Enhancing Foreign Language Learning in Ukraine: Immersive Technologies as Catalysts for Cognitive Interest and Achievement

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Abstract

Amidst disruptions in learning and massive displacement of students, the integration of immersive technologies, such as virtual reality (VR), augmented reality (AR), mixed reality (MR), and artificial intelligence (AI), offers promising solutions to enhance language education. The study found that various immersive technologies have been commonly employed in foreign language education, with semi-immersive experiences being the most prevalent. Combining VR with full immersion and AR with semi- immersion were the most frequently observed approaches. These technologies engage multiple senses, creating authentic and engaging learning experiences that foster students' motivation, curiosity, and self-regulation. The research was conducted at the Center for Innovative Technologies (ICR-class) within the Faculty of Pedagogical Education at Borys Grinchenko Kyiv University, focusing on students enrolled in the specialty 013 "Primary Education." Innovative immersive technologies were integrated into the course "Modern English with a practicum," presenting advantages and specifics for students. The paper explores a range of immersive technologies used in language learning, including Second Life, Google Translate, Labster, Insta 3600 One, Google Expeditions, mozaBook, mozaWeb, Influent, FluentU, and 3D modeling. The study's findings reveal that immersive technologies contribute to the development of professional communication skills in foreign languages, promoting active engagement and understanding of the target language and culture. The study also highlights the preference for immersive technologies among students, with Second Life and Influent garnering significant interest. Future research directions include exploring teachers' roles as facilitators and designers of immersive learning environments, investigating the effects of VR as a fully immersive intervention form, and measuring behavioral outcomes related to inter- and transcultural learning and teaching. Overall, embracing immersive technologies in foreign language learning can address the challenges posed by crises, enhance students' cognitive interest, and improve language achievement in Ukraine. These technologies offer valuable tools to bridge educational gaps and cultivate a deeper understanding of global languages and cultures, empowering students to excel in language acquisition despite adverse circumstances. As the educational landscape continues to evolve, immersive technologies hold the potential to revolutionize foreign language learning and teaching, opening new horizons for education in Ukraine and beyond.

Keywords [1]

Foreign language; immersive technologies; structural and functional model; educational potential.

1. Introduction

The trends of modern society towards the professional training of future specialists are due to the spread of the COVID-19 pandemic in the context of the socio-economic situation in the world, the implementation of the basic principles of the student-centered approach to the application of educational programs for the professional training of future specialists, the rapid development of multimedia

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software, as well as the Russian invasion of Ukraine in 2022 [1]. These events have posed unprecedented challenges and opportunities for education in Ukraine and beyond [2, 3].

The war has disrupted education for more than five million children in Ukraine, with an average of 22 schools a day coming under attack [4]. Schools were closed or disrupted due to COVID-19 for 31 weeks in Ukraine, or nearly 8 months [5], leading to an estimated learning loss of around 20 Programme for International Student Assessment (PISA) points [6]. The war has also caused massive displacement and migration, with more than four million people fleeing the country, two million of them children. An estimated two out of three Ukrainian refugee children are not currently enrolled in host country education systems.

In response to these crises, Ukraine has taken steps to protect and shore up education spending in 2021 by increasing transfers to local governments for teaching aids and equipment, providing further support and social protection to teachers and academic staff through salary increases, and implementing a new transfer to local governments for school safety and other COVID-19 related measures [7]. The country has also implemented measures to support remote teaching and learning, starting with broadcasting video lessons via television and using online distance learning platforms. However, these measures have faced various challenges, such as lack of personal interaction between teacher and student, lack of digital literacy and competencies for learners and teachers, lack of access and quality of internet connection and devices, and lack of alignment with curriculum standards and pedagogical principles. In this context, immersive technologies such as virtual reality (VR), augmented reality (AR), mixed reality (MR), and artificial intelligence (AI) can offer innovative solutions for enhancing foreign language learning and teaching. Immersive technologies can provide authentic, engaging, and multimodal learning experiences that foster students' motivation, curiosity, and self-regulation. They can also help overcome the digital divide and the infrastructural and contextual barriers that limit access and quality of education [8]. Furthermore, they can facilitate intercultural learning and communication by exposing students to diverse cultures and perspectives [9].

However, despite the potential benefits of immersive technologies for foreign language learning and teaching, there is a lack of empirical research on how they can be effectively used in different educational contexts, especially in times of crisis. Therefore, this paper aims to address the following research question: How can immersive technologies be used to enhance students' cognitive interest and achievement in foreign language learning in Ukraine during and after the COVID-19 pandemic and the Russian invasion of Ukraine?

