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A STRUCTURED REVIEW OF MOBILE AUGMENTED REALITY FOR LANGUAGE INSTRUCTION AND LEARNING

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Abstract:

Mobile technology has revolutionized various aspects of our lives, including education. With the rapid advancement of mobile devices and their increasing accessibility, educators have begun exploring new and innovative ways to enhance learning experiences. One such innovation is the integration of augmented reality (AR) applications into education. However, there is still limited research about teaching and learning in a foreign language. Therefore, the present study discusses the potential of AR technology in teaching as an educational tool, specifically for language teaching and learning. Thus, this paper employed the method of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) to highlight the potential of AR technology as an educational tool. Advanced searching has been used through Scopus and Web of Science (WoS) databases were the main platforms for sources for articles. Based on the search results, we found (n=25) published articles that associated AR in language instruction and learning were extracted out of (n=705), from 2022 to 2023. Expert scholars decided to develop three themes which are (1) the type of platforms used for mobile augmented reality (MAR) applications in language instruction and learning, (2) the language proficiencies focused on MAR applications, and (3) the impacts of MAR applications on language instruction and learning. By showcasing MAR's potential to motivate and engage learners, this paper underscores its significance in modern language education.

Keywords:

Mobile Augmented Reality, Augmented Reality, Education, Language

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Introduction

The realm of education is experiencing a paradigm shift, shaped by the rapid evolution of technology. One of the most intriguing innovations to emerge in recent years is mobile augmented reality (MAR). In the context of language instruction and learning, MAR is opening up new horizons, and transforming the way languages are taught and acquired. This systematic review aims to offer an in-depth exploration of the state-of-the-art in the field of MAR applications for language instruction and learning. Language education has always been a cornerstone of cultural understanding, communication, and personal development. In a globalized world, proficiency in multiple languages is increasingly recognized as a valuable skill (Nolte, Fletcher-Watson, Sorace, Stanfield, & DIgard, 2021; Upadhyay, 2020). This recognition has fueled the demand for effective, engaging, and accessible language instruction. As such, language educators and learners are continually seeking innovative tools and methodologies that can facilitate the language learning process.

Mobile technology has played a pivotal role in reshaping language education (Li, Bonk, & Zhou, 2023; Raj & Tomy, 2023; Wang, Yuizono, Wang, Kim, & Lu, 2023; Zakian, Xodabande, Valizadeh, & Yousefvand, 2022). The ubiquity of smartphones and tablets has provided an unprecedented opportunity to make learning accessible anytime and anywhere. However, it is not just the mobile devices themselves that are propelling change. It is the fusion of mobile technology with AR that is revolutionizing language instruction (Al-Ansi, Jaboob, Garad, & Al-Ansi, 2023; Yangin Ersanli, 2023). AR is a technology that overlays digital information on the physical world (Taskiran, 2019), enhancing the user's perception of reality. It brings a layer of interactivity, engagement, and immersion to learning experiences (Zuo, Jiang, Van der Spek, Birk, & Hu, 2022). In language education, AR applications offer the potential to bridge the gap between theoretical language instruction and real-world language usage (Huertas-Abril, Figueroa-Flores, Gómez-Parra, Rosa-Dávila, & Huffman, 2021; Majid, Mohammed, & Sulaiman, 2015; Taskiran, 2019). One of the distinctive features of AR is that it blurs the lines between the virtual and the physical, making it particularly suitable for language instruction. It allows learners to see, hear, and interact with language elements in their natural context (Akcayir & Akcayir, 2016). For instance, learners can point their mobile devices at objects or scenes and receive immediate translations or pronunciations (Wan Daud, Ghani, Rahman, Bin Mohamad Yusof, & Amiruddin, 2021). They can engage in conversations with virtual characters, practice language in authentic scenarios, and explore cultural elements within the language environment (Liao, Wu, Gunawan, & Chang, 2023).

