UDC 378.016:81.091.31-021.385:004
DOI https://doi.org/10.32782/2415-3605.25.2.6

KATERYNA HAVRYLENKO
ORCID ID: 0000-0001-9474-1990
asdi15@i.ua
Candidate of Pedagogical Sciences, Senior Lecturer
National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"
37 Beresteiskyi avenue, Kyiv

INNA MELESHKO
ORCID ID: 0000-0002-7414-7828
inameleshko@ukr.net
Senior Lecturer
National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"
37 Beresteiskyi avenue, Kyiv

IMMERSIVE TECHNOLOGIES IN FOREIGN LANGUAGE TEACHING FOR ENGINEERING STUDENTS

The digital transformation of education is vital for developing foreign language proficiency. Immersive technologies revolutionise education by offering dynamic, interactive, and context-rich learning experiences that surpass traditional methods. These technologies create realistic scenarios for language practice and cultural immersion in safe, controlled settings, thereby enhancing motivation, comprehension, and personalised learning.

In education, immersive technologies have evolved to transform learners from passive observers to active participants in simulated events, creating a sense of reality. Virtual reality simulates three-dimensional environments for interactive experiences, generating real situations. While immersive technologies offer significant possibilities, their full didactic potential for foreign language learning remains an area for continued exploration and strategic implementation.

A number of scientific works laid the groundwork for understanding the importance of immersive technologies for foreign language studying. By the early 2000s, researchers began exploring the educational potential of immersive technologies, highlighting their appeal for communication and problem-solving alongside technological and cognitive challenges. They observed the growing integration of immersive media into online courses, fostering new student-teacher-content interactions.

The paper highlights the growing need for digital transformation in education and investigates the didactic potential of immersive technologies for foreign language acquisition, particularly for students in technical universities. The paper conducted a comparative analysis of existing approaches, identified the characteristics and advantages of immersive learning environments, and surveyed both students and teachers regarding their attitudes towards these technologies. The research concludes that while immersive technologies offer significant benefits for enhancing motivation, interactivity, and practical language application, their full implementation in higher education requires further methodological development and addressing existing challenges.

Key words: *augmented reality, education, engineering students, immersive technologies, gamification, language learning, virtual reality, virtual immersive environments.*

КАТЕРИНА ГАВРИЛЕНКО
кандидат педагогічних наук, старший викладач
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
просп. Берестейський, 37, м. Київ

ІННА МЕЛЕШКО
старший викладач
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
просп. Берестейський, 37, м. Київ

ІМЕРСИВНІ ТЕХНОЛОГІЇ В НАВЧАННІ ІНОЗЕМНИХ МОВ СТУДЕНТІВ ТЕХНІЧНИХ СПЕЦІАЛЬНОСТЕЙ

Актуальність роботи полягає в тому, що оскільки традиційні методи навчання не завжди відповідають потребам сучасних студентів технічних університетів, яким потрібні практичні професійні навички володіння іноземних мов, імерсивні технології пропонують революційний підхід до навчання. Вони забезпечують динамічний інтерактивний досвід як доповнення традиційних методів і дозволяють створювати реалістичні та безпечні сценарії для мовної практики і культурного занурення, що сприяє глибшому розумінню та кращому засвоєнню матеріалу.

Метою статті є висвітлення щораз вищої потреби цифрової трансформації в освіті та дослідження дидактичного потенціалу імерсивних технологій у вивченні іноземних мов для студентів технічних університетів. Дослідження спрямовано на аналіз наявних наукових підходів до використання імерсивних технологій у навчанні, визначення їх переваг та недоліків, а також вивчення ставлення викладачів до цих технологій.

Дослідження базується на комплексному підході, що включає кілька ключових методів. Було проведено порівняльний аналіз сучасних наукових підходів до використання імерсивних технологій у викладанні іноземних мов, що дозволило виявити основні тенденції, переваги і недоліки різних методик та підходів. Здійснено детальний огляд наукової літератури з метою вивчення досвіду використання імерсивних технологій у навчанні іноземних мов, виявлення ключових досліджень та визначення нерозв'язаних питань.

