

**Yevhen Kuznietsov\***

Master, Teacher

Hryhorii Skovoroda University in Pereiaslav  
08401, 30 Sukhomlynskyi Str., Pereiaslav, Ukraine  
<https://orcid.org/0009-0008-3994-9092>

**Olha Kostiukevych**

PhD in Educational and Pedagogical Sciences  
Hryhorii Skovoroda University in Pereiaslav  
08401, 30 Sukhomlynskyi Str., Pereiaslav, Ukraine  
<https://orcid.org/0000-0002-5583-2168>

## The influence of the integration of neuropedagogy, trend-watching, gamification, robotics, and immersive technologies on the development of pedagogical skills

**Abstract.** The real value of the topic lies in the need to improve the educational process in the conditions of constant technological changes in society. The integration of new teaching methods and technologies is a key factor in improving the quality of education and developing the professional skills of teachers. The aim of the study was to determine the synergistic effect of integrating innovative pedagogical methods into the educational process and to determine their impact on the development of teachers' professional skills. The methods of problem analysis included theoretical analysis of scientific literature, generalisation of pedagogical experience, application of statistical methods of analysis and examination of the practise of applying innovative teaching methods. The main results of the research are evidence of the synergistic effect of integrating advanced pedagogical approaches in the context of promoting the development of teachers' professional competencies. It was found that neuropedagogy helps to understand students' brain activity and personalise the learning process for each of them. Trendwatching enables teachers to react to new trends in time and adapt their practise. Gamification creates a motivating learning environment, and robotics helps complete routine tasks, allowing more time for individualised attention to each learner. Immersive technologies allow students to immerse themselves in the learning process and explore it in practise. It has been noted that the integration of advanced pedagogical approaches is an important step for the development of teachers' professional skills and the improvement of the quality of education. The synergy effect and personalisation of education allow for greater success in the educational process and provide an individual approach to each student. The value of the results obtained lies in the development of recommendations that can be applied in practise to improve the educational process and develop pedagogical practise in the digital age

**Keywords:** innovative approaches in education; synergy effect; modernisation; personalisation; learning process

### INTRODUCTION

The relevance of the research is determined by the fact that in wartime conditions pedagogical skills become much more important than in peacetime. The recovery and reconstruction of Ukraine require the training of a

new generation of professionals who can effectively use modern innovative educational methods. The COVID-19 pandemic and the war in Ukraine have become catalysts for the acceleration of progress in education, forcing

**Suggested Citation:**

Kuznietsov, Ye., & Kostiukevych, O. (2024). The influence of the integration of neuropedagogy, trend-watching, gamification, robotics, and immersive technologies on the development of pedagogical skills. *Scientia et Societus*, 3(1), 92-103. doi: 10.69587/ss/1.2024.92

\*Corresponding author



Copyright © The Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (<https://creativecommons.org/licenses/by/4.0/>)

educational institutions to actively use the latest technologies and approaches.

The literature review has shown that there is a considerable amount of research dealing with individual innovative teaching methods. According to L. Lysiak (2020), neuropedagogy, based on knowledge of brain activity, helps teachers to optimise the educational process, taking into account the individual characteristics of students. Research by A. Hamdan (2020) also confirms the effectiveness of using neuropedagogy to improve educational outcomes. O. Bilier *et al.* (2023) state that the use of neuropedagogical methods contributes to the development of critical thinking and increasing the motivation of those seeking education. E. Anisimova (2021) emphasises that trendwatching allows teachers to keep abreast of current trends in educational programme development and apply current teaching methods. Trendwatching helps to determine the strategic directions of educational program development. Trendwatching is important for adapting the educational process to rapidly changing conditions.

Gamification makes learning more exciting and motivating for students and thus contributes to better acquisition of knowledge and skills. The use of gamification increases student engagement and motivation to learn. I. Star *et al.* (2021) emphasise that gamification promotes the development of critical thinking and creativity. Gamification improves learning outcomes and overall satisfaction with the learning process. O. Bazelyuk (2023) emphasised the role of digital culture in the professional activities of teachers, noting that digital skills are becoming an integral part of modern education. N.E. Bilonozhko (2021) considered the pedagogical aspects of the quality of teaching technological English in the process of internationalisation and identified the key factors that influence the effectiveness of teaching.

Robotics frees up teachers' time for more creative and productive work and provides students with more individual attention. H. Wojtaszek *et al.* (2023) argue that robotics contributes to the development of learners' technical skills and increases their interest in learning. Ya. Slupska & O. Shkurenko (2022) also note the positive impact of robotics on the development of teachers' professional competences. Immersive technologies create artificial environments that allow learners to explore and learn experientially. According to T. Kramarenko & O.S. Kochina (2023), such technologies contribute to a better understanding of complex concepts in education. K.V. Zavalko (2022) points out that immersive technologies develop learners' practical skills, which is important for their future professional development. G. McDermott *et al.* (2023) also add that the use of immersive technologies enhances the overall learning experience and promotes deeper immersion in the subject matter.

Although each of these methods has been sufficiently researched on its own, the question of the effectiveness of their integrated use in pedagogical practise is still insufficiently investigated. It is particularly important to

investigate how these methods can interact and reinforce each other, creating a synergistic effect that contributes to improving the quality of education and developing pedagogical skills. Therefore, this study aimed to analyse the impact of a complex of innovative teaching methods (neuropedagogy, trendwatching, gamification, robotics, immersive technologies) on the pedagogical skills of teachers and to determine how their integration contributes to the improvement of pedagogical competences.

## MATERIALS AND METHODS

Researching the impact of the integration of neuro-pedagogy, trend monitoring, gamification, robotics and immersive technologies on the development of pedagogical skills requires a comprehensive approach and the use of different methods to obtain objective results. The research methodology is based on a synergetic combination of several scientific and practical approaches. Analysis of literary sources and scientific publications. A systematic literature review was conducted to assess the current state of research in selected topics - neuropedagogy, trendwatching, gamification, robotics and immersive technologies. Expert surveys and interviews. Interviews were conducted with researchers and practitioners in the fields of neuropedagogy, trendwatching, gamification, robotics and immersive technologies to gather opinions and impressions about their impact on pedagogy. Questionnaires and surveys. A questionnaire has been developed to determine the opinions, preferences and attitudes of pedagogical professionals regarding the use of new pedagogical approaches and technologies. Experimental study. An experimental study was conducted using interactive technologies and game methods in the educational process to determine their impact on the development of pedagogical skills. Observation and analysis of field tests. The implementation of new pedagogical methods and technologies in different educational institutions was monitored to evaluate their efficiency and effectiveness. Statistical data analysis. Statistical analysis of the data obtained was carried out to identify statistically significant differences and correlations between variables.

