BRAIN. Broad Research in Artificial Intelligence and Neuroscience
e-ISSN: 2067-3957 | p-ISSN: 2068-0473
Covered in: Web of Science (ESCI); EBSCO; JERIH PLUS (hkdir.no); IndexCopernicus; Google Scholar; SHERPA/RoMEO; ArticleReach Direct; WorldCat; CrossRef; Peeref; Bridge of Knowledge (mostwiedzy.pl); abcdindex.com; Editage; Ingenta Connect Publication; OALib; scite.ai; Scholar9; Scientific and Technical Information Portal; FID Move; ADVANCED SCIENCES INDEX (European Science Evaluation Center, neredataltics.org); ivySCI; exaly.com; Journal Selector Tool (letpub.com); Citefactor.org; fatcat!; ZDB catalogue; Catalogue SUDOC (abes.fr); OpenAlex; Wikidata; The ISSN Portal; Socolar; KVK-Volltitel (kit.edu)
2025, Volume 16, Special Issue 1 (April 2025), pages: 231-238.
Special Issue 1: *Neuroscience, Artificial Intelligence, and Innovation in Education*
Submitted: January 15th, 2025 | *Accepted for publication:* March 13th, 2025

Teacher Preparation for Lessons in the Context of Modern Education: Traditions and Innovations

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Abstract: *The article examines theoretical approaches and neuro-pedagogical aspects of methods and techniques used to enhance the quality of teacher preparation for contemporary lessons. Based on scientific articles, methods for teacher preparation in the context of innovation are analysed. Approaches to organising the educational process and addressing how teachers can effectively present educational material in an era of unlimited information are discussed. The article explores theoretical aspects of teacher preparation for modelling modern teaching. The model is viewed as a logical scheme of phased interaction between the teacher and students during a lesson. Examples of technologies, including neural networks in teacher preparation for modern lessons, aimed at organising learning activities to develop students' universal competencies are presented, and the teacher's role in applying various teaching methods is defined. As the education system constantly evolves and technologies plus teaching approaches develop, it is essential to explore how pedagogical methods, traditional approaches, and innovations can interact to achieve optimal results. One of the challenges is adapting traditional methods to modern conditions. In particular, it is necessary to examine how traditional pedagogical strategies, such as lectures, discussions, or visual aids, can be effectively combined with new technologies to maintain their effectiveness in the context of digitalised education.*

Keywords: *contemporary lesson; neural networks; educational process; innovation; modern education.*

How to cite: Grytsyk, N., Androshchuk, I., Stetsula, N., Kuzmenko, I., Shapoval, O., Nozdrova, O., & Maksymchuk, B. (2025). Teacher preparation for lessons in the context of modern education: Traditions and innovations. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, *16*(Sup1), 231-238. https://doi.org/10.70594/brain/16.S1/19

1. Introduction

Modern education is a dynamic process that constantly evolves and changes. At the center of this process is always the teacher, who plays a key role in shaping future generations. Lesson preparation is an integral part of pedagogical activity that requires a creative approach, deep knowledge, and constant self-improvement. The article's relevance lies in the necessity of rapid adaptation to innovative conditions. The education system is not static, and many teaching methods are losing their effectiveness. In an era when a student can access the Internet to find any information, a teacher must become a guide who aids not only in learning but also in adapting to society and self-development. This demands new approaches to preparing future teachers, which contribute to expanding the influence and professional skills of educators.

Research on teacher preparation for lessons in the context of modern education and the use of innovative technologies in the educational process has been conducted by numerous domestic and foreign scientists, including Hurevych et al. (2023), Kelly et al. (2012), Macaro, Handley, and Walter (2012), Sarancha et al. (2022) among others.

In this context, a question arises: How can we combine centuries-old traditions of pedagogical mastery with innovative approaches to modern education? On the one hand, we must preserve the best that has been accumulated in pedagogy over the centuries. On the other hand, we must remain open to new ideas and technologies that can make the learning process more effective and engaging.

A teacher with knowledge of neuroplasticity, memory, and attention can develop educational materials and methods that best meet students' needs. Neuro-pedagogy helps to understand how the brain assimilates information, what factors influence learning motivation, and how to create an optimal learning environment.

