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A Systematic Review of Augmented Reality and Virtual Reality Integration in English as a Foreign Language Education

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Abstract: Augmented reality (AR) and virtual reality (VR) have emerged as transformative technologies in English as a Foreign Language (EFL) education, offering immersive, adaptive environments that enhance learner engagement, retention, and motivation. This systematic review synthesized 48 peer-reviewed studies published between 2019 and 2024 to examine AR/VR applications, implementation strategies, challenges, and learning outcomes within EFL contexts. The researchers established inclusion criteria—English language studies published from 2019 onward in Scopus-indexed language teaching and learning journals, fully accessible online, and thematically aligned with research objectives—and applied exclusion criteria to studies that were non-English, dated before 2019, restricted in access, or published in low-impact or non-verified outlets. Data from the selected articles were imported into MAXQDA 24 for qualitative coding, yielding 64 open codes that were consolidated into 12 axial codes and further synthesized into six overarching themes: learner engagement, integration strategies, implementation practices, learner perceptions, adoption challenges, and language acquisition outcomes. Findings indicate AR/VR interventions significantly bolster engagement and linguistic competence when embedded within pedagogically sound frameworks, although technical constraints, cost considerations, and teacher readiness can hinder adoption. Educators should design scalable, user-friendly experiences and invest in targeted professional development to optimize outcomes. This review advances our understanding of AR/VR's pedagogical potential in EFL settings by highlighting evidence-based practices and persistent challenges. It offers actionable recommendations for future research.

Keywords: Augmented Reality, Immersive Learning, Language Learning and Teaching, Systematic Review, Technology Integration, Virtual Reality.

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Introduction

The rapid advancement of new technologies and the growing emphasis on collaboration have revolutionized educational practices, giving rise to innovative approaches to learning. Among these, computer-supported collaborative learning (CSCL) has garnered significant attention, enabling learners to engage in a dynamic, meaning-making process through peer interactions facilitated by digital tools. Technology has become indispensable today, permeating nearly every aspect of daily life and playing a particularly transformative role in education. Within this context, technology integration into language learning has emerged as a prominent focus of research in recent years. However, the success of such integration often hinges on teachers' experiences and emotions, which can profoundly influence how technology is utilized in the classroom (Nezakatgoo et al., 2025; Soleimani et al., 2020; Taheri et al., 2024).

Information technology's quick development, fueled by the pervasive use of computers and mobile devices, has profoundly transformed language learning landscapes over the past two decades. Within this context, technology-enhanced language learning (TELL) has evolved significantly, spawning specialized approaches such as mobile-assisted language learning (MALL) and integrative computer-assisted language learning (CALL). MALL has emerged as a particularly valuable tool for international English learners, providing flexible, on-the-go access to learning resources. Similarly, integrative CALL has demonstrated measurable improvements in student outcomes, notably in linguistic accuracy and fluency (Wu, 2019). Concurrently, technological progress and globalization have amplified the global prominence of English as a lingua franca, rendering proficiency in the language increasingly essential (Chen, 2020). As technology continues to evolve, its integration into education holds immense potential to enhance learning experiences (Naji et al., 2023), prompting many nations to prioritize foreign language proficiency within their lifelong learning frameworks (Chien et al., 2020).

In recent years, immersive technologies—namely virtual reality (VR) and augmented reality (AR)—have garnered increasing attention as innovative tools for education and training. VR creates fully computer-generated, three-dimensional settings accessible via head-mounted displays (HMDs), motion-tracking apparatus, and haptic feedback devices; by replacing all sensory input with synthetic stimuli, it affords users a profound sense of "presence" divorced from their physical surroundings (Asad et al., 2021; Slater & Sanchez-Vives, 2016). In contrast, AR enhances real-world perception by superimposing digital elements, such as 3D models, annotations, or multimedia, onto live environment views, thereby preserving contextual grounding while enriching information delivery (Azuma, 2017;

Billinghurst et al., 2015). At opposite ends of Milgram and Kishino's (1994) reality-virtuality continuum, AR occupies intermediary positions blending actual and virtual content, whereas VR resides at the fully virtual terminus. Both modalities share core technical infrastructures—real-time rendering engines, spatial-tracking systems, and interactive user interfaces—but diverge fundamentally in their mediation of the user's environment: VR through total sensory substitution, AR through integrative overlay (Billinghurst et al., 2015; Hu et al., 2021). Traditional EFL classrooms typically depend on teacher-led lectures, printed materials, and face-to-face interaction. These methods often emphasize rote memorization and standardized curricula, which, while beneficial for foundational learning, may lack the contextual richness and authentic language exposure necessary for optimal communicative competence (Liu et al., 2023). In such settings, opportunities to practice language in situationally meaningful contexts can be limited, potentially impeding students' ability to transfer classroom knowledge to real-world communication tasks. By contrast, AR and VR introduce interactive, immersive, and adaptive environments that can address these limitations (Naji et al., 2023). AR applications enable learners to manipulate virtual labels, diagrams, or dialogues anchored to physical objects, turning a static image or textbook page into a dynamic learning experience. VR environments, accessed through HMDs, transport students into simulated contexts—ordering meals in a virtual café, navigating a foreign street market, or engaging in a scripted interview—where they can rehearse language spontaneously and receive immediate feedback. Such multisensory, experiential learning heightens engagement and supports deeper encoding and long-term retention of vocabulary and structures (Karacan & Polat, 2022). Moreover, AR tends to facilitate peer collaboration by allowing multiple learners to view and interact with the same augmented objects in real-time, fostering negotiation of meaning and collective problem-solving. VR, on the other hand, often promotes learner autonomy: individuals can explore scenarios at their own pace, experiment with language use without social inhibitions, and repeat activities until mastery is achieved. Although initial studies highlight these advantages, empirical investigations into AR's specific effects on collaborative learning outcomes and VR's precise impact on retention compared to traditional methods remain in their infancy, underscoring the need for rigorous, longitudinal research (Karacan & Polat, 2022).

The transformative potential of information technology extends beyond AR and VR to include gamification, which leverages game-like elements to heighten student motivation and engagement. Since Ivan Sutherland pioneered VR in 1965 with the invention of the head-mounted display, its educational applications have expanded, incorporating tools such as

motion-tracking devices and, more recently, artificial intelligence (AI). AI-driven VR systems can generate intelligent avatars and realistic simulations, enabling adaptive, student-centered language learning experiences (Chaudhary, 2019; Oyelere et al., 2020). For instance, VR allows learners to engage in dialogues with AI-powered characters that respond dynamically, fostering independence and enhancing interactional competence (Shi et al., 2024). The affordability of VR applications has broadened access to these tools, yet their successful integration into education demands meticulous planning, clear pedagogical objectives, and well-defined implementation strategies (Hung et al., 2023). Challenges persist, however, as developing high-quality 3D VR content is costly and time-intensive, and many educators lack the technical expertise required for effective design. Nevertheless, research consistently demonstrates that VR surpasses traditional methods in boosting student engagement and motivation, offering a compelling case for its adoption (Chien et al., 2020).

The rise of online education, accelerated by the global pandemic, has further underscored the relevance of technologies like AR. AR applications have gained traction across diverse educational contexts, blending physical objects with digital overlays—such as interactive 3D models or annotations—to create enriched learning experiences (Demirdag et al., 2024). This surge reflects a broader shift in the twenty-first century toward a learner-driven educational culture that favors digital content and hands-on practice over passive instruction (Lopez-Belmonte et al., 2023). AR's versatility makes it suitable for both formal classroom settings and informal self-directed study, reassuring educators of its practical utility (Topu et al., 2023). Studies highlight AR's capacity to enhance visualization of abstract concepts, support individualized learning paths, and facilitate real-world communication skills, all of which contribute to improved vocabulary retention, motivation, and student-teacher interaction (Khan et al., 2023; Topu et al., 2023). For English as a Second Language (L2) teachers, AR introduces innovative teaching environments that spark student interest, sharpen critical thinking, and elevate academic performance (Demirdag et al., 2024; Lin & Wang, 2022). Learners report higher satisfaction, confidence, and enjoyment, which drive active participation and sustained engagement (Chen et al., 2020). Unlike many online platforms that offer limited interactivity, AR and VR deliver immersive, adaptive experiences that align with modern pedagogical goals (Liu, 2024).

Despite these advancements, an over-reliance on technology poses notable risks, including the potential to undermine critical thinking skills by prioritizing automated processes over analytical reasoning and exacerbating the digital divide, where students without adequate access to technology are disproportionately disadvantaged. Research

indicates that excessive dependence on AI-driven tools can diminish students' ability to engage in independent analytical reasoning and critical decision-making (Zhai et al., 2024). This over-reliance may lead to a preference for automated solutions, reducing opportunities for students to develop higher-order cognitive skills essential for problem-solving (George et al., 2024). Furthermore, the digital divide remains a significant barrier, with studies showing that unequal access to technology widens educational disparities, particularly for students from underserved communities (Van Dijk, 2020). This disparity underscores an urgent need for educators and policymakers to implement strategies that bridge this gap, ensuring equitable learning opportunities for all students (Selwyn, 2021).

Given the profound implications of these technological advancements, this systematic review analyzed the effectiveness, challenges, and potential benefits of integrating AR and VR into English language education, drawing on literature published between 2019 and 2024. By synthesizing findings from selected studies, this research provides a comprehensive overview of current trends, methodologies, and outcomes related to language skill development and learner engagement. It also examines critical barriers, including accessibility issues, technological constraints, and pedagogical shortcomings, such as the need for teacher training and curriculum alignment. The significance of this study lies in its potential to empower educators, researchers, and policymakers with evidence-based insights to optimize the use of AR and VR in language instruction. This research highlights how AR and VR can revolutionize English language learning by fostering immersive, student-centered environments and addressing the gaps in traditional and online teaching methods, such as low engagement and limited interactivity. Moreover, it identifies underexplored areas, such as the long-term impact of these technologies on linguistic proficiency and their scalability across diverse educational contexts, proposing avenues for future inquiry. Continuous evaluation of these tools is essential to ensure their alignment with rapid technological advancements and evolving educational needs, making this study a vital step toward shaping the future of language education.

