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The Use of Digital Services and the Role of Neurodidactics in Learning a Foreign Language in Today's Educational Institutions

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Abstract: *The relevance of this article lies in its focus on how secondary and higher education institutions have adapted to rapidly evolving educational conditions. These changes resulted from the COVID-19 pandemic, the war in the country, and the forced move towards distance learning. As a result, both students and teachers were required to adopt digital technologies across all academic disciplines. Online education also created several obstacles. Some regions faced limited technical infrastructure and lacked high-speed internet. Organising lessons in a virtual environment often proved challenging. At the same time, teachers were able to make more systematic use of digital tools. These included online courses, e-textbooks, educational videos, and other resources. This article aims to study how digital technologies facilitate the process of foreign language learning. It is also important to define the concept of digital technologies and their pedagogical value. Furthermore, the article examines how insights from neuroscience-informed teaching can enhance the effective use of these tools. Finally, it suggests some practical ways of introducing digital resources into foreign language instruction. A comprehensive analysis demonstrates that these resources can significantly improve the teaching and learning of foreign languages.*

Keywords: *information and communication technologies; neuroscience-informed education; foreign language learning; digital resources.*

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1. Introduction

The importance of this study arises from the fact that interest in using digital technologies in foreign language teaching is shaped by conflicting perspectives in the scientific literature. In educational research, it remains unclear which approaches are most effective. These approaches form the foundation of digital teaching methods.

This article is relevant because it examines how the use of digital technologies in foreign language teaching at universities can support the development of students' competencies. It also presents practical methods for teaching foreign language vocabulary using a variety of digital resources.

Digital technologies in English language teaching have been widely studied by both Ukrainian and international scholars. Brock and Kohli (2023) explore different aspects of digital services. Makukhina (2024) discusses the use of digital technologies in the process of foreign language learning. Bahji, El Alami, and Lefdaoui (2015) analyse the positive and negative aspects of using digital technologies. Solomakha and Kosharna (2020) examine the readiness of primary school teachers to digitalise foreign language teaching. Chaudhry et al. (2021) investigate higher education teachers' attitudes towards digital services. Simkova et al. (2024) investigate digital inclusion in English language teaching in Ukraine. Zou et al. (2025) highlight the most effective studies on digital learning in current educational settings.

The aim of this article is threefold. First, it clarifies the concept of digital technologies. Second, it identifies the role of information and communication technologies (ICT) in foreign language teaching. Third, it describes and analyses digital resources used to teach vocabulary at universities. The study focuses on developing students' competencies. It also demonstrates how neuroscience-informed teaching can improve the effectiveness of such tools.

The research methodology combines the study of digital technologies with strategies for organising students' independent work. It integrates traditional teaching methods with innovative approaches. These include advanced digital tools and unconventional teaching strategies. The approach supports the development of a virtual learning environment. It also seeks to establish an organisational and methodological system. This system provides strategies for fostering communicative competence and guiding students' work with digital technologies.

Systematisation and classification were applied. Content analysis was used to evaluate the effectiveness of online resources in teaching foreign languages. Description and comparison helped analyse the role of digital technologies and identify their features.

The theoretical foundation of this article is based on research on methodological issues related to using digital technologies in foreign language teaching at universities. Its practical significance lies in the potential for language teachers to use the analysed digital resources in their professional activities. These resources can enhance the teaching and learning process in higher education.

2. Theoretical Review

In the context of educational digitalisation, neuroscience-informed education is gaining increasing importance. Digital tools create favourable conditions for implementing teaching principles based on brain function and learning mechanisms. It enables teachers to organise the educational process according to learners' cognitive characteristics. These include levels of attention, memory, and thinking, as well as the ability to perceive information.

The flexibility and adaptability of digital content allow cognitive load to be regulated, which is the key condition for effective learning. Such a strategy relies on the methods of neuroscience-informed education and cognitive load theory. It enables the prevention of inadequate cognitive stimulation through the flexible adjustment of the amount and complexity of information. At the same time, digital tools positively affect learning outcomes as they support learners' motivation. The interactivity and multimodality of material strengthen their involvement in the

educational process. In turn, its visualisation facilitates comprehension, while prompt feedback enhances information processing (Tsymbal-Slatvinska et al., 2022).