Результати дослідження виявили, що імерсивні технології мають значний потенціал для покращення процесу вивчення іноземних мов, оскільки сприяють підвищенню мотивації студентів, роблячи навчання більш інтерактивним та захопливим і дозволяючи створювати реалістичні сценарії для мовної практики, що сприяє кращому засвоєнню матеріалу та розвитку комунікативних навичок.

Серед переваг імерсивних технологій – підвищення мотивації, оскільки вони сприяють перетворенню студентів з пасивних спостерігачів на активних учасників освітнього процесу, що сприяє підвищенню їх мотивації та зацікавленості в навчанні. Імерсивні середовища забезпечують високий рівень інтерактивності, дозволяючи студентам взаємодіяти з віртуальним середовищем та виконувати різноманітні завдання, сприяють створенню реалістичних сценаріїв для мовної практики, розвиваючи практичні навички і впевненість в іншомовному спілкуванні та дозволяють адаптувати освітній процес до індивідуальних потреб і можливостей здобувачів вищої освіти.

Одним із недоліків імерсивних технологій є те, що їх впровадження може бути пов'язане з низкою технічних проблем, зокрема таких, як висока вартість обладнання, необхідність спеціального програмного забезпечення та технічна підтримка.

У роботі зроблено висновок, що імерсивні технології мають значний потенціал для покращення процесу вивчення іноземних мов у технічних університетах. Їх використання сприяє підвищенню мотивації студентів, покращенню якості навчання та розвитку практичних навичок. Однак для ефективного впровадження імерсивних технологій необхідно враховувати технічні та методологічні проблеми, а також забезпечити відповідну підготовку викладачів. Подальші дослідження повинні бути спрямовані на розроблення ефективних методик використання імерсивних технологій в освітньому процесі та оцінювання їх впливу на результати навчання.

Ключові слова: *доповнена реальність, освіта, студенти технічних спеціальностей, імерсивні технології, гейміфікація, віртуальна реальність, віртуальне імерсивне середовище.*

The increasing digitisation of modern society necessitates a corresponding digital transformation across all levels of education. This shift is crucial for the effective development of professional skills, including foreign language proficiency. Digital technologies are seen as essential tools for developing communicative abilities, enriching intercultural experience and ensuring easy adaptation of students to a new language environment.

Immersive technologies, including Virtual Reality, Augmented Reality, and Virtual Immersive Environments, are rapidly transforming language education by offering engaging, interactive, and contextualised learning experiences. These technologies address limitations of traditional methods by providing realistic scenarios for language practice and cultural immersion in a safe, controlled environment. While offering significant

benefits such as increased motivation, improved comprehension, and personalised learning, widespread adoption faces challenges related to accessibility, cost, content creation, and the need for adequate teacher training. Future trends point towards further integration of AI, enhanced natural language processing, and increased affordability, necessitating continued research and strategic implementation.

At the beginning of the twenty-first century, researchers began exploring the potential of virtual reality in education. M. Dunleavy, C. Dede, and R. Mitchell investigate the capabilities and limitations of immersive augmented reality simulations for education, noting both the appeal of technology-mediated communication and interactive problem-solving, and the unique technological, managerial, cognitive challenges posed by AR simulations. S. Bronack observes that educators are increasingly integrating immersive media (virtual worlds, serious games, simulations, and augmented reality) into online courses, enabling new forms of interaction between students, teachers, and content. L. Freina and M. Ott conduct a literature review on immersive virtual reality in education, identifying its ability to improve learning performance. J. Cummings and J. Bailenson research the sufficient level of safe immersion and the impact of immersive technology on user presence.

M. Akçayır and G. Akçayır publish a systematic review detailing the advantages of Augmented Reality in educational institutions, categorised by learning outcomes, pedagogical contribution, interaction, and other factors. They highlight the novelty effect of AR, which may diminish over time.

Yu. Chang, C. Chen, and C. Liao's study show that AR-based simulations help students focus on spoken English practice, boost confidence in real communication, and increase satisfaction with the educational process. M. Hamad and E. Alnuzaili demonstrate that simulation strategies in English as a Foreign Language (EFL) reduce student anxiety, increase motivation, and enhance collaborative engagement.