Literature Review

Integrating AR and VR into EFL education has garnered substantial scholarly attention. Systematic reviews have elucidated these immersive technologies' transformative potential and persistent challenges. Recent systematic reviews underscored AR's preferential application in vocabulary acquisition, particularly through mobile, marker-based platforms that superimposed lexical content onto real-world contexts to enhance retention via

contextual learning. For instance, Schorr et al.'s (2024) analysis of 40 empirical studies (2016–2023) revealed that AR implementations frequently prioritized vocabulary training (e.g., multimedia overlays of lexical items) but lacked pedagogical alignment with broader language domains such as syntax or discourse. While their derived design principles—emphasized contextual learning, multimedia integration guided by the Cognitive Theory of Multimedia Learning (CTML), and collaborative instructional models—demonstrated enhanced engagement, the authors cautioned that AR's efficacy remained constrained by insufficient theoretical grounding and uneven classroom integration (Schorr et al., 2024). This sentiment resonated with Parmaxi & Demetriou's (2020) earlier review of 54 publications (2014–2019), which mapped AR's alignment with 21st-century skills (KSAVE framework) but critiqued the field's overreliance on mobile platforms (23.9% vocabulary focus) and neglect of learning theories. Their work highlighted a critical paradox: Despite AR's capacity for immersive skill-building, studies seldom addressed long-term retention or ecological validity, limiting translatability to diverse educational settings (Parmaxi & Demetriou, 2020). In contrast to AR's lexical focus, VR-assisted language learning (VRALL) demonstrated pronounced efficacy in oral and aural skill development. Deng & Yu's (2022) systematic analysis of 23 studies identified consistent improvements in pronunciation, listening, and speaking proficiency, attributing these gains to VR's capacity for simulating authentic communicative scenarios. However, mixed results in vocabulary, reading, and writing—mediated by variables such as learner proficiency and immersion levels—underscored the need for interdisciplinary collaboration to mitigate cognitive load and optimize task design (Deng & Yu, 2022). Expanding the scope, Ece et al. (2023) narrowed their review to 21 tertiary-level EFL studies, identifying VR's strengths in fostering cultural immersion, oral proficiency, and creative self-efficacy through strategies like progressive question prompts and peer tutoring. Despite significant performance boosts, their findings remained confined to university cohorts, with limited exploration of cost-effective hardware or younger learners (Ece et al., 2023). Broader syntheses of AR/VR integration revealed convergent themes. Huang et al. (2021) consolidated findings from 88 studies, emphasizing immersive experiences as central to enhancing motivation, reducing anxiety, and improving learning outcomes, particularly among university students. However, they critiqued the field's methodological heterogeneity, overreliance on qualitative designs, and lack of teacher training initiatives—barriers that impeded scalable implementation (Huang et al., 2021). Similarly, Peixoto et al. (2021) employed PRISMA guidelines to affirm immersive VR's superiority over traditional methods in boosting learner motivation and satisfaction.

However, they identified persistent gaps: small sample sizes, underexplored mixed-reality applications, and insufficient longitudinal data to assess sustained efficacy (Peixoto et al., 2021). Christou et al. (2025) extended this critique to XR technologies, noting a disproportionate focus on VR (28/33 studies) in foreign language education, with AR and mixed reality implementations remaining nascent. While XR tools enhanced authentic context provision and oral proficiency, their review stressed systemic barriers such as teacher unfamiliarity and explicit classroom orchestration (Christou et al., 2025).

The rapid evolution of artificial intelligence (AI) is driving profound transformations across multiple sectors, with education being a key beneficiary, mainly through the adoption of VR and AR as transformative tools (Kaur et al., 2024). AR uses smartphones or glasses to enhance real-world settings by overlaying digital information, such as text, images, or 3D models, onto physical environments (Azuma, 1997; Bacca et al., 2014). In contrast, VR creates entirely immersive, computer-generated worlds that users experience through headsets, effectively isolating them from their physical surroundings (Radianti et al., 2019). These technologies are revolutionizing education by delivering interactive, immersive learning experiences that overcome traditional barriers such as geographic distance, limited resources, or socioeconomic constraints, thus democratizing access to high-quality educational content (Radianti et al., 2019; Villena-Taranilla et al., 2022). AR and VR platforms significantly enhance student engagement and deepen comprehension by integrating simulations, detailed 3D visualizations, and rich audio-visual elements, outperforming conventional teaching methods in fostering critical skills and knowledge retention (Merchant et al., 2013; Parong & Mayer, 2018).

Empirical evidence underscores the superior potential of VR in specific educational contexts. For instance, Hung et al. (2023) conducted a study comparing VR-based English lessons with traditional and AR-supported approaches, finding that VR's highly immersive and interactive design led to better learning outcomes among young learners (Parong & Mayer, 2018). This improvement was particularly evident in increased student confidence and the perceived relevance of the material, likely due to VR's ability to simulate realistic conversational scenarios and provide immediate feedback within a distraction-free environment. Similarly, Annamalai et al. (2022) explored the broader benefits of AR and VR in English language education, identifying enhanced learning outcomes, greater student motivation, and seamless integration with bring-your-own-device (BYOD) policies as key advantages. They also noted that these technologies promote active learning by encouraging students to interact dynamically with content rather than passively absorb it. However, not all

findings are unequivocal. Soleimani et al. (2020) designed an innovative classroom where students leveraged AR and VR for collaborative language activities. AR-enhanced peer support, while VR sparked dynamic idea-sharing. Educators valued AR for fostering help among students and VR for enabling collective knowledge-building, viewing both as a means to promote independence and collaboration. Motivated, they aimed to blend these tools to enrich learning through connectivity and imagination.

Dhimolea et al. (2022), in a comprehensive review of 32 studies on VR in language learning, found that while repeated VR exposure improved contextual vocabulary acquisition and language retention, its overall effectiveness remained inconsistent across diverse learner groups and settings. Additionally, Poupard et al. (2024) analyzed 36 studies. They highlighted a critical limitation: VR often induces cognitive overload, especially among novice learners, due to the intense sensory input and navigational demands of fully immersive environments. In contrast, AR strikes a better balance for beginners by augmenting rather than replacing the real world, though its effectiveness wanes for intermediate learners who require more complex linguistic challenges. These mixed results suggest that while AR and VR hold immense promise, their educational impact hinges on cognitive load management, learner proficiency levels, and physical comfort during prolonged VR use, necessitating further investigation (Hung et al., 2023).

VR's potential in second language acquisition is particularly compelling due to its capacity to create realistic, interactive environments tailored to language practice. Tai et al. (2020) emphasized that VR provides authentic contexts, such as virtual marketplaces or social settings, where learners can rehearse language skills in scenarios mimicking real-life interactions. This immersion minimizes external distractions, requires minimal instructor expertise to facilitate, and fosters collaboration among learners, heightening engagement and motivation. VR tools are also relatively portable and cost-effective compared to traditional lab-based setups, broadening access to language education (Ebadi & Ebadijalal, 2020). Specific linguistic benefits include improved speaking and listening skills, with Chien et al. (2020) noting reduced errors and heightened creativity among learners attributed to VR's interactive realism. Furthermore, VR enhances knowledge retention by offering memorable, experiential learning opportunities that outstrip static textbook methods (Yeh et al., 2020). In English as a Foreign Language (EFL) contexts, VR fosters immersion, reduces speaking anxiety, and supports struggling learners through vivid, contextual visuals that manage cognitive demands effectively (Hoang et al., 2022; Luan et al., 2024). However, nuances exist within VR modalities: Desktop VR outperforms high-immersive VR in vocabulary

retention due to lower physical discomfort, while gamified VR systems yield better outcomes than non-gamified counterparts by leveraging motivational game mechanics (Luan et al., 2024; Zhao et al., 2023). Mobile VR, meanwhile, excels in specialized domains like medical English, improving communication skills and proficiency (Derakhshan et al., 2024). Despite these advantages, challenges persist, including high initial costs, the complexity of designing VR content, and the need for affordable, scalable solutions (Liu et al., 2023).

AR, by contrast, integrates virtual elements with the physical world in real time, using technologies like object recognition to overlay computer-generated content, such as annotations or 3D models, onto tangible settings, engaging multiple senses to enrich learning (Naji et al., 2023). AR boosts motivation, sustains attention, and accelerates skill development in education, though it faces hurdles like usability issues, instructor reluctance, and technical glitches (Chang et al., 2020). By blending virtual and real environments, AR enhances comprehension and facilitates real-time collaboration, such as sharing annotated views during lessons (Naji et al., 2023). Its use in language education is growing, with adoption expected to rise as instructors gain proficiency with digital tools. However, engaging, pedagogically sound AR content remains a barrier to widespread implementation (Karacan & Polat, 2022).

Using AR and VR in the classroom, especially for teaching and learning English, has gained significant attention due to their immersive and interactive nature, which holds immense potential to enhance language acquisition and retention. These technologies offer significant potential to enhance language acquisition, retention, and engagement, transforming traditional pedagogical approaches. Despite their promise, a comprehensive understanding of their effectiveness and practical application in English language learning (ELL) remains underdeveloped. Existing research often lacks cohesion, frequently focusing on isolated case studies rather than providing a systematic exploration of how AR and VR can be seamlessly embedded into curricula. A systematic literature review can address this gap by synthesizing findings, identifying recurring themes and challenges, and laying the groundwork for robust pedagogical frameworks. This study conducts a systematic review of research published between 2019 and 2024 to investigate the role of AR and VR in English language education. It addresses key research questions and offers evidence-based insights that can guide educators in leveraging these technologies to optimize English language instruction. The current systematic review focuses on answering the following four research questions:

1. What are AR and VR's reported benefits and challenges in English language education?
2. How do AR and VR applications impact learners' engagement and language acquisition compared to traditional instructional methods?
3. What factors influence the successful implementation of AR and VR technologies in various educational contexts?
4. How do learners' perceptions of AR and VR influence their language learning experiences?