The main components of neuroscience-informed education include neurophysiology, cognitive science, and learning theory. The biological mechanisms of brain activity form the foundation of neurophysiology. Cognitive science examines information processing and the internal representation of experience. Learning theory explains how individuals interact with and adapt to their environment.

The purpose of neuroscience-informed education is to stimulate cognitive processes such as perception, attention, memory, and thinking. It also supports emotional and volitional regulation of learning activities. This approach relies on knowledge of the brain's functional capacities, psychodiagnostic methods, and cognitive technologies. These are used to enhance or correct mental processes when working with information resources, including documents stored in information systems, archives, libraries, collections, and databases. In this context, these concepts are often regarded as overlapping.

In educational research, the concept of digital technologies is frequently highlighted. Scholars have argued that ICT should integrate all aspects of the learning process (Msambwa, Daniel, & Lianyu, 2024). They should involve teachers, students, parents, administration, and the wider community. Educational technologies employ computer systems, audio-visual media, and specialised software. They are used to collect, process, store, display, and provide information to learners. These tools are intended to support pedagogical objectives and enhance the learning experience.

Vasko et al. (2024) view digital technologies as innovative methods that rely on computer and network resources in distance, blended, group, or individual learning. Moreover, these methods facilitate authentic foreign-language interactions. They develop students' cognitive and creative abilities through various forms of communication. This perspective highlights the role of digital technologies in stimulating cognitive activity, as well as their multifunctional nature.

Khomenko (2024) believes that educational informatisation has transformed the perspective of pedagogy, including the structure and content of learning. Special emphasis is now placed on independent study and, consequently, on the transformation of traditional methods. Thus, one can observe a shift from collective information perception to more interactive and individualised learning experiences.

Software tools and educational systems are increasingly used to support traditional teaching methods. Educational software performs specific teaching functions. Therefore, each programme should be designed according to didactic principles that determine the instructional requirements for such tools (Nerubasska & Maksymchuk, 2020).

Digital services provide an innovative way for teachers and students to interact. Both teachers and students use technical tools to address pedagogical tasks that have traditionally been taught using conventional methods. In foreign language learning, digital services perform several interrelated functions. They have an *instructional* function, as they present new material, support the acquisition of language skills, and enable the monitoring of their application. Their *educational* function lies in fostering personal qualities, values, and attitudes, as well as the development of general and professional competencies; in addition, they stimulate learners' interest in the culture of the target language and promote an understanding of linguistic and behavioural etiquette. Digital services also fulfil a *developmental* function by supporting holistic personal growth, enhancing thinking and cognitive abilities, and creating opportunities for creative tasks, communicative problem-solving, and project-based activities. A *motivational* function is realised through the use of visual tools and immersive experiences that engage learners in a digitally created target-language environment. Finally, their *cognitive* function supports the formation of a structured knowledge system and the ability to apply it in practice through diverse forms of communicative interaction among learners (Nerubasska, Palshkov, & Maksymchuk, 2020).

Therefore, digital technologies contribute to the main pedagogical mission. They develop both cultural and professional competencies. They also facilitate the acquisition of knowledge and skills, as well as their practical use.

Ongoing debates over the classification of digital technologies highlight their significance in pedagogy. In the context of foreign language learning, digital technologies can be grouped into several categories that rely on competence- and activity-based approaches. Basic technologies and methods combine traditional instruction with e-learning materials. E-learning technologies allow teachers to choose the most effective methods. For example, webinars and online classes via Zoom or Skype foster group communication. The most advanced networked and cloud-based technologies facilitate collaboration, strengthen information competence, and develop sociocultural skills (Piedra-Muñoz et al., 2025).

In the digital era, foreign language teaching increasingly relies on electronic resources such as data, software, e-publications, websites, and multimedia programmes, including Google Books, Google Scholar, YouTube, e-dictionaries, and podcasts. In higher education, these tools are primarily used to support vocabulary learning, which is a central goal of foreign language instruction (Huda, Janattaka, & Prayoga, 2023). Mastery of vocabulary allows students to develop the communicative competence needed for both academic and professional contexts. This involves acquiring lexical, grammatical, and stylistic knowledge to participate effectively in oral and written interactions, as well as professional terminology and the ability to apply basic grammar accurately in their fields of study.

