The Power of Virtual Reality to Improve Pronunciation in the Process of Learning English

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Annotation. The relevance of using virtual reality (VR) in English language teaching is driven by the need for innovative technologies that improve the quality of teaching and learning foreign languages. VR creates a realistic language environment that provides active immersion in communicative situations, contributing to the development of pronunciation skills and speech confidence of learners. This technology not only helps to overcome the language barrier but also forms key components of communicative competence.

The study analyzes the advantages and limitations of virtual reality in improving pronunciation while learning English. The main focus is on assessing the effectiveness of VR as an interactive tool that helps develop phonetic skills, increase motivation to learn, and overcome communication difficulties.

The study uses a comparative analysis and review of modern scientific sources on using VR in teaching pronunciation. It also detailed the critical aspects of the technology, including feedback, interactive tasks, and opportunities for social interaction in the virtual environment.

The study results show that virtual reality effectively improves pronunciation through interactive feedback that promptly corrects errors. Realistic scenarios created in VR environments reduce learners' anxiety when communicating in English and facilitate the acquisition of phonetic features. At the same time, several limitations have been identified, including the high cost of equipment, possible physical discomfort, technical failures, and restrictions on social interaction.

It is concluded that virtual reality is a promising tool for improving pronunciation while learning English. However, its implementation requires considering certain limitations. To improve learning efficiency, it is recommended to use high-quality equipment, adapt training sessions to learners' physical capabilities, and integrate gamification elements.

Prospects for further research include developing methods to minimize physical and technical limitations and studying the impact of VR on other aspects of language competence, including the development of listening skills and the acquisition of grammatical structures.

Keywords: virtual reality, pronunciation improvement, English language, interactive learning, feedback, communicative competence, usage limitations, gamification.

Introduction

Modern linguistic competence increasingly emphasizes mastering proper pronunciation, which is critical for effective communication. This trend drives the demand for innovative tools capable of replicating real communicative situations. Virtual reality (VR) offers a transformative approach, enabling learners to practice pronunciation in controlled, simulated environments that mimic authentic contexts and speech challenges. This technology addresses

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the main limitations of traditional language learning, where students often have limited access to native speakers, immersion in the language environment, and individualized feedback.

The relevance of virtual reality in this context lies in its ability to bridge the gap between classroom learning and real-world language use. This is especially crucial for developing accurate pronunciation, one of the most challenging aspects of language acquisition. In traditional educational settings, learners frequently encounter constraints such as insufficient contact with native speakers, a lack of individualized feedback, and an emphasis on grammar and vocabulary over phonetics. VR environments minimize these limitations by providing realistic interaction with virtual interlocutors, instant feedback, and adaptive tasks tailored to learners' individual needs.

Virtual reality's features align with modern language education's primary goals, including improving pronunciation accuracy, boosting confidence in speaking, and enhancing overall communicative competence.

From a scientific perspective, exploring the potential of VR in language education contributes to a deeper understanding of its role in cognitive activity and audio-motor learning processes. Empirical analysis of VR-based interventions allows researchers to evaluate their effectiveness in acquiring phonetic skills, paving the way for specialized applications designed to support learners. Additionally, studying the impact of VR on pronunciation improvement has practical significance, as accurate pronunciation facilitates integration into diverse linguistic environments and expands opportunities for academic and professional development in English-speaking contexts. Thus, investigating VR in pronunciation training is closely tied to current scientific inquiries and educational needs, underscoring the importance of advancing this area for theoretical and applied achievements in language learning technologies.

The potential of VR to enhance English pronunciation skills has garnered significant interest among researchers exploring various aspects of this topic. In her work, Soroko N. highlights the importance of using VR to teach English to higher education students. The author emphasizes methodological elements and demonstrates how VR improves students' overall communicative competence, mainly through pronunciation enhancement via interactive tasks and instant feedback provided by the technology [1].

Orlova V. and Volynets V. explore the implementation of VR technologies in education, focusing on their application in foreign language learning at higher education institutions. Their findings reveal that VR enables learners to simulate real-life communication scenarios in a modeled linguistic environment, significantly improving phonetic skills and stimulating learning [2, 3].