The evolution of AR has taken a significant step forward with the integration of mobile devices. Likewise, MAR applications, commonly accessed through smartphones and tablets (Majid et al., 2015), have made AR more accessible, affordable, and user-friendly. This evolution holds immense promise for language instruction and learning. MAR applications for language learning have the potential to revolutionize the traditional language classroom (Majid et al., 2015). They offer a dynamic and personalized learning experience (Geetha & Mala, 2022; Konstantakis, Lykiardopoulou, Lykiardopoulou, Tasiouli, & Heliades, 2022), catering to the diverse needs and preferences of learners (Anderson, 2019). Whether in a formal educational setting, self-study, or informal learning contexts, MAR applications provide learners with a powerful tool to engage with languages in a manner that is immersive, interactive, and enjoyable (Liu, Gao, & Ji, 2023).

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In the ever-expanding landscape of MAR applications for language instruction and learning, educators, researchers, and learners alike face the challenge of navigating the multitude of available options. While MAR's potential is clear, there is a need to assess the current state of the field systematically. This structured review seeks to address this need by critically examining the literature, identifying key themes and trends, and providing a comprehensive overview of MAR applications for language learning. Hence, this structured review aims to provide a comprehensive overview of the current state of MAR applications for language instruction and learning, with three research questions as follows:

1. What are the types of platforms utilized in MAR applications for language learning?
2. What are the language proficiencies focused on MAR applications?
3. What are the impacts of MAR applications on language instruction and learning?

The scope of this review encompasses MAR applications for the learning of any language. It includes formal language instruction in educational institutions and applications used for specific language skills, such as vocabulary acquisition, pronunciation practice, and cultural immersion. The review will consider a wide range of MAR applications designed for learners of different ages and language proficiency levels. The significance of this structured review lies in its potential to shed light on the current state of MAR applications for language instruction and learning. By providing a comprehensive overview, identifying key themes and trends, and offering insights and recommendations, this review aims to inform educators, researchers, developers, and policymakers in the field of language education. It serves as a valuable resource for those seeking to harness the potential of MAR enhance language learning experiences.

In conclusion, MAR applications are redefining the landscape of language instruction and learning. This structured review embarks on a systematic exploration of the field, offering a comprehensive examination of the current state of MAR applications for language education. As we delve into the literature and assess the impact and challenges of MAR in language learning, we hope to provide valuable insights that will shape the future of language education and make language learning more engaging, effective, and accessible.

Material and methods

Identification

The three fundamental elements of the systematic review technique were used to pick a large number of pertinent papers for this investigation. In the first stage, keywords are selected and related terms are searched for using dictionaries, thesauri, encyclopedias, and previous research. The search strings for the databases Scopus and Web of Science in Table 1, have been produced once all pertinent phrases have been chosen. 705 papers were successfully retrieved from both databases during the first phase of the systematic review procedure for the current study topic.

Table 1: The Search String

Scopus	TITLE-ABS-KEY (("mobile augmented reality" OR "augmented reality") AND education AND language) AND PUBYEAR > 2021 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (LANGUAGE, "English"))

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WoS	("mobile augmented reality" OR "augmented reality") AND education AND language(Topic) and 2022 or 2023 (Publication years) and Article (Document) and English (Language)

Screening

After the articles are identified, the first screening stage involves removing duplicate papers. Duplicate papers were purposefully excluded from the first screening to guarantee that only original and unique materials were taken into consideration for additional examination. A total of twenty-five papers were eliminated from the initial round due to their duplicate content. After 110 papers were thoroughly reviewed, stage two was initiated. A variety of thoughtfully crafted inclusion and exclusion criteria were used throughout the screening process. As the principal source of pertinent information, research publications, in particular, constitute a fundamental criterion that was considered. Therefore, no systematic reviews, reviews, books series, books, chapters, meta-analyses, or conference proceedings were included in the current investigation. Moreover, only English-language publications were eligible for assessment. It should be noted that the approach was developed for the most recent two-year term (2022–2023), during which time a total of 595 articles were excluded based on particular criteria.