Given these requirements, acquiring foreign language vocabulary is a primary objective in higher education language courses. Teachers therefore seek the most effective methods to enhance vocabulary acquisition. Digital technologies play a crucial role in this process. In particular, they encompass webinars, online courses, and classes delivered via Zoom, Skype, and other digital platforms. These tools enable more effective application of communicative methods in group work and support the development of students' professional competences. Furthermore, network-based and cloud-based interaction technologies contribute to more flexible and collaborative learning environments. They provide interactive and engaging ways to support learning, increase student motivation, stimulate interest in the language, and promote more autonomous and effective learning (Uzorka & Odebiyi, 2025).

At the initial stage of developing lexical experience, students are introduced to specialised vocabulary related to their field of study. Electronic dictionaries are accessible and convenient for language learning. They assist students in mastering pronunciation via audio features, understanding correct spelling, grammatical forms, and word structures, as well as grasping meanings and definitions (Oxford University Press, n.d.-a, n.d.-b; Cambridge University Press, n.d..; Collins English Dictionary, n.d.; Encyclopedia.com, n.d.).

Lexical items can be acquired using both translation methods, where equivalents are provided in the students' native language, and non-translation methods, such as defining words in the target language or using them in context. For example, the Oxford Learner's Dictionary contains clear information on the word *railway*, including its part of speech, pronunciation, translations, definitions, and example sentences (Oxford University Press, n.d.-a).

Some entries also link to the Oxford Collocations Dictionary, which shows common words that go with railway (e.g., "mainline," "high-speed," "disused") (Oxford University Press, n.d.-b). Later, students can practice new vocabulary through simple exercises, such as looking up words in electronic dictionaries, checking their meanings and collocations, finding synonyms and antonyms, and writing sentences using the new words.

Furthermore, dictionary entries often provide additional reading material related to the word. For instance, the entry for railway in the Oxford Learner's Dictionary contains a text on the history of the first railway in England. The entry may also link to similar thematic texts, such as the "Burmese Railway" or the "Liverpool and Manchester Railway," for extended reading (Oxford University Press, n.d.-a).

Overall, using electronic dictionaries and collocation resources supports students in mastering specialised vocabulary. These tools facilitate comprehension, pronunciation, and contextual usage, contributing to the development of communicative competence and professional language skills in a foreign language (Oxford University Press, n.d.-a, n.d.-b.; Cambridge University Press, n.d.; Collins English Dictionary, n.d.; Encyclopedia.com, n.d.).

Students can read and translate texts on the history of railways, noting unfamiliar words in electronic dictionaries. They can also create short presentations on historical railways with the help of the acquired vocabulary. Such activities allow students to use new words in different contexts and, thus, consolidate communicative skills.

Google's Ngram Viewer is another valuable tool that allows students to study terms in any academic field in a foreign language (Zięba, 2018). This service is popular because it can calculate word usage frequency in books over time, link to books in multiple languages, analyse millions of texts, and present trends as graphs. It also provides links to each search result in Google Books, enables comparison of multiple words, gives access to raw research data, and is free to use. These features support verbal-graphical learning methods, including constructing graphs, identifying comparative and generalising features of concepts, and creating linguistic maps or clusters.

When studying the history of railway transport in English, students expand their vocabulary with tools such as Google Ngram Viewer. They begin by listing important terms and names (e.g., freight transportation, Liverpool and Manchester Railway, Great Western Railway) and then create a map connecting a chosen word to related concepts. Finally, students visualise the collected data in the form of graphs using Google Ngram Viewer. They analyse changes in the frequency of lexical items across different sources, compare the results, and prepare a short report on their findings (see Figure 1).

