

## Implementing Neuropedagogical Innovation in Schools: From Theory to Practice

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**Abstract:** *In the article, the possibilities of using the neuropedagogical approach in the educational process for the child to achieve a high level of school knowledge and skills and personal development are considered. The features of the modern educational space and their readiness to introduce innovations are analyzed. The role of neuropedagogy and its elements in the practice of teaching and upbringing of children is determined. The fundamental ideas of modern neuropedagogy, its principles and objectives are formulated, and the need for their application is substantiated. It also substantiates the need for the introduction of neuropedagogical innovations and such a position as a neuroeducator. The main research methods in this article are historical, comparative methods of synthesis and analysis, as well as theoretical analysis of a scientific letter, thematic journals. Thanks to which a large number of sources have been worked out, the quality and level of research already conducted and the effectiveness of introducing the principles of neuropedagogy into the educational process have been assessed. As a result, the problem of school failure was highlighted, the shortcomings of traditional teaching methods were revealed, appropriate neuropedagogical innovations were proposed, and practical recommendations for teachers were provided. It is concluded that the introduction of the principles of neuropedagogy and neuropedagogical innovations will improve and modernize the educational system.*

**Keywords:** *Neuropedagogy at school, neuropsychological approach, school education, principles of neuropedagogy, traditional teaching methods, cognitive functions.*

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## Introduction

Since the end of the twentieth century, scientists and educators began to take an active interest in the brain and the processes occurring in it, they directly linked the features of its functioning with the problems of education. They made a number of discoveries that became fundamental for the future formation of a new industry - neuropedagogy. Applied science combines knowledge of such related fields as psychology, biology, pedagogy and others. The principles of neuropedagogy have been the subject of many scientific studies and monographs. The work examined scientific articles and works of prominent psychologists and educators, including the books by O. R. Luria (2013) "Fundamentals of Neuropsychology", V. D. Eremeeva and T. P. Khrizman (1998). Neuropsychology - for teachers, educators, parents, school psychologists ", learning principles in action "and others, as well as articles by L. S. Vygotsky (1991)", O. V. Voznyuk (2019) "Neuropedagogy - a powerful resource for adult education", etc. In the above-mentioned works, neuropedagogy is viewed as a qualitatively new field of science, on which teachers should rely in their professional activities, and the neuropedagogical approach as a response to the challenges of our time. Many scientists have tried to determine the goals, objectives and historical significance of this science. However, much less research has focused on the implementation of neuropedagogy and neuropedagogical innovation in schools. Therefore, the topic of introducing neuropedagogical innovations in school is quite relevant and requires detailed consideration.

Research in the field of neuropedagogy is gaining in popularity due to advances in technology and informatization. More and more scientists argue that a neuropedagogical approach will help modernize the education system, improve the teaching and educational process and overcome the problem of school failure (Demchenko et al., 2021; Komogorova et al., 2021; Kosholap et al., 2021; Prots et al., 2021; Melnyk, 2021; Maksymchuk et al., 2020). Based on this, the purpose of this article is to confirm or refute the submitted statements, to study the problems that neuropedagogy can solve in the context of the educational process, opportunities to improve the quality of education and the introduction of neuropedagogical innovations. The article is intended to show how the achievements of neuropedagogy can be used to solve professional problems of a teacher in the process of organizing the educational space.

## **Neuropedagogy as a Science: A Historical Excursion**

The nineties of the twentieth century received the title "The Decade of the Brain" for a reason (Zeer & Symanyuk, 2021). We have learned more about the brain than in all previous centuries combined during this period. In turn, these discoveries initiated the further acquisition and development of new amazing knowledge about the brain. This data is accumulated and synchronized, forming an integral system. Thanks to such a treasury of knowledge about the brain, their integration into various sciences, in particular into pedagogy, was inevitable, Glushchenko (2017). Thus, a qualitatively new direction in education appeared as "neuropedagogy".

Based on knowledge about the functioning of the brain and nervous system, the main criteria and conditions for effective learning in this system are investigated. Neurodidactics is an integral part of neuropedagogy, which also includes cognitive diagnostics, development of an educational system and correctional and developmental support of students. In turn, such scientific and applied disciplines as neuropedagogy, neurodiagnostics, neurodidactics and neuropsychology closely interact with each other and are key elements of neuroeducation. L.S. Vygotsky (1991) and O.R. Luria (2013), who laid the foundations for the future direction in their works.