Eligibility

For the third phase, the eligibility evaluation, 110 papers were collected. At this step, we made sure that every article met the inclusion criteria and was pertinent to the goals of the ongoing study by carefully going over its title and key points. 60 papers were not included in the analysis because their titles were irrelevant, their abstracts did not pertain to the research issue, or both, and they were not related to the study's objectives based on empirical data. 25 articles were therefore retained for additional review (Table 2).

Table 2: The Selection Criterion Is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2022-2023	< 2022
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press

Data Abstraction and Analysis

An integrative analysis was employed as one of the study's evaluation techniques to examine and integrate several research approaches (quantitative, qualitative, and mixed methods). Finding pertinent subjects and subtopics was the competence study's aim. The collection of data marked the start of the subject's development. Figure 1 shows how the authors meticulously examined a set of 25 papers to look for assertions or details relevant to the topics of the current study. The authors then evaluated current, pertinent research on the application of augmented reality. All of the research's conclusions are being investigated, as are the methods employed. Following that, the author and the other co-authors worked together to create themes using the data within the study's framework.

A log was maintained throughout the data analysis process to record any analyses, viewpoints, riddles, or other concepts that might be relevant to the interpretation of the data. After comparing the results, the authors searched for differences in the theme design process. It is important to remember that the writers discuss any conceptual disagreements. Final tweaks

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were made to the developed themes to ensure consistency. The analytical selection to determine the authenticity of the issues was carried out by two experts: Radhwa Abu Bakar, a specialist in linguistics, and Mohd Feham Md Ghalib, an expert in educational technology and media in the field of education. The expert review process finds it easier to ensure that each subtheme is unique, significant, and relevant when the domain is defined.