2. Literature review

Immersive technologies are defined as technologies that create or enhance a feeling of immersion in a virtual or augmented environment. Immersion can be understood as the subjective impression that one is participating in a comprehensive, realistic experience [10]. Immersive technologies include virtual reality, augmented reality, mixed reality, and artificial intelligence, among others. These technologies have been increasingly used for educational purposes, especially for foreign language learning and teaching. This section reviews the existing literature on the use of immersive technologies for foreign language learning and teaching, focusing on the following aspects: (1) the benefits of immersive technologies for foreign language learning and teaching, (2) the challenges of immersive technologies for foreign language learning and teaching, and (3) the types of immersive technologies for foreign language learning and teaching.

2.1. Benefits of immersive technologies for foreign language learning and teaching

Immersive technologies offer various benefits for foreign language learning and teaching at cognitive, affective, and conative levels. According to Hein et al [10], who conducted a systematic review of 54 studies on foreign language learning with immersive technologies from 2001 to 2020, immersive technologies can provide authentic, engaging, and multimodal learning experiences that foster students' motivation, curiosity, and self-regulation. They can also facilitate intercultural learning and communication by exposing students to diverse cultures and perspectives. Moreover, they can

enhance collaboration and interaction among learners and teachers by creating shared virtual spaces and enabling synchronous and asynchronous communication.

Several empirical studies have supported these claims by demonstrating positive effects of immersive technologies on various aspects of foreign language learning and teaching. For example, Huang et al [11] found that VR-based English learning improved students' vocabulary acquisition, listening comprehension, speaking fluency, and self-confidence compared to traditional classroom instruction. Amelina et al. [12] reported that AR-based language learning increased students' engagement, enjoyment, autonomy, and cultural awareness compared to textbook-based instruction. Ribeiro [13] showed that AI-based English learning enhanced students' grammar skills, pronunciation accuracy, feedback quality, and learner satisfaction compared to web-based instruction.

2.2. Challenges of immersive technologies for foreign language learning and teaching

Despite the potential benefits of immersive technologies for foreign language learning and teaching [14], there are also various challenges that need to be addressed in order to ensure their quality and effectiveness: (1) technical issues, such as hardware requirements, software compatibility, network connectivity, data security, etc., (2) pedagogical issues, such as curriculum alignment, instructional design, learning objectives, assessment methods, etc., (3) ethical issues, such as data privacy, informed consent, user safety, etc., and (4) social issues, such as digital divide, cultural sensitivity, user diversity, etc.

2.3. Types of immersive technologies for foreign language learning and teaching

Immersive technologies can be classified into different types based on the degree of immersion and the technology used. Laurillard [15] distinguished between three degrees of immersion: (1) non-immersive, which refers to the learning in a different environment, such as a classroom or a library, and technologies that do not create a sense of immersion, such as websites, podcasts, etc., (2) semi-immersive, which refers to technologies that create a partial sense of immersion, such as video games, simulations, etc., where learner may feel like they are part of the learning experience, but they are still aware that they are in a different environment, and (3) fully immersive, when the learner feels like they are completely transported into the learning experience. This type of immersion refers to technologies that create a complete sense of immersion, such as VR headsets, haptic devices, etc.

It is important to acknowledge the differentiation made among four distinct types of technology. Firstly, VR stands out as it creates a completely immersive virtual environment, replacing the user's real surroundings. This is made possible through the utilization of VR headsets, VR glasses, and similar devices. Secondly, AR deserves attention as it overlays virtual elements onto the real environment, enhancing the user's perception. AR glasses, AR apps, and similar tools enable this experience. Additionally, MR technology is worth mentioning, as it combines virtual and real elements within a hybrid environment. MR headsets, MR apps, and related advancements facilitate this merging of realities. Lastly, AI plays a crucial role by utilizing intelligent algorithms to provide services and interactions. Chatbots, voice assistants, and similar AI-powered tools exemplify this facet [16].

The systematic review [10] shed light on the prevalence of different immersive technologies in foreign language learning and teaching. VR emerged as the most commonly utilized technology, followed by AR, AI, and MR. Among the degrees of immersion, semi-immersive experiences were the most prevalent, followed by fully immersive and non-immersive ones. The combination of VR with full immersion was found to be the most commonly observed, followed by AR with semi-immersion, AI with semi-immersion, and MR with semi-immersion. These findings provide valuable insights into the types and levels of immersion employed in language education with immersive technologies.

3. Research methodology and findings

Immersive technologies, characterized by their capacity to engage multiple senses, were central to our investigation. We defined "immersion" as the extended exposure of students to a foreign language

environment, with minimal reliance on their native language or through bilingual education. The immersion approach employed modern information and communication technologies, incorporating video, audio, and text information to develop relevant professional competencies among future social pedagogues.

VR was an essential component of our research. It was defined as a combination of hardware and software systems that aim to create an immersive sensory illusion of being in an alternate environment, offering diverse topography, movement, and physics to simulate a realistic experience beyond the actual world.