The methods used made it possible to obtain a detailed picture of the influence of neuropedagogy, trend-watching, gamification, robotics, and immersive technologies on the development of pedagogical skills, and also provided the opportunity to repeat the study to verify its results. The research methods chosen are key to obtaining objective and complete results within the given topic. The analysis of literary sources and scientific publications played a key role in determining the current state of research on the selected topics. This method made it possible to obtain an overview of scientific research, theoretical concepts, and practical experience in the fields of neuropedagogy, trend monitoring, gamification, robotics, and immersive technologies. In this way, a theoretical basis for further research phases could be created. Expert surveys and interviews played a strategically important role in gathering opinions and impressions from experts and practitioners

in the respective fields. This feedback helped to establish links between theory and practise and to identify the most important aspects of the impact of the selected technologies on pedagogical quality.

Questionnaires and surveys were used to gather the opinions, preferences and attitudes of pedagogical professionals towards the use of new pedagogical approaches and technologies. This data helped to understand the practical aspects of introducing innovations into the educational process. An experimental study was conducted using interactive technologies and game methods in the educational process to determine their impact on the development of pedagogical skills. This method made it possible to test hypotheses and determine the practical effectiveness of the use of innovative pedagogical approaches. Observations and analysis of field tests were carried out to evaluate the effectiveness and efficiency of the introduction of new pedagogical methods and technologies in different educational institutions. Statistical data analysis was conducted to determine statistically significant differences and correlations between variables, which made it possible to obtain objective research results.

Respondents for the survey and interviews were selected using a stratified random component. This made it possible to capture a representative group of teachers from different age groups, with different professional experience, with different qualification levels and from different types of educational institutions. Sampling criteria: 1) age: 25-60

years; 2) professional experience: at least 3 years; 3) qualification category: not lower than the second; 4) type of educational institution; 5) experience in the use of innovative pedagogical approaches and technologies; 6) the degree of interest in the use of neuropedagogy, trend watching, gamification, robotics and immersive technologies.

The survey was conducted from January to March 2024 in educational institutions in Kyiv, Pereiaslav, Boryspil, Yagotyn and Berezan. 313 teachers took part. The survey was a group survey, personal and anonymous. Participants were informed about how their responses would be used and that all data collected would be used solely for scientific purposes and would remain confidential. The ethical norms of research were adhered to in accordance with the documents "Ethical principles and rules for conducting research with human participation" (Ukrainian Educational Research Association, 2015). A questionnaire was developed to capture the opinions, preferences and attitudes of educational professionals regarding the use of new pedagogical approaches and technologies. The questionnaire consisted of several questions (Table 1). The survey (Table 2) was conducted on the basis of statements that respondents were asked to answer on a Likert scale (from "strongly disagree" to "strongly agree"). 217 teachers took part in the survey. A questionnaire with 20 statements was developed to capture teachers' opinions, preferences, and attitudes regarding the use of new pedagogical approaches and technologies.

**Table 1.** Questionnaire

Questions
1. How would you rate your level of knowledge in the field of neuropedagogy?
2. How often do you familiarize yourself with new trends in pedagogy?
3. Do you use gamification in your educational practice?
4. Which game methods do you use in education?
5. Do you have experience with the use of robotics in the educational process?
6. Do you use interactive technologies in your work?
7. How do you evaluate the effectiveness of the use of interactive technologies in the educational process?
8. Do innovative pedagogical approaches have an impact on your professional activity?
9. How do you rate your pedagogical skills?
10. Which technologies do you consider particularly promising for use in the educational process?
11. Does the use of innovative methods influence your professional satisfaction?
12. How do you assess the possibilities of using immersive technologies in the educational process?
13. Do you have sufficient resources to implement new pedagogical approaches?
14. Do you feel supported by the administration in implementing innovative changes?
15. Do you notice differences in students' academic performance after implementing new methods?
16. What obstacles do you encounter when implementing innovative approaches?
17. How would you rate student response to new teaching methods?
18. Has your approach to learning changed after the introduction of new technologies?
19. How would you rate your ability to adapt to new pedagogical technologies?
20. What opportunities do you see for increasing the efficiency of the educational process by implementing innovative approaches?

**Source:** developed by the authors

Table 2. Questionnaire

No	Statements
1	I am familiar with the term "Neuropedagogy".
2	I believe that neuropedagogical methods can help me to improve my teaching skills.
3	I am willing to use neuropaedagogical methods in my work.
4	I am familiar with trend monitoring in education.
5	I believe that trendwatching can help me keep up with the latest trends in education.
6	I am willing to use trendwatching in my work.
7	I am familiar with the term "Gamification".
8	I believe that gamification can make learning more interesting and exciting for students.
9	I am willing to use gamification in my work.
10	I am familiar with robotics in education.
11	I believe that robotics can help me to automate some routine tasks so that I can focus more on the creative and interactive aspects of learning.
12	I am willing to use robotic systems in my work.
13	I am familiar with the term "immersive technologies".
14	I believe that immersive technologies can create a more engaging and interactive learning environment for students.
15	I am willing to use immersive technologies in my work.
16	I believe that integrating neuropedagogy, trendwatching, gamification, robotics, and immersive technologies can help me develop my pedagogical skills.
17	I am willing to use innovative methods to develop pedagogical skills in my work.
18	I believe that my management supports the use of innovative methods for developing pedagogical skills.
19	My educational institution provides the conditions for the use of innovative methods to develop pedagogical skills.
20	I believe that using innovative methods to develop pedagogical skills can improve the learning outcomes of my students.

Source: developed by the authors

The research methods chosen are scientifically sound and provide the opportunity to re-do the research to verify its findings. They provide a complete picture of the progress of the research and allow other scientists to repeat the research using the same methods and materials.