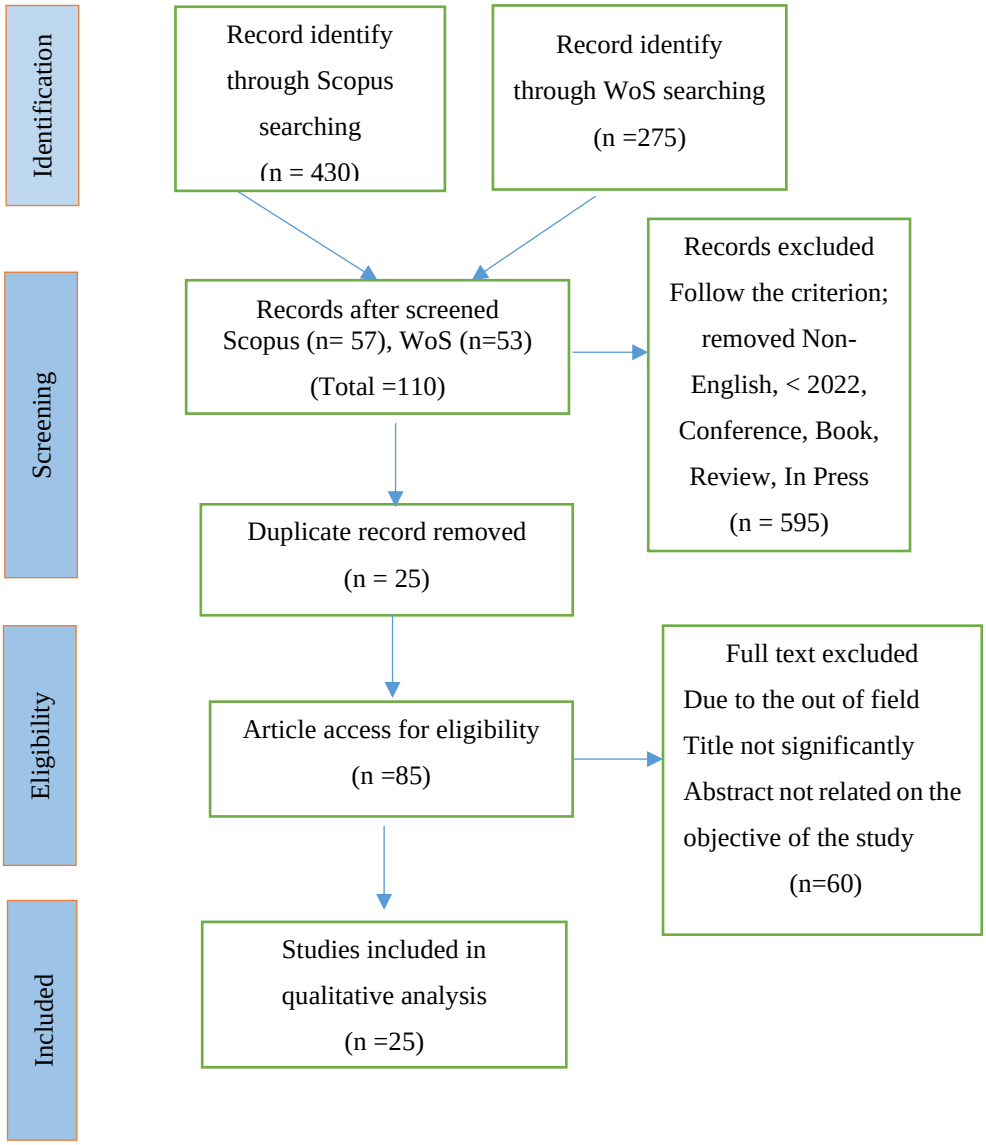

Fig 1. Flow Diagram Of The Proposed Search Study (Page et al., 2021)

Result and Findings

We found 25 published papers from 705 in the recent years between 2022 and 2023 that were relevant to augmented reality (AR) for language training and learning based on the search results. The results demonstrated how each examined work had a variety of aims and MAR applicability. The research purpose, MAR platform, and findings are presented in Table 3, which is a matrix of the investigations.

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Table 3: Summary Of the Selected Studies

No.	Study	Aim	Platform	Findings
1	'AReal-Vocab': An Augmented Reality English Vocabulary Mobile Application to Cater to Mild Autism Children in Response towards Sustainable Education for Children with Disabilities (Hashim, Yunus, & Norman, 2022)	The study aimed to address the learning challenges faced by children with autism spectrum disorder, focusing on their social communication difficulties and restricted behaviors.	Mobile AR application	The findings demonstrated that the application significantly improved English vocabulary learning among children with moderate autism. AReal-Vocab not only enhanced engagement and interest in language learning but also served as a platform for leisure learning at home, improving pronunciation skills and language articulation.
2	An examination of vocabulary learning and retention levels of preschool children using augmented reality technology in English language learning (Yilmaz, Topu, & Takkaç Tulgar, 2022)	This study aimed to investigate preschool children's vocabulary learning and retention using AR technology.	Marker-based AR-supported educational toys	Results showed a 72-point increase in word/concept learning after the AR implementation, with a 17-point drop in retention after a two-week break. Children correctly answered 93% of visual English words and 55% of word equivalents. Qualitative findings indicated children's positive attitudes toward AR materials, highlighting its beneficial impact on learning.
3	AREL – Augmented Reality–based enriched learning experience (Geetha & Mala, 2022)	The study aims to enhance primary student learning through a multi-modal mobile-based AR platform, AREL.	Mobile AR-based enriched learning (AREL) platform	User feedback indicates that AREL significantly improves the learning experience for learning Tamil and Hindi language, and mathematics for primary students.
4	Assessing the efficacy of augmented reality in enhancing EFL vocabulary (Khan, Ali, Kumar, & Venugopal, 2023)	This study investigates the impact of AR on vocabulary development in English as a foreign language (EFL) learning.	AR-supported materials in the Nearpod platform	Data collection includes pretests, post-tests, delayed post-tests, and semi-structured interviews. T-test analysis of these tests showed that AR positively influenced vocabulary skills, and learners expressed favorable perceptions of AR in vocabulary learning.