Purpose of the Article: Discuss contemporary approaches to preparing future teachers. Examine the stages, methods, and techniques of teacher preparation for modern lessons, identify the neuro-pedagogical aspects of methods and techniques, and analyse the impact of neural networks in teacher preparation.

Theoretical Significance: The article takes into account theoretical approaches and trends used in professional teacher preparation for modern lessons.

Practical Significance: Identifying new forms of professional pedagogical activities emerging in contemporary sociocultural conditions.

2. Stages, Methods, and Approaches to Teacher Preparation for Modern Lessons

The entire education system is transitioning to a new level of ideas, tasks, and principles. New specialised directions are emerging in pedagogy, and the preparation of future teachers is becoming standardised. This shift responds to certain negative factors hindering educational development: reduced teaching hours, an abundance of "old-school" pedagogical literature, and a lack of textbooks dedicated to modern approaches that emphasise developing students' individuality.

According to Nesterenko (2019), "Contemporary trends in lesson preparation focus on a student-centered approach, considering each student's interests, needs, and abilities, encouraging them to analyze information, express their opinions, substantiate their viewpoints, engage in collaborative problem-solving, showcase their creativity, and integrate knowledge from various subjects for deeper understanding". Preparing a contemporary teacher is a continuous process of learning and self-improvement. Using various methods and approaches, as well as innovative technologies, enables lessons to be more engaging and effective, meeting the needs of modern students.

Thus, there is a trend toward improving teacher preparation quality. Possible directions for working with future teachers include:

1. Specially organised training courses to familiarize educators with new, progressive teaching methods.

2. The theoretical part of training courses should address modern teaching trends, emphasising the need for interdisciplinary integration of educational material, the interdisciplinary nature of knowledge, and its applicability in modern conditions.

3. Creating conditions for engaging educators in research activities by enhancing theoretical training on research methods in educational institutions, as part of professional development, and establishing organisational frameworks for research activities in schools.

Skvortsova and Britskan (2018) state, "During the professional preparation of future teachers, immersion into pedagogy itself occurs first, understanding its theoretical foundations, followed by integration and practical teaching skills development in mastering professional pedagogical activities".

Dmytrenko et al. (2016) emphasise that "teachers should not only prepare to transmit knowledge but also respond to contemporary social trends by creating their curricula. A teacher no longer just teaches a subject; they 'educate.' At the same time, the task of a modern teacher is to master progressive methodological approaches in education". In recent years, the pedagogical practice of preparing future teachers of various profiles has actively incorporated the following leading methodological approaches: competency-based, learner-centered, interdisciplinary, systemic, and multi-subject.

The aforementioned approaches are not entirely new trends in pedagogical science; however, they are being actively tested in the educational process, with ongoing efforts to find effective practical mechanisms for their implementation in teaching various disciplines. These approaches primarily differ in the nature of the learning process, as well as in the goals and methods employed. For modern pedagogical education, the competency-based approach is considered the most effective. This approach not only develops the competencies necessary for effective teaching but also familiarises educators with the psychological aspects of teaching, methods for nurturing students, and contemporary trends in working with them.

As a methodological foundation, various cases and studies are used to demonstrate effective teaching methods (through feedback, group work, projects, etc.). The main goal of such education is to gain relevant experience, enabling the teacher to integrate all the disciplines they have studied into a cohesive whole, allowing them to apply their experience in creating an effective educational program. In turn, such a program not only leads to effective learning outcomes but also aligns with modern educational trends and the requirements that teachers are expected to meet. Namely, to create an educational process in which the child not only acquires the necessary knowledge but also learns self-education, grows as an individual, and develops skills essential for future professional activity and life in society as a whole. Thus, the competency-based approach fully aligns with the goals of education development at the current stage—skills development, support for self-realisation and self-determination, personal growth, and socialisation. In this approach, key roles are played by personal characteristics such as competencies and meta-qualities.

Khmil (2017) states that in this way, a future teacher not only masters the theoretical foundation but also develops as an individual and professional in various working conditions.