Methodology

This study conducted a systematic review of peer-reviewed literature examining the application of AR and VR in English as a Foreign Language (EFL) education, covering publications from January 2019 to December 2024. A systematic review is a research method that synthesizes existing evidence by systematically identifying, appraising, and analyzing all relevant studies on a specific topic, following a predefined protocol to minimize bias and ensure reproducibility. Unlike primary research that generates original data, this study re-evaluated and integrated findings from previously published works to uncover patterns, gaps, and new perspectives. The review aimed to synthesize AR and VR applications in EFL education comprehensively. It offered fresh insights into their efficacy and contributed to a more nuanced understanding of their role in language pedagogy.

To achieve this, researchers systematically searched seven major academic databases (Scopus, Web of Science, ScienceDirect, SpringerLink, Taylor & Francis Online, Sage Journals, and Google Scholar) for relevant articles published within the specified timeframe. The search process employed a combination of keywords (e.g., "Augmented Reality," "Virtual Reality," "EFL education," "English language learning") and Boolean operators to ensure comprehensive coverage. Initial screening identified 91 articles meeting the inclusion criteria: peer-reviewed studies focused on AR/VR in EFL teaching or learning, written in English, and published between 2019 and 2024. Following a detailed full-text review, 48 articles were selected for in-depth analysis based on their relevance, methodological rigor, and contribution to the research question.

The methodology adhered to Sandelowski and Barroso's (2007) seven-phase framework for qualitative systematic reviews, which includes: (1) formulating the review question, (2) defining inclusion/exclusion criteria, (3) systematically searching the literature, (4) appraising study quality, (5) extracting data, (6) analyzing and synthesizing findings, and

(7) presenting results. This structured approach ensured a rigorous and transparent process. To maintain reliability in article selection and data coding, inter-coder agreement was assessed using Cohen's kappa statistic, a widely recognized measure of consistency between two or more raters. Inter-rater reliability in the study-selection phase was evaluated by randomly selecting 50 % of retrieved titles and abstracts for independent screening by a second researcher; this yielded a Cohen's κ of 0.81, reflecting excellent agreement beyond chance. In the subsequent qualitative coding phase, 20 % of text segments extracted in MAXQDA 24 were randomly sampled and independently double-coded, producing a Cohen's κ of 0.83 and confirming a high level of consistency in theme identification. Discrepancies between coders were resolved through discussion and consensus, enhancing the study's academic rigor. This meticulous methodology underpinned the validity and trustworthiness of the findings regarding AR and VR's impact on English language learning and teaching.

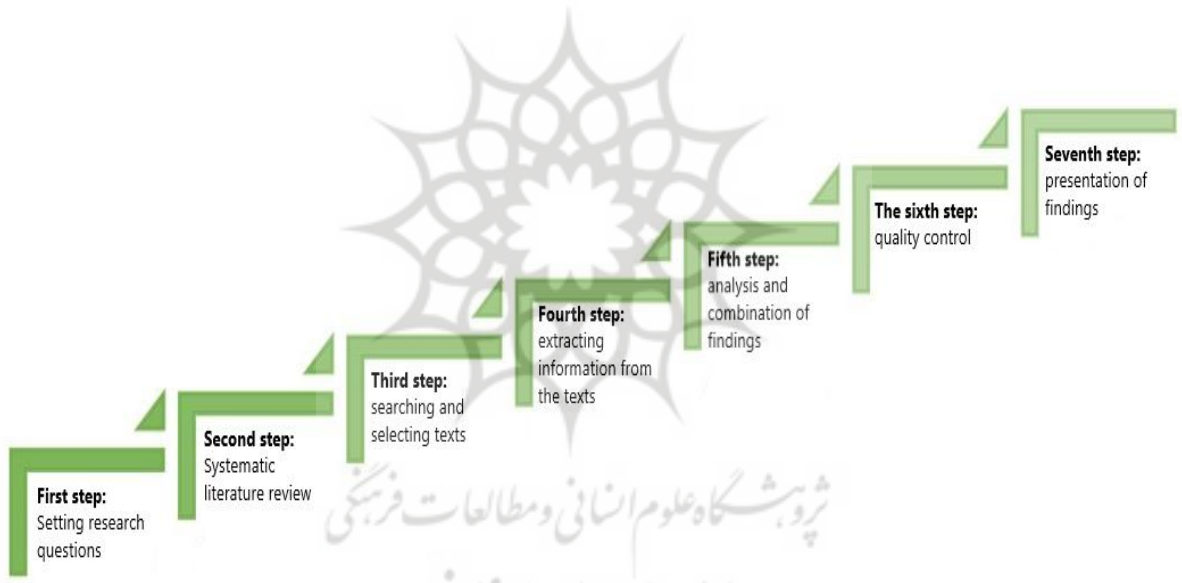

Figure 1. Sandelowski and Barroso's Seven-Phase Framework for Qualitative Synthesis (2007, p. 105)

Step 1: Formulating Research Questions

This study investigated the use of AR and VR in English language instruction to promote cutting-edge second-language learning strategies. Specifically, it had three main goals: 1) to identify and evaluate AR/VR-based ELT approaches supported by strong empirical evidence, 2) to provide evidence-based recommendations for integrating AR/VR in language classrooms, and 3) to address gaps in the existing literature by highlighting effective AR/VR

strategies. The study examined the current landscape of AR/VR in English language learning and teaching and offered recommendations for optimal implementation.

Steps 2 and 3: A Systematic Review of Existing Research and Selection of the Articles

A systematic review of AR/VR integration literature in English as a Foreign Language (EFL) education followed a structured, multi-stage protocol (Figure 2). First, seven major scholarly databases—Scopus, Web of Science, ScienceDirect, SpringerLink, Taylor & Francis Online, Sage Journals, and Google Scholar—were searched using the terms "AR/VR in English Language Teaching (ELT)" and "AR/VR and English as a Foreign Language (EFL)." To ensure methodological rigor and interdisciplinary relevance, journals were eligible only if indexed in Scopus or Web of Science and carried an official impact factor. Moreover, priority was given to outlets specializing in educational technology (e.g., *Computer Assisted Language Learning*, *Interactive Learning Environments*, *Computers & Education*) and in applied linguistics or language-teaching methodology (e.g., *TESOL Quarterly*, *English for Specific Purposes*, *Innovation in Language Learning and Teaching*). In the first screening phase (title and abstract), the initial search yielded 91 records. Forty-three were excluded for one or more of the following reasons: no substantive focus on AR/VR in EFL settings (n = 26), duplicate publications (n = 2), non-English language outlets (n = 5), inaccessible full texts (n = 8), or publication in non-peer-reviewed or non-indexed journals (n = 2). The remaining 48 articles satisfied all inclusion criteria—peer-reviewed status, thematic relevance, English language, and full availability—and progressed to full-text review. During the third phase, both researchers independently assessed the 48 retained studies against a set of predetermined quality criteria (Table 1). Inter-coder reliability was confirmed with a Cohen's kappa of 0.81, indicating substantial agreement. All studies that met these standards were advanced to the final synthesis, resulting in a core corpus of 48 empirical investigations of AR/VR integration in EFL contexts. This rigorous, transparent process ensured the subsequent literature review was grounded in high-quality, thematically aligned research.

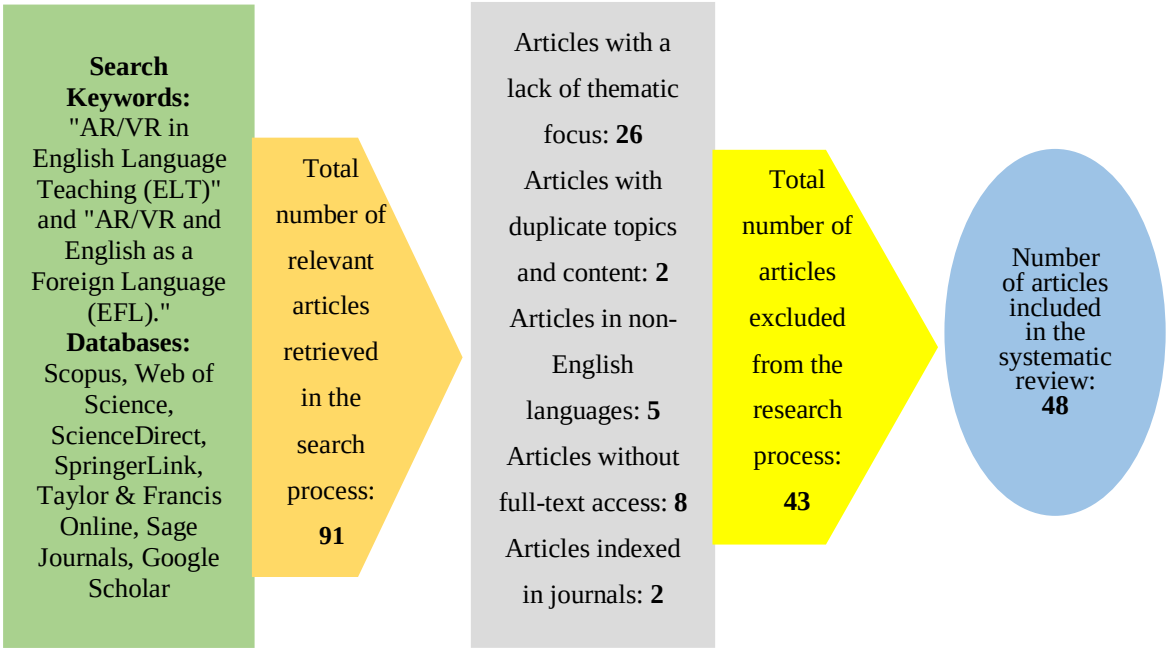

Figure 2. Flowchart Visualizing Article Inclusion in Systematic Literature Review

Table 1. Eligibility Criteria for Article Selection in the Screening Process

Exclusion	Inclusion
Lack of a subject and a thematic relation to the research questions	The relationship between the title and content of the article and the research topic
Language other than English	Up-to-date article - publication year 2019 or later
Lack of access to the full text of the article	Published in a Scopus-indexed or high-impact factor journal
Indexed in a journal with a low or unknown impact factor	The relevance of the article's topic to the field of education and language learning

Step 4: Extraction of Article Information

A comprehensive data extraction table (Table 2) was developed to summarize the key characteristics of the included studies. This table (see Appendix A) includes the authors, publication year, journal name, study location, research objectives, methodologies, and significant findings. Each article was meticulously reviewed, with relevant data systematically extracted and organized in a clear and user-friendly manner to facilitate the forthcoming data analysis and coding process.