Throughout our study, we identified several general approaches to integrating immersive technologies into higher education institutions' educational processes:

- *Activity approach*: Organizing educational activities with the aid of VR to activate students' cognitive engagement and self-development.
- *Person-oriented approach*: Recognizing individual uniqueness and fostering personal growth, motivation, and suitable learning conditions through VR applications.
- *Cognitive approach*: Identifying causes and solutions for educational challenges that contribute to students' mental development with VR technology.
- *Differentiated approach*: Providing diverse opportunities for gifted students and those with functional limitations to access quality education through VR-based learning.
- *Systematic approach*: Purposeful participation of all stakeholders in the educational process, taking into account the connections between goals, tasks, content, and methods of learning with VR integration

Immersive technologies demonstrated a remarkable impact on foreign language learning among students, facilitating enhanced expression, interactive engagement with study material, and activation of visual, auditory, and tactile channels. The immersive nature of these technologies surpassed other interactive approaches, encouraging a higher level of language skill development and bolstering students' ability to communicate effectively in foreign language scenarios.

In the context of the study, the levels of language skill development and bolstering students' ability to communicate effectively in foreign language scenarios are determined: high, medium, low.

A high level indicates the presence of positive motives for mastering and deepening knowledge of a foreign language); awareness of the value and significance of mastering a foreign language speech competence for future professional activity; availability of deep, stronger, generalized, systematic knowledge; mastering the skills of flexible and critical thinking; ability to build grammatically and lexically correct sentences understandable to the interlocutor; ability and willingness to support communicative topics that cover different aspects of human life based on an innovative approach).

The intermediate level indicates situational interest and partial presence of positive motives for mastering and deepening knowledge of a foreign language; lack of clear idea and desire to master foreign language speech communicative competence; unstable and incomplete knowledge; weak skills and abilities of flexible and critical thinking, the ability to build grammatically and lexically correct sentences understandable to the interlocutor; fragmentary readiness to support communicative topics that cover various aspects of human life.

A low level indicates a low rate of positive motives for mastering foreign language speech competence; non-systemic knowledge; lack of skills of flexible and critical thinking and the ability to build grammatically and lexically correct sentences understandable to the interlocutor; lack of ability to construct grammatically and lexically correct sentences understandable to the interlocutor. To establish the validity of the results of the study, we used the method of statistical evaluation of hypotheses, Pearson's criterion χ 2, which allows us to compare two empirical distributions and decide whether the difference between them is random or not. Such distributions in our study are the distributions of the control and experimental groups according to the levels of the positive influence of immersive technologies in foreign language learning.

According to the algorithm of application of the criterion χ 2, the zero and alternative hypotheses were formulated: $H0$ - states the existence of a sufficient level of language skill development and bolstering students' ability to communicate effectively in foreign language scenarios. $H1$ - claims the lack of a sufficient level of language skill development and bolstering students' ability to communicate

effectively in foreign language scenarios. Therefore, at the level of significance $\alpha = 0,05$ and three degrees of freedom, the critical value is 7.82. Our findings highlighted the positive influence of immersive technologies in foreign language learning:

1. Improved language skills in professional activities.
2. Increased motivation and engagement among students, especially during collaborative work and interactions with native speakers.
3. Reduction of anxiety and discomfort during foreign language conversations.
4. Enhanced experiential learning, allowing students to interact with objects, situations, and scenarios in a three-dimensional space.
5. Acclimation to psychological challenges and application of language skills to fulfill assigned tasks.
6. Simulation of professional challenges, activating creative thinking for effective problem-solving.
7. Increased effectiveness in training, directing behavior, overcoming barriers, and resolving real-life situations

Educational activities conducted in virtual reality promoted spontaneity among students and encouraged full immersion in the virtual environment, leading to heightened interest in tasks and stronger motivation to excel in the course. Game modeling facilitated reflection and comprehensive analysis, allowing for a deeper understanding of results. Furthermore, students' communication skills were significantly improved as they engaged with virtual partners, sharing similar emotions and experiences that occur in natural language interactions. Our research was conducted at the Center for Innovative Technologies (ICR-class) within the Faculty of Pedagogical Education at Borys Grinchenko Kyiv University. We focused on students enrolled in the 3rd-4th years of the specialty 013 "Primary Education," totaling 64 participants. The table summarizing the essence, advantages, and specifics of implementing immersive technologies in foreign language learning during practical tasks of the course "Modern English with a practicum" is provided below (table 1).

Table 1 offers a comprehensive overview of the specifics of implementing immersive technologies in foreign language learning, particularly during practical tasks in the course "Modern English with a practicum." Each technology's purpose, advantages in application, and implementation specifics are highlighted, giving valuable insights into their potential impact on language education.