Scientists have been talking about the need to use neuroscience in pedagogy for a long time, but only at the end of the twentieth century did it become possible to apply the achievements of neuropsychology and neurobiology in pedagogical practice. That is why, on the territory of the post-Soviet space, "neuropedagogy" as an applied science appears in the nineties of the twentieth century, but begins to actively declare itself only in the twenty-first. The most interested in the problems of neuropedagogy were scientists, among whom V.A. Moskvina, and N.V. Moskvina (2001), V.D. Eremeeva and T.P. Khrizman (1998), T.V. Akhutina et al. (1996), O. L. Podlinyaev and K.A. Mornov (2015) and others, as well as the Ukrainians I.A. Zyazyun (2013) and A.V. Voznyuk (2019). Nina Moskvina and Viktor Moskvina (2001) analyzed a new direction of science and outlined the main provisions of neuropedagogy, its tasks and goals in their work "Neuropedagogy as an applied direction of pedagogy and differential psychology".

In parallel, neuropedagogy as a new interdisciplinary branch developed in the USA. The following American researchers were involved in its development: Mazzucchelli et al. (2009), I. Jensens (2000) and others. In many countries, research centers for neuropedagogy were created. Also, the

Center for Educational Research and Innovation organized an international project "Brain and Learning", which included thirty countries of the world - teachers, psychologists, neuroscientists, sociologists, doctors, etc. Its main task was also to popularize knowledge about the work of the brain among teachers. The research carried out within the framework of the project provides teachers with all the necessary information about the principles of brain functioning, which can be further applied in practice.

Neuroeducators identified certain patterns of brain functioning and formulated and presented a number of tips and recommendations for teachers based on the information received. However, the practical application of the data obtained remains in the background and requires implementation into the education system as such. And education itself requires reform and renewal to ensure effective learning, as well as to create the necessary conditions for introducing a neuropedagogical approach into the educational process (Mynbayeva et al., 2017).

What provoked such a need? There are a number of reasons, but we will focus on the most important ones. "Innovative technologies" of teaching and upbringing of children, which are outlined in the psychological and pedagogical literature, have long been used in pedagogical practice and are no longer considered the latest discoveries, as they guarantee success in learning, high results and development of children's abilities, Naegele (2015). At the same time, the social and cultural environment of the child's education has changed qualitatively and quantitatively. In the modern globalized world, the information space is characterized by variability and provides the child with a wide range of alternative means and methods of obtaining information, Churilo (2018). And most importantly, the child must master basic school skills, such as writing, reading, number, which he will need already at the stage of enrollment in school even in preschool age, Churilo (2018). Why so untimely? Because today, more than ever, the issue of increasing the efficiency of the educational process is relevant. Modern educational standards are focused on students obtaining a wide range of knowledge in different areas. Thus, on the one hand, the requirements for the level of training and education are constantly growing and this leads to an increase in the intensity of training and its deepening, and on the other hand, to a deterioration in the psychophysical health of children. High demands, and sometimes too high, increase the risk of psychosomatic diseases, emotional and behavioral disorders in children whose brains are not yet sufficiently formed to meet them (Peterson, 2018).

That is why, together with the increase in requirements for the quality of education, it became necessary to introduce qualitatively new teaching methods focused on the personality of the child, his abilities and characteristics. Modern children differ significantly from those born fifty or even twenty years ago, and the education system has practically not undergone any changes, starting with preschool education and ending with a higher educational institution. The lion's share of teachers are teachers and educators who use in their work the principles and methods of teaching and educating children since Soviet times. And this is a big problem, since modern education and science must meet the requirements of the time and respond to challenges in time. Another problem is the uncontrollably growing number of children lagging behind in learning, who have difficulties in mastering the school curriculum and significant problems with adaptation, in the absence of impairments to the intellect, vision, hearing, language and musculoskeletal system. Judging by all of the above, it can be argued that the means and approaches of the traditional psychology of teaching and upbringing of children have exhausted themselves and they are simply not enough to organize an effective educational process (Churilo, 2018). In other words, we can observe a significant deterioration in the parameters of the neuropsychic health of the population against the background of a dramatic decrease in the effectiveness of traditional teaching methods. That is why the introduction of not just a neuropedagogical approach, but neuropedagogical innovations, is an urgent and priority task for heads of schools and preschool educational institutions.