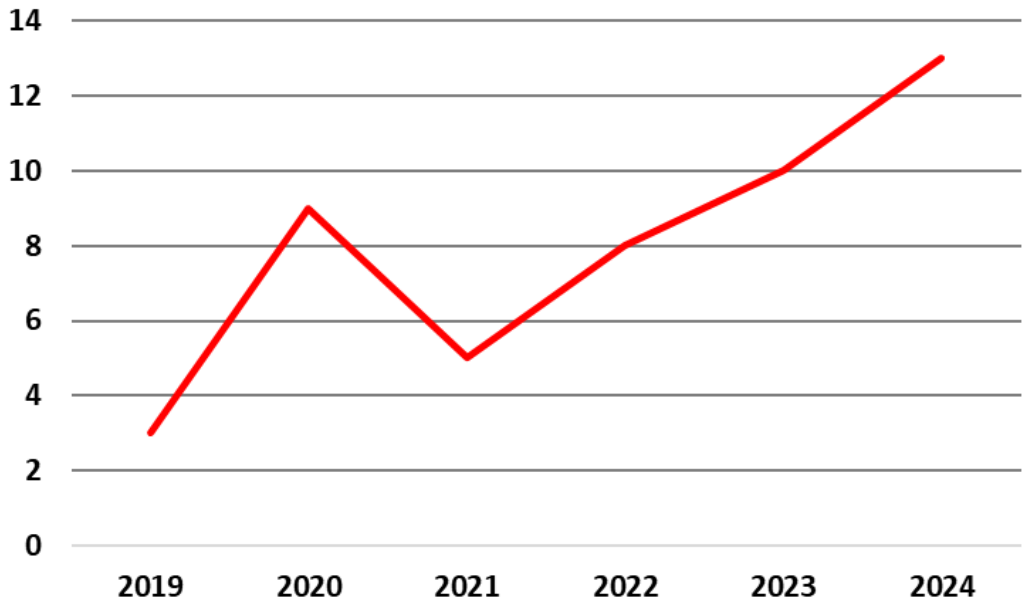

Figure 3. Line Chart Depicting Annual Count of Indexed Articles

A comparative analysis of the selected articles from 2019 to 2024 showed a significant rise in research on the use of AR and VR in English language teaching and learning, especially from 2021 onwards (Figure 3). This growth is driven by AR/VR technology advancements, increasing demand for innovative teaching methods, and the recognition of immersive environments as practical tools for language learning. Notably, Taiwan has emerged as a leader in this field, supported by its focus on technological innovation and educational reform. China also plays a crucial role in expanding research on AR/VR in language education, reflecting broader regional trends (Figure 4). The increasing global interest and East Asia's prominent role in educational technology innovation are highlighted by a steady rise in publications and the geographic spread of research. The upward trajectory of publication frequency in this field, as depicted in Figure 3, illustrates a consistent increase in publications over the past few years. Meanwhile, Figure 4 presents an analysis of the geographic distribution of scholarly efforts in AR/VR-integrated EFL education, mapped according to the origin of empirical data and research samples. By identifying key regional hubs and methodological trends, the visualization underscores the global academic engagement with immersive technologies in language learning contexts.

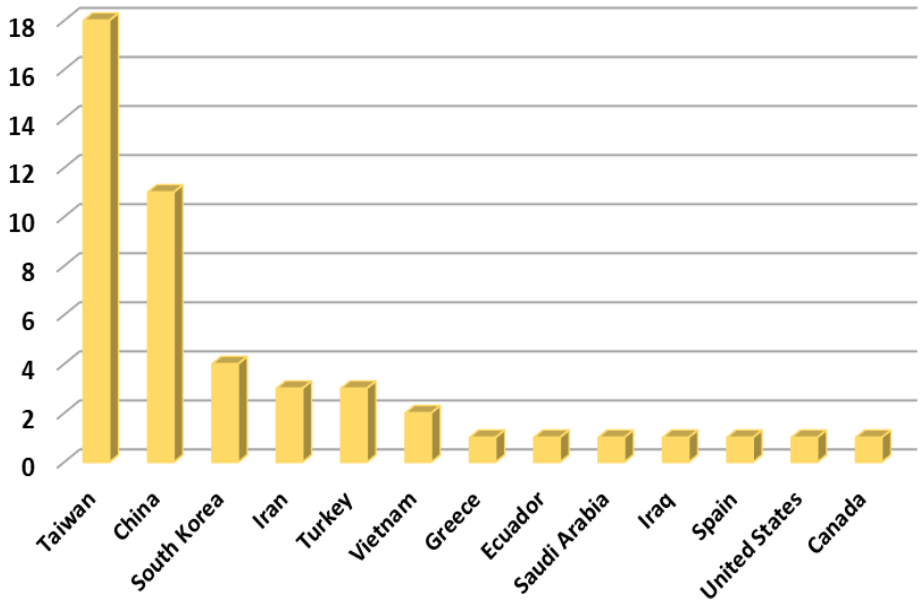

Figure 4. Bar Chart Depicting the Geographic Distribution of Research (Derived from Collected Data and Study Sample Locations)

Step 5: Analysis and Synthesis of Findings

A qualitative content analysis was conducted on the data synthesized in Table 2 (see Appendix A). Using MAXQDA 24 software, relevant codes were extracted from the discussion and findings sections of the selected studies. This process resulted in a hierarchical coding scheme: 64 initial open codes were aggregated into 12 axial codes and further synthesized into six overarching selective codes. To ensure inter-coder reliability, a second coder (Second Author) independently coded a randomly selected subset of the data. Cohen's kappa was used to assess the agreement between the two coders, yielding a score of 0.83, indicating substantial agreement. This rigorous process minimized subjective bias and ensured the reliability of the identified themes. The complete coding framework, including definitions and illustrative examples, is presented in Table 3 (see Appendix B), providing transparency and enhancing the robustness of the study's findings.

Step 6: Quality Control

The current systematic review ensured high quality by focusing on transparency, thorough article selection, and detailed analysis. The comprehensive literature review covered AR and VR in English language learning and teaching. Scholarly works from various periods were compared and validated, confirming the research's reliability. Cohen's kappa coefficient was used to assess reliability and validity, with two expert faculty members confirming the

findings. Their unanimous agreement in identifying critical concepts, axes, central themes, and the kappa coefficient of 0.83, which is significantly high at $p \leq 0.05$, supports the study's high reliability and validity.

Step 7: Presentation of Findings

The seventh and final phase summarized the findings from earlier stages, offering practical insights for educators, researchers, and practitioners in language teaching and technology use. It analyzed research on integrating AR and VR into language learning and teaching, focusing on methodologies, key variables, and challenges. The phrase highlighted potential obstacles in using AR/VR for English language learning and teaching. It also presented the insights visually within a theoretical framework, as shown in Figure 5, enhancing the understanding of the research findings.

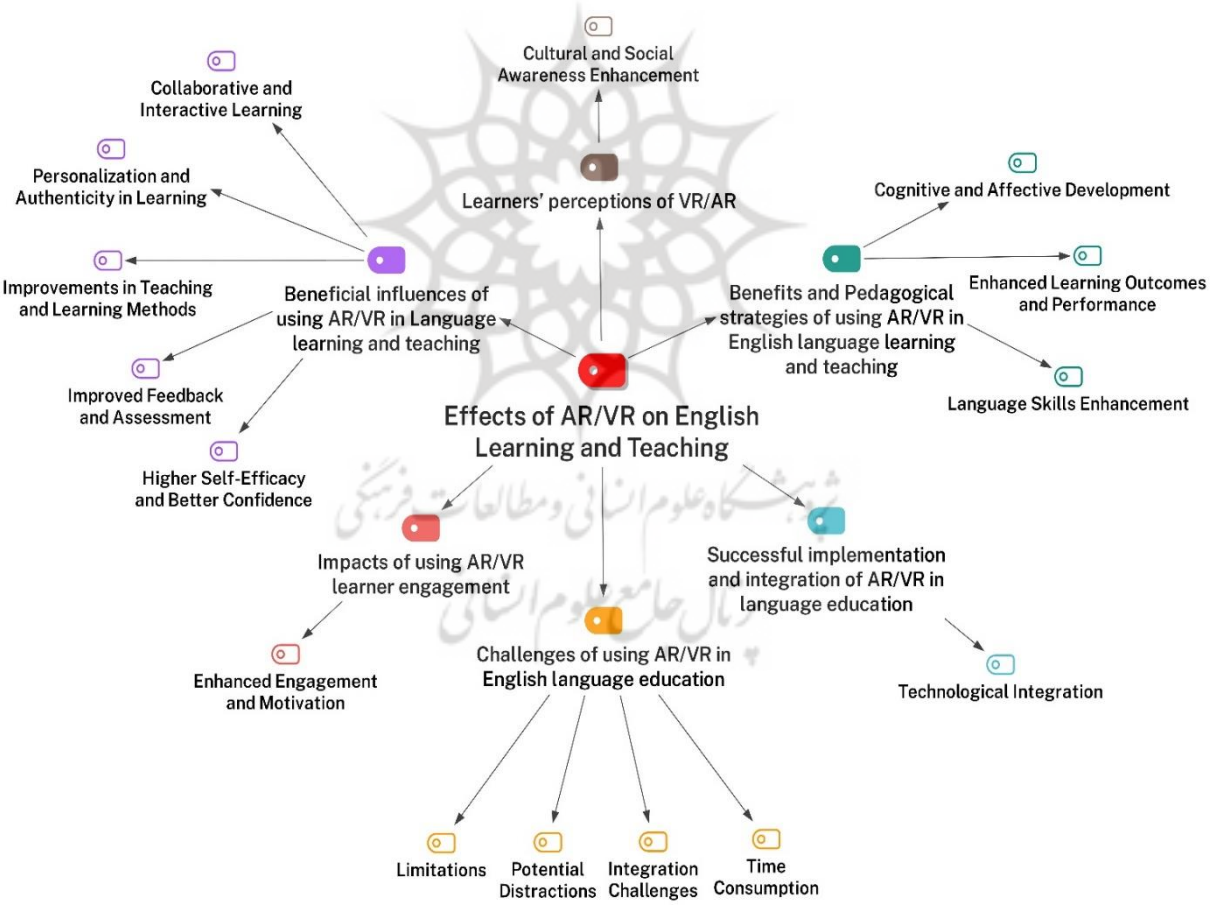

Figure 5. Theoretical Framework Derived from Empirical Findings

Table 3 (see Appendix B) summarizes the coding results from an analysis of 48 studies on AR and VR in English language learning and teaching. The findings reveal six central

themes and twelve subthemes, highlighting the impact of AR/VR on educational practices. These themes include 1) Impacts of using AR/VR on learners' engagement, 2) benefits and pedagogical strategies for AR/VR integration, 3) successful implementation in language education, 4) learners' perceptions, 5) challenges in AR/VR usage, and 6) positive influences on language learning. Most international studies from Taiwan and China indicated growing interest in AR/VR technologies in these regions.

