pISSN:2349-5707 Volume:13,Issue 4, April -2026 eISSN:2349-5715

METHODOLOGY OF OPTIMIZING THE COGNITIVE LOAD OF STUDENTS BASED ON NEUROPEDAGOGICAL APPROACHES AND ARTIFICIAL INTELLIGENCE

Samandarova Dildora Abdujabbor qizi
Student of Termiz State Pedagogical Institute
dildorasamandarova@gmail.com

Abstract: This article analyzes the method of optimizing the cognitive load of students based on the use of neuropedagogical approaches and artificial intelligence technologies. In the study, the specific characteristics of human brain activity, mechanisms of information reception, processing and storage during the educational process are highlighted from the point of view of neuropedagogy. Also, with the help of artificial intelligence-based adaptive teaching systems, the possibilities of creating an educational environment suitable for students' level of knowledge, learning rate and individual characteristics will be considered.

As a conclusion, it has been proved that by introducing innovative technologies into the educational process, it is possible to effectively manage the cognitive load and increase the educational efficiency.

Key words: neuropedagogy, artificial intelligence, cognitive load, cognitive load theory, adaptive education, individual approach, educational process, information processing, attention and memory, educational technologies, digital educational environment, teaching methodology, knowledge optimization, educational efficiency, innovative approaches, personalization, educational activity, reflection, intellectual systems, educational load management.

Enter.

In the 21st century, the educational system has been fundamentally renewed, and the process of imparting knowledge is developing not only in terms of content, but also methodologically. One of the important tasks facing modern pedagogy is a deep study of how students receive, process and remember knowledge. In this context, the importance of the science of neuropedagogy is increasing.

Neuropedagogy is a scientific direction that emerged as a result of the integration of pedagogy, psychology and neurobiology, which aims to harmonize the educational process with the activity of the human brain. This approach serves to develop effective teaching strategies, taking into account the individual characteristics of students.

Stages of formation and development of neuropedagogy. Neuropedagogy is a relatively new scientific direction, and its formation is closely related to the development of neuropsychology and cognitive sciences. Since the second half of the 20th century, scientific research on the study of the human brain brought new views to the education system [1].

Initially, only the psychological approach prevailed in the educational process, but later, as a result of the development of neuroscience, it became necessary to consider brain activity in the educational process. Today, neuropedagogy serves as an important scientific basis for understanding the mechanisms of students' learning.

The human brain is a complex system that controls the processes of receiving, processing and storing information. The following cognitive processes play an especially important role in the educational process:

Attention - paying attention to the educational material;

Memory - storage and recovery of acquired knowledge;

Thinking-problem solving and analysis.

pISSN:2349-5707 Volume:13,Issue 4, April -2026 eISSN:2349-5715

Neuropedagogy develops methods aimed at ensuring the effective operation of these processes.

According to the theory of cognitive load, the human brain can process a limited amount of information at the same time. Therefore, giving too much information during the teaching process can have a negative effect on students' learning. Therefore, it is important to simplify lessons, use visual aids and give information step by step [2].

Perspectives of neuropedagogy in modern education.

In the future, neuropedagogy will develop further, integrating with artificial intelligence, adaptive learning systems and digital platforms. This makes it possible to individualize education and increase its efficiency.

Taking into account the rapid digitization of the modern education system and the introduction of innovative technologies, the individualization of the educational process of artificial intelligence technologies, the determination of teaching and the solution of this problem of students are of great importance to neuropedagogy.

Neuropedagogy serves to effectively organize education by teaching the activity of the human brain, cognitive processes and learning mechanisms.

Therefore, neuropedagogical productions and artificial intelligence represent the system of optimizing the cognitive load of students based on integration as a scientific problem. The purpose of this article is to analyze the theoretical foundations of production and to think that it is possible to achieve educational efficiency by using them in educational practice.

Analysis of literature on the topic.

Issues of neuropedagogy and cognitive load are one of the important areas of modern pedagogy and psychology. Scientific research conducted in this field shows that it is possible to increase efficiency by harmonizing the educational process with the activity of the human brain [3].

John Sweller is recognized as the founder of cognitive load theory. In his research, it is justified that the working memory of a person is limited and overloading of information has a negative effect on the learning process. The theory of cognitive load developed by Sweller emphasizes the need to take into account three types of load - intrinsic, extraneous and useful loads in the development of educational materials. This approach serves as an important theoretical basis for optimizing educational content.

In neuropedagogy research, scientists like Eric Jensen and David A. Sousa have made a significant contribution to the development of teaching strategies based on the activity of the human brain. Their work shows the important role of emotional state, attention control and motivation in the learning process. In particular, the effectiveness of repetition, visualization and active learning methods for strengthening neural connections is scientifically based [4].

The issues of organizing education based on artificial intelligence have been widely researched in recent years. Scientists such as Geoffrey Hinton, Joshua Bengio and Sebastian Thrun laid the foundations for the development of adaptive learning systems through the integration of artificial intelligence into the teaching process. The systems developed on the basis of their scientific work allow to determine the individual characteristics of students, adjust the teaching process and analyze it in real time.

Also, in modern studies, it is noted that multimodal teaching, that is, the integrated use of visual, audio and interactive elements, is effective for reducing cognitive load. In this regard, Mayer's theory of multimedia teaching is of particular importance, which justifies the need to present educational materials in a simple, clear and without redundant elements.

The analysis of domestic and foreign studies shows that the combination of neuropedagogical approaches and artificial intelligence technologies significantly improves the process of students' acquisition of knowledge. However, in this direction, the issues of

pISSN:2349-5707 Volume:13,Issue 4, April -2026 eISSN:2349-5715

systematic development of methodical approaches, their wide introduction into practice and comprehensive assessment of their effectiveness have not been sufficiently studied [5].