Before talking about neuropedagogical innovations, it is necessary to understand what this new branch of "neuropedagogy" is and why it is so important in teaching?

Neuropedagogy is an applied neuroscience that uses knowledge of cognitive neurology, differential psychophysiology, neuropsychology, data on the organization of the processes of mastering different types of educational material by the brain. It takes into account the compatibility of individual lateration profiles of students and teachers in the educational process, their interaction and fully reflects the personal approach to learning.

Based on factual knowledge about the patterns of processes, the goal of neuropedagogy taking place in the structures of the brain and psyche is to build a training and education system that takes into account the individual neuropsychological characteristics of students based on factual knowledge about the patterns of processes occurring in the structures of the brain and

psyche (Podlinyaev & Mornov, 2015). Thus, to contribute to the optimal physical, intellectual, spiritual, moral and professional development of a person, the satisfaction of his educational needs and interests. In other words, effectively teach and educate, creatively solve pedagogical problems, promote personal development and professional self-realization of a person, relying on the work of the brain and knowledge of individual characteristics.

1. The main tasks of neuropedagogy follow from here (Voznyuk, 2019):

2. To investigate the neuropedagogical mechanisms of consciousness and behavior of students, their personal, subjective and individual relationships, as well as the principles of the formation of a common neuropedagogical space.

3. Analyze objective psychological phenomena and laws arising as a result of neuropedagogical communication between people in the context of solving a single educational problem.

4. Identify and consider the patterns of neuropedagogical processes, the structure of the neuropedagogical space, developing under the influence of joint activities.

5. To develop and introduce into educational practice psychodiagnostic and psychocorrection technologies that increase the effectiveness of the professional activities of teachers and psychologists. These include magnetic resonance imaging (MRI), computed tomography, electroencephalography (EEG). These technologies help to diagnose disorders in a timely manner and contribute to their correct treatment, as well as allow the study of the pedagogical process, taking into account the neurological changes in the brain.

6. Provide inclusive education for children with disabilities, that is, provide an opportunity for such children to study in a mainstream school with other children.

The main area of application of neuropedagogy remains the school - the place where children learn. In order to maximize the educational process and make it effective, teachers must understand how our brain works, how it perceives, remembers, processes, stores and reproduces information (Dehaene, 2013). They also need to understand that the relationships among classmates, the structure of the class, the tasks that the children perform, the words and emotions experienced that affect the development of the brains of students and the way they learn. An important feature of modern education is the desire to ensure the maximum realization of the abilities of "gifted" and "special" children, mainly through the development of

individual learning plans. However, all students must realize their abilities and the approach must be individual to every child, regardless of whether he has disabilities or not (Naegele, 2015). Hence, a problem arises that looks something like this - children are different, but they teach them in the same way, although each student thinks "in his own way", respectively, and everyone has different learning abilities. It is necessary to take into account the needs and abilities of the child in order for learning to bring results, and for this it is necessary to explore the student's thinking strategy, to understand how his brain works. And the fact that the modern education system is not brain-friendly and is the reason for the lag in perfectly normal and healthy students, Peterson (2018).

The neuropedagogical approach involves the application of fundamental knowledge about the human brain and its functioning in the educational process. Consider the main provisions about the work of the brain, which are based on neuropedagogy:

1. By its nature, the brain is multifunctional, which means it can perform several functions at the same time. The teacher must use different methods and means of teaching, develop rich classes in which he will involve students in educational and cognitive activities of different content and forms. It should be borne in mind that underloading the brain, like its overloading, can negatively affect its development (Voznyuk, 2019).

2. Learning and cognition are the main vehicles for brain development. By nature, a person is inquisitive, so he tends to be interested in everything around him. And pedagogy as a science must create an appropriate environment to meet these needs (Voznyuk, 2019).

3. The constant search for meaning and reliance on experience are innate qualities of the brain. The brain analyzes any new situation through the prism of previous experience, acquired knowledge, experienced emotions and realizes it only after it draws a parallel between this knowledge and already existing ideas. Therefore, it is very important to update and replenish this knowledge in the learning process (Terno, 2011).

4. The brain seeks truth through the establishment of patterns, and disorder and chaos complicate its productive activities. For learning to be effective, the potential of the human brain must develop, overcoming intellectual difficulties and establishing patterns, Voznyuk (2019).

