

THEORETICAL FOUNDATIONS FOR THE USE OF NEUROTECHNOLOGIES IN THE EDUCATIONAL PROCESS

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Abstract

This article examines the theoretical foundations of the use of neurotechnologies in the educational process. It analyzes the potential of neurotechnologies for personalizing learning, developing students' cognitive potential, and improving the effectiveness of education. In addition, the pedagogical, ethical, and social aspects of implementing neurotechnologies in educational practice are discussed, and the necessity of their rational use in modern education is substantiated.

Keywords: Neurotechnology, educational process, neuroplasticity, cognitive development, learner-centered education, artificial intelligence, digital education, pedagogy.

Introduction

Annotatsiya. Ushbu maqolada o'quv jarayonida neyrotexnologiyalardan foydalanishning nazariy asoslari yoritilgan. Neyrotexnologiyalarning ta'limni individuallashtirish, o'quvchilarning kognitiv salohiyatini rivojlantirish va ta'lim samaradorligini oshirishdagi imkoniyatlari tahlil qilingan. Shuningdek, ularni amaliyotga joriy etishning pedagogik, axloqiy va ijtimoiy jihatlari ko'rib chiqilib, zamonaviy ta'limda neyrotexnologiyalardan oqilona foydalanish zarurligi asoslab berilgan.

Kalit so'zlar: neyrotexnologiya, ta'lim jarayoni, neyroplastiklik, kognitiv rivojlanish, shaxsga yo'naltirilgan ta'lim, sun'iy intellekt, raqamli ta'lim, pedagogika.

Аннотация

В данной статье рассматриваются теоретические основы использования нейротехнологий в образовательном процессе. Проанализированы возможности нейротехнологий в индивидуализации обучения, развитии когнитивного потенциала обучающихся и повышении эффективности образовательного процесса. Кроме того, рассмотрены педагогические, этические и социальные аспекты внедрения нейротехнологий в практику образования, а также обоснована необходимость их рационального использования в современной системе образования.

Ключевые слова: нейротехнологии, образовательный процесс, нейропластичность, когнитивное развитие, личностно-ориентированное обучение, искусственный интеллект, цифровое образование, педагогика.

The theory of using neurotechnologies in the educational process has emerged at the intersection of several contemporary scientific disciplines, including neuroscience, pedagogy, cognitive psychology, and information technology. Its primary objective is to investigate how knowledge about the brain and neurophysiological mechanisms can be integrated into educational practice through the application of advanced technological solutions.

This theory is based on the premise that the learning process is directly associated with brain functions and that educational effectiveness can be enhanced by considering learners' neurocognitive characteristics. The fundamental scientific principle underlying this approach is neuroplasticity, which refers to the brain's ability to adapt, reorganize, and recover in response to learning and life experiences. Proponents of the neurotechnological approach argue that the appropriate use of technology can stimulate cognitive development and improve memory, attention, and learning abilities [6].

Neurotechnology in education encompasses a wide range of tools, including brain activity monitoring systems, such as electroencephalography (EEG), as well as adaptive learning platforms that analyze students' behavioral data. These technologies enable educators to collect and analyze information on how learners perceive, process, and retain educational content. Based on these data, individualized learning pathways can be designed, fully aligning with the contemporary principles of personalized education.

In recent years, numerous studies have focused on the issues of Neuro-Linguistic Programming (NLP), resulting in diverse theoretical perspectives and interpretations. Consequently, an analysis of learner-centered educational tools and the effectiveness of applying NLP in learner-centered education has revealed several contradictions. These include the discrepancy between the humanistic orientation of learner-centered education and the insufficient availability of effective instructional tools for its implementation; the inconsistency between the extensive theoretical and methodological potential of NLP techniques and their limited application in educational practice by teachers and parents; and the gap between secondary school students' need for self-determination, self-education, self-awareness, and mastery of personal development strategies and the limited opportunities available to satisfy these needs [3].

If Neuro-Linguistic Programming (NLP) techniques are mastered by secondary school students as a means of solving personal problems and promoting self-development, NLP can become an effective tool for learner-centered education. The positive dynamics of students' self-realization and personal growth serve as important indicators of the effectiveness of NLP as a learner-centered educational approach.

From a theoretical perspective, one of the most significant developments is the transition from the traditional model of education to a data-driven educational model. Within this framework, the learning process becomes more flexible and adaptive, with educational content, instructional pace, and teaching methods tailored to the individual characteristics and learning needs of each student. This approach is particularly relevant in the context of educational digitalization and the rapid advancement of artificial intelligence technologies.

However, the theory of applying neurotechnologies in education extends beyond purely technological aspects. It also addresses important philosophical and methodological issues, including the relationship between objective neurophysiological data and learners' subjective educational experiences. Questions such as the extent to which brain activity can be regarded as an indicator of students' understanding, motivation, or learning outcomes remain the subject of ongoing scientific debate and require further investigation.

A fundamental component of this theory is the critical evaluation of both the potential and the limitations of neurotechnologies. Although these technologies offer considerable opportunities for improving educational practice, there is also

a risk of overestimating their role in the learning process. It is widely recognized that not all aspects of learning can be explained solely by neurophysiological processes, since social, cultural, and emotional factors continue to exert a substantial influence on educational outcomes. Moreover, data obtained through neurotechnological methods often require complex interpretation and may be susceptible to misinterpretation or analytical errors.

The ethical and moral dimension of this theory deserves particular attention, as the use of neurotechnologies in educational settings involves the collection of sensitive data concerning students' brain activity. This raises important issues related to privacy, informed consent, and data security. Furthermore, there is a potential risk of placing undue pressure on students or their parents, especially if such technologies become mandatory in educational institutions. Under these circumstances, the likelihood of emerging social and ethical challenges may increase significantly.

From a pedagogical perspective, the theory emphasizes the need to prepare a new generation of educators who possess fundamental knowledge of neuroscience and are capable of accurately interpreting data obtained through neurotechnological tools. Achieving this objective requires the modernization of teacher education programs in higher educational institutions, as well as the development of interdisciplinary approaches that integrate pedagogy, neuroscience, psychology, and information technologies.

As noted by scholars, "Science as a form of activity represents a system of scientific knowledge that meets the criteria of objectivity, accuracy, and validity. It strives to preserve its intellectual independence and maintain neutrality with respect to ideological and political influences. The pursuit of truth, to which scientists devote their lives, remains the fundamental driving force and the greatest value of science" [4]. At the same time, the social accessibility of neurotechnologies remains a critical issue. Their implementation requires substantial financial investment, which may lead to unequal distribution of resources among educational institutions and regions. Therefore, the theoretical framework should be grounded in the principles of social equity and support the development of accessible, scalable, and sustainable solutions.

In conclusion, the theory of using neurotechnologies in the educational process represents a multidimensional field that integrates scientific, technological, pedagogical, and ethical perspectives. Its further development depends on

achieving a balance between technological innovation and humanistic values, while carefully evaluating both the opportunities and the limitations of modern neurotechnologies in educational practice.

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