From this point of view, the development of new methods based on the integration of neuropedagogy and artificial intelligence in optimizing the cognitive load of students is scientifically and practically relevant.

Research methodology.

This study is aimed at developing a methodology for optimizing the cognitive load of students based on the use of neuropedagogical approaches and artificial intelligence technologies and determining its effectiveness. In the course of the research, theoretical and empirical methods were used in harmony based on a comprehensive approach.

The theoretical basis of the research is the theory of cognitive load, the principles of neuropedagogy and the concepts of adaptive teaching. Based on these approaches, mechanisms were developed to effectively organize students' cognitive activities, take into account information processing capabilities, and regulate the educational load during the educational process [6].

Empirical research was conducted with the participation of students studying in higher education institutions. In the study, participants were divided into experimental and control groups. In the experimental group, neuropedagogical approaches and adaptive teaching methods based on artificial intelligence were used, while in the control group, traditional teaching methods were preserved.

The following methods were used during the research:

Theoretical analysis - study and generalization of scientific literature, concepts and best practices related to the topic;

Pedagogical observation - monitoring of student activity, attention level and learning indicators during the educational process;

Questionnaires and tests - to determine the level of cognitive loading of students, acceptance and understanding of educational materials;

Pedagogical experience-testing — practical verification of the effectiveness of the developed methodology;

Mathematical-statistical analysis — processing of obtained results and determination of their level of reliability.

Adaptive learning platforms, learning analytics and individual recommendation systems were used as artificial intelligence technologies. With the help of these systems, students' knowledge level, learning speed and level of difficulty were analyzed in real time and suitable educational materials were presented to them.

The following were defined as the main criteria of the study: the level of knowledge acquisition of students, the indicator of cognitive load, the efficiency of attention and memory, and the level of motivation for educational activities. The results were compared between the experimental and control groups, and the effectiveness of the developed methodology was evaluated[7].

Thus, the used methodology made it possible to develop and practically justify a complex system aimed at optimizing the cognitive load of students, combining neuropedagogical approaches and the capabilities of artificial intelligence.

Analysis and results.

In the course of research, the impact of neuropedagogical approaches and artificial intelligence-based adaptive teaching methods on students' cognitive load was comprehensively studied. The obtained results were analyzed in terms of experimental and control groups, and their mutual differences were clarified.

During the pedagogical experiment, the teaching process in the experimental group was organized on the basis of neuropedagogical principles, that is, educational materials were divided into parts, enriched with visual and interactive elements, and presented in accordance

pISSN:2349-5707 Volume:13,Issue 4, April -2026 eISSN:2349-5715

with the individual characteristics of students. With the help of adaptive systems based on artificial intelligence, students' activities were regularly monitored, and the educational load was adapted to their level of mastery. Traditional teaching methods were used in the control group [8].

The results of the analysis showed that the level of cognitive load of students in the experimental group was significantly reduced. In particular, it was observed that excessive (extraneous) loading decreased, and useful (germane) loading aimed at understanding the main educational materials increased. This served to deepen knowledge acquisition by students.

Also, the following positive changes were found in the experimental group:

the level of concentration of students has increased;

indicators of recall and recovery of educational materials have improved;

increased speed of comprehension of complex concepts;

motivation for educational activities increased.

The results of mathematical and statistical analysis showed a significant difference between the experimental and control groups. In the experimental group, it was confirmed that the rate of acquisition was high and the level of cognitive load optimized was statistically reliable.

The use of artificial intelligence-based systems has served as an effective tool for determining the individual characteristics of students and choosing appropriate learning strategies for them. In particular, difficulties in students' activities were quickly identified through educational analytics, and an opportunity was created to give them individual recommendations. This ensured the flexibility of the educational process.Natijalar shuni ko‘rsatadiki, neyropedagogik yondashuvlar va sun’iy intellekt integratsiyasi asosida ishlab chiqilgan metodika talabalarning kognitiv yuklamasini samarali boshqarish, o‘quv jarayonini optimallashtirish va ta’lim samaradorligini oshirishda yuqori natija beradi[9].

Conclusions and suggestions:

The results of the conducted research showed that the integration of neuropedagogical approaches and artificial intelligence technologies into the educational process is an important factor in optimizing the cognitive load of students. During the research, it was found that the methodology developed on the basis of the theory of cognitive load allows to improve the process of effective preparation, presentation and assimilation of educational materials.

The educational process organized on the basis of neuro-pedagogical approaches activates students' attention, memory and thinking processes and serves to deepen knowledge acquisition. And adaptive systems based on artificial intelligence provide an individual approach and help to manage the educational load in accordance with the capabilities of students. As a result, excessive cognitive load decreases and educational efficiency increases significantly.

Based on the results of the research, the following proposals were developed:

strict adherence to the principles of cognitive load theory in the development of educational materials during the educational process;

organization of lessons based on neuropedagogical approaches, in particular, extensive use of visualization, interactivity and step-by-step teaching methods;

individualization of education by introducing adaptive learning systems based on artificial intelligence;

increase the digital and pedagogical competencies of teachers, especially the development of the skills of using artificial intelligence;

establishing a system of continuous monitoring and analysis of students' cognitive load during the educational process;

effective use of modern educational platforms and educational analytics tools;

expansion of scientific-research works and popularization of practical experiences in this direction.

pISSN:2349-5707 Volume:13,Issue 4, April -2026 eISSN:2349-5715

In short, methodical approaches developed on the basis of the combination of neuropedagogy and artificial intelligence become important in the modern education system and serve to organize the learning process of students more effectively and qualitatively.

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