## RESULTS AND DISCUSSION

The results of the survey show that the majority of teachers (70%) are positive about the impact of innovative teaching methods on their professional activities. They believe that these methods make learning more interesting and effective for students (about 60% and 50% respectively). However, not all teachers have sufficient resources (around 55%) and administrative support (around 45%) to implement innovative approaches. This is one of the biggest obstacles they face (around 40%). It is important to mention that the majority of teachers (about 75%) are willing to adapt to new pedagogical technologies and believe that this is an opportunity to increase the effectiveness of the educational process (about 40%, 35% and 20% respectively). The results of the survey show that the majority of pedagogical professionals (approx. 70%) positively assess the impact of innovative methods of developing pedagogical skills on their work. They believe that these methods can help them to improve their skills (approx. 65%) and make learning more interesting and effective for students (approx. 60%). However, not all teachers have sufficient support from management (about 50%) and conditions in educational institutions (about 45%) to apply innovative methods. It is important to mention that the majority of teachers (about 65%) are willing to use innovative methods to develop pedagogical skills in their work.

The study results demonstrate the importance of integrating neuropedagogy, trend observation, gamification, robotics, and immersive technologies for developing pedagogical skills. The implementation of these methods showed a significant positive impact on various aspects of teachers' professional activities. In particular, the study found that these innovative methods not only improve the learning/educational process but also increase learners' motivation and interest, as well as develop critical thinking and creativity.

The data analysis showed that teachers who actively use modern pedagogical approaches have a higher level of professional competence. They can adapt their teaching methods more effectively to the needs of learners, integrate new technologies more quickly into the educational process and maintain a high level of interest among learners. The use of neuropedagogy helps teachers to optimise the educational/educational process, taking into account the individual characteristics of those seeking education, and trendwatching allows you to keep up with modern trends in the development of education. Gamification makes learning more engaging and motivating, while robotics and immersive technologies promote practical skills and technical knowledge. The results obtained are presented in the form of tables, charts, and graphs that help to visualise the data and make their analysis more understandable and accessible. The presentation of changes in the level of knowledge and skills of teachers "before" and "after" the implementation of the innovative methods (Table 3) allows you to see the effectiveness of the implemented methods and their impact on the professional development of teachers.

**Table 3.** Comparison of the level of knowledge and skills “before” and “after” the implementation of innovative pedagogical approaches, %

Evaluation criteria	Before implementation	After implementation	Change
Awareness of pedagogical theory	3.5	4.2	+0.7
Mastery of teaching methods	3.8	4.5	+0.7
Ability to use ICT	3.2	4.0	+0.8
The level of pedagogical skill	3.7	4.4	+0.7

Source: developed by the authors

The distribution of responses by category in the questionnaires and surveys was also analysed to obtain additional information on the perception of innovation and its impact on different aspects of pedagogical activity. In particular, the analysis of these responses made it possible to find out which innovative methods are most frequently used by teachers, which of them are considered the most

effective, and what difficulties are encountered in their implementation. The detailed distribution of responses by category (Table 4) enabled a deeper understanding of teachers' attitudes toward innovative methods and their impact on professional activity. This data is valuable for identifying the most successful practises and recommendations for further use of the latest approaches in pedagogical activity.

**Table 4.** Distribution of responses by category in questionnaires and surveys, %

Answer category	Neuropedagogy	Trendwatching	Gamification	Robotization	Immersive technologies
Not familiar	10	15	20	25	30
Aware, but I don't use it	20	25	30	35	40
I use it from time to time	30	35	40	45	50
I use it regularly	40	30	30	25	20

Source: developed by the authors

The analysis of the distribution of responses by category in the questionnaires and surveys has shown that innovative pedagogical approaches such as neuropedagogy, trendwatching, gamification, robotics, and immersive technologies are becoming increasingly important among teachers. According to the results of the survey, the majority of teachers are already familiar with these approaches, but a fairly large proportion do not yet use them in practise. Nevertheless, a significant number of teachers already use innovative pedagogical methods from time to time or regularly, which indicates a certain level of acceptance and use of innovation in the educational process.

This multi-level approach makes it possible to better understand which methods are the most effective and in

demand among teachers. Determining the levels of innovative implementation methods is just the first step to fully understanding their impact. The next important stage is the study of correlations between the use of these technologies and pedagogical skills. The analysis of these connections is particularly interesting, as it allowed us to discover how different levels of implementation of innovative approaches affect the professional development of teachers and which of them contribute to the improvement of their skills the most. This analysis (Table 5) helps to understand which specific innovative technologies provide the greatest effect and how their integration can optimise the learning and educational process and improve the quality of education as a whole.

**Table 5.** Correlations between the use of innovative technologies and pedagogical skills, %

Correlation	Correlation coefficient
The use of neuropedagogical methods	0.78
The use of trendwatching	0.65
The use of gamification	0.72
The use of robotics	0.68
The use of immersive technologies	0.74

Source: developed by the authors

The obtained results of correlations between the use of innovative pedagogical technologies and pedagogical skills indicate the presence of a significant positive relationship between these indicators. In particular, the use of neuropedagogical methods, trend-watching, gamification, robotics, and immersive technologies has a high degree of correlation with the development of pedagogical skills.

This analysis made it possible not only to determine the relationship but also to understand its direction, to identify the most effective methods, to optimise pedagogical practise, and to develop strategies for the development of pedagogical skills at the system level. This shows that the introduction of innovative pedagogical approaches significantly impacts the improvement of teachers' professional

competencies and the quality of their work. After analysing the questionnaire and survey results answered by 217 and 313 educators, respectively, we formulated concrete and metaphorically integrated recommendations. These recommendations are aimed at improving the quality of education and creating a stimulating environment for the implementation of innovative approaches in pedagogical practise. The authors' approach considers the needs of the modern educational process and innovative ideas implementation to improve the effectiveness of the future generation's education and training.

The author's contribution in this part of the study consists of the detailed analysis of the collected data and the development of practical recommendations for the optimisation of pedagogical practise. Based on the obtained results, the key factors contributing to the development of pedagogical skills were identified, as well as strategies for improving the quality of education through the implementation of innovative methods were developed. In addition, the authors developed and applied a stratified random selection of respondents, which ensured the representativeness of the sample and the correctness of the data obtained. The authors also developed a two-factor questionnaire that included key questions and statements that allowed a comprehensive assessment of the perception and use of innovative pedagogical methods.

