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THE INFLUENCE OF NEUROSCIENCE ON FOREIGN LANGUAGE TEACHING METHODS

Abstrac. This article explores the integration of neural networks and artificial intelligence (AI) technologies in the process of foreign language acquisition. Drawing on recent advances in neuroscience and educational technology, the study analyzes how AI-driven tools enhance lexical and grammatical competence by personalizing content, adapting to individual learning trajectories, and facilitating emotional engagement. Key concepts such as neuroplasticity, synaptogenesis, and memory consolidation are discussed in the context of their practical application in language learning environments. Special attention is given to mobile applications like PickLang and AI-based systems such as Creative Reality Studio, which allow learners to interact with personalized visual and audio content. The article also emphasizes the role of neural networks in addressing the shortage of qualified language instructors and increasing the accessibility of high-quality education. Despite the numerous benefits, challenges such as ethical concerns, lack of qualified educators in AI, and risks of overreliance on digital tools are also addressed. The study concludes with recommendations for effective and responsible implementation.

Keywords: artificial intelligence, neural networks, learning foreign languages, neuroeducation, personalization, PickLang, Creative Reality Studio, neuroplasticity, digital learning.

Introduction. In an era of global integration and constant technological progress, modern society requires foreign language teachers to introduce innovations and modify traditional teaching methods in accordance with modern needs. The Internet provides a variety of resources, ranging from cultural aspects to the morphology and syntax of the language being studied. [1] Modern education is increasingly integrating the achievements of digital technologies and neuroscience to improve the effectiveness of the learning process. One of the promising areas is the use of neural networks and artificial

intelligence (AI) in teaching foreign languages. The field of neuropedagogy is developing gradually, attracting more and more attention among teachers of English and other foreign languages. Today, many experts are becoming actively interested in how exactly the human brain works in the learning process and how new scientific discoveries in neuroscience can be used to improve the effectiveness of teaching. Of particular interest are studies on the mechanisms of memory, attention, neuroplasticity — the brain's ability to change and adapt under the influence of learning — as well as the emotional

involvement of students. A deep understanding of these biological foundations makes it possible to make the process of learning a foreign language more focused and individualized, taking into account the unique characteristics of each student. Thanks to this, learning becomes not only more conscious, but also more adapted to the needs and capabilities of each person, which contributes to better assimilation of the material and the formation of strong language skills.[2].

In the English-language scientific literature, terms such as neuroteaching, neuroeducation, neuroscience for teaching and Neuro ESL are used to denote this field of teaching [3]. The key principles of applying neuroscience in teaching foreign languages are a synthesis of knowledge from various disciplines, including neuroscience, cognitive neuroscience, psychology, language teaching methodology, neuro-linguistics, and other related fields. At the intersection of cognitive sciences and modern digital technologies, a new interdisciplinary field is being formed that combines neuroeducation, linguodidactics and engineering developments in the field of artificial intelligence.

Research conditions and methods.

The present study is based on an interdisciplinary approach combining the neuroscientific and digital aspects of linguistic education. The methods of content analysis, comparative analysis of technologies, as well as the study of empirical data obtained during the analysis of educational cases and user experience are used as a methodological base.

The materials were selected based on their relevance, scientific significance and practical applicability. The main sources were:

- Publications in peer-reviewed scientific journals on neuroscience, cognitive psychology and pedagogy;
- analytical reviews and technical documentation of modern AI tools (such as

Duolingo, PickLang, Memrise, Creative Reality Studio, etc.);

- data from real educational practice reflecting the experience of using digital solutions based on neural networks.

Special attention was paid to comparing neurobiological principles (neuroplasticity, attention, memory, emotional involvement) with algorithms and functionality of digital educational platforms.

The study is qualitative in nature and does not involve experimental measurements, but is based on a comprehensive analysis of available theoretical and practical data.

Research results. Studies have shown that language acquisition is associated with brain neuroplasticity, the ability of neural connections to change under the influence of external stimuli [4]. Key principles:

- Neuroplasticity explains why children learn languages more easily than adults [5].