- *Second Life*: This applications aims to enhance role-playing interviews with native speakers, facilitating the development of professional communication skills in a foreign language [17]. Its implementation involves utilizing a game-like approach, allowing students to analyze and solve situations within the communication process.
- *Google Translate*: The application of Google Translate expands possibilities for real-time translation, fostering faster automatic simultaneous translation of English texts, words, and expressions [18]. It enhances listening and oral monologue skills through voice input, acting as an extended dictionary to provide contextual translation variations.
- *Labster*: This application simulates case methods of professional guidance, providing students with visually detailed and motivating experiences to foster creativity and playful learning [19]. It visualizes communicative processes and employs language as a tool for developing relevant professional competencies.
- *Insta 3600 One* and *Google Expeditions*: These applications create the illusion of attending events held by foreign speakers in real-time, allowing students to actively participate in virtual reality [20]. This expands knowledge in the chosen profession by providing access to foreign events without the need for physical travel, making it particularly relevant in times of quarantine and distance learning.
- *mozaBook* and *mozaWeb*: These applications offer visualization of 3D models of professional situations, enabling participants to focus solely on educational material without distractions [21]. They allow for the exploration of leading foreign events and contribute to expanding knowledge in the chosen profession.
- *Influent*: This three-dimensional visualization of scenes related to everyday life helps develop professional communication skills and expands vocabulary by memorizing foreign words that occur in daily situations [22].

• *FluentU* 's versatile interface enables language learning through real videos with interactive subtitles, offering an engaging and comprehensive experience. It enhances listening skills by incorporating authentic content, including commercials, movie trailers, and music videos, and provides practice exercises to test attention [23].

Table 1 showcases the diverse array of immersive technologies available for language learning and their unique contributions to foreign language education. From improving communication skills to expanding vocabulary and providing virtual experiences, these technologies offer innovative and effective approaches to language learning in the modern educational landscape. By integrating immersive technologies into language courses like "Modern English with a practicum," educators can create engaging and enriching learning experiences for students.

3D modeling for language learning is a novel approach that combines gamification and 3D design to enhance foreign language education. 3D modeling for language learning can create a multi-sensory learning experience that increases the long-term retention of linguistic skills. Students can make strong links between the physical item and the accompanying vocabulary or grammar when they actively involve in the creation of 3D models connected to language topics. For example, students can form teams and embark on a journey to learn slang words from different languages by creating and printing 3D models of objects that represent those words. Within the Center for Innovative Technologies (ICR class) at the Faculty of Pedagogical Education, Borys Grinchenko Kyiv University, practical classes were conducted using 3D modeling (Second Life) to develop students' professional communication skills in a foreign language (figure 1). Through synchronous role-playing interviews using avatars, students communicated and interacted with each other in a three-dimensional graphic environment, utilizing facial expressions and verbal communication through built-in microphones. The positive outcomes of this approach indicate that the virtual environment positively influenced students' theoretical and practical knowledge of the foreign language.

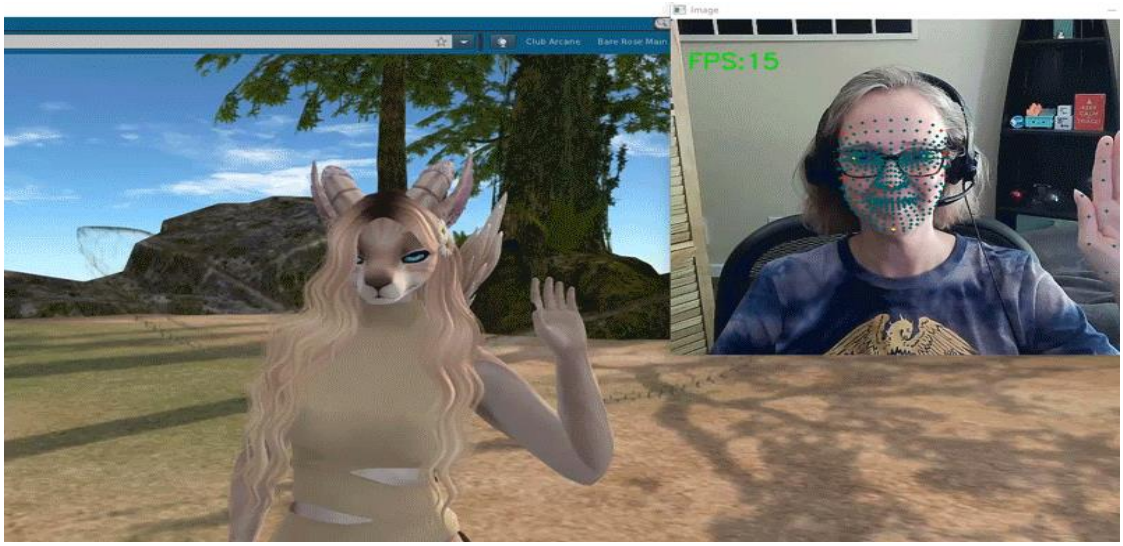

Figure 1: An example of 3D modeling performed by students (Second Life)