Reviewed studies demonstrated AR/VR's positive impact on language education, mainly through enhanced engagement and immersive learning. While pedagogical benefits and strategies were prominent themes, implementation challenges received less attention, suggesting a potential research gap. However, the limited scope of this review precludes definitive conclusions. Variations in findings, likely due to differing samples, methodologies, and contexts, necessitate further investigation. Future research should provide a balanced analysis of AR/VR's potential and limitations, emphasizing strategies to overcome adoption barriers.

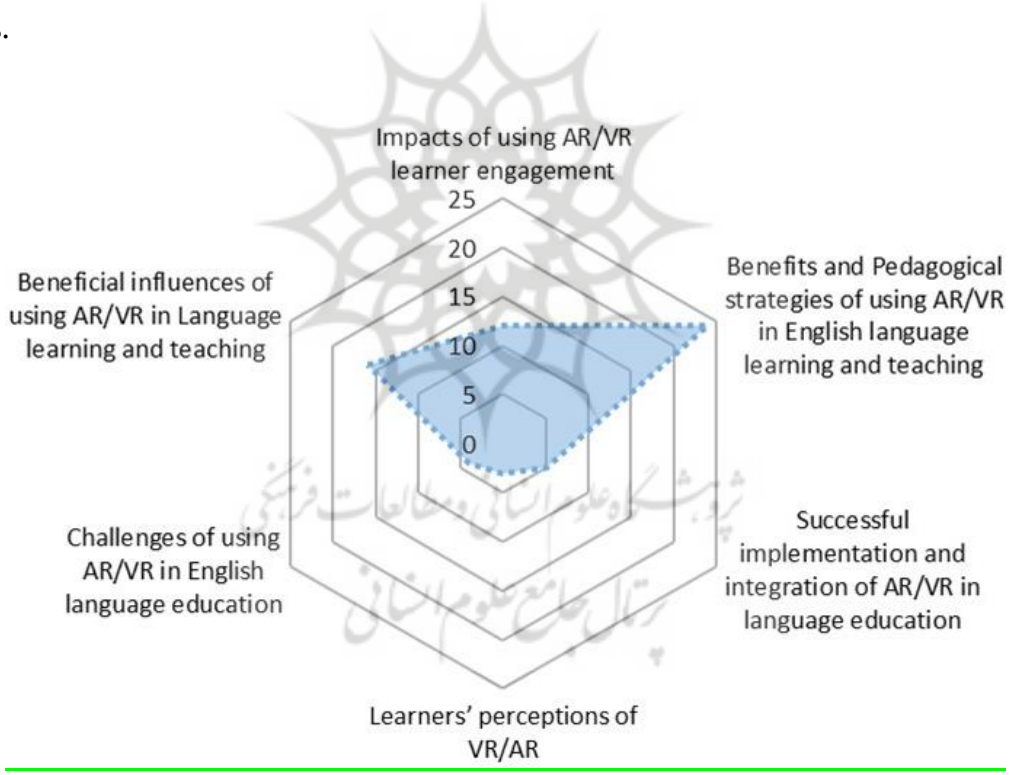

Figure 6. Radar Chart Illustrating Thematic Evaluation

Discussion

The integration of Augmented Reality (AR) and Virtual Reality (VR) into English language education has garnered attention. However, a comprehensive understanding derived from the systematic review of existing studies is still needed. This understanding will lead to the

development of a unified framework for evaluating the effectiveness of AR/VR in language learning, thereby simplifying its use in educational settings. This article aims to address this need by reviewing 48 peer-reviewed articles on AR/VR in English language learning and teaching published between 2019 and 2024, highlighting the benefits, such as increased learners' engagement, and the challenges, such as technological accessibility, high costs, and the need for solid pedagogical frameworks. Overcoming these challenges is crucial for successfully using AR/VR in language education.

Research shows that new technologies can boost student motivation early in learning, but maintaining this requires engaging materials, teaching methods, and educators. Interactive textbooks, thoughtful design, and digital tools like simulations and educational games stimulate curiosity (Chen et al., 2020). Sustaining motivation requires technology and pedagogical strategies such as project-based learning, flipped classrooms, and personalized pathways, which foster active participation and autonomy. The quality of content, tailored to students' needs and guided by educators, is also crucial for maintaining engagement (Demirdag et al., 2024; Li et al., 2023). Educators play a crucial role in fostering student motivation and curiosity by creating engaging learning environments. Innovative tools like VR, AI-driven adaptive platforms, and data analytics can personalize learning, track progress, and provide immediate feedback. These technologies enhance motivation by promoting critical thinking and problem-solving. While new technologies can spark initial engagement, their long-term impact on motivation depends on their thoughtful integration with effective instructional strategies. Educators who combine these tools with robust teaching methods can sustain student motivation and curiosity (Khan et al., 2023; Lin & Wang, 2022; Zhang et al., 2023).

The findings highlight the potential of VR in English language learning and teaching, offering significant theoretical, pedagogical, and practical insights. It encourages educators to integrate VR into speaking lessons, enhancing interaction, engagement, and student motivation while urging higher education institutions to explore mobile and VR technologies for professional development (Hoang et al., 2022). This aligns with Tai et al. (2020), who found that VR outperformed video content in enhancing vocabulary acquisition by creating an immersive, interactive environment. Yudintseva (2024) emphasized VR's role in increasing communication willingness and fostering social, collaborative learning through immersive tasks. Derakhshan et al. (2024) highlighted the potential of educational technology, especially VR, to enhance language learning, particularly in developing productive English skills for real-life communication. VR's realistic 3D elements were shown

to be effective in academic and medical contexts, with customizable scenes supporting specific language needs. Multi-touch mobile VR also aids practical skill development. Hoang et al. (2022) emphasized VR's role in improving oral proficiency and vocabulary and reducing communication anxiety. They viewed language development as an emergent process shaped by environmental opportunities, with VR offering dynamic learning experiences. VR users exhibited enhanced creative thinking and language skills. Mubarak et al. (2023) found that VR-based collaborative methods improved English presentation skills, but the limited scope calls for broader research on VR's impact in diverse settings. Integrating high-immersion VR with collaborative argument mapping can enhance learning outcomes, particularly in cultural contexts. The VR-assisted Project Learning approach improved engineering students' specialized English vocabulary and fostered a positive attitude toward language acquisition (Chen et al., 2021). VR's visualization capabilities aid vocabulary recognition, recall, and contextual understanding, enhancing language learning through multiple modalities. VR promotes authentic language learning by creating interactive environments that boost engagement and speaking opportunities (Lee et al., 2024). However, VR's effectiveness may vary, benefiting learners with solid foundational knowledge more than those with limited prior understanding (Li et al., 2023). VR is more effective than traditional methods, especially for elementary students (Chang et al., 2023).

VR-assisted English instruction enhances motivation and learning effectiveness through immersive experiences that deepen language comprehension. However, a 2024 study by Shi et al. found that VR alone does not improve oral language skills compared to traditional methods. Educators significantly enhance oral English skills and engagement when combining VR with project-based learning. This integrated approach fosters active learning and critical thinking, leading to motivated students and potential language education transformation. Wang (2024) found that AR improved oral presentations in content, vocabulary, and pronunciation while boosting interest. AR, though beneficial, needs further development to address fluency and grammar issues. AR was more effective than digital flashcards for vocabulary learning, showing superior retention after 15 minutes and one week, though it has a higher forgetting rate. AR technology also boosts preschool English learning by improving academic performance, engagement, and motivation (Demirdag et al., 2024). It enhances language skills in listening, speaking, reading, and writing while fostering curiosity and enthusiasm. Wang (2024) noted AR's positive impact on vocabulary, pronunciation, and spelling, with improved reading comprehension and phonics. AR promotes self-directed learning by reducing cognitive load and anxiety, but poorly designed

applications can diminish interest. Ultimately, successful AR learning requires sustained engagement and commitment.

Topu et al. (2023) found that students using AR materials excelled in learning English vocabulary, displaying more positive attitudes and enjoyment than those of a control group. However, more research is needed on children's perceptions of AR in language learning, especially among preschoolers. Lin and Wang (2022) explored motivational factors in AR teaching and found positive correlations between attention, relevance, confidence, and satisfaction, emphasizing the importance of aligning AR goals with students' needs. They also noted that prior success had little impact on relevance or satisfaction. To foster confidence, teachers should promote positive expectations and provide regular feedback. Participation in AR improved students' creative idea generation but had little effect on evaluating ideas, which may improve with more time. Students felt overwhelmed by time and workload, suggesting the need to assess project demands carefully. Khan et al. (2023) studied AR in vocabulary learning, finding that AR participants performed better in post-tests, though follow-up assessments showed no significant differences. AR's success was linked to improved comprehension, enjoyment, and social interaction, though some students faced technological issues. The study emphasized the need for further research into AR's potential in education. AR offers an immersive learning experience by allowing interaction with real-world objects, enhancing understanding, and stimulating multiple senses. It strengthens connections between abstract concepts and physical objects, improving vocabulary and long-term memory retention (Wang, 2024).

