

The Place of Neuropedagogy and Neurotechnologies in the Educational Process

Mavlanova Nasiba Akhmedovna¹

¹ Urgench State University, independent researcher

Abstract:

The article examines the history of the development of neuropedagogy — the organization of the human brain based on neurophysiological mechanisms. The main goal of neuropedagogy is the organization of the educational process from the point of view of the physiological characteristics of the human brain, cognitive abilities and organizational mechanisms.

Keywords: Pedagogy, psychology and neurobiology, neuropedagogy, neuropsychology and cognitive psychology, neurotechnology, artificial intelligence and virtual learning.

Introduction. The formation of neuropedagogy is aimed at developing teaching methods based precisely on brain activity, and requires the use of knowledge about the human mind and neurophysiological processes to effectively organize the educational process. Since each person's learning ability, information processing, and information acquisition processes are individual, improving teaching methods based on neurobiology creates the opportunity to improve the quality of education. Therefore, today, one of the important tasks is to develop innovative pedagogical technologies, increase students' cognitive abilities, and identify methods for effective assimilation of knowledge through in-depth study of the relationship between neurobiology and the educational process. The human brain works through complex neurophysiological mechanisms in the process of learning and training. Each cognitive process - attention, memory, logical thinking, problem solving and decision-making - is associated with the activity of certain parts of the brain. In neuropedagogy, the functional structure of the brain, the activity of neurons and the processes of communication between them play an important role in the effective organization of the learning process.

Literature review. The formation of neuropedagogy developed in several stages, and its scientific foundations are closely related to the development of neuropsychology and cognitive psychology in the 20th century. The studies of such pedagogues and psychologists as John Dewey and Jean Piaget played an important role in highlighting the importance of cognitive development in the learning

process. They laid the foundation for the study of factors influencing the cognitive process of the human mind. For example, John Dewey emphasized the importance of experience and reflection in education, and encouraged students to think independently. Jean Piaget studied the stages of cognitive development in children and revealed the characteristics of their learning process[1].

Analysis and Results. The main areas of the brain involved in the learning process are:

1. Prefrontal Cortex – provides logical thinking, decision-making and attention control. This part is important in the formation of critical thinking, planning and analytical abilities.
2. Hippocampus – controls the processes of memory and long-term storage of information. This part is involved in the assimilation of new knowledge and its connection with previous experience.
3. Amygdala – provides emotional and stress management processes. Since motivation and emotions play an important role in the learning process, the activity of the amygdala affects memory and attention processes.
4. Temporal Lobe – controls language and information processing processes. This part plays an important role in speech comprehension and cognitive processes.
5. Neuronal Connections – During the learning process, new connections are formed between neurons, which helps transfer information to long-term memory.

Neuroplasticity is the brain's ability to adapt to new experience and knowledge. Its main feature is that the connections between neurons are constantly changing, supporting the process of consolidating newly learned knowledge and skills. N.A. Abdullaeva emphasizes in her research that neuroplasticity helps students effectively assimilate new knowledge in the educational process[2].

The following stages are important in the use of neurophysiological mechanisms in the learning process:

1. Attention control. The prefrontal cortex plays a key role in focusing attention. Interactive methods and multi-sensory learning technologies are considered effective in supporting this process.
2. Memory consolidation. Since the hippocampus is responsible for forming long-term memory, the use of repetition and multimodal learning methods improves the retention of information.
3. Emotions and motivation. The amygdala responds to motivation and emotions during the learning process. Therefore, creating a positive emotional environment in the learning process, reducing stress, and encouraging students to actively participate increases efficiency.
4. Individualizing learning using neurobiological processes. Each person's brain works differently when assimilating information. Therefore, personalized learning methods - for example, adaptive learning using artificial intelligence and virtual reality - create the opportunity to make the most of the brain's capabilities.

The relationship between brain activity and learning is one of the main scientific directions of neuropedagogy. Studies have shown that the effectiveness of the educational process can be increased by adapting it to the physiology of the brain. Neuroplasticity, memory, attention, motivation, and emotions are central mechanisms of the learning process, and pedagogical strategies developed taking them into account help students learn more effectively. Memory, attention, and learning processes are considered key components of human cognitive activity and are associated with complex neurobiological processes occurring in various areas of the brain. A deeper study of these processes is important for improving the education system, effectively directing teaching methods, and increasing students' ability to assimilate knowledge. Neuropedagogy is aimed at taking these processes into account and adapting the learning process to the natural activity of the brain. Memory refers to the ability of the brain to store, process, and

retrieve information when necessary. This process is mainly controlled by the hippocampus, prefrontal cortex, and amygdala. The hippocampus plays a key role in the formation of long-term memory, while the prefrontal cortex regulates the processes of using memory, its management, and decision-making. The amygdala is involved in the formation of emotional aspects of memory, helping to better retain information associated with emotions. The effectiveness of memory in the learning process is associated with the process of transferring information from short-term memory to long-term memory. This process is carried out by strengthening synaptic connections between neurons. Studies have shown that repetition, the use of visual and audio materials, and emotional connections help to strengthen memory. Such methods increase the reliance on memory in the learning process and enable long-term retention of knowledge. Attention is related to a person's ability to selectively receive and process information. This process is controlled by several areas of the brain. The prefrontal cortex is responsible for focusing and sustaining attention for long periods of time, while the parietal cortex is responsible for receiving external signals and directing them to the center of attention. The thalamus, on the other hand, organizes sensory information and enhances its effectiveness.