Observing the introduction of robotics to the educational process confirms the importance of this direction as another means of improving pedagogical skills. The use of assistant robots in the educational process opens up new opportunities for personalisation of learning and provides access to more interactive and interesting learning methods. This approach becomes an important factor in the formation of teachers' professional competencies in the conditions of the modern educational environment when in the light of rapid technological changes, the use of robot teachers in the educational process becomes an integral synergistic component. This innovative approach transforms not only the technical side but also affects the formation of the relevant competencies of those seeking education. This allows us to understand how the paradigm of education is changing – from primary school to professional corporate training – and how these changes are reflected in the training of a new generation of Ukrainians in the conditions of the XXI century challenges.

Teacher robots are a new reality that opens up many educational opportunities. Personalisation of learning, increasing motivation, accessibility of education, and development of new skills are just some of them. At the same time, there are challenges: cost, preparation, and ethical issues. In today's educational landscape, the use of robot teachers has become not only a fantastic possibility but also a reality. Some innovative developments allow you to see how digital technologies are integrated into the educational processes of the New Ukrainian school (n.d.) and the Scientific and pedagogical project "Intellect of Ukraine" (n.d.), changing the way we interact with the management

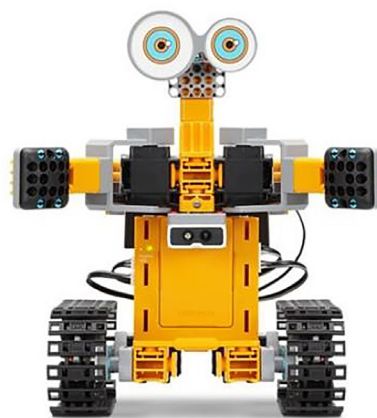
process. The focus is on the companion robot Buddy (Fig. 1), which has a special purpose to help children (including those with autism) in their learning and development. Thanks to its friendly and accessible form, Buddy promotes the development of social skills, the perception of information, and the understanding of emotions. His interaction with students leads to the creation of an open and friendly educational environment that promotes effective learning and social development of each participant in the educational process.



**Figure 1.** The appearance of Buddy the robot

Source: Robot Buddy (n.d.)

Another exciting robot mentor in this series is Robo Wunderkind. Its interactive game format promotes learning the basic principles of programming from an early age and the development of creative abilities in children. Worthy of attention is the Ubtech Jimu Robot (Fig. 2). This designer robot opens up endless opportunities for students in science, technology, engineering, and mathematics (STEM) disciplines. It allows learners to create and programme their works while developing creativity, logical thinking, and emotional intelligence.



**Figure 2.** Appearance of the Ubtech Jimu robot

Source: UBTECH MeeBot 2.0 (n.d.)

These examples show that teacher robots are increasingly becoming an integral part of the modern educational process as companions, mentors, and designers, opening

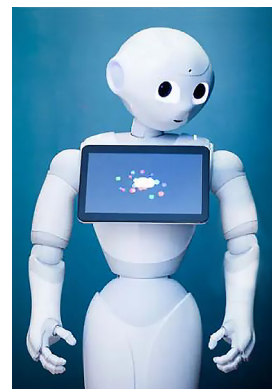
up new opportunities for the development of students from different countries. The introduction of robot teachers into the educational process in the role of a friend, assistant, or partner is a characteristic feature of the European Union countries, which is declared in European standards. Another virtual assistant that helps to learn language and mathematics is Nao Robot (Fig. 3), developed by SoftBank Robotics (n.d.). Not only does it provide instructions and explanations but also tests knowledge, motivates, and supports. It has several functions designed to educate, entertain, and interact with users. Nao has an interactive interface capable of recognising voice commands, faces, and gestures, making it an ideal candidate for use in educational institutions and training programmes. Not only can it help with language and math tasks, but it also helps develop creative skills and engage in social interactions, helping educators and learners in the learning process.



**Figure 3.** The appearance of Nao the robot

Source: NAO V6 programmable humanoid robot (n.d.)

Pepper Robot (Fig. 4) is an equally useful and interesting robot that can interact with people. His social skills and ability to recognise emotions allow him to effectively communicate and interact with people in various situations. It understands language, shows empathy, and adapts to the needs of users, making it an ideal assistant for developing communication skills. With its unique features, Pepper helps people develop communication skills and emotional intelligence. He can play the role of a trainer, an interlocutor, or even a student, depending on the needs of the user. When interacting with Pepper, people get the opportunity to improve their skills in articulating, emoting, and connecting with others. Skills that can be developed with Pepper include not only communication and empathy but also collaboration, conflict resolution, and interpersonal culture. Interaction with robots helps people better understand themselves and others, which is especially useful in today's world of education, where communication skills and emotional intelligence are increasingly important for successful social and professional adaptation.



**Figure 4.** Appearance of Pepper the robot

Source: Pepper (n.d)

Emotional partner Probo the Robot (Fig. 5) is a robot assistant who is always ready to listen and support. It helps to overcome fear, insecurity, and other emotions that interfere with learning and development.



**Figure 5.** Probo, an intelligent huggable robot for HRI training with children

Source: H.-L. Cao *et al.*

Interaction with a robot teacher is not just learning, but a real adventure. The robot can provide instructions and explanations of new material; check the students' knowledge and skills; assign tasks and evaluate their performance; and provide emotional support and motivation. The impact of teacher robots on learning is impressive in terms of increasing motivation when robots make learning more interesting and interactive; personalisation, when robots adapt training to the needs of each student; improving results, as learning with robots leads to better results (Prasad Bhatt, 2021; Mihai & Returns, 2024); development of new skills when robots help develop the 21<sup>st</sup>-century skills: critical thinking, creativity, and emotional intelligence.

Robot teachers have significant potential to improve education. They do not replace human teachers but become their valuable assistants as companions, mentors, designers/instructors, assistants, partners, etc. European society not only recognises but also actively develops standards for

the use of robot teachers, based on ethical principles and pedagogical recommendations. With the deepening of digital transformation in the field of education, there is a need for effective management of digital processes. To achieve success in this dynamic area, we have considered new tools and methods that will truly revolutionise the educational process, as the role of digital education in ensuring efficiency and security increases.