Similarly, the application of immersive technologies through the Labster virtual reality laboratory during the seminar class on the course "Modern English with a practicum" resulted in an engaging and interactive game simulation called "Dialogue of Ages." The game allowed students to analyze pedagogical ideas and concepts of various historical figures and linguists, fostering creativity and a deeper understanding of the subject matter. This approach integrated language learning with the exploration of various academic contributions and virtual 3D images. One example of using immersive technology for language learning is Google Translate, a free online service that can translate text, speech, images, and web pages between different languages. Google Translate can be used as part of the "Hot Seat" game among students, where students are divided into two teams, and each team is assigned its color (the color was chosen randomly by drawing lots). The practical session was held within the framework of the topic "Modern methods of children's upbringing." Thus, before the beginning of the lesson, the teacher places colored sticks of two teams in the same number with

inscriptions of English phrases or sayings from the chosen topic in the audience. Students must find all the sticks, translate them into Ukrainian using Google Translate, and make sentences with them in each tense that would relate to the problems of the practical lesson (20 minutes are allotted for the game). The team that will do it as well as possible from the point of view of the grammatical structure of the construction of English sentences, as well as from the semantic and functional point of view, is the winner. During the game, students are allowed to use Google Translate for simultaneous automatic translation. Thus, students turned on the cameras of their smartphones and received an automatic translation: the same font, color, and size.

Another example of using immersive technology for language learning is Pictionary Air, a 3D game that combines drawing and guessing with augmented reality [24]. Pictionary Air has players sketching words in the air with a special pen that connects to a smartphone or tablet app. The app then displays the sketch on the screen for others to guess. Pictionary Air can be used to practice vocabulary and spelling in a fun and interactive way. For example, students can form teams and embark on a journey to learn slang words from different languages by creating and printing 3D models of objects that represent those words. Platte et al. [25] suggests using ARTranslate, a software that recognizes up to 1000 objects in the user's environment using deep learning methods based on convolutional neural networks, and names these objects accordingly in different languages. With ARTranslate, users can point their smartphone camera at any object and see its name in their target language on their screen. ARTranslate can help users to learn new words and phrases in context and improve their pronunciation and comprehension skills. The student survey conducted in our research provided valuable insights into the preferences for immersive learning technologies (figure 2). Among the technologies considered, Second Life emerged as the top choice, with 37% of the respondents expressing a preference for it. The appeal of Second Life lies in its immersive mode, offering users the opportunity to create and interact with three-dimensional virtual environments, objects, and scenes, resulting in a highly engaging and interactive learning experience.

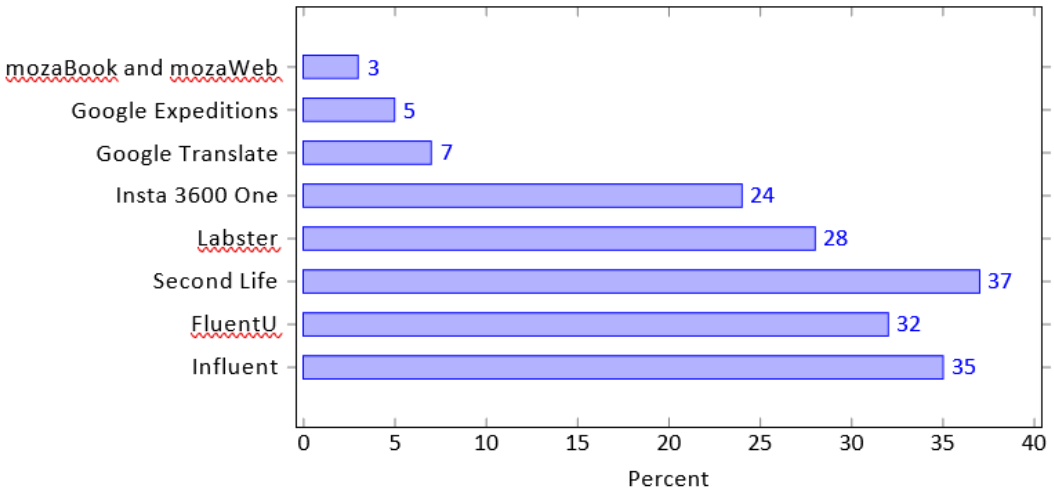

Figure 2: The attitude of future teachers to the use of virtual educational simulators during practical classes in a foreign language

What sets Second Life apart is its ability to offer a level of immersion that surpasses traditional 2D environments. This heightened sense of immersion contributes to a more realistic and captivating learning journey. Additionally, Second Life's detailed digital representation of real objects and scenes within the virtual world adds depth to the learning experience, making it more authentic and relevant for language learners. Similarly, the Influent video game garnered significant interest, with 35% of respondents expressing a preference for it. This video game enhances vocabulary and listening skills through interactive three-dimensional scenes that mirror everyday life situations. By engaging with this dynamic and interactive content, students can effectively strengthen their language skills in a context that closely resembles real-life scenarios.