M. Osadchyi, Y. Chemerys, K. Osadcha and V. Kruhlyk discuss conceptual models of learning based on the combined capabilities of augmented and virtual reality technologies with adaptive learning systems, developing student motivation to learn a foreign language through educational platforms.

The purpose of the study. The work analyses the specific role of immersive technologies for foreign language learning in universities teaching engineering students, conducting a comparative analysis of existing approaches, and identifying the advantages of immersive learning environments.

Originally, *immersion* described an effect of presence in a theatre and cinema now the term is extended to education shifting, the learners from passive observers to active participants in simulated events, creating a sense of reality. *Virtual Reality* is defined as the use of computer technology to simulate a three-dimensional environment, providing the user with the ability to interact with virtual objects, which generates a sense of presence. *Augmented Reality* enhances the real world with digital information, *Mixed Reality* blends real and virtual worlds to produce new environments and visualisations. Virtual reality is a technology that allows users to immerse themselves in a simulated environment that can be similar to the real world or completely different [14]. Augmented Reality has emerged as a popular technology due to its ability to virtually overlay objects onto the real world and the relatively low hardware costs for AR systems [12, p. 2]. They all create an immersive learning environment or a dynamic system that influences users through various components of a simulated external/internal environment.

Immersive technologies hold exclusive possibilities, but their didactic potential for foreign language learning is still insufficiently studied. Immersive environments, especially with a gamified approach, increase the involvement and motivation of students, demonstrating a strong positive attitude. A Virtual Immersive Environment is a simulated digital environment that provides the user with a high level of interactivity and immersion. Virtual Immersive Environment can be designed to simulate real-world or entirely fictional environments, often allowing users to interact with the environment and other users in real time [16, p. 189].

These technologies allow creating realistic language practices with maximum approximation to real-life situations for foreign language acquisition, and foreign language becomes not only a subject but also an environment for interaction and solving professional problems. Immersive technologies create the effect of full presence and immersion in the language environment, interactivity, expanding ideas about surrounding processes and phenomena, sensory perception of updated data in a familiar environment, which contributes to the formation of communicative competence necessary for mastering a foreign language. They offer the possibility of visualising various processes and practical application of learning material, demonstrating high potential for personalisation of the entire learning process, individualisation, and differentiation and providing a safe environment for experimentation and problem-solving, fostering independent search for creative approaches to solving problems in a safe virtual environment.

Benefits of Immersive Technologies in Language Learning include enhanced engagement and motivation as they are highly interactive and enjoyable, boosting student interest and motivation, and preventing monot-

ony often associated with traditional methods. Immersive experiences capture students' attention and generate a sense of presence, making learning more engaging and memorable [2]. The dynamic and interactive nature of the developed technologies and tools helps engage students and motivates them to learn and, in our case, practise the target language [6].

These technologies support linguistic and cultural immersion, creating through VR and AR authentic, culturally rich environments, facilitating language acquisition by exposing learners to real-world contexts and interactions without leaving the classroom. This is particularly valuable for foreign language learners who often lack contextualised practice. Students can explore different places and cultures, learning about the customs, traditions, and ways of life of people who speak the language they are learning [14].

Immersive Technologies in Language Learning help learners practise their skills in a controlled, low-stress environment, allowing them to make mistakes without real-world consequences and build confidence and contextualise learning by active, hands-on learning, allowing students to interact with digital content in real-time, such as navigating a virtual city or simulating a job interview. By immersing themselves in realistic language scenarios, learners can practise and apply their language skills in a practical context, making it easier to transfer their knowledge to real-life situations [7, p. 286]. Experiences can be tailored to individual learning needs, paces, and interests, with analytics and AI-powered characters providing customised feedback and adjusting difficulty. VR is multimodal, integrating audio, text, images, and movement for a rich learning experience, catering to various learning styles (visual, auditory, kinesthetic) [14].