The introduction of robot teachers is only one aspect of the dynamic transformation taking place in modern education. This process leads to the evolution of education, opening up new horizons for the development and improvement of a holistic system through data analytics systems, namely the collection and analysis of data on the success of learners, which allows the teacher to get a clear idea of their strengths and weaknesses, as well as the dynamics their development, which makes it possible to personalise education and adapt it to the needs of each student; online learning platforms make education more accessible and flexible because students get the opportunity to study anywhere and at any time, having access to educational materials and interactive tasks; artificial intelligence systems used to personalise learning, adapt content, and automate routine tasks, allowing educators to focus on more important aspects of their work.

At the same time, the role of the head of the educational institution is also evolving through management of the process of robotisation of education, when the teacher is responsible for the implementation and use of digital technologies in the educational process (coordination of the work of teachers, administration and IT specialists, as well as ensuring the effective and safe use of teacher robots); mastering digital technologies by teachers, when the teacher organises training and seminars to help specialists in the educational field master new tools and work methods; ensuring the ethical and safe use of teacher robots, when the teacher develops and implements regulating rules and procedures.

The introduction of robot teachers opens up many opportunities for improving education at all levels. Primary school (development of basic reading, writing, and mathematics skills; study of STEM disciplines in game and interactive forms; development of social and emotional skills). Secondary education (study of languages, mathematics, natural sciences, and other disciplines with the help of robot teachers; personalisation of education and its adaptation to the needs of each student; preparation for final exams and admission to a higher educational institution. Higher education (conducting interactive lectures and seminars on the use of teaching robots; the use of teaching robots in research work; the training of highly qualified specialists who meet the needs of the labour market; professional training and development of flexible skills of employees; training of new employees in the Code of Ethics; support for continuous development and self-learning throughout life (Resolution of the general meeting of the National Academy, 2009).

The author's recommendations: 1) to provide teaching staff with the necessary resources for the implementation of innovative teaching methods; 2) provide teachers with more support from the administration in implementing innovative changes; 3) conduct additional studies and training for teaching staff on the use of innovative teaching methods; 4) develop methodological recommendations for the use of innovative teaching methods in various subject areas. The implementation of these recommendations will help create conditions for more effective use of innovative teaching methods in Ukrainian schools, which, in turn, will contribute to improving the quality of education.

Also, based on the results of the questionnaire, the authors proposed recommendations: 1) support pedagogical workers from the management in using innovative methods of developing pedagogical skills; 2) create conditions in educational institutions for the use of innovative methods of developing pedagogical skills; 3) conduct additional studies and training for pedagogical workers on the use of innovative methods of developing pedagogical skills; 4) to develop methodical recommendations regarding the use of innovative methods for the development of pedagogical skills in various subject areas. The implementation of these recommendations will help create conditions for more effective use of innovative methods of developing pedagogical skills in Ukrainian educational institutions, which, in turn, will contribute to improving the quality of education.

Thus, the impact of integrating neuropsychology, trend-watching, gamification, robotics, and immersive technologies on the development of pedagogical expertise is that these innovative approaches help educators create more effective and personalised learning/educational environments. They enable teachers to adapt training to the needs of each learner while developing their professional competencies. This approach takes into account various learning styles and promotes the active participation of students in the educational process. Thanks to this, teachers can more effectively implement new strategies and methods, which enhances their teaching skills (Ramírez-Montoya, 2021; Yildiz, 2021; Folomieieva, 2024).

The study results indicate a significant positive impact of the integration of neuropsychology, trend-watching, gamification, robotics, and immersive technologies on the development of pedagogical skills. At the same time, various views are expressed regarding the effectiveness and the possibility of challenges in the application of these innovative methods. Trendwatching, or the analysis of trends in the field of education, is noted as a means of raising the professional level of teachers and adapting to changes in the educational environment. However, some researchers fear that this approach may distract them from traditional teaching methods. In particular, Ya. Slupska & O. Shkurenko (2022) and M.S. Ramirez-Montoya *et al.* (2021) note the positive impact of trend-watching on professional teachers' development, however, with a certain possibility of distraction in case of hyper-focus on trends.

Neuropedagogical methods, based on the knowledge about the cognitive processes of the brain, are also recognised for their ability to improve academic performance. However, there are concerns about a possible over-reliance on these methods, which could affect the individual approach to learning. For example, Ukrainian scientists O. Dushchenko (2021) and O. Nikulochkina *et al.* (2022), as well as Chinese researchers Yu. Cui & H. Zhang (2021) support the importance of the role of neuropedagogy in personalising learning but express concerns about the loss of the individual approach due to excessive reliance on these methods. Using artificial intelligence and robotics to personalise learning and analyse student needs opens new horizons in the educational process. However, it is important to maintain a balance between technology and the human factor in order not to lose the personal contact between teachers and learners. For example, A. Rakhmanina *et al.* (2022) emphasise the importance of robotics for increasing the effectiveness of the educational process, however O. Piddubna *et al.* (2023) caution against the possible loss of personal human interaction due to dependence on software.

Closely related to robotics is gamification, that is, the use of game elements to motivate teachers and increase the interest of students in learning. This study fully proved that gamification with the use of robotics and immersive technologies makes the educational process more interesting and exciting, which contributes to better assimilation of educational material and increased motivation of students. N. Folomieeva *et al.* (2024) emphasise that gamification significantly increases learner engagement and promotes a better understanding of complex concepts. At the same time, S. Fedko (2023) warns that gamification can lead to a decrease in the seriousness of learning, turning education into entertainment, which is not always appropriate. It is worth using gamification responsibly not to make the process look too childish and irresponsible to students. A study by H. Alsadoon (2023) proved that the use of gamification increased the motivation of teachers and learners, and also improved learning outcomes.