Andreev D. and Kuchera A. investigate using interactive educational environments to support language practice among university students. They underline that VR creates settings that replicate English-speaking environments, which promote pronunciation development and help reduce communication-related anxiety, which is essential for effective language acquisition [4].

Immersive technologies described in the work of Kuznetsov O., Vysotska V., and Vlasenko O. open new possibilities for interactive pronunciation training. The authors stress that applying VR systems with elements of complete immersion ensures continuous feedback, enabling real-time pronunciation correction, which is crucial for refining phonetic skills [5].

Technologies and online resources for language training are analyzed in research by Krasnopolsky V. and Guslenko I. They highlight VR's effectiveness in creating immersive linguistic environments that allow learners to feel part of the English-speaking world, improving pronunciation skills. At the same time, they note the high potential of the technology for pronunciation practice while emphasizing the need for further research on technical limitations and the impact of VR on learners' fatigue levels [6].

Berns A. and colleagues study the effectiveness of VR applications in phonetic skills development and learner motivation. Their work highlights the benefits of gamification and

social interaction in VR environments, stimulating learning interest. They also emphasize how interactive situations help learners overcome language barriers and practice pronunciation [7].

The study by Symonenko S., Zaitseva N., Osadchyi V., Osadcha K., and Shmeltser E. examines the application of VR for foreign language teaching in higher education. The authors argue that VR enables effective modeling of authentic linguistic environments. Learners receive constant feedback, facilitating quick correction of pronunciation errors [8].

Chen Y.-L. and Hsu C.-C. analyze mobile learning of English in VR environments. The researchers emphasize that VR's interactive features enhance learners' autonomy and highlight the importance of enabling learners to monitor their progress in pronunciation training [9]. Hsu T.-C., in turn, focuses on the significance of learning styles in VR environments and the need to adapt them to individual student needs for better outcomes [10].

Wu Y.-H. and Hung S.-T. explore VR's effects on oral language development, communication readiness, and learning autonomy. Their research demonstrates that VR positively influences learners, encouraging them to practice English in real communicative situations, which is critical for improving pronunciation [11].

Bonner E. and Reinders H. present practical ideas for integrating VR into language classrooms. Their work proposes tasks to enhance pronunciation skills and stresses the importance of focusing on pronunciation practice [12].

Rogerson-Revell P.'s research involves computer-assisted pronunciation training (CAPT) combined with VR technologies. The author analyzes critical challenges educators face when using VR and suggests possible solutions, emphasizing the technology's importance for improving phonetic skills [13].

Ulishchenko A. and Ulishchenko V. focus on using immersive technologies in higher education. The authors note that implementing such technologies significantly increases learner engagement, encouraging them to practice pronunciation in authentic communicative situations [14].

An analysis of scientific publications highlights the high potential of virtual technologies as tools for improving English pronunciation. However, further research is needed to develop transparent methodologies that account for learners' characteristics and to determine the impact of various VR technologies on language competence development.

Despite significant progress in implementing virtual technologies in English language education, several issues remain unresolved, limiting their effectiveness. For instance, reviewing current VR technologies suitable for pronunciation improvement is still insufficient. Identifying the technologies that best meet phonetic training requirements is necessary, enabling educational institutions to integrate them more effectively into curricula.

Additionally, there is a lack of empirical studies on methods for integrating VR technologies into the learning process, focusing on English phonetics. The absence of adapted methodologies complicates using VR for pronunciation training, particularly for learners with varying knowledge levels. Moreover, the influence of VR on learners' motivation and activity levels, which are crucial to successful language acquisition, requires more detailed examination.

It is also essential to overcome limitations such as physical discomfort, technical failures, and the high cost of equipment. These aspects require additional analysis to develop practical recommendations to minimize such barriers.