5. Emotions play a huge role in learning and teaching. They are necessary for the productive activity of the brain, since the learning material is remembered better if it is associated with the corresponding positive

emotions. Emotional learning is essential for both learners and teachers as it stimulates thinking and creativity. And emotional intelligence is just as important as intelligence (IQ) itself.

6. The human brain is able to simultaneously analyze and synthesize information, operate in whole and in part. Neuropsychologists in their research prove that the brain has a unique ability to simultaneously perceive an object as a whole and in parts. Analysis and synthesis are very important interconnected thought processes that develop with the help of correctly selected teaching methods. That is why educational material should be presented through the interaction of induction and deduction, the whole and the separate, analysis and synthesis, specificity and generalization, etc.

7. The brain assimilates information equally in conditions of focused attention and peripheral perception. With a well-organized learning process, such a property can be useful for a teacher, but it can also act as a destructive element (Blake, Choshanov, Paso & Peyp, 2003).

8. The processes in consciousness and subconsciousness proceed simultaneously. In the process of learning, the student receives much more information than it seems. The child is influenced not only by what the teacher said or done, but the whole complex of internal factors, such as his own experience, emotional state, level of motivation, individual characteristics and others, and external among which is the general atmosphere in the classroom, light, sound, etc.(Blake et al., 2003).

9. The brain has at least two memory systems: a visual-spatial memory system and a memorization system (Blake et al., 2003). The first is more natural for the functioning of the student's brain, the other is more artificial and laborious. Knowledge gained through "memorization" is unstable and unproductive. As a rule, they are located in the memory randomly and haphazardly. And the more such information, the more difficult it is for the brain to find it. Visual-spatial memory is systematized in such a way that any information occupies its own niche assigned to it. Therefore, it is convenient not only to accumulate and store data, but also to quickly find and reproduce. In addition, a person understands and remembers better if knowledge and skills are fixed in the visual-spatial memory system.

10. Brain development is stimulated under the conditions of creative freedom and stops when pressure, coercion or threat is felt. Some educators adhere to strict discipline, suppressing the creative atmosphere. As a result, students simply cannot develop their abilities and acquire new knowledge and skills (Blake et al., 2003).

11. The brain is unique. It differs not only physically, but also in characteristics. The brain of each person differs in the volume and speed of data processing, the predominance of one of the memory systems, the speed and quality of memorization, flexibility of thinking, etc.

Many schools use a traditional learning model based on memorization and review. It views the class as an integral personality, which is designed for one teacher and the same teaching methodology for all. That is, the teacher must convey the provided educational material for the standard forty-five minutes of the lesson to twenty or thirty students, therefore, teaching children in accordance with their inclinations is not provided. Although some teachers try to take into account individual characteristics, character and temperament, this is not enough, and all children continue to try to fit the same template (Dehaene, 2013). What should be the students? Diligent, attentive, concentrated, etc. The list goes on. But if a child is absent-minded, cannot sit still, or he is simply not interested in learning, he is simply referred to the so-called category of children who are lagging behind in learning, without looking for a reason and refutation of such behavior (Tarasov, 2008). Therefore, the words of Eremeeva & Khrizman (1998) that the child's brain is developed by the teacher, and any violation of the normal development path can lead to its functional deformation even in a normal healthy child, they are very accurate and fully show the blunders of the modern education system.

The ability to organize the process of teaching and moral education of children, taking into account the individual characteristics of children, is one of the most important components of the teacher's professional competence. The quality of education and socialization depends on how much the personal characteristics of students are taken into account in the educational process, as well as their physical and mental health, (Ansari et al., 2017). What should be an effective education system? Focused on establishing trust between the pupil and the teacher, based on the recognition of the child's personal responsibility for the results of his activities, contributes to the development of the child's abilities and potential. That is, the education system, which is primarily focused on the development of the child, stimulating his activity and independence, strengthening the relationship between the teacher, the child and his family.

In order to solve the problem of "same" learning, it is necessary to introduce new methods and technologies and look for new approaches, Naegele (2015). One of these is the neuropedagogical approach, which

involves close interaction between the student and the teacher, revealing the hidden abilities and talents of the child and making it possible to make learning effective. Guided by the principles of neuropedagogy, the teacher can not only increase the effectiveness of teaching, but also make it interesting and motivating. What neuropedagogical principles should he rely on in order for the learning to be as productive as possible?