Therefore, in the experimental group at the beginning of the experiment, the level of development of language skills and strengthening of students' ability to communicate effectively in the

experimental group was at a high level of 41.6% (40.4% in the control group); at an average level of 35.4% among respondents of the experimental and control groups; at a low level, 22.7% in the experimental group, 24.6% in the control group (figure 3).

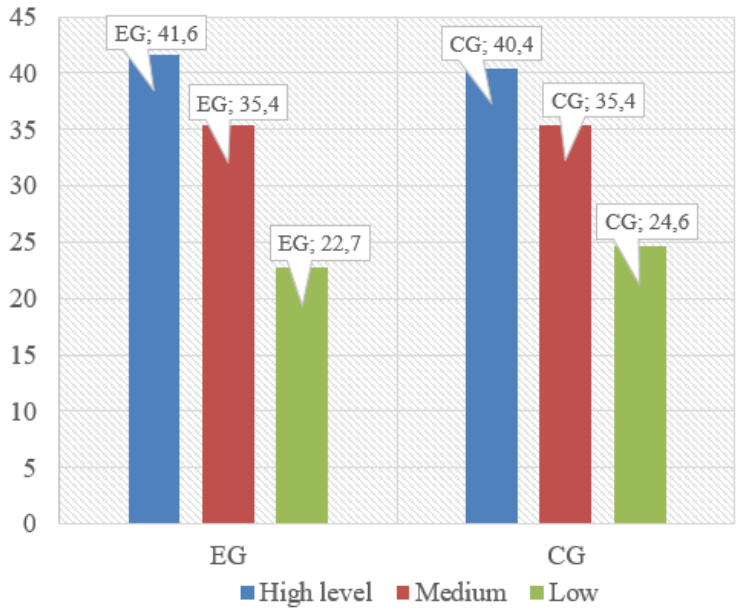

Figure 3: The level of development of language skills and strengthening of students' ability to communicate effectively at the ascertainment stage of the experiment

However, after the introduction of immersive technologies in the study of foreign languages, in particular, during the performance of practical tasks from the course "Modern English with a workshop", the overall level of language skills development and strengthening of students' ability to communicate effectively in the experimental group at a high level increased by 11.1% (6 .0% in the control group); on average, by 7.5% in the experimental group and by 3.9% in the control group of respondents; at a low level decreased by 18.1% in the experimental group and by 10.5% in the control group (figure 4).

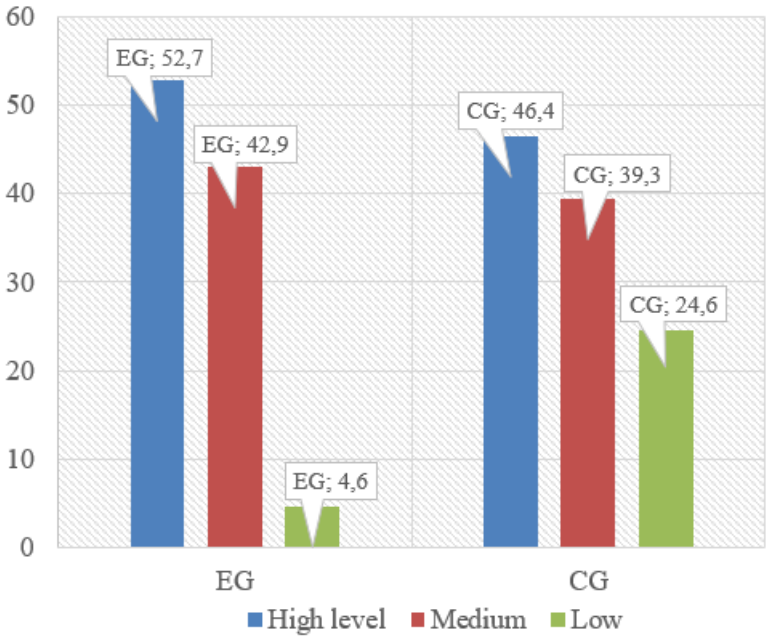

Figure 4: The level of development of language skills and strengthening of students' ability to communicate effectively after the formative stage of the experiment

4. Conclusion

The theoretical-practical substantiation of the educational potential of using immersive technologies in foreign language teaching of students in the example of the course "Modern English with a practicum" proved the effectiveness of the use of the aforementioned technological component. The study found that the use of immersive technologies in students' foreign language education contributes to the development of professional communication skills of future specialists in a foreign language. This is because immersive technologies promote maximum involvement in the communication process in the form of a game, analysis, and solution of the situation. Additionally, immersive technologies can be used to visualize the details of any professionally-oriented situation, which can help students to develop a better understanding of the target language and culture.