Immersive technologies, especially the use of virtual and augmented reality for modelling educational situations and immersing participants in the learning/educational process in a virtual environment, allow them to gain new experiences and knowledge that they can use in their work to create more interesting and effective classes. Research by N.V. Soroko & S.H. Lytvynova (2022) and R.A.Z. El Islami *et al.* (2022) confirm that immersive technologies significantly increase the interest of learners and improve their learning outcomes, but S.H. Alshammari (2019) notes that the implementation of such technologies requires significant resources and training, which is not available to all educational institutions. Yu. Trach (2023) notes the huge potential in the implementation of these technologies but emphasises that this requires significant investment, training, and adjustment, both on the part of teachers and on the part of the administration of educational

institutions, which is still a complex and long process. This study showed that, regardless of financial difficulties, the use of immersive technologies allows teachers to create a more exciting educational environment, which contributes to both the improvement of teaching skills and better assimilation of educational material by students.

The use of innovative methods makes the work of teachers more interesting and exciting, which contributes to increasing their motivation and interest in professional development. I. Szököl *et al.* (2023) and L. Sharma & M. Srivastava (2020) provide many examples of how innovative approaches stimulate teachers' self-development and continuous improvement. B. Artman & S. Crow (2022) and S. Prasad Bhatt (2021) insist that innovation in education is the key to improving the quality of teaching and learning. Innovation can sometimes lead to a loss of focus on the basic skills and knowledge required for foundational learning.

The integration of trendwatching, gamification, and immersive technologies allows teachers to go beyond traditional teaching methods and look for new, more creative, and innovative ways of presenting educational material and organising the educational process. O.V. Sagan (2023) and L. Elouafi *et al.* (2021) sharpen the focus of attention only on individual methods as unique, but this study demonstrates that a comprehensive approach in the form of integration of these methods brings the most positive results. The use of interactive elements offered by gamification and immersive technologies together promotes the activation of the educational process and increases the level of interaction between teachers and students. Students are more involved in learning and take an active part in educational activities, which allows teachers to better assess their knowledge and skills, as well as provide them with individual support. R. Nacional (2024) and N.A. Grigorieva *et al.* (2021) confirm that interactive methods are an important component of modern education, which is fully correlated with this study.

It is important to continue a fruitful and constructive discussion and to join the efforts of educators and scientists to determine the most effective ways of integrating innovative methods, developing optimal models of their application, and evaluating the long-term impact of these methods on the educational/educational process, as well as creating conditions for all educators to be able to take advantage of both individual innovative methods and their combinations. Achieving these goals will contribute to the creation of a new generation of Ukrainians and the construction of a new European Ukraine, making Ukrainian education one of the best in the world.

## CONCLUSIONS

Education is a key tool for adapting to new challenges and ensuring the successful development of society. The results of this study confirm that the integration of neuropedagogy, trend-watching, gamification, robotics, and immersive technologies has a significant positive impact on the development of pedagogical skills. The obtained results testify to

the positive impact of the introduction of innovative pedagogical approaches on the level of teachers' knowledge and skills. A comparison of the data "before" and "after" the implementation shows a significant improvement in all evaluation criteria, in particular, increasing knowledge of pedagogical theory, mastery of teaching methods, and the use of information and communication technologies (ICT), as well as increasing the level of pedagogical skills. The observed positive changes testify to the effectiveness of new approaches in the development of pedagogical practise and the preparation of pedagogical personnel for modern challenges.

Teachers who use these innovative methods demonstrate better knowledge and skills, which becomes an important prerequisite for improving the quality of education. In particular, the use of innovative technologies helps to increase the motivation and interest of teachers in professional development, which has a direct impact on the effectiveness of the educational process. The world of robotics in education opens up many new opportunities to improve learning and development at all levels. The rapid development of artificial intelligence, interactive robots, and data analysis systems creates the prerequisites for personalised learning and improving the quality of education. The

introduction of robot teachers is not just a change of tools, but a real transformation of the entire education system.

Further research should be aimed at studying the long-term impact of these technologies on pedagogical skills, as well as at developing effective models of their integration into the system of educators' professional development. Only through the joint efforts of the government, educational institutions, and the public will Ukraine be able to respond to the challenges of global digital transformation and provide quality education for future generations. Within the scope of further research, neuropedagogical design of educational environments using immersive technologies to stimulate transversal thinking will be of great importance.

### ACKNOWLEDGEMENTS

We would like to express our sincere gratitude to the library of Hryhorii Skovoroda University in Pereiaslav for providing excellent technical assistance that made the research possible.

### CONFLICT OF INTEREST

None.

### REFERENCES

- [1] Alsadoon, H. (2023). The impact of gamification on student motivation and engagement: An empirical study. *Dirasat: Educational Sciences*, 50(2), 386-396. doi: 10.35516/edu.v50i2.255.
- [2] Alshammari, S.H. (2019). The role of virtual reality in enhancing students' learning. *International Journal of Educational Technology and Learning*, 7(1), 1-6. doi: 10.20448/2003.71.1.6.
- [3] Anisimova, E. (2021). Interactive educational process participants' engagement in the higher education institutions. *Prospects and Innovations of Science*, 5(5), 16-27. doi: 10.52058/2786-4952-2021-5(5)-16-27.
- [4] Artman, B., & Crow, S. (2022). *Instructional technology integration and self-directed learning: A dynamic duo for education*. *International Journal of Self-Directed Learning*, 19(1), 30-44.
- [5] Bazelyuk, O. (2023). The role of digital culture in the professional activities of teaching employees of vocational education institutions. *Innovative Professional Education*, 2(9), 81-85. doi: 10.32835/2786-619X.2023.2.9.81-85.
- [6] Bilier, O., Reshetniak, V., Vasko, O., Drokina, A., Klanichka, Y., & Barda, S. (2023). Innovative learning technologies for future elementary school teachers in the context of neuropedagogy. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 14(4), 66-81. doi: 10.18662/brain/14.4/492.
- [7] Bilonozhko, N.E. (2021). Some aspects of the ESP quality of teaching in the process of internationalization. *Perspectives and Innovations of Science*, 5(5), 28-35. doi: 10.52058/2786-4952-2021-5(5)-28-35.
- [8] Cao, H.-L., Pop, C., Simut, R., Furnemónt, R., De Beir, A., Van de Perre, G., Esteban, P.G., Lefeber, D., & Vanderborcht, B. (2015). Probolino: A portable low-cost social device for home-based autism therapy. In A. Tapus, E. André, J.-C. Martin, F. Ferland & M. Ammi (Eds.), *Social robotics* (pp. 93-102). Cham: Springer. doi: 10.1007/978-3-319-25554-5\_10.
- [9] Cui, Yu., & Zhang, H. (2021). Educational neuroscience training for teachers' technological pedagogical content knowledge construction. *Frontiers in Psychology*, 12, article number 792723. doi: 10.3389/fpsyg.2021.792723.
- [10] Dushchenko, O. (2021). Current state of digital transformation of education. *Physical and Mathematical Education*, 28(2), 40-45. doi: 10.31110/2413-1571-2021-028-2-007.
- [11] El Islami, R.A.Z., Anantanukulwong, R., & Faikhamta, C. (2022). Trends of teacher professional development strategies: A systematic review. *Shanlax International Journal of Education*, 10(2), 1-8. doi: 10.34293/education.v10i2.4628.
- [12] Elouafi, L., Lotfi, S., & Talbi, M. (2021). Progress report in neuroscience and education: Experiment of four neuropedagogical methods. *Education Sciences*, 11(8), article number 373. doi: 10.3390/educsci11080373.
- [13] Fedko, S. (2023). Neuropsychology of learning as a modern interdisciplinary field: Prospects and limitations. *Scientific Perspectives*, 1(31), 556-566. doi: 10.52058/2708-7530-2023-1(31)-556-566.
- [14] Folomieieva, N., Pelekh, V., Haidamashko, I., Sivak, N., & Koriakin, O. (2024). Gamification in the educational process of higher education institutions. *Amazonia Investiga*, 13(73), 331-343. doi: 10.34069/AI/2024.73.01.28.