Synaptogenesis, enhanced by emotionally colored information, promotes stronger memorization of vocabulary. [6]

- Time-distributed repetition (Yost's Law) improves memory consolidation. [7]

Emotional involvement activates the formation of new neural connections and improves memory. [8]

These principles are becoming important guidelines for the development of teaching methods, especially when using digital tools based on personalization and multi-channel perception.

The possibilities of neural networks and AI in language teaching

Neural networks extend traditional teaching methods by offering interactivity, adaptability, and personalization of content. They are used in various forms:

- Chatbots and voice assistants can act as round-the-clock tutors; [9]
- PickLang is an application that generates tasks based on user photos in real time. It develops vocabulary through visual association and repetition; [10]

- Duolingo, Memrise, and other platforms use AI algorithms for speech recognition, error analysis, and exercise selection; [11]

- Creative Reality Studio (D-ID) allows you to create video tutorials with digital avatars, personalized for language, accent and subject [12].

AI is able to create not only tasks, but also visual, interactive, emotionally rich content that enhances cognitive learning processes.

Discussion of scientific results. The modern paradigm of language education is undergoing a transformation under the influence of digitalization, neuroscience discoveries and the introduction of artificial intelligence (AI). These changes affect not only the content and format of learning, but also the cognitive processes involved in learning a foreign language.

Let's consider the main features of the application of neuroscience in teaching English:

1. Possible collaboration between neuroscience and foreign language teaching is still being discussed. Although an increasing number of researchers are striving to combine these fields of sciences, nevertheless, there is an ongoing discussion about the potential for practical cooperation between them, and how feasible the application of neurobiological research in the practice of teaching a foreign language is.

2. There is a shortage of specialists with knowledge in both fields of teaching and neuroscience. This feature is the main problem of introducing knowledge about the human brain into the teaching process in general and in teaching a foreign language in particular [13]. In order to ensure the competent implementation of cognitive neuroscience in pedagogical practice, it is necessary to have specialists working at the junction of these fields and able to control the quality of the results obtained from the study of the interaction of these two areas.

Nevertheless, there are conclusions that are common to both foreign language teaching and neurobiological research, which are already actively used in some English teaching methods and are generally recognized for achieving high student results. Let's look at some of them:

1. First of all, it is important to emphasize that the effectiveness of neural networks in language education directly depends on understanding how the brain works in the learning process. Neuroscience provides the scientific basis for pedagogical principles such as repetition, emotional engagement, visualization, and personalized learning. These principles, in turn, can be enhanced with the help of artificial intelligence technologies. Learning languages is good for our brain. The beneficial effects of learning foreign languages on people's perception and behavior are well known nowadays. Numerous studies have shown that people who learn foreign languages have better cognitive functions than people who speak only one language. People who speak more than one language have improved attention, stronger organization and analysis skills, and a better theory of thinking than those who speak only one language [4]. These conclusions are based on the principle of neuroplasticity of the brain.

Neuroplasticity of the brain, as the ability to make structural and functional changes under the influence of external experience, explains the need for repeated and contextual repetition of lexical units. Neuroplasticity of the brain is a key concept for understanding learning processes. It manifests itself in the form of changes in the structure and functions of the brain that occur during the development of new skills, under the influence of socio-cultural factors, as well as in response to psychological stress [14]. Previously, it was believed that neuroplasticity is characteristic only of childhood, but research in the second half of the 20th century demonstrated that the brain retains

the ability to undergo plastic changes in adulthood [15]. Nevertheless, the degree of plasticity in the developing brain is significantly higher, which explains the more successful acquisition of English by children compared to adult learners. Modern neural network algorithms, such as in the PickLang application, adapt the frequency of repetition of words depending on the success of the tasks performed by the students. This reflects the implementation of Yost's Law and the principles of memory consolidation identified in neurobiological research [6]. According to Jost's Law (the law of accumulation and distribution of repetitions), based on the research of Hermann Ebbinghaus, repetitions distributed over time turn out to be significantly more effective for memorization compared to repetitions concentrated in one time interval [16]. For example, if a student repeats new words for 10 minutes every day for a week, they will remember them better than if they repeated everything in one hour on one day. This is explained by the process of memory consolidation — the transfer of information from short-term memory to long-term memory [17].