1. Learning should be deliberate and meaningful for both the student and the teacher. First of all, we are talking about using the child's direct experience, important and outstanding events, and understandable categories in the learning process. Lesson topics should be formed based on the interests and hobbies of the child, as well as his life situations, Churilo (2018).

2. Age should be taken into account, namely training to be timely and flexible. According to L.S. Vygotsky (1991) in his own work: "There is no one for a seven-year-old child, there is nothing and why to write", Churilo (2018). Considering the general laws of mental development, age norms of brain development, knowledge of mental neoplasms, it should be remembered that the boundaries of normal development are too arbitrary and blurred. Therefore, an individual approach, his educational needs and cognitive strategies, is a very important principle of teaching and raising a child at school, taking into account the characteristics of the child. In this case, the teacher must take into account the sensitive periods of the child's development, the so-called "windows of opportunities", suggesting the optimal period for teaching the child something and for the development of the corresponding mental functions. Since accelerated and in-depth training of a child without taking into account the morphogenesis of the brain can lead to a violation in the formation of higher mental functions, including in the link of arbitrariness and regulation of mental activity. That is, if the development of mental functions is complicated by the disagreements between the pedagogical and psychological terms of mastering, then the arbitrariness is also formed in a distorted manner.

3. Any educational and educational interaction must be consistent and logical. This position is based on the patterns of the formation of a child's thinking, in which visual representations and visual-figurative thinking become the basis for the formation of verbal-logical and abstract thinking (Churilo, 2018).

4. It is necessary to use the explanation by the method of complication (from simple to complex), deduction and induction in each

lesson in order to make the learning process gradual and accessible (Churilo, 2018).

5. In the development of a child, his physicality occupies an important place. Limitations of the child's motor needs can lead to a violation of analytical and synthetic activity. Disorders in psychomotor development are associated with the unformed scheme of their own body and with a violation of orientation in space, Churilo (2018).

6. Effective learning should not be multimedia, but multimodal, that is, rely on different modalities: visual, tactile and auditory instead of the active use of media. As you know, modern schools in most cases use verbal teaching methods, Churilo (2018).

Therefore, according to the formulated principles of neuropedagogy in the learning process, it is necessary to use not "interactivity", but joint productive activity. And the implementation of an individual-personal approach in school education is possible only if knowledge about the cognitive strategy and characteristics of the child's behavior is applied, understanding why he has difficulties at school, and identifying opportunities for further development.

In addition to all of the above, neuroeducation takes into account knowledge about how the way of thinking of boys and girls, left-handers and right-handers, what happens in the brain of children, during school, what teaching methodology to choose depending on the individual characteristics of the child, Glushchenko (2017). For example, if a boy sees a written text, the reaction takes place in one place in his brain, and when he hears the same words - in other places (Blake et al., 2003). Another example, when we see a number, for example "5", the occipital lobe of the brain is activated. When we hear or read a number like the word "five", the area of the cerebral cortex is activated, which is adjacent to the "groove of Sylvius". And when we perceive the number as a quantity, the parietal lobe is activated, for example, "5 is more than 2". That is, each lobe of the cerebral cortex performs characteristic functions and responds to the corresponding stimuli, which together ensure the correct functioning of the brain (Blake et al., 2003).

It would seem, what difference does it make how and what in the brain reacts if in the end a person grasps the meaning of the phenomenon and finds an answer to the task. But there is a difference and it lies in the fact that a significant advantage of one or another intracerebral "locator" gives this individuality such a characteristic as a learning style, Tarasov

(2008). Even without resorting to neurological fine distinctions, a truly talented educator or scientist can notice this. In modern pedagogy, you can often find the concept of "stress" or "inclination" to something that is actually one and the same. For example, a child has a talent for mathematics and he is perfectly understood in this science. However, mathematical abilities come in different combinations, which means that different types of thinking correspond to different areas of mathematics. Who has the best geometric abilities, who has combinatorial or algorithmic skills. Accordingly, when studying different sections of mathematics, the same mathematically capable students can master a given topic at different rates, even lag behind, Tarasov (2008).