- [15] Grigorieva, N.A., Fedorova, S.O., & Honchar, N.P. (2021). Innovation of preschool education: Foreign practices and domestic experience of their implementation. *Prospects and Innovations of Science*, 5(5), 36-47. doi: [10.52058/2786-4952-2021-5\(5\)-36-47](https://doi.org/10.52058/2786-4952-2021-5(5)-36-47).
- [16] Hamdan, A. (2020). Recent trends in curriculum and teaching methods in science education. *Natural Science Education*, 17(1), 24-43. doi: [10.48127/gu-nse/20.17.24](https://doi.org/10.48127/gu-nse/20.17.24).
- [17] Kramarenko, T., & Kochina, O.S. (2023). The use of immersive technologies in teaching mathematics to vocational students. *Journal of Physics Conference Series*, 2611, article number 012006. doi: [10.1088/1742-6596/2611/1/012006](https://doi.org/10.1088/1742-6596/2611/1/012006).
- [18] Lysiak, L. (2020). 21<sup>st</sup> century innovations: Librarians, trend-watching, and the warning signs of fads. *Pennsylvania Libraries: Research & Practice*, 8(2), 130-137. doi: [10.5195/palrap.2020.232](https://doi.org/10.5195/palrap.2020.232).
- [19] McDermott, G., Byrne, A., McLaughlin, R., O'Connor, N., & Griselain, S. (2023). Exploring the use of immersive technologies to enhance the student experience. *Ubiquity Proceedings*, 3(1), 283-288. doi: [10.5334/uproc.98](https://doi.org/10.5334/uproc.98).
- [20] Mihai, M., & Mapheto, D. (2024). Teachers' and learners' acceptance of the use of robotics in the intermediate phase. In *Navigating computer science education in the 21<sup>st</sup> century* (pp. 206-240). Hershey: IGI Global. doi: [10.4018/979-8-3693-1066-3.ch011](https://doi.org/10.4018/979-8-3693-1066-3.ch011).
- [21] Nacional, R. (2024). [Gamifying education: Enhancing student engagement and motivation](https://doi.org/10.15111-1524). *Puissant*, 5, 1511-1524.
- [22] Nikulochkina, O., Teslenko, T., Kokhanko, O., Sevastiuk, M., Yankovska, I., & Teletska, L. (2022). Neuro-pedagogical aspects of forming the professional competence of elementary school teachers and their interaction with students. *Revista Romaneasca Pentru Educatie Multidimensionala*, 14(4(1)), 128-154. doi: [10.18662/rrem/14.4Sup1/663](https://doi.org/10.18662/rrem/14.4Sup1/663).
- [23] New Ukrainian school. (n.d.). Retrieved from <https://mon.gov.ua/tag/nova-ukrainska-shkola?&type=all&tag=%D0%BD%D0%BE%D0%B2%D0%B0%20%D1%83%D0%BA%D1%80%D0%B0%D1%97%D0%BD%D1%81%D1%8C%D0%BA%D0%B0%20%D1%88%D0%BA%D0%BE%D0%BB%D0%B0>.
- [24] Pepper. (n.d.). Retrieved from <https://www.aldebaran.com/en/pepper>.
- [25] Piddubna, O., Maksymchuk, A., Lytvychenko, D., Revutska, O., Moskalenko, M., & Sopina, O. (2023). Implementing neuropedagogical innovation in schools: From theory to practice. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 14(2), 37-58. doi: [10.18662/brain/14.2/443](https://doi.org/10.18662/brain/14.2/443).
- [26] Prasad Bhatt, S. (2021). Self-directed professional development: EFL teachers' understanding. *International Journal of Language and Literary Studies*, 3(4), 196-208. doi: [10.36892/ijlls.v3i4.737](https://doi.org/10.36892/ijlls.v3i4.737).
- [27] Rakhmanina, A., Pinchuk, I., Vyshnyk, O., Tryfonova, O., Koycheva, T., Sydorko, V., & Iliencko, O. (2022). The usage of robotics as an element of STEM education in the educational process. *International Journal of Computer Science and Network Security*, 22(5), 645-651. doi: [10.22937/IJCSNS.2022.22.5.90](https://doi.org/10.22937/IJCSNS.2022.22.5.90).
- [28] Ramírez-Montoya, M.S., Andrade-Vargas, L., Rivera-Rogel, D., & Portuguese-Castro, M. (2021). Trends for the future of education programs for professional development. *Sustainability*, 13(13), article number 7244. doi: [0.3390/su13137244](https://doi.org/10.3390/su13137244).
- [29] Code of Ethics for Scientists of Ukraine. (2009, April). Retrieved from <https://zakon.rada.gov.ua/rada/show/v0002550-09?lang=en#Text>.
- [30] Robot Buddy. (n.d.). Retrieved from <https://fr.vittascience.com/shop/319/robot-buddy>.
- [31] NAO V6 programmable humanoid robot. (n.d.). Retrieved from <https://www.generationrobots.com/fr/403100-robot-humanoide-programmable-nao-v6.html>.
- [32] Sagan, O.V. (2023). Gamification as a modern educational trend. *Collection of Scientific Works "Pedagogical Sciences"*, 100, 12-18. doi: [10.32999/ksu2413-1865/2022-100-2](https://doi.org/10.32999/ksu2413-1865/2022-100-2).
- [33] Sharma, L., & Srivastava, M. (2020). Teachers' motivation to adopt technology in higher education. *Journal of Applied Research in Higher Education*, 12(4), 673-692. doi: [10.1108/JARHE-07-2018-0156](https://doi.org/10.1108/JARHE-07-2018-0156).
- [34] Slupska, Ya., & Shkurenko, O. (2022). Application of virtual reality (VR) in education. *Young Scientist*, 9(109), 82-88. doi: [10.32839/2304-5809/2022-9-109-19](https://doi.org/10.32839/2304-5809/2022-9-109-19).
- [35] Scientific and pedagogical project "Intellect of Ukraine". (n.d.). Retrieved from <https://intellect-ukraine.org>.
- [36] SoftBank Robotics. (n.d.). Retrieved from: <https://www.softbankrobotics.com/aboutus/>.
- [37] Soroko, N.V., & Lytvynova, S.H. (2022). The benefits of using immersive technologies at general school. In J. Filipe, A. Ghosh & L. Zhou (Eds.), *Communications in computer and information science* (pp. 247-257). Cham: Springer. doi: [10.1007/978-3-031-14841-5\\_16](https://doi.org/10.1007/978-3-031-14841-5_16).
- [38] Szököl, I., Pšenáková, I., & Kováč, O. (2023). The influence of innovative teaching methods on student motivation. *R&E-SOURCE*, 1, 196-203. doi: [10.53349/resource.2023.is1.a1203](https://doi.org/10.53349/resource.2023.is1.a1203).
- [39] Trach, Yu. (2023). Immersive VR applications as a tool for familiarization with objects of cultural heritage. *Issues in Cultural Studies*, 41, 134-145. doi: [10.31866/2410-1311.41.2023.276702](https://doi.org/10.31866/2410-1311.41.2023.276702).
- [40] UBTECH MeeBot 2.0. (n.d.). Retrieved from <https://www.amazon.com/UBTECH-MeeBot-App-Enabled-Building-Coding/dp/B08D35RXXD>.
- [41] Ukrainian Educational Research Association. (2015). Retrieved from <https://www.uera.org.ua/uk>.