2. Emotional involvement in the learning process stimulates synaptogenesis, the formation of new connections between neurons, which significantly improves the memorization and understanding of information [6]. In this context, the capabilities of neural networks go far beyond automatic test generation or speech recognition. For example, the Creative Reality Studio service allows you to create emotionally intense visual materials, including videos with lecturer avatars with specific facial expressions, voice, accent, and intonation. This can be especially useful in teaching pronunciation, intonation, and socio-cultural aspects of the language.

In addition, personalized scenarios and visual content promote student engagement, activate emotional memory, and enhance

long-term memory, especially for visual and kinesthetic learners.

4. One of the main advantages of using AI in teaching is the ability to personalize the trajectory of language learning. Traditional educational materials and programs often do not take into account the individual cognitive characteristics of the student, such as the speed of information processing, learning style (analytical, reflective, active) or the level of motivation. Neural networks, analyzing the user's action history, can form an individual learning route, offer tasks with an optimal degree of difficulty, and adjust the plan in real time [11].

For example, if a student makes mistakes in using a certain grammatical construction, the system may offer additional exercises on this particular topic, rather than advancing the student further along the "tutorial", as it happens in traditional teaching. In such systems, the principle of "learning from weaknesses" works, which directly echoes the cognitive theory of the zone of proximal development (Vygotsky).

5. The use of AI and neural networks increases student motivation through interactivity, gamification, and immediate feedback. Many learning platforms include game elements, ratings, challenges, and visual rewards, which is especially effective for schoolchildren and students accustomed to the digital environment.

Applications using a smartphone camera for object recognition and instant translation, as in Memrise, create a live learning effect, turning the surrounding reality into a learning environment. This contributes to the formation of a sustained interest in language learning and the development of student autonomy, since the process goes beyond the formal lesson.

Neural networks can significantly expand access to quality education, especially in regions with a shortage of qualified teachers. Automated systems can act as a tutor's assistant: assess the level of

knowledge, offer individual assignments, track progress, and adapt the course. In the context of mass online learning, this is of particular relevance.

AI does not replace the teacher, but complements him, removing the routine burden and allowing him to focus on more complex tasks: the development of critical thinking, intercultural communication, argumentation, creativity.

Despite the obvious advantages of using neural network technologies in training, a number of significant limitations should be taken into account. First of all, many teachers lack competencies in the field of artificial intelligence, which makes it difficult to effectively integrate these technologies into the educational process [16]. In addition, there is currently no unified scientific consensus on the terminology and methodological foundations of neuroeducation and the use of AI in linguodidactics, which creates difficulties for the systematic development of this field. Equally important are ethical issues related to protecting the confidentiality of student data, possible dependence on digital assistants, and a decrease in the level of live communication between participants in the educational process. It is also necessary to take into account the unpredictability of algorithms, especially large language models, which do not always guarantee the pedagogical adequacy and correctness of the created content. Thus, the introduction of neural network technologies into language learning has significant potential, but its implementation requires a scientifically based and pedagogically thought-out approach. This implies not only the availability of technical infrastructure, but also interdisciplinary training of specialists capable of combining knowledge from neuroscience, pedagogy and artificial intelligence.

Conclusions. The use of neural networks in teaching foreign languages is an effective and flexible solution combining the achievements of cognitive science and digital pedagogy.

Based on neurobiological principles, such training becomes more targeted, dynamic and effective. The use of AI technologies in teaching foreign languages allows:

- increase motivation;
- Improve memorization;
- accelerate the formation of language competence;
- Adapt the learning process to the specific needs of each student.