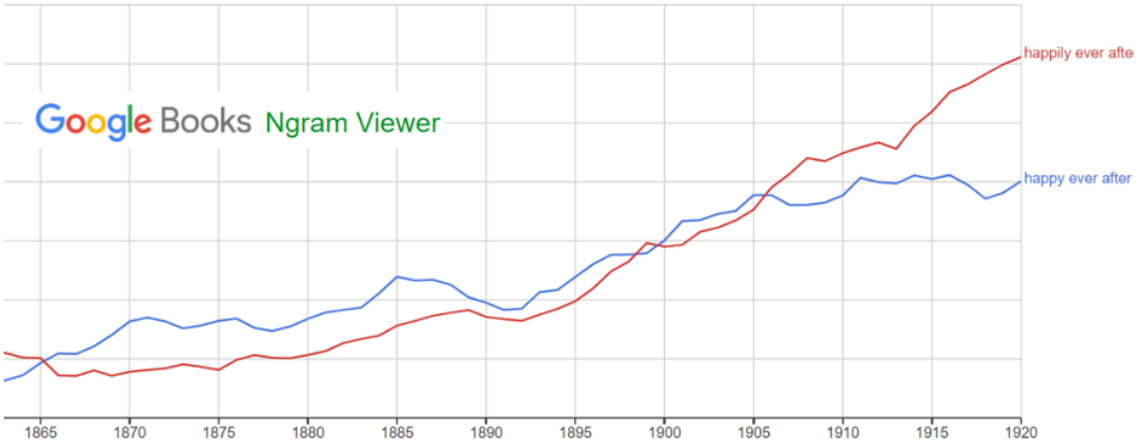

Figure 1. Trends in the use of foreign-language lexemes across various sources according to Google Ngram Viewer
Source: the authors' own conception

Figure 1 illustrates foreign-language lexical units that are actively used in today's academic, educational, and sociocultural discourse. These units reflect key trends in the development of the European educational space. The analysis focuses on lexemes such as *globalisation, digitalisation, inclusion, sustainability, multiculturalism, competence, mobility,* and *lifelong learning*, among others. These terms are widely found in academic publications, educational policies, and international documents. The selection of lexical units was guided by several criteria: 1) *terminological relevance* (the selected lexemes represent core concepts linked to axiological and institutional changes in education; examples include values, inclusion, mobility, sustainable development, and digitalisation); 2) *frequency of use* (the chosen terms demonstrate stable or increasing usage in English-language sources; this is supported by data from Google Ngram Viewer); 3) *interdisciplinary nature* (the lexemes are used not only in pedagogy but also in

sociology, cultural studies, political science, and neuroscience; this reflects the interdisciplinary orientation of the study); 4) *international applicability* (the lexemes are widely recognised in global academic and educational discourse; they are often adopted by other languages without significant semantic change); and 5) *dynamics of semantic actualisation* (the selected units highlight new meanings associated with the transition to a holistic, value-orientated, and institutionally modernised model of education).

Thus, Figure 1 highlights the trends in the growth and transformation of key foreign-language lexemes. These terms act as linguistic markers of significant changes within the European sociocultural and educational space, emphasising the importance of analysing them in the context of research on holistic education.

Meanwhile, Figure 2 illustrates the frequency dynamics of terms related to railway transport in the English-language book corpus over the period from 1900 to 2019. The data were obtained using the Google Ngram Viewer, which analyses the relative frequency of lexical units across the entire collection of digitised texts. Frequency is expressed as the percentage of occurrences of each lexeme relative to the total number of words in the corpus for the corresponding year. The analysed terms include *freight flow*, *carrying capacity*, *platform wagons*, and *tank wagons*. The terms *"carrying capacity"* and *"freight flow"* appear most frequently, indicating that these concepts have remained particularly relevant throughout the history of railway transport. This task corresponds to a project-based approach. It helps students retain new vocabulary and develops their overall linguistic competence. Such outcomes reflect key objectives in the teaching of foreign languages.