- [42] Wojtaszek, H., Świeczarz, G.P., Micuła, I., & Wójcik-Czerniawska, A. (2023). Integrated approach to education management: Innovative strategies and methods in combining pedagogy and management in a modern school. *Journal of Modern Science*, 53(4), 592-621. doi: 10.13166/jms/176681.
- [43] Yildiz, İ., Topçhu, E., & Kaymakci, S. (2021). The effect of gamification on motivation in the education of pre-service social studies teachers. *Thinking Skills and Creativity*, 42, article number 100907. doi: 10.1016/j.tsc.2021.100907.
- [44] Zavalko, K.V. (2022). Neuropedagogy: Theory and methodology of ORFF approach in music education. *Innovative Pedagogy*, 51(1), 80-85. doi: 10.32782/2663-6085/2022/51.1.15.

### Євген Кузнецов

Магістр, викладач

Університет Григорія Сковороди в Переяславі

08401, вул. Сухомлинського, 30, м. Переяслав, Україна

<https://orcid.org/0009-0008-3994-9092>

### Ольга Костюкевич

Кандидат освітніх та педагогічних наук

Університет Григорія Сковороди в Переяславі

08401, вул. Сухомлинського, 30, м. Переяслав, Україна

<https://orcid.org/0000-0002-5583-2168>

## Вплив інтеграції нейропедагогіки, трендвотчингу, гейміфікації, роботизації, імерсивних технологій на розвиток педагогічної майстерності

**Анотація.** Актуальність теми полягає в необхідності вдосконалення освітнього процесу в умовах постійної технологічної трансформації суспільства. Інтеграція нових методів і технологій навчання є ключовим фактором підвищення якості освіти та розвитку професійної майстерності педагогів. Метою дослідження було виявлення синергетичного ефекту від інтеграції інноваційних педагогічних методів до навчального процесу та визначення їхнього впливу на розвиток професійних компетентностей педагогів. Методи аналізування проблеми включали в себе теоретичний аналіз наукової літератури, узагальнення педагогічного досвіду, використання методів статистичного аналізу та дослідження практики використання інноваційних методів навчання. Основними результатами дослідження є доведення синергетичного ефекту інтеграції передових педагогічних підходів в контексті сприяння розвитку професійної майстерності педагогів. Встановлено, що нейропедагогіка допомагає зрозуміти мозкову активність учнів та персоналізувати навчальний процес для кожного з них. Трендвотчинг надає можливість вчителям вчасно реагувати на нові тенденції й адаптувати свою практику. Гейміфікація створює мотиваційне середовище для навчання, а роботизація допомагає виконати рутинні завдання, звільняючи час для індивідуального підходу до кожного здобувача освіти. Імерсивні технології дозволяють учням відчувати занурення до навчального процесу та досліджувати на практиці. З'ясовано, що інтеграція передових педагогічних підходів є важливим кроком у розвитку професійної майстерності вчителів і підвищенні якості освіти. Синергетичний ефект і персоналізація навчання дозволяють досягти більшого успіху в навчальному процесі та забезпечують індивідуальний підхід до кожного учня. Цінність отриманих результатів полягає у розробці рекомендацій, що можна застосовувати на практиці для покращення навчального процесу та розвитку педагогічної практики в цифрову епоху

**Ключові слова:** інноваційні підходи до навчання; синергетичний ефект; модернізація; персоналізація; навчальний процес