Purpose of the Study

The proposed research aims to address existing gaps by systematically reviewing the most effective VR technologies, analyzing methods for their integration into the learning process, and examining VR's impact on learners' motivation. This will provide a deeper understanding of the technology's opportunities and limitations, promoting its effective use in English language education.

Objectives of the Article

1. Conduct a review of modern technologies and methodologies for integrating VR into the learning process, focusing on improving pronunciation skills in English, particularly in the phonetic aspect.
2. Analyze the advantages and limitations of applying VR technologies in English language education.
3. Develop scientifically grounded recommendations for the optimal use of VR to enhance the effectiveness of pronunciation training for learners.

Results

Virtual reality (VR) provides unique opportunities for foreign language learning, particularly in improving pronunciation. Modern VR technologies offer interactive platforms and applications that simulate authentic linguistic environments, creating realistic scenarios for pronunciation practice. These tools enable learners to actively engage in the learning process by offering real-time individualized correction and interactive feedback.

Unlike traditional teaching methods, which often limit learners' opportunities for regular practice with native speakers, VR ensures continuous language practice in a virtual environment. This technology allows the learning process to be tailored to the specific needs of each learner, significantly enhancing the acquisition of phonetic skills (see Table 1).

Table 1

The primary virtual reality technologies for improving pronunciation in English language learning

Technology	Features	Impact on Pronunciation Learning	Example
Real-World Simulations	Creation of scenarios that simulate communication with native speakers.	It improves pronunciation in near-real environments, builds confidence, and reduces language barriers.	Engage VR, where learners can practice conversations in a café or train station.
Speech Recognition and Correction	Detects pronunciation errors in real time and provides recommendations for improvement.	It enhances articulation, reduces accent, and improves accuracy through instant feedback.	Mondly VR has sound recognition and pronunciation correction features.
Interactive Tasks and Gamified Content	Phrase repetition tasks and interactive scenarios for active pronunciation practice.	Encourages social interaction, improves communication skills, and reduces anxiety in conversations.	VRChat allows learners to practice pronunciation with other users.
Avatars with Realistic Articulation Movements	Visualizes the articulation process to understand proper lip and tongue positioning better.	It improves pronunciation accuracy, enhances self-monitoring, and boosts confidence in public speaking.	Virtual Speech for simulating public speaking scenarios.

Source: compiled by the author based on [1, 7, 15, 16].

Modern virtual reality (VR) technologies demonstrate high effectiveness in pronunciation training, providing learners with tools to improve phonetic skills in realistic settings continuously. Simulations of authentic linguistic environments, such as Engage VR, allow

learners to practice speaking in scenarios that closely mimic real-life conditions [1]. This approach reduces language barriers and boosts confidence in communicating in English as learners immerse themselves in the cultural context of English-speaking environments. Exposure to such situations facilitates adaptation to linguistic challenges and the development of pronunciation skills that can be easily applied in practical contexts. Technologies with speech recognition and correction capabilities, such as Mondly VR, offer instant feedback that enhances articulation and reduces accent. During training, learners receive personalized pronunciation recommendations, allowing them to refine their phonetic skills and achieve greater accuracy gradually [1]. This is particularly important for mastering complex sounds or words that previously posed challenges, as learners can quickly assess their progress. Interactive tasks and gamified content in platforms like VRChat energize the learning process through interaction with other users. This interaction reduces anxiety levels and makes communication more natural [3]. Using VRChat not only fosters the development of communication skills but also creates opportunities to practice pronunciation in live conversations. Users can experiment with their pronunciation and receive feedback, making learning more engaging and motivating.

Avatars with realistic articulatory movements, featured in Virtual Speech, help learners better understand the positioning of speech organs such as the lips and tongue. This is especially useful for training pronunciation accuracy. By observing avatars, learners can improve their articulation and maintain speech clarity, even in stressful situations such as public speaking. This approach enhances self-monitoring of pronunciation and builds confidence in public speaking, which is valuable for academic and professional settings.