According to Arnold-Garza (2014), "the vast amount of information negatively affects the ability to filter, systematise, and use it in the learning process. A child will have no trouble learning a new social network or any online resource, but a modern teacher must teach them to process vast amounts of material systematically, find the necessary background, and most importantly, form their own opinion and attitude towards what they read online".

We have identified specific actions that teachers can take right now in the educational process. First and foremost, in the context of constant innovative development, it is crucial not to stand still, as without change, one can easily lose competitiveness, professionalism, potential, and professional stability. A modern educator is constantly evolving, reorganizing their educational process, and developing potential. A teacher must formulate specific goals that will help them create a learning plan and follow it. In their work, a teacher realises their individual professional potential, uncovers personal abilities, and applies their knowledge and skills in the teaching process.

Sarancha et al. (2022) said it is important that a teacher is no longer just an observer but a creator. Therefore, the primary task in preparing such a teacher is the development of individuality, an adequate assessment of their abilities, and critical thinking. It is necessary to rethink the traditional teacher training system since previously acquired knowledge is no longer relevant; instead, it is essential to develop relevant experience in the modern informational field.

In the modern era of national education system development, teachers are becoming multitasking talents, with new professions emerging, such as student learning activity coordinators, tutors, and more. According to statistics on modern professions, in addition to well-known teaching roles such as tutors, there are also innovative educational professions, such as:

- Mentor for educational startups – a professional with experience in implementing their own startup projects in education, who supervises new startup teams and trains them practically through their own business projects.
- Game Master – a developer of educational games (on any topic). Such games can be used to immerse students in a learning environment from a practical perspective.
- Mind fitness trainer – an instructor who trains students' memory, attention, and other cognitive skills using special apps and online games.
- Eco-teacher – an educator who teaches sustainable living, environmental protection, and conscious consumption of ecological resources.

The educational environment is moving away from the conservative model. The learning process is being rethought, and specialists in the field of education are becoming increasingly in demand. This is especially true for teachers familiar with IT. And rightly so, as the online learning format has reached a new level of popularity (online classrooms, courses, simulations).

At present, many countries are actively conducting surveys and studies on teachers' lesson preparation, especially in the context of changes in modern education. Statistical data and the results of such surveys indicate several key trends in teachers' lesson preparation, particularly regarding traditional teaching methods and new innovative approaches.

According to a survey conducted by the State Statistics Service in Ukraine among 500 teachers in 2023, over 70% of teachers reported actively using digital technologies in their lessons. However, only 45% stated that they have a sufficient level of training to apply these tools. This suggests that while technology is widely implemented, the need for additional teacher training remains relevant. Furthermore, only 30% of teachers believe that modern teacher training programs fully address all aspects of digitalisation.

According to the results of a survey conducted in 2024 among 400 teachers, over 50% of educators noted feeling stressed due to the increasing demands on their professional preparation and the use of innovative teaching methods. At the same time, only 20% receive regular psychological support or consultations within their educational institutions. This highlights the need to expand psychological support programs for teachers.

A study conducted among 300 teachers found that approximately 45% believe that their professional development is not sufficiently supported by school administrations. Meanwhile, 68% of teachers stated that they are eager to pursue continuous professional development, particularly through participation in various training sessions, seminars, and professional development courses.

These statistical findings emphasise the importance of improving teachers' lesson preparation, particularly in the face of rapid changes in education. Training in the use of modern technologies, inclusive education, critical thinking development, psychological support, and neuro-pedagogical approaches should be an integral part of teachers' professional development to ensure effective work in contemporary educational settings.

"As more and more formats appear in education, and self-education becomes more practical and meaningful, new professions in the field of pedagogy are also developing. The teacher becomes the designer of the educational trajectory. He can develop online courses himself and participate in the creation of full-fledged e-learning platforms" (Dumont, Istance, & Benavides, 2010).

Teacher preparation, according to Chernetska (2011), "should be as closely linked as possible to their future professional activity".

Only in this way can the progress of educational standards and all educational processes in 21st-century schools be ensured. Only in this way can the progress of the 21st century be guaranteed. This will be impossible if schools face problems related to excessive formalisation of teaching methods, where the goal is not to create a healthy and effective environment for the child's development as a personality, but merely to transmit information.