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5	Augmented reality games in linguistic education: the model of cultural concepts in the linguistic worldview of philology students (Khamitova, Tymbolova, Omarbayeva, & Zholshayeva, 2023)	The study evaluated the efficacy of integrating linguistics, sociolinguistics, ethnolinguistics, and psycholinguistics into the learning process using AR tools.	AR games-based in linguistic education	Students' Kazakh cultural knowledge increased from 5% to 22% after a year of studying disciplines, with games positively impacting linguistic and cognitive skills and filling teaching methodology gaps.
6	Beyond borders: exploring the impact of augmented reality on intercultural competence and L2 learning motivation in EFL learners (Liu et al., 2023)	This mixed-methods study aimed to investigate the impact of AR on intercultural competence and second language (L2) learning motivation among Chinese English as a Foreign Language (EFL) learners.	AR-based language instruction application	Pre- and post-tests revealed that the experimental group exhibited significantly higher intercultural competence and L2 learning motivation. Qualitative data supported these findings, indicating that AR-enhanced engagement, motivation, and cultural understanding. The study suggests AR's potential for innovative pedagogical approaches in language education.
7	Development and evaluation of a didactic tool with augmented reality for Quechua language learning in preschoolers (Zapata-Paulini, Beltozar-Clemente, Sierra-Liñan, & Cabanillas-Carbonell, 2023)	The study aimed to preserve cultural identity by promoting the mother tongue, Quechua, using AR in preschool education.	Mobile AR application for Quechua vocabulary	An AR application significantly improved learning, satisfaction, and preference in preschool students, enhancing Quechua language learning and preserving cultural identity, demonstrating design thinking and performance improvement over traditional methods.
8	Exploring the Promise of Augmented Reality for Dual Language Vocabulary	The study explores the promise of AR for early childhood education, specifically for	Mobile AR application for English vocabulary	The research presents iterative design data and a proof-of-prototype user study, including child and parent acceptance data. Findings suggest the potential of AR to offer English vocabulary

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	Learning Among Bilingual Children: A Case Study (Smith, Carlo, Park, & Kaplan, 2023)	English language learners (ELLs).		instruction with native language support for children.
9	Exploring the viability of augmented reality game- enhanced education in WhatsApp flipped and blended classes versus the face-to-face classes (Khodabandeh, 2023)	The study investigates the effectiveness of augmented reality games (ARG) in teaching English as a foreign language, specifically giving and asking for directions.	AR game-based education in WhatsApp	After 8 weeks of ARG-enhanced education (flipped and blended approaches), the comparative groups outperformed the control group in learning directions. This research suggests ARG technology can enhance language learning in both online and traditional classrooms.
10	Integrating augmented reality in language learning: pre-service teachers' digital competence and attitudes through the TPACK framework (J Belda-Medina & Calvo-Ferrer, 2022)	The study examines pre-service teachers' digital competence and attitudes toward integrating AR in foreign language classrooms.	Mobile AR application	Findings revealed that participants lacked practical knowledge in AR content creation and implementation in education, particularly regarding the intersection of Technological Pedagogical Knowledge (TPK). The research highlights the need for better preparation of pre-service teachers as AR content creators.
11	Motivational Readiness of Future Teachers-Philologists to Use the Gamification with Elements of Augmented Reality in Education (Petrovych, Zavalniuk, Bohatko, Poliarush, & Petrovych, 2023)	The article investigates philology students' motivations for incorporating gamification with AR elements in education, specifically through the board game "Fantaziarium".	AR game-based	A survey involving 47 fourth-year students majoring in Secondary Education (Ukrainian language and literature) revealed the effectiveness of creative project-oriented activities, suggesting a sequence of steps to enhance students' motivational readiness for gamification with AR.
12	Problem-based gaming via an	This study aimed to compare the	AR mobile game	The study found that both AR and print-based language