### **Neuropedagogical Innovations: New Methods and Technologies**

Based on the theory, it becomes clear that with the help of advances in the field of neuropedagogy, it is possible to significantly increase student performance in school and diversify education. If you comply with the principles of neuropedagogy and find the "learning style" of each student, then the problem of lagging and academic failure can be solved once and for all, Larina (2016). However, how can this knowledge be applied in practice in the educational process? Since in order to obtain a positive result, it is necessary not only to study and theoretically analyze the relevant data, but also to learn how to apply them in practice. First of all, it is necessary to clearly understand that in order for education to reach a qualitatively new level, the introduction of neuropedagogical innovations is inevitable.

Today, teaching innovation is often driven by changes in information technology and schools must keep up with these changes. Given modern progress and informatization, the use of information and communication technologies (ICT) is already an integral part of the educational process, Lafuente (2018). The latest technologies are actively used in preschool and higher educational institutions and much less in schools. Although it is they who are the main guides of neuropedagogy, an individual approach to the pace and methods of learning. ICTs perfectly complement traditional teaching methods, diluting the existing system of memorization and repetition. They allow each student to collect their multimedia stock from videos, photographs, drawings, texts, cartoons, exercises and games characteristic of his perception.

School is the main goal of neuropedagogy, in which the teaching methodology is guided by the mechanisms of the child's organic perception

of the surrounding information and building on its basis "his own world" with a sense of personal participation in this process. The teacher should start teaching children based on the understanding or not understanding of reality, which has already developed naturally, so that children can subsequently comprehend the same patterns already at the level of scientific concepts. In schools, you can effectively use the conditions of the game, spontaneous improvisations, feedback, competitions, all kinds of projects, that is, everything that develops the initiative. You can provide children with the opportunity to test themselves in the role of a teacher, scientist, researcher, and not just tell them about a particular science. This is a clever stimulation of the educational instinct characteristic of the human brain.

Given today's realities, it is state with confidence that in the modern educational process there are a lot of teachers, but few neuroeducators (Friedman et al., 2016). This is why there is a tendency to lag and underperform in school. Finding that some of the child's sense organs are not working as well, neuroscientists are trying to discover and apply the compensatory capabilities of the brain to restore balance. And teachers guided by traditional methods will not even notice the problem. The most useful information neuropedagogy offers to teachers is in skills such as reading and writing. Reading problems can occur for a number of reasons: vision problems, poor hearing, inappropriate strategies that cause cognitive dysfunction. That is, it becomes clear that even completely healthy children may have problems with the development of reading or writing skills, if the strategy is not individual and developed in accordance with the needs of the child and his characteristics, abilities.

The question arises if it is necessary to determine the characteristics and abilities of each child, and there are about thirty of them in the class and the lesson lasts 45 minutes, how to do this. An educational online platform CogniFit (hereinafter referred to as Cognifit) was developed especially for teachers, which is based on the principles of neuroeducation, Cerdán (2017). It is used in many schools around the world and has been performing very well, especially among students with special educational needs and learning difficulties. What is this educational neurotechnology and how can it help? This is a scientifically developed tools for teachers who can use it to improve the quality of the educational process, even without special education in the field of neuropedagogy. The platform allows teachers to identify the neurological reasons for the failure behind in schoolchildren and helps to restore the basic neurocognitive functions of children. With its help, you can

deepen your knowledge of the processes of the brain responsible for learning and psychomotor development, taking into account individual needs, enhance cognitive functions, create a personal brain training mode.

How does the platform work? Students must first take a cognitive test that will identify strong and weakened cognitive functions (attention, memory, thinking, perception). According to the test results, the Cognifit platform will automatically create a personalized brain training program, which is aimed at improving the neurocognitive abilities of the student. That is, the online platform provides digital tools for the effective measurement and training of cognitive abilities and brain plasticity. Since school failure is one of the biggest problems in the education system, the use of a neuroeducational innovation such as Cognifit will help improve teaching methods to optimize the learning process and improve the quality of teaching, (Cerdán, 2017).

Experiencing new teaching methods is always a risk, how will the students, their parents, the leadership perceive it? However, the result is worth it. Brain-driven innovation can dramatically improve teaching and learning, reduce or even overcome the problem of failure. Neuropedagogical innovations are designed to work for the benefit of the learner and the educator, so the result can be expected to be twofold. The practice of using non-traditional teaching methods is more common in the United States and Europe than in the post-Soviet space. Consider the most illustrative innovations.