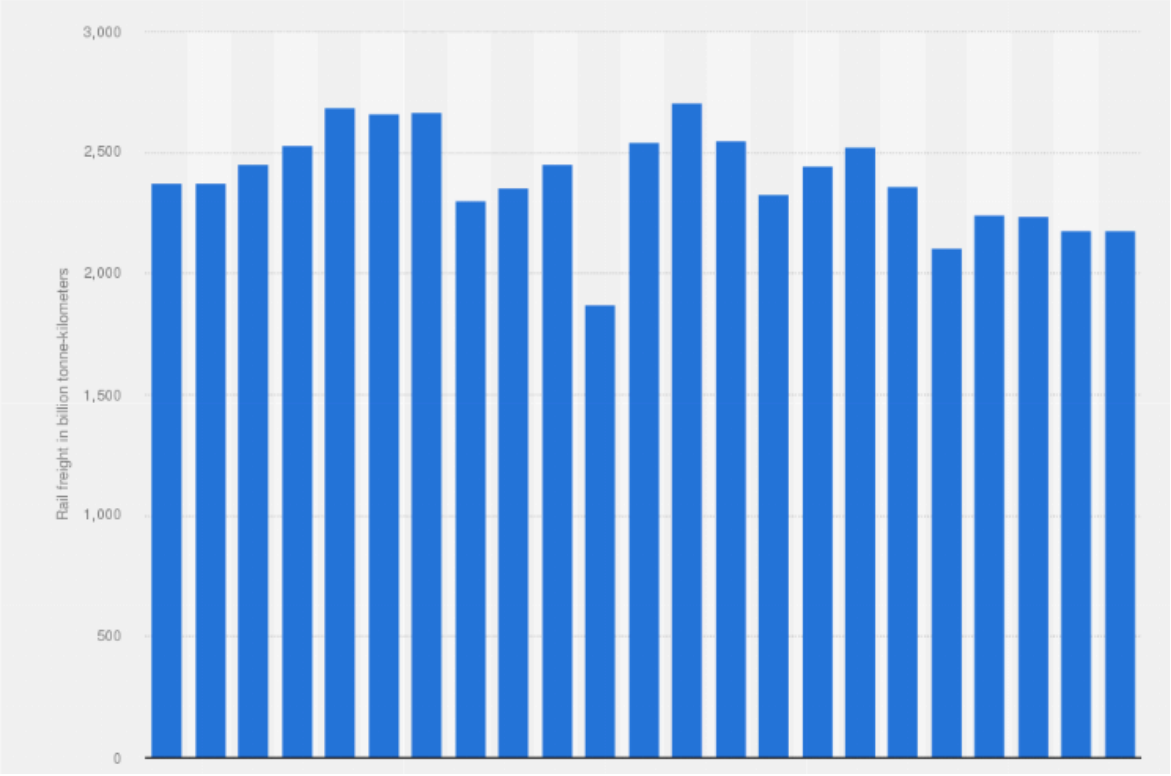

Figure 2. Frequency of railway transport terms
Source: the authors' own conception

Figure 3 presents the frequency of the names *Albert Einstein*, *Sherlock Holmes*, and *Frankenstein* in the English-language book corpus, analysed using the Google Ngram Viewer. The choice of these names is deliberate, reflecting a combination of cultural, educational, and cognitive considerations. *Albert Einstein* exemplifies scientific-rational thinking and academic culture. *Sherlock Holmes* represents logical-analytical reasoning, deduction, and narrative-based learning

strategies. *Frankenstein* embodies ethical and value-related dilemmas in science and technology. Together, these figures cover scientific, literary, and ethical-philosophical dimensions of knowledge. These names are also highly recognisable in European and global educational contexts. They frequently appear in curricula, interdisciplinary courses, and initiatives for popularising science. Beyond their cultural significance, they have strong pedagogical potential. They are used as tools to develop critical thinking, scientific imagination, ethical reflection, and interdisciplinary connections. In addition, their semantic stability over time allows researchers to track usage trends reliably, as their meanings have remained relatively consistent throughout history.

Pedagogically, Figure 3 illustrates how iconic figures and literary characters can serve as instruments for transmitting knowledge and values in the learning process. Changes in the frequency of their use reflect shifts in educational priorities. These shifts include a movement from a focus on classical scientific rationality to increasing interest in the ethical dimensions of scientific and technological progress, as well as in narrative-based learning approaches. In this way, cultural symbols play an important didactic role. They support the development of holistic thinking, foster integration between the humanities and natural sciences, and encourage value-orientated reflection among learners.