The integration of the results of neuroscience research into pedagogical practice helps to raise teachers' awareness of how their students learn a foreign language. Understanding key processes such as neuroplasticity of the brain — the ability of the nervous system to change and adapt under the influence of learning, synaptogenesis — the formation of new connections between neurons, as well as the principle of distributed repetition of material over time, gives teachers the opportunity to more deeply comprehend and analyze their professional methods. This not only expands their knowledge of the biological and cognitive mechanisms of language acquisition, but also helps to build more effective learning strategies that take into account the individual characteristics of students and modern scientific data. As a result, teachers receive tools for a more informed approach to learning, which contributes to improving the quality and effectiveness of the educational process.

Thus, neural networks do not replace the teacher, but become his intellectual assistant, improving the quality and effectiveness of the educational process.

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НЕЙРОҒЫЛЫМНЫҢ ШЕТ ТІЛІН ОҚЫТУ ӘДІСТЕРІНЕ ӘСЕРІ

Аңдатпа. Мақалада жасанды интеллект пен нейрондық желілердің шетел тілін оқыту процесіне интеграциялану мүмкіндіктері қарастырылады. Нейроғылым және білім беру технологиялары саласындағы соңғы жетістіктер негізінде жасанды интеллект құралдарының лексикалық және грамматикалық құзыреттілікті қалыптастырудағы рөлі талданады, соның ішінде контентті жекелеңдіру, оқу траекториясын бейімдеу және эмоционалды қызығушылықты арттыру аспектілері қарастырылады. Нейропластикалық, синаптогенез және жадыны консолидациялау сияқты негізгі ұғымдар тілдік білім беру ортасында олардың қолданылуы тұрғысынан қарастырылады. PickLang сияқты мобильді қосымшалар мен Creative Reality Studio сияқты нейрондық жүйелердің визуалды және

аудио мазмұнмен персоналдандырылған өзара әрекеттесу мүмкіндіктері атап өтіледі. Сондай-ақ, білікті мұғалімдердің жетіспеушілігін еңсеруде нейрондық желілердің маңызы мен сапалы білімге қолжетімділікті қамтамасыз ету мәселелері қарастырылады. Мақалада жасанды интеллект технологияларын тиімді және жауапты қолдану бойынша ұсыныстар беріледі.

Тірек сөздер: жасанды интеллект, нейрондық желілер, шетел тілін үйрену, нейрооқыту, персонализация, PickLang, Creative Reality Studio, нейропластикалық, цифрлық оқыту.

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ВЛИЯНИЕ НЕЙРОНАУКИ НА МЕТОДЫ ПРЕПОДАВАНИЯ ИНОСТРАННОГО ЯЗЫКА

Аннотация: в статье рассматриваются возможности интеграции нейронных сетей и технологий искусственного интеллекта (ИИ) в процесс обучения иностранным языкам. На основе современных достижений в области нейронаук и образовательных технологий анализируется, как ИИ-инструменты способствуют формированию лексической и грамматической компетенции за счёт персонализации контента, адаптации к индивидуальной траектории обучения и повышения эмоционального вовлечения. Обсуждаются ключевые понятия нейропластичности, синаптогенеза и консолидации памяти в контексте их практического применения в языковой образовательной среде. Особое внимание уделяется мобильным приложениям (например, PickLang) и нейросетевым системам (таким как Creative Reality Studio), позволяющим взаимодействовать с персонализированным визуальным и аудиоконтентом. Также подчёркивается роль нейросетей в преодолении нехватки квалифицированных преподавателей и обеспечении широкого доступа к качественному образованию. Помимо преимуществ, рассматриваются и риски, связанные с этикой и избыточной цифровизацией. Статья завершается рекомендациями по эффективному и ответственному использованию технологий ИИ в языковом образовании.

Ключевые слова: искусственный интеллект, нейросети, изучение иностранных языков, нейрообразование, персонализация, PickLang, Creative Reality Studio, нейропластичность, цифровое обучение.

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