However, not all students or institutions have access to the necessary hardware (VR headsets, high-spec computers, recent mobile devices) or the digital literacy required, exacerbating socioeconomic disparities [14]. The initial investment in hardware and software, alongside ongoing maintenance and updates, can be a significant financial hurdle for many educational institutions. Designing pedagogically sound and technologically sophisticated immersive content is complex, resource-intensive, and requires specialised skills [2, p. 173]. Teachers need adequate training not only in using the technology but also in effectively integrating it into the curriculum and adopting appropriate pedagogical strategies. There's a gap between technological knowledge and pedagogical practice. Teachers may need training to effectively use VR in English language teaching, which may require time and resources [14].

Traditional teaching methods often fail to meet the expectations of modern technical students, who are characterised by a tendency to work with technical devices, a desire to improve operational processes, independent decision-making, and balanced, stable behaviour. However, immersive technologies cater to these innate predispositions and encourage the accumulation of experience in independent cognitive activities and unleash the creative potential of the individual.

The most crucial is the necessity to develop methodological support for the successful implementation of immersive technologies in the educational process, including scientific and pedagogical support as well as monitoring of the obtained results. Successful implementation also depends on combining the right choice of digital technical capabilities with carefully selected content of the curriculum. Equipping educators with the skills and knowledge to effectively utilise these technologies.

Immersive Technologies in Language Learning need effective implementation. Applying established instructional design models is crucial for creating effective and engaging VIE experiences. This ensures alignment with learning objectives and systematic development. By incorporating sound instructional design principles, VIE designers can create immersive, engaging, and impactful learning experiences that meet the needs of learners in the 21st century [16, p. 189–191].

Applying principles of multimedia learning (e.g., coherence, contiguity, modality, and personalisation) in VIEs can enhance learning outcomes by reducing cognitive load and improving memory retention [16]. Strategies to reduce cognitive load, such as avoiding split attention and redundancy, providing worked examples, and progressive disclosure, are vital for effective learning in immersive environments [16, p. 189–190].

Teacher training should go beyond technical skills to include pedagogical knowledge of how to effectively integrate technology and strategies to build teacher confidence. Microteaching in virtual reality can be a valuable tool for this. Teaching in virtual reality requires not only systematic training in teaching strategies but also strategies to increase teacher confidence and self-efficacy in using virtual reality [12, p. 11].

VIEs offer unique opportunities for collaborative learning, fostering communication and teamwork through shared virtual spaces and interactive tools [16]. Incorporating game elements and simulations of real-world scenarios can significantly increase motivation, engagement, and the development of problem-solving and critical thinking skills [2, p. 174].

The most efficient language learning may involve a hybrid model combining immersive experiences with other study tools, acknowledging that pure immersion might not always be the fastest route for all learners or all aspects of language learning.

Immersive technologies present a transformative opportunity for language education, offering unparalleled advantages in engagement, immersion, and contextualised practice. While significant challenges related to cost, accessibility, content development, and teacher preparedness exist, ongoing advancements and strategic implementation can overcome these hurdles.

Immersive technologies represent a highly promising way of digital transformation of education, offering substantial benefits for foreign language learning, especially for engineering students. Their ability to create engaging, interactive, and realistic learning environments significantly boosts student motivation and facilitates the development of practical communicative competence. However, their full potential in higher education is currently hampered by challenges related to infrastructure, technical support, and, most critically, the lack of comprehensive methodological frameworks and teacher training. Addressing these issues through targeted development and ongoing research will be essential for the successful and widespread adoption of immersive learning.

Continued research is needed to address the identified problems, explore the impact on different age groups, and refine didactic approaches. Future trends include the integration of Artificial Intelligence (AI) for personalised coaching and real-time feedback, advancements in natural language processing and speech recognition for more natural interactions, and improved motion tracking technology for greater immersion.

More research is needed to determine the effectiveness of VR/AR compared to traditional methods, identify best practices for integrating VR/AR into existing curricula and training teachers, understand the long-term impact on knowledge retention and student motivation and explore how to maximise benefits in diverse educational contexts and for different student groups. Developing effective assessment methods for learning outcomes in games and simulations is crucial for successful language learning.

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Дата надходження статті: 09.09.2025
Дата прийняття статті: 06.10.2025
Опубліковано: 24.11.2025