Professor of psychology, Psyche Loui (2020) looks at the introduction of neuropedagogy into learning through the use of music. Students learn about the latest research in auditory cognitive neuroscience and pursue their own group projects. One of these was a project to use music to help people with epilepsy. Or a project that explored how rhythm affects how music and speech are processed in the brain. Some students even rapped about their opinions. This approach allows students to apply scientific ideas in everyday life as it will engage them in research and help develop problem-solving and coping skills, Salas (2015).

Today, most sources of information about the discovery are freely available. All the data you need can be found on the Internet and you don't need to go to the library. This fact was used in his classes by Professor Stephen Engle, Salas (2015). He did not begin to explain to the students about a certain concept, but invited them to find explanations themselves in Wikipedia. When they did not find him there, he invited them to make the corresponding article themselves. That is, turned a challenge into an

opportunity. In addition to the excitement of being the first, students had the opportunity to contribute to the online encyclopedia. And in the process of work, students master new tools and functions of Wikipedia, which they did not even know about before. In the end, students are satisfied with their participation in the general dissemination of knowledge.

For twenty years, Professor Sean McCann has taught American literature in the usual way, Salas (2015). But one day, he decided to change this and instead of lectures, he created 15-minute videos for each lesson, assigned them as homework and devoted the rest of the lesson to a short summary and discussion. To do this, he made discussion groups led by technical experts (juniors and seniors who attended the class before). The main goal of such an experiment is to fully involve students in the process, their passion for working with technical experts who reflect the well-known saying "to master a subject, teach it to someone else."

And although all these innovations were introduced in higher education institutions, they can be used in whole or in part in schools. Applying these approaches results in more interaction from students, a deeper understanding of concepts, and improved communication and teamwork skills. Around the world, only a small number of schools are using the principles of neuroeducation and introducing neuroeducational innovations to help children learn and acquire new skills and regulate their emotions. Some schools have developed striking neuroscience-based teaching projects.

*Computer Brain Training (New Zealand)*, Matchar (2015).

In April 2014, on the North Island of New Zealand, Korakonui introduced a neuroscience-based program called Brain Gain to help students with problems such as ADHD and dyslexia. The program consists of three parts. The first part is the online program CogMed, which is designed to improve concentration by improving working memory. Students perform exercises that resemble computer games and are aimed at memorizing patterns and numbers. The second part of Brain Gain is a literacy program called Steps, another gamified online program designed to help students develop the cognitive skills they need to read well, such as visual recognition, auditory sequencing, kinesthetic memory, etc. The third part is another Fast ForWord computer program that uses neuroscience research to train students' brains, improving cognitive skills such as memory and comprehension. Brain Gain is showing positive results according to parent and teacher reviews.

*Let teens (and their brains) sleep (UK)*, Matchar (2015).

It is a well-known fact that teenagers love to sleep, and the reason for this is not just laziness. The biological rhythms of adolescents are, on average, two hours behind adults. This means that their brains "tell" them to go to bed two hours later than their parents. But despite falling asleep late, on weekdays, when you need to go to school, you have to wake up at 7 or 8 in the morning. Therefore, researchers at the University of Oxford in 2014 embarked on an experiment that involved more than 100 schools across England. Its main goal is to find out if students will perform better and more productively if school starts no earlier than 10 o'clock in the morning. The results of the study turned out to be positive and confirmed this statement, however, they require more detailed analysis in the future.

*Neuroscience for Rest (Australia)*, Matchar (2015).

Broadmeadows Primary School in Melbourne is attended by the children of the poorest families in the Australian city. However, her students get better test scores than students in neighboring schools with similar demographics, as well as higher than national ones. The school attributes this striking result to a new neuroscience-based program created with the help of neuroscientists and psychologists. They believe that stress, worry, and anxiety interfere with learning. And it is precisely this principle that was taken as the basis for the development of the program.

First, in the morning, students are fed a nutritious breakfast that they cannot get at home, and then they are sent to the "wall of emotions" to post their photo next to the emotions they experience that day. This helps teachers recognize students who are having a difficult day so they can provide appropriate assistance. Students are also given regular opportunities to engage in physical activity that helps improve learning and emotional regulation. The program not only helped to improve academic progress, but also positively influenced student behavior.

*Breakthrough in the study of Mathematics (US)*, Matchar (2015).