The use of interactive teaching, discussions, and teamwork methods to develop attention in the learning process is considered effective. Therefore, instead of long lectures, providing short and clear information helps to better maintain attention. Similarly, multi-sensory teaching, that is, the use of visual and audio materials at the same time, also serves to increase attention.

During learning, new synaptic connections are formed between neurons, a process called neuroplasticity. New knowledge and skills are formed by changing the connections between neurons in the brain. Research suggests that neuroplasticity enhances the brain's ability to adapt to new information. To promote neuroplasticity, it is recommended to use active learning methods, organize a learning process based on practice and experience. In addition, through the use of neurotechnologies in the learning process, memory, attention and learning processes can be effectively directed. For example, brain activity is analyzed using EEG and FMRG technologies, and individual learning strategies for students are developed. The use of virtual reality and artificial intelligence also allows us to take the learning process to a new level and improve personalized learning methods. At the same time, motivation also plays an important role in the learning process. Neurotransmitters in the brain such as dopamine, serotonin, and acetylcholine affect the learning process. Dopamine, which is involved in the reward system, increases motivation and contributes to the successful learning process. Therefore, the use of motivating factors in the learning process increases students' interest and improves their cognitive performance.

In general, memory, attention, and learning processes are considered the main neurobiological mechanisms that determine the effectiveness of learning. These processes are associated with the activity of different areas of the brain and neurotransmitters, and are of great importance for developing an individual approach to the learning process, strengthening cognitive abilities, and consolidating knowledge. Therefore, modern pedagogy focuses on improving teaching methods using these neurobiological principles. One of the important issues in the modern education system is ensuring an individual approach. Since each student has different cognitive abilities, learning styles, and individual needs, personalizing the learning process helps to increase learning efficiency. For this purpose, the use of neurotechnologies opens up new opportunities for improving individualized learning models. Neurotechnologies help to study the activity of the human brain, analyze how it assimilates knowledge, how it concentrates attention, and how it consolidates memory. Among these technologies, EEG (electroencephalography), FMRG (functional magnetic resonance imaging), neurofeedback methods, and artificial intelligence-based learning platforms play an important role. With the help of electroencephalography, a student's brain activity is analyzed and his level of attention, stress state, and mental fatigue are monitored. This allows teachers to better understand the learning situation of students and adapt the teaching process

accordingly. For example, if a high level of stress or attention deficit is detected, it may be necessary to change the student's learning methods and apply a more motivating approach to him.

Functional magnetic resonance imaging (fMRI) can help assess the effectiveness of learning by identifying which parts of the brain are activated. It can also help determine what format or style of presentation the brain uses to best absorb information. For example, some students may learn best through visuals, while others may benefit from audio or interactive methods.

Conclusion. Neurofeedback techniques are designed to help students monitor and improve their own neural activity. These technologies involve students performing specific exercises to improve attention, memory, and stress reduction. For example, students can monitor their brain activity using live graphs on the screen and try to control their activity levels. This method is important for increasing concentration and effectively organizing the learning process. Using artificial intelligence and adaptive learning platforms, personalized learning materials are presented, taking into account the individual learning pace and abilities of each student. Such systems automatically adjust the learning process depending on the student's level of success. For example, if a student is having difficulty with a particular topic, the AI will provide additional explanations and exercises for him. If the student is successful in a particular topic, the system will direct him to more difficult tasks. The use of neurotechnologies allows not only to strengthen the individual approach, but also to increase the motivation of students, reduce stress, and effectively organize the learning process. For example, virtual reality technologies can create a learning environment for students based on practical experience. This method has a significant impact on the quality of education, especially in fields such as medicine, engineering, and natural sciences.

References

1. Piaget J. *The Psychology of Intelligence*. – London: Routledge, 1950. – p. 64
2. Абдуллаева Н.А. *Maktabda samarali ta'limni ta'minlashda neyropedagogikaning ahamiyati*. – International Journal of Education and Social Science Research: Fars Publishers, 2024.
3. Eric R. Kandel. *In Search of Memory: The Emergence of a New Science of Mind*. – New York: W. W. Norton & Company, 2006.
4. Stanislas Dehaene. *Reading in the Brain: The Science and Evolution of a Human Invention*. – New York: Viking Penguin, 2009.