The current systematic review highlights VR's potential to improve communication, influenced by factors like representation accuracy, sound quality, spatial skills, and sensitivity to motion sickness, which affect cognitive load, enjoyment, and confidence, thus impacting communication willingness (Yudintseva, 2024). VR learning experiences must account for technological, personal, and emotional factors. Active learning strategies, such as peer tutoring and experiential learning, enhance student performance and engagement (Chen et al., 2021). However, challenges like dizziness, eye strain, and device issues hinder language learning, especially with mobile VR, and regions like Asia face additional obstacles due to device and connectivity shortages (Hoang et al., 2022). To ensure equity, future research must address socioeconomic and technological disparities. While immersive VR is widely studied, desktop VR, more affordable and accessible, is gaining popularity for English language learning, though research on its impact remains limited (Luan et al., 2024).

Augmented Reality (AR) also shows promise but requires careful design to avoid distractions, ensuring it enhances rather than hinders learning.

Conclusion and Implications

This study reviewed 48 studies on using AR/VR in English language learning and teaching (2019-2024). The analysis found that AR/VR enhances language acquisition and 21st-century skills like teamwork, autonomy, and cultural awareness. However, successful implementation depends on aligning AR/VR tools with appropriate pedagogy and learning theories. AR/VR methods outperformed traditional techniques in vocabulary, oral skills, motivation, and listening comprehension but sometimes had less impact on student engagement. Prolonged exposure only sometimes yielded better results. The study highlights AR/VR's benefits and underlines the urgent need for further research to address areas for improvement.

With an emphasis on their beneficial effects on academic achievement, the current systematic review looked at how AR and VR may improve English language instruction and learning. Key factors influencing their effectiveness include educational stage, teaching strategies, targeted skills, assessment types, and intervention duration. The study emphasized how spherical video-based virtual reality (SVVR) and peer evaluation may enhance critical thinking, motivation, and speaking abilities. It also underscored the crucial need for further research to align VR with pedagogical principles, particularly in writing, reading, cultural awareness, and critical thinking. Challenges in fostering collaboration in virtual environments were acknowledged, and the development of AR/VR tools for older adults, those with disabilities, and students with special needs was encouraged. Policymakers should consider cost-effective AR/VR tools for enhanced learning. The study's findings support using AR/VR in language teaching, with AR/VR providing immersive environments that improve vocabulary, integrated skills, and phonetics while promoting learner autonomy. For best results, teachers should model AR/VR usage. Future research should also focus on creating high-quality AR/VR materials and integrating them into all areas of English learning, with a need for more robust theoretical frameworks to support findings.

This systematic review of selected studies on the application of AR and VR in English language learning and teaching has identified several critical gaps in the existing literature. The findings underscore an urgent need for further research into the specific impacts of AR and VR on key dimensions of language education, including contextual learning, cognitive skill development, and learner satisfaction. Moreover, a standardized framework for integrating AR and VR into instructional practices remains a significant barrier to widespread

adoption. Current challenges—technological limitations, inconsistent implementation, and a lack of evidence-based guidelines—highlight the academic community's need to prioritize targeted research efforts and establish consensus-driven best practices. However, a key limitation of this review is the relatively small sample of articles analyzed, which may constrain the generalizability of these findings and suggest caution in interpreting the breadth of the identified gaps. To address these issues, future studies should focus on expanding the evidence base and developing structured pedagogical frameworks to guide the creation of practical AR/VR educational resources, ensuring their potential is fully realized in language learning contexts.

This study reviewed the use of AR and VR in English language learning and teaching, acknowledging several limitations. These include a bias toward English-language studies, which may exclude valuable perspectives from non-English research, and a modest sample size of 48 articles that may not represent the full spectrum of the field. The review also focused on studies published between 2019 and 2024, potentially overlooking earlier foundational research. Despite these constraints, the review provides essential insights into integrating AR and VR in language education. It emphasizes the need for future research to address these limitations. It underscores the potential impact of broader studies on the field, making your audience feel the importance of their work.

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Appendix A

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
1	Demirdag et al. (2024) / International Journal of Human-Computer Interaction	Turkey	Analyzing the effects of Augmented Reality (AR) on preschoolers' English language acquisition compared to conventional teaching approaches.	An embedded mixed-method approach	Activities utilizing AR to learn English enhanced students' color vocabulary more effectively than conventional techniques. The children found the experience enjoyable, and observations indicated steady weekly advancements in their cognitive, emotional, and social/language abilities.
2	Khazaie & Derakhshan (2024) / English for Specific Purposes	Iran	To look at how AR may be used in robot-assisted language instruction to improve students' embodied cognition in medical English.	A quasi-experimental study	When listening and reading in English for Medical Purposes, individuals utilizing robot-assisted augmented reality performed better than those in the robot-only and control groups. Interviews indicated that the augmented reality robot was viewed favorably by participants.
3	Chen et al. (2019) / Computer-Assisted Language Learning	United States	Using the Funds of Knowledge approach to investigate how Google Earth VR enhances expository writing for English language learners	A sequential explanatory design using mixed techniques	The study found significant improvements in participants' expository writing skills, notably in description, cause/effect, comparison/contrast, and enumeration. Participants were engaged and favorable about Google Earth VR despite worries about time utilization, potential diversions, and integration challenges.
4	Lee & Park (2019) / Computer-Assisted Language Learning	South Korea	Examining how college students utilized context-aware augmented reality (AR) technology to improve language acquisition in an English as a Foreign Language (EFL) environment.	A mixed-methods study	Learners interacted with context by exploring actual locations, imaginative environments, and mixed realities, employing these to build understanding collaboratively. Technology-supported language acquisition across emotional, intellectual, and social aspects improves student learning outcomes.
5	Wu (2019) / Computer-Assisted Language Learning	Taiwan	Examining the general concept of augmented reality within the educational sector, its uses in mobile gaming, incorporating linguistic components in both English learning and the languages of Pokémon, and carrying out experiments linked to these topics.	A quantitative research design involving an experimental design	The differences between pre-test and post-test results in learning attitudes, learning satisfaction, and learning accomplishments demonstrated significant improvements in the experimental group over the control group.

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
6	Chen et al. (2020) / Computer-Assisted Language Learning	Taiwan	Examining the effects of different types of captions (none, English, and Chinese) along with English proficiency levels (proficient versus less proficient) on junior high students' effectiveness, motivation, and attitudes within an augmented reality (AR) learning setting.	A factorial design	Captions did not improve learners' understanding, but English proficiency was crucial. Lower proficiency learners experienced increased cognitive load with captions, making knowledge application harder, while higher proficiency learners had similar performance with or without captions. All students had a positive attitude towards AR-enhanced learning, with more proficient learners showing higher motivation, confidence, and practical strategies. Conversely, learners without captions felt more self-assured.
7	Tai et al. (2020) / Computer-Assisted Language Learning	Taiwan	To examine the impact of virtual reality through mobile-rendered head-mounted displays on the vocabulary acquisition of English as a Foreign Language (EFL) students.	A quasi-experimental design	Individuals using VR demonstrated superior vocabulary acquisition and retention than those watching videos. Most VR participants found the experience engaging because of its interactive and contextual elements. Conversely, those watching videos had varied responses; while some appreciated the context, others felt distracted by the absence of interactivity.
8	Lin et al. (2020) / Computer-Assisted Language Learning	Taiwan	Improving multimodal and digital literacy in EFL undergraduates with an augmented-reality writing application (ARCAUW) aims to enhance long-term memory, motivation, and self-regulated learning in writing.	A quasi-experimental design	The ARCAUW mode significantly enhances task schema development, motivation, and self-regulation in essay writing analysis compared to traditional writing modes. While the extra cognitive processing in AR-based learning has varied effects on writing performance, incorporating ARCAUW into mobile-assisted writing courses can improve outcomes. The study also suggests a five-step implementation procedure for EFL instructors.
9	Ebadi & Ebadijalal (2020) / Computer-Assisted Language Learning	Iran	To investigate how virtual reality (VR) technology influences English learners' oral competency and willingness to communicate (WTC).	A mixed-methods approach	The experimental group outperformed the control group significantly in terms of speech performance and communication preparedness. According to thematic analysis, the VR tool enhanced participants' general knowledge, motivation, excitement, cultural awareness, and self-confidence.