Many children and even adults have difficulty understanding math. Based on research on how the brain works, Stanford researchers have developed a special method to teach children how to operate with negative numbers. They analyzed how the brain's natural ability to process visual symmetry can help solve math problems. Scientists have found that it is much easier for students to determine the midpoint between negative and positive numbers if the distances of integers from zero are more symmetrical (i.e., it is easier to determine the midpoint between -4 and 6 than between -10 and 4). Based on this discovery, the researchers developed zero-hinge

magnetic digital whiteboards that allowed students to take advantage of their natural sense of symmetry to solve problems. Children who have worked with these boards have improved their understanding of math in general.

*Kids are allowed to run (Canada)*, Matchar (2015).

Numerous studies have shown a clear link between cardio training and increased ability to concentrate and hold information. Based on research by Harvard University psychiatrist John J. Ratie, eight Canadian schools have introduced exercise into the school day in a new way. Instead of a regular physical education, these schools give students quick 10-minute breaks every hour. Students can spin hoops, throw a ball in the gym, run on a treadmill, or play frisbee in the schoolyard. School leaders hope these breaks will help prepare students' brains for learning. Students themselves claim that taking breaks helps them feel more relaxed and focused.

Neuropedagogical innovations are seen not only in the use of ICT or the development of special programs and projects. This category includes a variety of teaching practices, tools, and even environments. Creative space is essential for learning. It is a kind of playground where students can interact creatively with each other and collaborate. Experts advise using more transparency, namely glass for display and more flexible learning spaces for different types of teaching and learning. For example, this could be a recording studio, an experimental classroom with telepresence and moving furniture. These kinds of innovations will be interesting for children, although some of them will be confusing. Difficult to teach when you have a full class of technology-savvy students accustomed to multimedia presentations and information from handheld devices. Most of them are not able to learn simply by sitting at their desks, as they were before. This is why educators must follow the principles of neuroeducation and be innovative. Modern social media, blended learning, video conferencing, Go Pro cameras, drones, and other technology familiar to today's kids will also come in handy. Each educator must select those innovations that are best suited for teaching their subject.

What is neuroeducational innovation? Something new or forgotten old? These are new approaches and technologies that are changing the way students learn. This is old content that is laid out in a new way, in an accessible format for every child.

## Conclusions

We live in a time when traditional teaching methods are receding into the background, and a qualitatively new applied branch of neuropedagogy is actively developing. The fact that a new direction has appeared in modern science shows its importance and relevance. Science, based on knowledge about the work of the brain and the peculiarities of its functioning, has combined such related fields as neuropsychology, biology, pedagogy, etc. Summing up all of the above, we can confidently assert that the application of the neuropedagogical approach in educational practice is simply necessary. Brain research and the latest technology have revealed many reasons why some children have so many learning difficulties and teachers are unable to help overcome them. The knowledge obtained by teachers in the framework of classical pedagogical technologies is not enough to ensure effective learning for every child without losing the quality component of education. Therefore, there is an urgent need for educators, teachers and teachers in the development of new knowledge in related fields, such as neuropsychology, medicine, etc. and the application of new approaches and techniques. In this regard, there is also a need to create new posts with the title neuroeducator, for example, neuroeducator-teacher of mathematics, Glushchenko (2017). In the meantime, on the basis of monitoring studies about teachers' knowledge of the basics of neuropedagogy and their readiness to apply them in their professional activities, appropriate recommendations have been developed for planning educational space and organizing educational and cognitive activities.

The main task of neuropedagogy is to help the teacher select technologies and methods from different systems and combine them into one that is effective for each student. By applying an individualized approach based on the principles of neuropedagogy, the teacher can significantly increase the effectiveness of teaching, make it realised, and also increase productivity. At the same time, it is important to give children motivation and interest. In order to "painlessly" introduce neuropedagogical innovations, teachers can use modern achievements of mankind, for example, social networks, various techniques, etc. Today neuropedagogy provides a significant range of resources for high-quality education of children in school, the education system itself requires reforming in parallel. And the main task of teachers is to use these resources for their intended purpose. Therefore, teachers have the right to choose what their lesson will

be, what technologies and approaches to use and whether to teach children in accordance with the laws of brain functioning.

Thus, we see what problems can be solved or minimized by introducing the foundations of neuropedagogy into the school system and using neuropedagogical innovations. That is, we make learning more conscious, multimodal, deductive and productive by applying the principles of neuropedagogy. And, perhaps, such changes will be able to bring modern pedagogy to a qualitatively new level.

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