Kelly et al. (2012) "believe that it is also necessary to optimise teachers' work processes: move away from ineffective tasks and transition to more targeted ones". The goal of working with children also needs to be reconsidered: it's not about numbers (ZNO, overall score), but about the potential of students as members of society and future professionals. We should not treat all educational institutions the same way, but we should consider the creative qualities of students, extracurricular activities allowed by the school, and the individuality of the teachers themselves. The teacher's environment plays an important role in the learning process.

Today, it's impossible to imagine a school without computers, the internet, and gadgets. And if a Skype lesson once seemed unusual, today, distance learning has become a regular part of teaching. According to Phillips (2010), "a modern teacher must not only be able to organise a lesson competently and engagingly but also adapt it to current online conditions".

Accordingly, the professional preparation of future teachers is expanding to include disciplines related to online learning, information technologies, the Internet, and so on. In addition, the most important goal is to teach teachers how to organize lessons in conditions of low interest, inconsistency of technical capabilities, and the absence of strict time constraints for students.

3. Neuro-Pedagogical Aspects of Modern Lesson Methods and Techniques

Contemporary pedagogy increasingly relies on scientific achievements, particularly in neuroscience. Neuro-pedagogy, which studies the biological foundations of learning, offers innovative approaches to organising the educational process. Understanding how the brain functions during learning allows teachers to create more effective and engaging lessons.

According to Scott (2015), one of the most critical neuro-pedagogical aspects of modern teaching is recognising that every brain is unique. Therefore, it is essential to consider different learning styles, paces of information acquisition, and cognitive characteristics of students. Positive emotions, Scott argues, enhance memory retention.

Creating a trusting classroom atmosphere, maintaining interest in the subject, and encouraging achievements are vital. The brain absorbs information more effectively when learners actively create it themselves. Students should be involved in activities such as discussions, projects, and experiments. The brain prefers holistic understanding, so showing connections between various topics and demonstrating real-life applications of knowledge are crucial. Furthermore, information is better retained when presented in diverse formats: visual, auditory, and kinesthetic.

The brain requires regular breaks for recovery, and physical activity stimulates blood circulation and improves cognitive functions. Methods and techniques of modern lessons based on neuro-pedagogical principles emphasise that play is a natural way for children to learn. Games foster creativity, critical thinking, and collaboration. When students seek answers themselves, they better retain material and develop independent thinking skills. Projects allow students to apply knowledge in practice, develop research skills, and enhance analytical and presentation abilities.

Mnemonics help remember large volumes of information through associations and imagery. Interactive boards, presentations, educational programs, and mobile apps make learning more engaging and effective. Neuro-pedagogy provides teachers with a robust set of tools for creating effective learning environments. By applying neuro-pedagogical principles, teachers can make learning more interesting, accessible, and effective for every student.

Traditional education and neuro-pedagogy may initially seem like opposing approaches. However, they can complement each other, creating an effective and individualized educational system. To achieve balance, teachers should:

- Maintain the traditional structure of the learning process while making it more flexible to accommodate students' individual needs.
- Incorporate elements of informal learning, project-based activities, and collaboration.
- Use diverse teaching methods to cater to different learning styles.
- Provide additional materials and assignments for students who require extra support.

4. Neural Networks in Teacher Preparation for Modern Lessons

Exploring the potential of neural network technologies in education highlights the need to transition from mass teaching methods to individualised methodologies. Personalised teaching strategies, grounded in next-generation neural networks, involve creating parametric models of students that reflect their cognitive development traits (e.g., knowledge assimilation levels, learning ability dynamics).

Neural networks can analyse test results, assignments, and other activities to identify students' strengths and weaknesses. Based on this data, neural networks can create personalised lesson plans tailored to individual needs. Artificial intelligence (AI) can adjust task difficulty depending on how quickly a student grasps the material.

Neural networks can generate lesson-relevant texts, images, videos, and even music, making learning more engaging and effective. Adaptive tests, tailored to students' responses, and diagnostic tools for evaluating communication skills are other examples. Neural networks can also automate the grading of straightforward tasks, freeing teachers to focus on creative work.