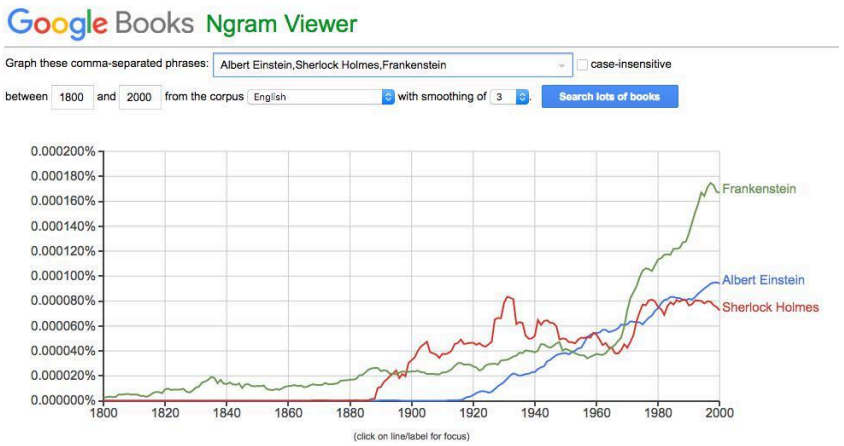

Figure 3. Frequency of Albert Einstein, Sherlock Holmes, and Frankenstein terms
Source: the authors' own conception

Figures 2-3 show how the Google Ngram Viewer tracks the frequency of individual words or terms in books over long historical periods using line graphs. Each line represents a specific word or phrase, allowing students to compare how often terms appear across different time intervals. This visualisation enables students not only to record the usage of particular lexemes but also to observe trends in their rise or decline within academic and journalistic discourse.

Thus, the Google Ngram Viewer employs a word-graphic method of learning that combines linguistic analysis with data visualisation. It improves the clarity and accessibility of learning materials. It also supports the understanding of the comparative characteristics of the studied concepts (Berbets et al., 2021). Additionally, it encourages more profound learning of foreign-language vocabulary through project and research activities.

Talk to Books is a helpful tool that provides a selected list of books on the topic. It facilitates independent study and consolidates new vocabulary. Instructors can also use Talk to Books as a creative teaching tool. Students may be asked to compile lists of books in the target language on relevant topics. They can explore and analyse authors' ideas and quotations, provide additional content in the foreign language, and participate in group discussions of the material.

Talk to Books can be applied in various educational contexts. It is useful for lecture and seminar preparation. It supports students' independent study, group discussions, and project and

research work. It can also be used for the selection of thematic quotations or different perspectives to deepen understanding of a topic.

The use of digital resources in university foreign language teaching aims to develop students' lexical skills. It also enhances their communicative competence and fosters their capacity for research activities. Experts actively examine optimal ways to support students throughout the learning process. The challenges of personalised learning, together with cognitive factors, shape teaching practices and the state of education systems.

Effective student support occurs when the curriculum and learning materials meet each learner's needs. This makes outcomes more meaningful and relevant. Content difficulty must be carefully balanced, not too easy but not overly demanding. Reaching this balance between engagement and cognitive fatigue preserves motivation and keeps cognitive load within an optimal range, which is essential for successful learning (Zeng et al., 2025).

One of the main challenges in using digital services for foreign language learning in educational institutions is the student–teacher relationship. When lessons are conducted entirely online, personal contact is limited, particularly in individual sessions. This lack of physical presence is an inherent feature of online learning (Lavrysh, 2023). Nevertheless, experienced instructors often transform this limitation into an advantage by integrating interactive and game-based elements. Students can take part in role-play exercises, such as simulating professional conversations. These activities make the educational process more engaging.

Another limitation of digital learning is that teachers cannot always monitor students' written work in real time. This fact makes immediate feedback rather difficult. It follows that online English instruction focuses on spoken communication, while grammar and other exercises are done independently. Teachers review mistakes and present new material at the beginning of the next lesson. Screen-sharing tools allow corrections to be shown visually, effectively replacing a classroom whiteboard.