Integrating virtual reality into the learning process to improve English pronunciation requires a comprehensive approach that accounts for educational goals and technical possibilities. Modern implementation strategies rely on the adaptive use of tools that train phonetic skills and provide instant feedback, progressive task complexity, and opportunities for social interaction. Unlike traditional teaching methods that rely on passive listening and repetition, VR offers new opportunities for interactive and personalized learning, enabling the adaptation of the learning process to the needs of each student (see Table 2).

Table 2

Methods of Integrating Virtual Reality into the Learning Process for Improving English Pronunciation

Method of VR Integration	Characteristics	Practical Application
Contextual Implementation	Integration of VR sessions into specific stages of the learning process to activate phonetic skills.	Incorporating VR lessons during the introduction of new topics or before classroom activities.
Sequential Integration	Progressive increase in task complexity within VR for pronunciation practice.	Designing a series of VR sessions from simple exercises to more complex interactive scenarios.
Combination with Traditional Methods	VR is used as a supplementary tool alongside traditional classes.	Using VR after lectures or practical lessons to reinforce the material.
Individualized Adaptation	Applying VR for personalized learning tailored to the learner's needs.	Automatic adjustment of exercises and feedback based on the learner's performance.

Source: compiled by the author

Integrating virtual reality (VR) into the learning process confirms the effectiveness of various methods under specific conditions for teaching English. The contextual implementation method allows for the seamless incorporation of VR sessions into the structure of the curriculum. For example, instructors can organize virtual lessons to practice pronunciation

before main classroom sessions, introducing learners to key aspects of phonetics and facilitating further material acquisition.

The sequential integration method ensures the gradual adaptation of learners to the phonetic features of the English language through a series of sessions with increasing exercise complexity. This approach promotes steady pronunciation skill development: learners progress from mastering simple sounds to tackling complex sentences that require control over rhythm, intonation, and pauses.

Combining VR with traditional teaching methods proves effective when using VR as a supplementary tool. For instance, after a lecture or practical phonetics session, learners can perform additional exercises in a virtual environment, reinforcing theoretical knowledge through interactive practice [4]. This approach enriches the learning experience and creates further opportunities to consolidate material.

The individualized adaptation method tailors the learning process to each learner's level. By analyzing performance results, virtual systems adjust tasks, allowing learners to concentrate on their weak areas. This approach is precious in contemporary education, as it provides personalized recommendations and real-time feedback. This enables learners to improve their pronunciation based on individual phonetic needs [8].

Virtual reality opens new possibilities for improving pronunciation skills by creating dynamic language situations that support complete immersion in learning [10]. VR enables a shift from static exercises to interactive environments that continuously respond to learners' actions and enhance phonetic skills. Figure 1 illustrates the key aspects positively impacting learners' motivation and engagement in studying English.