Artificial intelligence can predict which students may have difficulties and provide additional support. According to the expert, this system can be used to analyse how complex, coherent, and consistent a person's speech is and whether their speech is diverse. Such speech analysis allows you to diagnose students' communication skills, choose the right learning trajectory, and evaluate the effectiveness of learning by comparing pre- and post-tests. Thus, you can recognise the problem in time and solve it by choosing an individual learning scenario.

According to Vozniuk (2019), modern education actively integrates technologies, with neural networks emerging as powerful tools for educators. They open new opportunities for personalising learning, creating interactive materials, and automating routine tasks. However, teachers must guide the educational process, foster a supportive environment, and encourage critical thinking and creativity.

Neural networks can help teachers create individualised curricula, based on which they can analyse data on student performance and learning styles or create personalised tasks and exercises. It is also possible to develop interactive educational materials (generation of various types of content: texts, images, videos, presentations; creation of adaptive tests and games; development of virtual laboratories and simulations).

Examples of how neural networks can be used in the preparation of modern teaching include the creation of original texts, images and music to illustrate educational material, the analysis of large volumes of data to recognise learning patterns and develop predictive models, individual support for students in the learning process, the translation of texts, the creation of subtitles for videos and the automatic assessment of oral responses.

On the one hand, the teacher has traditionally been considered the central figure in the educational process. On the other hand, the development of artificial intelligence opens up new opportunities for automating many routine tasks and personalising learning. So, what is the teacher's role in this new context? Can AI completely replace teachers? The answer is a definite no.

AI can be a powerful tool in the hands of educators, but it will never fully replace the human factor. Teachers create an emotionally safe learning environment, motivate students, and help them

develop social skills or resolve conflicts. These aspects are difficult to algorithmise and will remain the prerogative of humans.

Thus, artificial intelligence is not a competitor to teachers but rather a powerful tool to support them. Artificial intelligence will not replace teachers but will enhance their capabilities. Teachers remain the key figures in the educational process, responsible for fostering a positive atmosphere, motivating students, and developing their social and critical thinking skills.

Neural networks open up new possibilities for teachers, who can use them to create more personalised, effective, and engaging lessons. However, it is important to remember that neural networks are tools that complement, but do not replace, the teacher. The teacher's role is to guide the learning process, create a conducive atmosphere, and encourage critical thinking and creativity in students.

The results of the study show that neural networks can significantly increase the efficiency of learning. To implement these technologies in the educational process, it is necessary to develop clear strategies, invest in expanding the infrastructure, and train the teaching staff. Only under these conditions will we be able to create an education system that meets the requirements of the modern world.

5. Conclusions

The importance of this article lies in highlighting that teacher preparation today involves more than transmitting knowledge—it focuses on developing professionals capable of creating innovative educational environments. This requires mastering new technologies, methodologies, and pedagogical theories, experimenting in practice, and fostering collaboration and self-improvement.

The article explores modern approaches to training future teachers, examining stages, methods, and techniques for lesson preparation. It delves into the neuro-pedagogical aspects of teaching methods and the role of neural networks in teacher preparation for modern lessons.

A modern teacher is not merely a knowledge transmitter but a facilitator who helps students grow as individuals and prepares them for life in a dynamic world. The key to success lies in adapting to changes, employing innovative approaches, and fostering personal development.

The article proves that the key areas of development of modern pedagogical education are the formation of a wide range of competencies in future teachers necessary for effective work in a modern school, the creation of conditions for the development of each student, taking into account his or her characteristics and needs, the integration of information and communication technologies into the educational process, and the combination of knowledge from different subject areas for a deeper understanding of the world.

Neural networks have the potential to revolutionize education by providing personalised learning trajectories for every student. Automating routine tasks enables teachers to focus on cultivating critical thinking and creativity. However, successful integration of neural networks requires developing clear strategies, investing in infrastructure, and preparing educators to work with advanced technologies.

While neural networks offer immense potential, their application in education poses challenges, such as ensuring data privacy and mitigating algorithmic bias. Nonetheless, resolving these issues will enable neural networks to become powerful tools for improving educational quality and ensuring equal opportunities for all students.