The main advantages of the implementation of immersive technologies in foreign language learning for students are visualization, concentration, direct involvement, and effectiveness. Visualization is the ability of immersive technologies to create a realistic and engaging learning experience that can help students to better understand the target language and culture. Concentration is the ability of immersive technologies to promote maximum involvement in the communication process, which can help students to develop their speaking and listening skills. Direct involvement is the ability of immersive technologies to allow students to interact with the target language and culture in a real-world context, which can help students to develop their fluency and accuracy. Effectiveness is the ability of immersive technologies to provide a more efficient and effective way to learn a foreign language.

Visualization of communicative processes is defined as a promising direction for the use of immersive technologies in foreign language learning for students. This is because visualization can help students to better understand the target language and culture, and it can also help students to develop their communication skills.

The obtained results testify to the positive dynamics of the changes that took place in the experimental group during the formative stage of the experiment due to the use of immersive technologies during the practical training of the course "Modern English with a practicum".

Estimated data were obtained, where the percentage of respondents with a high and medium level of development language skills and strengthening of students' ability to communicate effectively increased, and the low percentage decreased. In this way, according to the formula $\chi 2 = 0.508$ do not exceed the critical value of 7.82, and therefore, according to the decision rules, the obtained values disprove the hypothesis $H0$ and provide grounds for accepting the $H1$ hypothesis, which indicates a sufficient level of development language skills and strengthening of students' ability to communicate effectively using immersive technologies during practical foreign language classes.

The obtained results of the study also testify to the positive development of students to-wards the use of immersive technologies during practical foreign language classes. This is evidenced by the obtained statistics, where the vast majority of respondents, namely 37% prefer to use the 3D simulation Second Life, and the other 35% to the video game Influent.

Immersive technologies offer a promising avenue to enhance students' cognitive interest and achievement in foreign language learning in Ukraine. These technologies can address the challenges posed by the pandemic and the conflict, while providing engaging and effective language learning experiences. Here are some ways immersive technologies can be utilized:

1. Students can interact with teachers and peers in realistic language learning environments through *virtual language classrooms*, which create a sense of belonging and community among students and foster their cognitive interest and motivation.

2. *Virtual language tours* enable students to visit foreign countries, cities, and cultural sites, giving them authentic language input and real-world contexts – this not only improves their language abilities but also expands their cultural knowledge and global outlook.

3. Students can have fun and rewarding learning experiences through *gamified language learning* – language learning apps and games that use AR or VR elements can make the learning process more interactive and engaging.

4. *Language simulations* immerse students in situations where they have to use the target language to achieve goals and solve problems – such as real-life conversations, negotiations, or business interactions, providing them with opportunities to apply their language skills in

practical settings.

5. Ukrainian students can practice their language skills in authentic communication settings by connecting with native speakers of the foreign language they are learning through *virtual language exchange programs*, which also promote cognitive engagement and cultural exchange.

6. Students can participate in interactive language storytelling experiences through *language learning through virtual storytelling*, where they become part of the story and make language-related choices that affect the story's outcome – this approach stimulates critical thinking and cognitive involvement.

7. *Online language competitions* using immersive technologies can inspire students to excel in their language learning journey – these competitions can involve language-related challenges, quizzes, and creative tasks, encouraging healthy competition and cognitive stimulation.

8. Students can access interactive and dynamic language lessons through *language learning apps with AR and VR features*, which offer pronunciation practice, language games, and immersive cultural experiences, enhancing their cognitive interest and achievement.

During and after challenging times like the pandemic and the war, the integration of immersive technologies into foreign language learning can serve as a powerful tool to keep students engaged, motivated, and connected with the broader world. It allows them to continue their language learning journey despite physical restrictions and provides them with enriching and diverse language experiences. As the educational landscape continues to evolve, embracing immersive technologies in foreign language learning can unlock new opportunities for students in Ukraine to excel in language acquisition and foster a greater understanding of global languages and cultures.

5. Future work

The research findings suggest that immersive technologies have the potential to be a valuable tool for foreign language learning. Future research should investigate the effectiveness of immersive tehnologies in a wider range of contexts and with different types of learners. We suggest four main areas for further investigation:

(i) *Teachers as a target group.* Most of the studies focused on students as learners and users of immersive technologies, while neglecting teachers as facilitators and designers of immersive learning environments. Future research should investigate the role of teachers in the design, implementation, and evaluation of immersive learning environments for foreign language learning and teaching.