Technical difficulties also affect online learning (Faza, Santoso, & Putra, 2024). These include equipment malfunctions, unstable internet connections, background noise, fast speech, and complex vocabulary or grammar. The absence of face-to-face interaction can make communication more challenging. Even with these obstacles, digital services offer significant benefits. They support effective learning, increase engagement, and provide flexible ways to interact.

Thus, digital technologies are more than mere tools for learning or channels for delivering information. They are powerful tools for applying a neuropedagogical approach in education. When used purposefully and with sound methodology, they can optimise the learning process and improve both its efficiency and outcomes. Moreover, they support a harmonious integration of cognitive, emotional, and motivational components in students' learning activities.

3. Opportunities of Neuroscience-Informed Education in Using Digital Services

The educational potential of neuroscience-informed approaches in digital learning is closely linked to the personalisation of student activities. This approach is based on several key principles. The student is regarded as an active participant in personalised learning. The primary goal of teaching is to engage and enhance students' cognitive functions, including perception, attention, memory, and reasoning. The student's professional future serves as a motivating factor in their learning.

In addition, immersive technologies can simulate real professional situations. This fact demonstrates their positive role in improving practical training (Popova, 2024). Virtual technologies make it possible to personalise learning pathways, while networked neurotechnologies strengthen soft skills. Thus, one's professional growth largely depends on neurofunctional processes in the brain.

Immersive approaches to learning rely on various devices. These include tablets, computers, neuro-helmets, smartphones, and related digital tools. Cognitive development depends on

neuroeducational resources (e.g., targeted exercises, training modules, and game-based learning activities).

Neuroscience-informed education is based on three types of neurotechnologies (Williamson, Pykett, & Kotouza, 2025). The first type includes invasive methods, such as implanted electrodes that affect specific brain areas, used only in research. The second type covers medications that help correct unusual brain activity, applied only by neurologists and psychiatrists. The third group focuses on non-contact simulations, allowing students to interact with objects and processes within a "virtual world".

Virtual reality (VR) technology has become particularly widespread in neuroscience-informed education. It is used to develop skills required for high-tech professional training. In addition to VR, other tools include practice-oriented case studies, project-based learning, mind-mapping technologies, gamification, web quests, virtual simulators, and immersive technologies. The main goal of these approaches is to activate the brain's cognitive functions.

Several neuroscience-informed tools are applied in different educational contexts. In general schooling, the "CogniFit" programme is widely used. It targets the development of cognitive abilities such as perception, attention, memory, and reasoning. Students work on exercises aimed at strengthening these skills. These tools help learners overcome challenges and stimulate interest in personal achievements.

In higher education, particularly in foreign language learning, innovative neuroscience-informed methods include "educational workshops" and "virtual excursions". These approaches promote the development of both hard and soft skills using electronic devices and specialised equipment. The overall aim of these methods is to create a learning environment that maximises the development of students' cognitive abilities.

4. Conclusion

This article is significant for several reasons. Firstly, it examines the essence of the concept of "digital technologies". Secondly, it identifies the functions of information and communication technologies (ICT) in foreign language learning. Thirdly, it describes and analyses digital resources used in higher education to teach foreign language vocabulary and their role in developing students' essential competencies. Finally, it explores the potential of neuroscience-informed approaches in the use of digital services.

The study provides a scientifically grounded definition of "digital technologies" in foreign language learning. It also highlights the main functions of digital technologies in education. They are as follows: instructional, educational, developmental, motivational, and cognitive. These functions indicate that digital technologies align with the main goals of the educational process.

A classification of ICT types is proposed, along with a description of the digital tools used in teaching foreign language vocabulary. The electronic resources analysed include online dictionaries, as well as digital tools such as Google Ngram Viewer and Talk to Books. These tools provide comprehensive information about lexical items in a foreign language. They help students memorise meanings and translations, understand collocations, and explore paradigmatic relationships and usage patterns. Additionally, they encourage students to explore word etymology, historical usage, and related topics.

The prospects of further research lie in examining the representation of digital technologies in official educational documents. This should help teachers integrate digital resources more effectively into foreign language teaching and improve educational quality.

Statement on the Use of Artificial Intelligence

AI tools such as ChatGPT (OpenAI) helped draft and polish the manuscript. The authors took full responsibility for the data, analysis, and conclusions.

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