References

Arnold-Garza, S. (2014). The flipped classroom teaching model and its use for information literacy instruction. *Communications in Information Literacy, 8*(1), 7–22. https://doi.org/10.15760/comminfolit.2014.8.1.161

Chernetska, T. (2011). *Modern lesson: Theory and practice of modeling* [Textbook]. Kyiv. Retrieved from https://www.researchgate.net/profile/TetyanaMiier/publication/340413107_Sucasnij_urok_te

oria_i_praktika_modeluvanna/links/5e87551f299bf1307977f2de/Sucasnij-urok-teoria-i-praktika-modeluvanna.pdf

Dmytrenko, T. O., Yaresko, K. V., Nahaiev, V. M., Kolbina, T. V., Lutsenko, L. M., Koval, T. A., & Svyrydenko, D. O. (2016). *Foundations of modern pedagogy: Monograph.* Kherson: Kherson State University.

Dumont, H., Istance, D., & Benavides, F. (Eds.). (2010). *The nature of learning: Using research to inspire practice.* OECD Publishing. https://doi.org/10.1787/9789264086487-en

Hurevych, R., Boichuk, V., Konoshevskyi, L., Konoshevskyi, O., & Kostenko, N. (2023). The use of innovative technologies in the educational process. *Youth and the Market, 5*(213), 18–23. https://doi.org/10.24919/2308-4634.2023.282829

Kelly, M., Grenfell, M., Gallagher-Brett, A., Jones, D., Richards, L., & Hilmarsson-Dunn, A. (2012). The training of teachers of a foreign language: Developments in Europe (A report to the European Commission Directorate General for Education and Culture). Yarmouth: Intercultural Press. Retrieved from http://p21208.typo3server.info/fileadmin/content/assets/eu_language_policy/key_documents/studies/executive_summary_full_en.pdf

Khmil, N. A. (2017). *Future teachers' skills development to use a cloud-based service Google Calendar in a professional activity*. Academia.edu. Retrieved from https://www.academia.edu/98969616/Future_Teachers_Skills_Development_to_Use_%D0%B0_Cloud_Based_Service_Google_Calendar_%D1%96n_%D0%B0_Professional_Activity

Macaro, E., Handley, Z., & Walter, C. (2012). A systematic review of CALL in English as a second language: Focus on primary and secondary education. *Language Teaching, 45*(1), 1–43. https://doi.org/10.1017/S0261444811000395

Nesterenko, M. M. (2019). *Preparing future teachers for lesson modeling in conditions of variability in primary education* (Doctoral dissertation). Berdyansk State Pedagogical University. Retrieved from https://dspace.bdpu.org.ua/handle/123456789/2071

Phillips, M. (2010). The perceived value of videoconferencing with primary pupils learning to speak a modern language. *The Language Learning Journal, 38*(2), 221–238. https://doi.org/10.1080/09571731003790532

Sarancha, I., Maksymchuk, B., Kharchenko, S., Linnik, Y., Dovbnia, S., Pavelkiv, V., Maksymchuk, I., Shakhina, I., Saienko, V., Bashtovenko, O., Silaiev, V., Radovenchyk, A., & Zhytomyrskyi, L. (2022). The influence of parents' mutual support on the socialization of children with special needs in rehabilitation centres: Neuropsychological aspects. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 13*(4), 362-382. https://doi.org/10.18662/brain/13.4/393

Scott, C. (2015). *The futures of learning 3: What kind of pedagogies for the 21st century?* UNESCO Education Research and Foresight. UNESCO. Retrieved from http://unesdoc.unesco.org/images/0024/002431/243126e.pdf

Skvortsova, S., & Britskan, T. (2018). Training for future primary school teachers in using service learning apps teaching mathematics. *International Journal of Research in E-Learning (IJREL)*, 4(1), 59–77. Retrieved from https://doi.org/10.31261/IJREL.2018.4.1.05

Vozniuk, O. V. (2019). *Neuro-pedagogy – a powerful resource for adult education. Andragogical Bulletin, 10*, 19–27. Zhytomyr: Publishing House of Zhytomyr State University named after I. Franko. Retrieved from http://library.zu.edu.ua/andragogichnyi_visnyk.html