(ii) *VR as a fully immersive intervention form*. Most of the studies used VR as a semi-immersive intervention form or did not specify the degree of immersion. Future research should explore the effects of VR as a fully immersive intervention form on foreign language learning and teaching outcomes and processes.

(iii) *Behavior and implicit measurements related to inter- and trans-cultural learning and teaching.* Most of the studies measured cognitive outcomes such as vocabulary acquisition or grammar skills or affective outcomes such as motivation or attitude. Future research should measure behavioral outcomes such as intercultural communication skills or implicit outcomes such as cultural identity or empathy.

(iv) *Inter- and transcultural learning and teaching as an investigation subject*. Most of the studies investigated general aspects of foreign language learning and teaching such as vocabulary acquisition or speaking fluency. Future research should investigate specific aspects of inter- and transcultural learning and teaching such as intercultural competence or transcultural awareness.

In addition to these four areas, future research should also address the following methodological challenges:

- The difficulty of controlling for extraneous variables in VR studies.
- The challenge of measuring the long-term effects of VR-based interventions.

Despite these challenges, we believe that immersive technologies have the potential to be a powerful tool for foreign language learning and teaching. Future research should be conducted to fully explore the potential benefits of these technologies.

We also suggest that future research should examine the long-term effects of VR-based English learning on students' vocabulary retention and transfer. This would require a longitudinal study that tracks students' progress over a period of several months or years. Such a study would be valuable in deter-mining whether the benefits of VR-based English learning are sustained over time.

We believe that the research on immersive technologies for foreign language learning and teaching is still in its early stages. However, the potential benefits of these technologies are significant. We hope that future research will continue to explore the potential of immersive technologies to improve foreign language learning and teaching.

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7. Appendix

Table A1

The specifics of the implementation of immersive technologies in the foreign language teaching of students during the implementation of practical tasks of the course "Modern English with a practicum".

Immersive technologies	Purpose of immersive technologies	Advantages in application	Specifics of implementation
1	2	3	4
Second Life	Expanding the potential of imitation using synchronous roleplaying interviews of future specialists with native speakers.	Development of professional communication skills of future specialists in a foreign language.	Promotes maximum involvement in the communication process in the form of a game, analysis, and solution of the situation.
Google Translate	Expanding the possibilities of translating English texts, words, and expressions in real-time.	Acceleration of the process of automatic simultaneous translation of English texts, words, and expressions with the possibility of online listening and voice input.	Improving listening skills as well as oral monologue skills through voice in- put. The translator acts as an extended dictionary, showing all possible variants of the translation of the word and the peculiarities of its use depending on the context.

Table A2 (continue)

1	2	3	4
Labster	Simulations of solving case methods of professional guidance without negative consequences.	Visualized detailing of any professionally oriented situation; a motivating factor for the development of students' creativity and the implementation of learning in a playful way.	Makes it possible to visualize communicative processes as much as possible; in this case, the language is not only an educational spatial formation, but also a visual product, a didactic concept, and a tool for the formation of relevant professional competencies.
Insta 3600 One	Enables the illusion of presence at events held by foreign speakers in realtime.	Each subject of the educational process is an equal participant in the events presented in virtual reality.	Expanding the scope of knowledge in the chosen profession by visiting leading foreign events without physical travel, which is especially relevant in conditions of quarantine and distance learning.
Google Expe-ditions	Attending lectures, and seminars, participating in social events and projects of leading foreign scientists in real-time at hundreds of kilometers.		
mozaBook and mozaWeb	Visualization of the 3D model of the plots of professional situations in a threedimensional form and description of the event in English.	Does not distract the participant's attention to secondary external stimuli, which allows them to focus directly on the educational material and its visualization and audio, text, or graphic interpretation.	Expanding the scope of knowledge in the chosen profession by visiting leading foreign events without physical travel, which is especially relevant in conditions of quarantine and distance learning.
Influent	Three-dimensional visualization of scenes related to everyday life and a description of each clicked object in English.	Development of professional communication skills of future specialists in a foreign language. Clickability of all objects in the game. The game contains more than 420 nouns, adjectives, and verbs.	Expanding the vocabulary of foreign words, training memory, and developing listening skills by memorizing words that occur in everyday life.
FluentU	The versatility of the interface allows you to learn the language in the form of real videos, which are combined with interactive subtitles, which together create an exciting and comprehensive experience.	Morphological analysis of the structure of foreign words. Authentic con-tent.	Ability to improve listening skills by listening to English language commercials, movie trailers, and music videos with and without subtitles. Practice exercises with funny visual effects for each video to test your attention.