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
10	Chien et al. (2020) / Computers & Education	Taiwan	Investigating the effects of a spherical video-based virtual reality setting and peer evaluation on English as a Foreign Language students' speaking abilities, motivation, critical thinking, and learning anxiety.	A mixed-methods approach	The SVVR method, which uses peer assessment, improves speaking skills, boosts motivation, encourages critical thinking, and reduces anxiety compared to traditional methods. Four types of peer feedback were identified: praise (positive), criticism (negative), opinion, and irrelevant comments (initially neutral but later seen negatively)—student evaluations aligned with teacher assessments.
11	Yudintseva (2024) / Computers & Education: X Reality	Canada	To examine the effects of low-immersive and high-immersive virtual reality settings on the willingness to communicate among students learning English as a Second Language (ESL).	A mixed-methods quasi-experimental study	The study found no significant differences in willingness to communicate between the two modalities. However, the sequence of tasks and action-oriented approaches affected participants more noticeably, increasing cognitive load and enjoyment in immersive settings. This led to decreased speaking anxiety and enhanced self-confidence. Additionally, the qualitative analysis highlighted the interplay of technological, emotional-cognitive, and personal factors impacting willingness to communicate.
12	Yeh et al. (2020) / Interactive Learning Environments	Taiwan	Exploring how the development of VR content improves intracultural learning for Taiwanese college students studying English as a Foreign Language.	A quasi-experimental design	Students enhanced their understanding of different cultures by utilizing VR technology, mainly through features such as panoramic views, audio components, interactivity, and organization, which supported their learning about local culture.
13	Chen et al. (2021) / Interactive Learning Environments	Taiwan	To assess how effectively a peer-tutoring method that utilizes progressive question prompts in virtual reality (PQP-PTVR) improves learners' English-speaking skills.	A quasi-experimental design	Compared with the control group (C-PTVR), the experimental group (PQP-PTVR) showed more significant improvements in speaking abilities and self-efficacy. In addition, members of the experimental group engaged in more exchanges and worked harder to become better speakers.
14	Costuchen et al. (2020) / Innovation in Language Learning and Teaching	Spain	Studying the impact of augmented reality (AR) using visuospatial bootstrapping (VSB) to learn second-language vocabulary while contrasting it with the well-known Quizlet method.	A comparative experimental design	The AR-VSB approach is more effective for vocabulary acquisition than Quizlet, but has a higher forgetting rate after one week. It still outperforms the control group in retention, highlighting its effectiveness for initial vocabulary learning in second-language learners. The

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
					research suggests that immersive AR experiences can enhance vocabulary recall among university students.
15	Derakhshan et al. (2024) / Computers & Educational	Iran	To investigate how mobile Virtual Reality (VR) can enhance productive skills in general English and English for Medical and Academic Purposes for post-secondary students.	A quasi-experimental study	Mobile VR proved to be a valuable resource for acquiring English for Medical and Academic Purposes. Nevertheless, general English productive skills were not included in the VR activities, indicating a necessity for further advancements in this area.
16	Hoang et al. (2022) / Innovation in Language Learning and Teaching	Vietnam	To find out how VR may improve EFL students' oral competency and how they feel about using VR mobile technology in the classroom.	A mixed methods design	The research demonstrated notable advancements in oral proficiency, particularly in fluency, coherence, vocabulary use, and pronunciation, while also reflecting minor improvements in grammar. Discussions revealed the benefits of VR in language acquisition but also noted the challenges and constraints present in EFL classrooms.
17	Luan et al. (2024) / Interactive Learning Environments	China	Examining how Virtual Reality (VR) technology influences vocabulary acquisition among learners of English as a Foreign Language (EFL).	A quasi-experimental design	Individuals using VR for vocabulary acquisition benefit from a genuine experience and heightened presence compared to those just watching videos. While most students acknowledge the educational advantages of VR, there are mixed opinions regarding its effectiveness. The research recommends that language teachers and technology professionals create tasks and develop resources to enhance learning.
18	Yong (2024) / Entertainment Computing	China	To create a recommendation system for E-learning videos in a virtual reality atmosphere that offers tailored, interactive, and immediate feedback for teaching English.	Empirical research	The E-learning video suggestion system tailors education by examining user preferences to improve human-computer interaction, thereby updating the teaching of the English curriculum.
19	Wang (2024) / Innovation in Language Learning and Teaching	China	Exploring how an augmented reality (AR) application (Civilizations AR) impacts the oral proficiency of English as a Foreign Language (EFL) learners and their perspectives on AR technology.	A quasi-experimental design	The research revealed enhanced participant speaking abilities related to content, vocabulary, and pronunciation while utilizing the AR application. Moreover, learners indicated that the AR-supported approach promoted active learning, heightened their enthusiasm for education, and they desired to integrate AR into

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
					their future studies.
20	Mubarok et al. (2023) / Interactive Learning Environments	Taiwan	Analyzing how effective a virtual reality collaborative argument mapping method (VR-CAM) enhances English language abilities, emphasizing oral presentations, interest in cultural learning, and creative thinking among EFL students during emergency remote education.	A quasi-experimental design	The VR-CAM method notably enhanced students' oral presentation skills in English compared to the non-VR-CAM method. Although the VR-CAM participants exhibited more excellent scores in their interest in cultural learning, this difference did not reach statistical significance. Furthermore, students utilizing VR-CAM exhibited significantly improved computational and creative thinking over time, unlike those in the non-VR-CAM group.
21	Topu et al. (2023) / Education and Information Technologies	Turkey	To examine how Augmented Reality (AR) technology impacts vocabulary growth and perspectives on AR in preschool English teaching.	A quasi-experimental design	The experimental group demonstrated significant improvements in vocabulary acquisition, positive attitudes, and overall enjoyment compared to the control group, which had some negative feelings. Although both groups had similar emotional reactions, the experimental group favored AR activities more. Overall, AR technology was beneficial for language learning and enhanced enjoyment.
22	Hung & Yeh (2023) / Journal of Computer-Assisted Learning	Taiwan	Examining the impact of an Augmented Reality-enhanced game-based learning (ARGBL) method in language education, mainly focusing on enhancing vocabulary retention and creative thinking within flipped classroom settings.	A quasi-experimental design	Learners engaged in game-based learning enhanced by AR showed better vocabulary and creative thinking results than a control group and favorable feedback about the experience, indicating its effectiveness for flipped classrooms.
23	Liu et al. (2023) / Interactive Learning Environments	China	To assess how well the article-structure strategy-based SVVR (ASS-SVVR) method enhances reading comprehension for EFL students.	A quasi-experimental design.	The ASS-SVVR method enhanced reading comprehension, external motivation for learning, and awareness of metacognitive reading strategies in EFL students. Meanwhile, the two groups had no significant differences in cognitive load and sense of presence.
24	Shadiev et al. (2024) / Computer-Assisted Language Learning	China	To explore how evaluation and feedback influence learning results in two distinct video learning settings: traditional video technology (TVT) and 360-degree video technology (360VT)	A quasi-experimental design	Despite similar pre-test scores, the 360VT group outperformed the TVT group in post-test scores. They received more comprehensive feedback and reported better experiences. The findings suggest that 360VT settings improve learning

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
			within an English as a foreign language (EFL) course.		outcomes and assessment, prompting educators to incorporate 360VT in language learning activities.
25	Naji et al. (2023) / Education and Information Technologies	Iraq	To create and evaluate an augmented reality (AR) system that provides sound effects to help primary school students learn English vocabulary in real time.	A quasi-experimental design	Pupils utilizing the AR-based system attained a 90% success rate in their final exam, considerably higher than the 65% success rate of the control group. This illustrates the capability of AR technology to improve motivation and engagement in learning English.
26	Lin & Wang (2022) / Innovation in Language Learning and Teaching	Taiwan	Examining how an augmented-reality (AR) creative initiative influences English L2 students' views on creativity and exploring methods to enhance their learning motivation.	A mixed-methods research design	Participants generally had positive attitudes towards creative thinking, especially valuing the ideation process, though differences were not statistically significant. The project highlighted that being busy can hinder new idea generation. IMMS findings showed greater engagement correlated with increased relevance, confidence, and satisfaction in the AR experience.
27	Liu (2024) / Entertainment Computing	China	To create an engaging e-learning video environment for English instruction that utilizes virtual reality and gaming techniques to boost students' interest and learning outcomes.	Design-based research	The experiment group demonstrated significantly improved English learning outcomes compared to the control group, with increased interest and engagement. Additionally, students using the platform reported more positive emotions and reduced learning-related stress.
28	Ebrahimi (2022) /Interactive Learning Environments	Vietnam	Analyzing the accomplishments of 120 Vietnamese students by utilizing two mobile learning frameworks—LingAR and Augmented Reality—and assessing their enthusiasm for employing augmented reality in language acquisition.	A mixed-methods research design	Students using the LingAR Application performed better than those using the Augmented Reality model. Feedback from focus groups underscored the augmented reality model's benefits and drawbacks, providing valuable insights for successful implementation and future research involving a larger sample size.
29	Shi et al. (2024) / Education and Information Technologies	Taiwan	Exploring the impact of integrating immersive virtual reality (iVR) technology within project-based learning (PjBL) environments on students' oral English abilities and their level of engagement.	A quasi-experimental design	The PjVR group markedly enhanced their oral English abilities, such as grammar, vocabulary, pronunciation, and communication. They also saw significant progress in their behavioral, emotional, cognitive, and social involvement.

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
30	Khan et al. (2023) / Cogent Arts & Humanities	Saudi Arabia	To assess how augmented reality (AR) influences vocabulary acquisition among students learning English as a foreign language (EFL).	A mixed-methods design	Augmented Reality significantly enhanced learners' vocabulary abilities, and participants reported favorable views on using AR for vocabulary acquisition.
31	Chang et al. (2023) / Education and Information Technologies	South Korea	This study investigates the factors influencing students' ongoing utilization of virtual reality (VR) in language education. It analyzes how VR enhances English learning compared to conventional voice-video communication techniques.	A Theory-driven study	The findings showed that virtual reality (VR) surpasses conventional teaching techniques, highlighting its benefits in boosting creativity, interactivity, teamwork, and problem-solving skills in language acquisition, particularly among young students.
32	Chen (2020) / British Journal of Educational Technology	Taiwan	Exploring the possibilities of augmented reality (AR) to improve scaffolding in video learning resources designed for English as a foreign language (EFL) students.	Experimental research	The study revealed that the ARVEL approach notably enhanced students' academic performance, intrinsic motivation, and contentment with learning English as a foreign language compared to traditional video-based instruction.
33	Hung et al. (2023) / Interactive Learning Environments	Taiwan	To investigate how virtual reality (VR) influences English oral proficiency, speaking anxiety levels, emotional responses, and students' perceptions in English as a foreign language (EFL) classroom.	A mixed-methods design	Quantitative analysis showed no differences between the two groups regarding oral proficiency, speaking anxiety, or emotions. However, qualitative findings indicated that the VR environment could reduce speaking anxiety and be a valuable practice resource. Key themes included "training simulation," "learning without time or space constraints," and "creating a safe learning atmosphere."
34	Lee et al. (2024) / Education and Information Technologies	South Korea	Examining how immersive virtual reality (iVR) enhances speaking abilities among university students in Korea studying English as a Foreign Language within genuine learning settings.	A qualitative research method	Students preferred immersive virtual reality (VR) over traditional methods, valuing authentic discussions and active engagement with virtual items. Key advantages highlighted in interviews included realism, organic interactions, and enhanced speaking opportunities, which contributed to greater comfort and involvement.
35	Guanuche et al. (2024) / Systems, Smart Technologies and Innovation for Society	Ecuador	To create and assess an engaging virtual reality setting for teaching English as a second language to improve student motivation and understanding through technology.	A mixed-methods approach	The expert validation showed unanimous approval of the virtual reality tool for English instruction. Additionally, 95% of students found the virtual environment user-friendly and motivating and expressed interest in using it for other subjects.