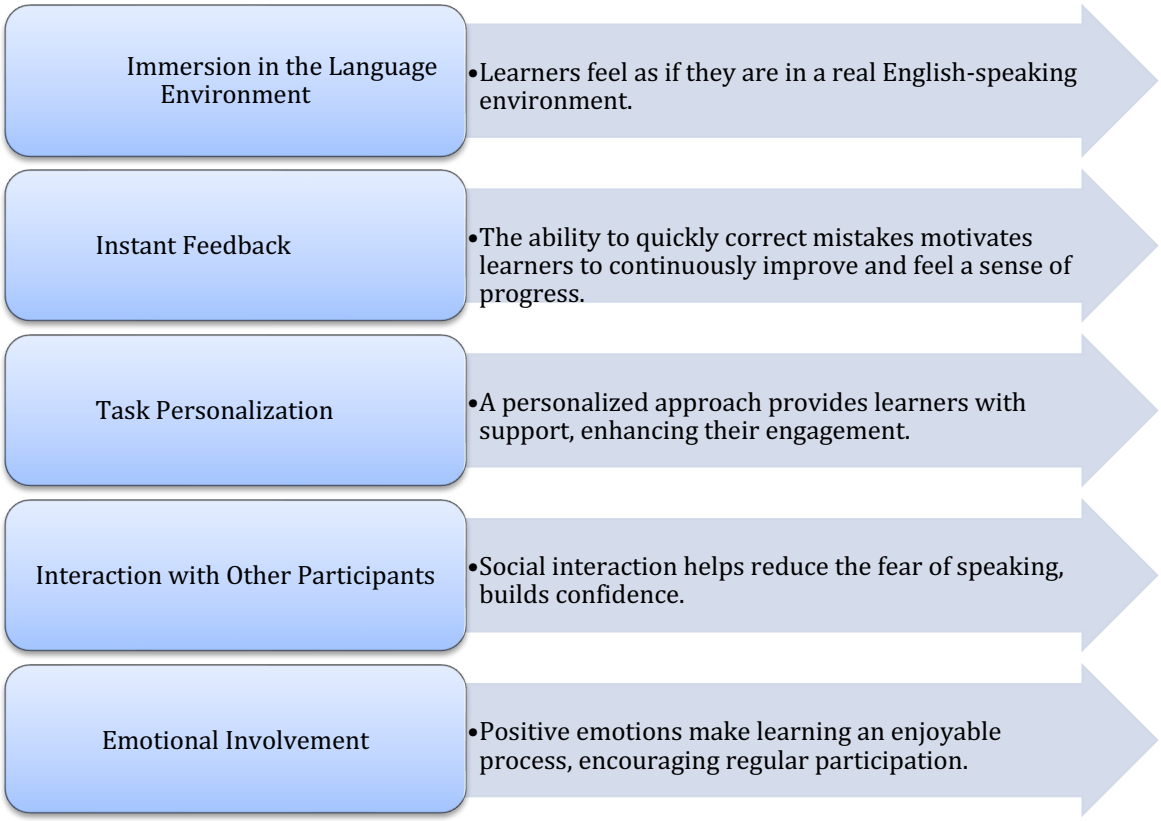

Figure 1. Key Factors of Virtual Reality's Impact on Motivation and Engagement in Learning English Pronunciation

Source: compiled by the author based on [2, 5, 6, 11, 12]

The use of virtual reality (VR) for learning English significantly enhances the effectiveness of immersion in the language environment [5]. Learning becomes an engaging adventure by

creating a sense of being in a real English-speaking space, and pronunciation practice becomes an enriching and captivating process. This approach encourages learners to actively participate in lessons, as each session brings new emotions and experiences [2].

The instant feedback provided by VR systems motivates learners to improve. The ability to immediately identify and correct mistakes helps build self-confidence. This gives learners a sense of quick progress, which encourages them to continue learning and refining their pronunciation. Individualizing the learning process through task personalization in VR boosts learners' interest in lessons. When tasks are tailored to each student's level, it feels as though the learning experience is designed specifically for their needs. This increases motivation and helps overcome difficulties, developing learners' strengths with continuous support at every stage. Interaction with other users in a virtual environment adds a social engagement element, reducing anxiety about speaking English [5]. In such an environment, learners can experiment with pronunciation without the fear of making mistakes, as the learning takes place in a friendly and supportive atmosphere rather than an official context. The aesthetic and emotional aspects of VR make learning beneficial and enjoyable. The use of visual and audio effects in VR environments stimulates positive emotions, helping learners stay motivated and look forward to the next session [13]. Despite numerous advantages, integrating VR into the learning process has limitations that affect its effectiveness. Current challenges include the high cost of equipment, technical difficulties, physical and psychological discomfort, and limitations in social interaction. These factors reduce the accessibility and completeness of the learning experience created through VR (see Table 3).

Table 3

Key Limitations and Risks of Using Virtual Reality for Improving English Pronunciation Skills

Aspect	Limitations and Risks
Cost of Equipment	High costs for VR headsets, powerful computers, and specialized software limit technology accessibility.
Technical Failures	Possible delays in feedback, low sound quality, or system crashes reduce the quality of the learning process.
Physical Discomfort	Prolonged use of VR may cause eye strain, headaches, and cybersickness, limiting practice duration.
Limitations in Social Interaction	Virtual communication may not provide a full live interaction experience, and a lack of non-verbal cues complicates interactions.
Dependence on Technology	Regular maintenance and equipment updates require additional costs and reliance on technology.

