni, M. (2024). How to Maintain Education During Wars? An Integrative Approach to Ensure the Right to Education. *Open Praxis*, 16(2), 160–179. <https://doi.org/10.55982/openpraxis.16.2.668>
- Shynkar, T., Ponomarenko, T., Kondratets, I., Litichenko, O., Holovatenko, T., & Polovina, O. (2025). Formation of Social and Civic Competence of Bachelors of Preschool Education During Distance Learning in Conditions of War. In *Communications in Computer and Information Science* (146–161). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-81372-6_11
- Storozhyk, M. (2024). Philosophy of future: analytical overview of interaction between education, science, and artificial intelligence in the context of contemporary challenges. *Futurity Philosophy*, 23–47. <https://doi.org/10.57125/fp.2024.03.30.02>
- Telychko, T. (2020). Pedagogical conditions of formation of professional competence of future educators of preschool education institutions on the basis of interdisciplinary approach. *Scientific Bulletin of Uzhhorod University. Series: «Pedagogy. Social Work»*, 1(46), 124–127. <https://doi.org/10.24144/2524-0609.2020.46.124-127>
- Tsekhmister, Y., Stetsenko, N., Volyk, O., Gumennykova, T., & Sharov, O. (2023). Forecast of Educational Trends in the Role of “Soft Skills” for the Professional Development of Future Specialists in the Conditions of Distance Learning: The Challenges of Our Time. *Journal of Higher Education Theory and Practice*, 23(10). <https://doi.org/10.33423/jhetp.v23i10.6195>
- Tsekhmister, Y. (2024). War, education and development: a pedagogical response to the challenges of modernity. *Academia*, 35–36, 1–8. <https://doi.org/10.26220/aca.4999>
- Vainola, R. (2024). Evaluating the Effectiveness of Social Media as a Means of Strengthening Family Values Among Young People. *Futurity of Social Sciences*, 2(4), 24–38. <https://doi.org/10.57125/FS.2024.12.20.02>
- Wan, Z. H., Jiang, Y., & Zhan, Y. (2020). STEM Education in Early Childhood: A Review of Empirical Studies. *Early Education and Development*, 1–23. <https://doi.org/10.1080/10409289.2020.1814986>
- Yang, W., Wang, C., & Bautista, A. (2023). A YouTube video club for teacher learning: Empowering early childhood educators to teach STEM. *British Journal of Educational Technology*, 55(2), 605–624. <https://doi.org/10.1111/bjet.13396>
- Zahorodnia, L., Melnyk, I., Chepil, M., et al. (2023). Crisis Challenges in Societal Development and the Peculiarities of Preparing Preschool Education Specialists in these Conditions. *Revista De Gestão - RGSA*, 17(5), e03389. <https://doi.org/10.24857/rgsa.v17n5-001>
- Zhazira, S., Izmagambetova, R., Khurshidam, M., et al. (2024). A Comprehensive Study on Fostering Innovative Activities in Future Specialists through Training and Student-Centered Learning Approaches. *Pakistan Journal of Life and Social Sciences (PJLSS)*, 22(1), 58–69. <https://doi.org/10.57239/pjlss-2024-22.1.005>
- Zhufeng, Y., & Sitthiworachart, J. (2023). Effect of augmented reality technology on learning behavior and attitudes of preschool students in science activities. *Education and Information Technologies*, 29, 4763–4784. <https://doi.org/10.1007/s10639-023-12012-z>

Zubalii, A., Sulaieva, N., Horska, O., Demchenko, Y., & Androsova, N. (2024). Preparing Future Teachers to Develop Children's Creative Abilities Through the Integration of Various Types of Activities. *Cadernos de Educação, Tecnologia e Sociedade*, 17(1), 482–494. <https://doi.org/10.14571/brajets.v17.n1.482-494>

Appendix 1

Test tasks for determining the level of pedagogical training.

Part 1: Theoretical questions (choose the correct answer).

1. Which method most effectively promotes the development of creativity in pre-schoolers? a) Dictation tasks b) Game method c) Lecture teaching d) Memorizing poems.
2. What is the main goal of children's sensory development? a) Influence on the development of thinking and speech b) Only the development of fine motor skills c) Prevention of hearing problems d) Formation of abstract thinking.
3. What is the main principle of learning in preschool education? a) The principle of coercion b) The principle of clarity c) The principle of memorisation d) The principle of individualisation.
4. What is the primary means of learning in preschool children? a) Reading books b) Observation c) Game d) Lectures by a teacher.
5. Which of the modern methods contributes most to children's critical thinking development? a) STEM approach b) Traditional lecture method c) Speech dictation d) Listening to music.

Part 2: Situational tasks

6. A child in a group avoids communication and plays alone. What actions of the educator will be most effective?
7. A group of children does not want to participate in an educational session. What motivation methods can be used?
8. A child has difficulties completing a task to develop fine motor skills. How should I help?
9. During the lesson, children quickly lose attention. How can the educator change the course of the lesson to interest them?
10. The parents of one of the children insist on using traditional methods of upbringing, not innovative ones. How can we build an effective dialogue with them?

Appendix 2

Questionnaire for assessing motivation and attitude towards innovations.

Likert scale (rate from 1 to 5, where 1 - completely disagree, 5 - completely agree).

1. I enjoy learning.
2. I am interested in learning new methods of preschool education.
3. I am confident that I can work effectively with children.
4. Innovative approaches improve my understanding of the material.
5. I would like to implement new methods in my future work.
6. I am well versed in modern pedagogical technologies.
7. Using innovative methods increases the effectiveness of the learning process.
8. I believe that traditional methods are more effective than modern approaches.
9. I regularly update my knowledge of pedagogical innovations.
10. The use of interactive technologies helps to make learning more interesting.