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
36	Li et al. (2023) / Virtual Reality	China	Examining the impact of students' existing knowledge on their learning experiences and results within a virtual reality (VR) setting, particularly regarding the development of abstract concepts in academic English writing.	A quasi-experimental design	Acquiring abstract knowledge in a virtual reality setting improves the educational experience compared to conventional methods. Furthermore, individuals with limited prior knowledge demonstrated more effective learning in VR than in traditional non-VR contexts.
37	Hsu et al. (2023) / Computer Assisted Language Learning	Taiwan	Offering an initial assessment of design principles and creating a learning model for English for tourism purposes (ETP) utilizing augmented reality (AR) and context-aware ubiquitous learning (CAUL).	A Design-Based Research procedure	Mobile AR devices should focus on multimodal, scenery-oriented education in mixed environments. Key aspects include an intuitive interface, customized features, and a learning progress portfolio. Effective conversations and proper terminology are vital for improving speaking skills, and resources must align with language learning principles in CAUL.
38	Rapti et al. (2022) / European Journal of Special Needs Education	Greece	Assessing the efficacy of an Augmented Reality (AR) approach for instructing English vocabulary to learners with intellectual disabilities.	A multiple-probe design	The augmented reality intervention enhanced vocabulary recognition for all three participants, demonstrated enduring effects during a follow-up, and was regarded as practical and beneficial in evaluations of social validity.
39	Chen & Hsu (2020) / Computers & Education	Taiwan	Examining how effective a VR game-based English learning app is for students in terms of their learning outcomes, engagement with the game, and self-regulation in learning from both cognitive and psychological viewpoints.	An empirical study	Self-efficacy, intrinsic value, and test anxiety influenced game involvement and experience. Immersion and flow strengthened self-efficacy, while absorption improved self-regulation, which was evident among students. The interactive elements and challenges of the VR application fostered flow, boosting students' motivation to learn.
40	Chen (2022) / Computer Assisted Language Learning	Taiwan	Exploring how technology-enhanced learning reduces public speaking anxiety (PSA) in students EFL.	A quasi-experimental design	All three groups showed decreased PSA levels, but only the VR group had a statistically significant reduction. Technology-enhanced learning groups performed similarly to the lecture-based group, suggesting technology may minimize individual disparities. Additionally, AI feedback played a role in reducing PSA, emphasizing technology's benefits and teachers' importance.

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
41	Ma (2021) / Mobile Information Systems	China	Improving students' English learning ability by implementing a virtual reality (VR) technology-based immersive context teaching method.	A quasi-experimental design	The experimental group attained a higher average level of English, scoring 2.8 points above the control group. This suggests the immersive context teaching approach significantly improves students' English skills.
42	Zhou (2021) / Mobile Information Systems	China	To create and evaluate a system for teaching English that utilizes VR technology while investigating the use of edge computing to enhance the recognition of human behavior in educational environments.	A Mixed methods approach	VR technology boosted students' motivation to learn and heightened their engagement, leading to a 19% rise in English comprehension skills and an 11% increase in resource sharing.
43	Han (2022) / Mobile Information Systems	China	Investigating how integrating virtual reality (VR) with English education can develop an engaging system that lessens foreign language anxiety and improves English proficiency among Chinese students.	Design-based research	90% of students express satisfaction with virtual simulations, and more than eighty percent feel that learning through avatars enhances their skills and connections. Eighty-five percent of participants report a heightened interest in learning English, demonstrating the system's strong viability.
44	Hu et al. (2022)/ Occupational Therapy International	China	Investigating the use of augmented reality (AR) games to teach English pronunciation to children and creating design guidelines for AR educational games informed by learning behaviors.	A mixed-methods experimental research design	The results highlighted elements that affect students' learning behaviors within the AR gamified setting and offered perspectives on students' acceptance of AR applications regarding usability and satisfaction.
45	Karacan & Polat (2022) / Journal of Digital Learning in Teacher Education	Turkey	examining the factors influencing pre-service English instructors' intentions to use AR in their future language training.	A mixed-methods correlational study	The research indicated that attitude, greatly swayed by perceived usefulness, emerged as the most critical predictor of intentions to utilize AR. Conversely, facilitating conditions and ease of use were found to have minimal effect.
46	Lin et al. (2021) / Computer-Assisted Language Learning	Taiwan	Using immersive, scenery-based virtual reality (SBVR) paired learning, investigate how textual, visual, and auditory inputs affect speaking and writing skills in English for Tourism Purposes (ETP).	A single-group quasi-experiment design	The research revealed notable advancements in speaking abilities, encompassing language accuracy, promotion of destinations, knowledge retention, and ETP language reproduction. There was also a noticeable enhancement in writing skills, especially in using advanced vocabulary and knowledge

Row	Authors/ Year/ Journal	Country	Objective	Method	Key Findings
					retention. The results indicate that SBVR positively influences the development of productive ETP skills.
47	Joo & Jin (2024) / TESOL Quarterly	South Korea	Investigating the impact of spherical video-based virtual reality (SVVR) on enhancing students' creativity and curiosity in project-based language learning (PBLL).	A mixed-methods approach	Students' evaluations of their creativity and curiosity demonstrated notable improvement. Qualitative assessments indicated that proficiency in the English language affected students' outcomes. The results suggest that SVVR has the potential to inspire students to adopt new concepts and participate in real-world problem-solving tasks.
48	Chen et al. (2021) / JCAL (Journal of Computer Assisted Learning)	Taiwan	Examining how the incorporation of virtual reality (VR) into problem-based learning (PBL) affects students' motivation, problem-solving abilities, and vocabulary development in learning English as a foreign language (EFL).	A quasi-experimental design	EFL learners who participated in immersive VR had more motivation and improved vocabulary expansion compared to a control group. On the other hand, there was no discernible variation in the ability to solve problems. These results highlight the advantages of virtual reality in language learning.

Appendix B

Reference No.	Open Coding	Axial Coding	Selective Coding
1	Enjoyment of the AR experience	Enhanced Engagement and Motivation	Impacts of using AR/VR on learners' engagement
3	Participants' engagement and positive attitudes		
10	Increased motivation		
39	Enhanced Motivation		
8	Enhanced Enthusiasm		
9	Boosting students' learning motivation and interest		
25	Positive feedback on the learning experience		
42	Increased positive emotions among students		
22	Reduced learning pressure		
27	Higher engagement		
26	Increased interest in learning among the participants		
19	Willingness to use AR in future education		
4	Overall, students' learning enhancement	Enhanced Learning Outcomes and Performance	
8	Enhanced learning outcomes		
19	Improvements in oral proficiency: content, vocabulary, and pronunciation		
16	Significant improvements in oral proficiency		
27	Better English learning performance		
46	Significant improvements in speaking skills		
5	Enhanced performance in Oral skills		
9	Improved learning interest		
25	Higher success rate in end-of-term exams		
	Notable improvements in writing skills		
4	Supporting language learning across affective, cognitive, and social domains	Cognitive and Affective Development	Benefits and Pedagogical strategies of using AR/VR in English language learning and teaching
10	Enhanced critical thinking		
20	Improved creative thinking		
47	A significant development in self-assessment		
8	Enhanced self-regulation		
39	Absorption supported moderate self-regulation in students		
25	Enhanced Motivation and engagement		
13	Engagement in more interactions		
1	Enhancement of color vocabulary better than traditional methods	Language Skills Enhancement and Improvement	
10	Improved speaking skills		
21	Significant improvement in vocabulary learning		
38	Improved vocabulary identification		
14	Enhanced vocabulary recall		
29	Better retention of vocabulary		
46	Improvements in Vocabulary		
	Use of sophisticated vocabulary		
33	VR as an effective practice tool	Technological Integration	Successful implementation and integration of AR/VR in language education
31	Learning without time or space Limitations (Potential Distractions, Integration Challenges, and Time Consumption)		
18	Facilitating collaboration in group settings		
35	Enhanced human-computer interaction		
45	User-friendliness and ease of use		
	Ease of use effect on intentions to use AR		
9	Deepened Cultural Self-Reflection	Cultural and Social Awareness Enhancement	Learners' perceptions of the effectiveness of AR/VR
12	Refined Interpersonal Cultural Sensitivity		
20	Guided Participatory Cultural Immersion		
	Elevated Cultural Curiosity and Engagement		
3	Challenges (time consumption, potential distractions, and integration challenges)	Challenges and Limitations	Challenges of using AR/VR in English language
15	Need for Further development		
7			

Reference No.	Open Coding	Axial Coding	Selective Coding
28	Mixed reactions among learners Importance of considering Advantages and Disadvantages (Physical health risks, learning inequality, distraction and engagement issues, high costs)		learning and teaching
18 37 34 33	Personalizing learning experiences Emphasizing authentic dialogues Enjoying dynamic interactions with virtual objects Realism and natural interactions Providing a safe learning environment	Personalization and Authenticity in Learning	Beneficial influences of using AR/VR in Language learning and teaching
11 13 9	Increased self-confidence Higher self-efficacy Enhanced Confidence	Higher Self-Efficacy and Better Confidence	
24 40	More detailed feedback AI feedback contributed to public speaking anxiety reduction	Improved Feedback and Assessment	
15 18 22 33	Effectiveness of Learning English for Specific Purposes Modernizing English curriculum teaching Effectiveness of flipped classroom settings Providing a safe learning environment	Improvements in Teaching and Learning Methods	
31 4 13	Facilitating collaboration in group settings Promoting interactivity among learners Co-construction of meaning through engagements Engagement in more interactions	Collaborative and Interactive Learning	