Source: compiled by the author

Modern limitations remain significant challenges for the widespread adoption of virtual reality (VR) in English language learning. One of the most substantial barriers is the high cost of equipment. Many educational institutions lack sufficient resources to purchase VR headsets and powerful computers to create an immersive experience. High costs remain a key obstacle, limiting the accessibility of this technology [3].

The technical aspects of implementing VR pose considerable challenges that can affect the quality of learning. Delays in feedback, system malfunctions, and poor sound quality significantly hinder the provision of accurate and continuous real-time feedback, which is critical for correcting pronunciation. The quality of the learning process heavily depends on the software and hardware, which require regular updates and maintenance. Physical and psychological discomfort is another critical factor impacting the effectiveness of virtual

environments. Prolonged exposure to virtual environments can cause eye strain, headaches, or "cyber sickness," necessitating frequent breaks and limiting session duration. These reactions result from intensive visual and sensory stimulation. Social interaction within virtual environments also faces certain limitations. Although communication with other users is possible, the lack of non-verbal cues and live emotional reactions can complicate communication and mutual understanding.

To optimize the use of VR for improving pronunciation during English language learning, it is essential to focus on critical aspects that enhance the effectiveness of the learning process and minimize potential limitations. Providing access to high-quality VR equipment and software that ensures realistic sound and minimizes feedback delays is a priority. This enables learners to receive accurate and timely feedback on pronunciation, which is essential for promptly correcting errors and improving phonetic skills. Regulating the duration of VR sessions during lessons helps prevent physical discomfort and maintain learner productivity. Limiting sessions to 20-30 minutes with mandatory breaks in between, supporting sustained attention, and preventing fatigue is recommended.

Adapting the content of virtual lessons to learners' knowledge levels and individual needs is critical. Personalized tasks targeting specific areas of difficulty will facilitate more effective acquisition of language skills. Leveraging the interactive features of VR environments for communication with other participants reduces language barriers and develops communicative skills. Scenarios set in virtual cafes, public places, or other authentic contexts allow learners to feel immersed in an English-speaking environment, promoting natural speech practice. Additionally, integrating cultural elements into the virtual environment's content familiarizes learners with linguistic behavior in different social situations.

Incorporating gamification elements into virtual lessons, such as achievement systems, points, and rewards for task completion, helps sustain motivation. This encourages active participation in the learning process, fosters a positive attitude towards lessons, and enhances engagement.

Conclusions

Virtual environments prove to be an effective tool for improving pronunciation skills among English learners. They provide an interactive platform for education, creating realistic conditions that simulate authentic communicative situations. This helps learners build confidence in speaking and overcome language barriers. The integration of speech recognition and correction technologies ensures instant feedback, facilitating individual improvement in phonetic aspects. However, using virtual environments for pronunciation training comes with several challenges, including high equipment costs, the need for regular maintenance, potential technical failures, physical discomfort, and limitations in social interaction. These factors restrict the accessibility of virtual environments for many educational institutions and learners. Additionally, the high intensity of visual and auditory stimulation can cause fatigue, negatively affecting the duration and quality of learning sessions. Several vital aspects should be prioritized to optimize the use of virtual environments in education. Ensuring access to high-quality equipment and software can help minimize technical difficulties. Shorter sessions of 20–30 minutes with breaks are recommended to avoid physical discomfort. It is also crucial to tailor the learning content to the individual needs of learners, taking into account their levels of preparation and specific pronunciation challenges. Incorporating gamification elements and combining virtual environments with traditional teaching methods can enhance learner motivation and reduce the risks associated with prolonged use of technology.

Future research should focus on developing effective methodologies to minimize virtual environments' technical and physiological limitations. Particular emphasis can be placed on creating new technologies that enable deeper social interaction and more accessible interfaces.

Further studies could also explore integrating virtual environments into various educational programs aimed at mastering other aspects of the English language.

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