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	augmented reality mobile game and a printed game in foreign language education (Lee, 2022)	impact of an AR mobile game and a printed game on student engagement and attitudes toward foreign language learning.		learning groups showed similar engagement and positive attitudes, with print reading being perceived as more useful.
13	Promoting Augmented Reality Technology in Teaching English Language to Non-Linguistic Students in Higher Education (Dukalskaya & Tabueva, 2022)	This study examines the advantages of using Information Technology (IT) in English language learning for non-linguistic students in higher education, with a focus on AR technology and Quick Response codes.	AR application and QR codes	The results demonstrated that the IT-assisted group exhibited higher motivation, interest in learning, and professional foreign-language competence. The study underscores the effectiveness of using IT in teaching English to non-linguistic students, providing valuable insights for educators and administrators in developing teacher training programs.
14	Psychological and pedagogical innovative technologies for teaching English to university students (Assem et al., 2022)	This research aims to gather opinions from 25 academics teaching English at various universities in Kazakhstan about the use of AR technology for teaching English to university students.	Mobile AR application	Most participants currently do not employ AR applications, but they suggest that AR can enhance learning by improving student performance, creating flexible learning environments, and increasing engagement, enjoyment, curiosity, and the desire to learn foreign languages. The study underscores the potential benefits of integrating AR technology into university English education curricula.
15	Teachers as augmented reality designers: A study on Italian as a foreign language teacher perceptions (Manna, 2023)	This investigation focuses on educators' perceptions of designing and implementing MAR for teaching Italian as a foreign language (TIFL).	Mobile AR application	The study reveals that, according to teachers, MAR can enhance the learning process, but considerations such as economic and infrastructural limitations should be addressed before implementing AR on a larger scale.
16	Teachers' Attitudes Towards the Use of Augmented	This study assesses teachers' readiness to use AR technology in	Mobile AR application	The results indicate that their readiness levels, especially among veteran teachers with limited IT experience, are at a

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	Reality Technology in Teaching Arabic in Primary Schools Malaysia (Asbulah, Sahrim, Soad, Rushdi, & Deris, 2022)	teaching Arabic in Malaysia.		moderate level. The study highlights the importance of promoting augmented reality technology in Arabic language teaching to enhance student performance and mastery of the language.
17	The Effect of Using Augmented Reality with Storytelling on Young Learners' Vocabulary Learning and Retention; [Artırılmış Gerçeklik ile Hikâye Anlatımının Çocuk Öğrenenlerin Sözcük Öğrenimi ve Hatırda Kalıcılığına Etkisi] (Yangin Ersanli, 2023)	This study aimed to assess the impact of AR on vocabulary learning and retention among 5th-grade students in Turkish.	Mobile AR application	The experimental group using AR materials displayed significantly better vocabulary retention than the control group using flashcards. AR technology was found to enhance student motivation, highlighting its potential as an innovative tool for vocabulary learning in educational settings.
18	The Effect of Web Augmented Reality on Primary Pupils' Achievement in English (Hussein et al., 2023a)	This study aims to integrate Web AR into school instructional materials to align teaching methods with technological advancements.	QR code-based tracking Web AR application	The research showed that using Web AR in education required a significant learning period due to students' acceptance and adaptation to the technology.
19	The effects of augmented reality storybooks on student's reading comprehension (Şimşek & Direkçi, 2023)	This study aimed to compare the reading comprehension levels of two groups of 11-12-year-old students using AR and traditional reading techniques.	Mobile AR application	In the pre-test, both groups performed similarly in total comprehension scores. However, in the post-test, the experimental group, which used AR, outperformed the control group, especially in reorganization, inferential comprehension, evaluation, and appreciation. This suggests that AR content

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				can enhance students' reading comprehension.
20	The Impact of Augmented Reality (AR) on Vocabulary Acquisition and Student Motivation (J Belda-Medina & Marrahi-Gomez, 2023)	The research aimed to measure perceptions of AR technology, its impact on vocabulary development, and student motivation.	AR-based lessons via Scope App.	While positive attitudes towards AR were observed, no significant differences in vocabulary learning performance were found between the groups, indicating that AR did not significantly enhance vocabulary development in this context.
21	The Use of Augmented Reality through Assemblr Edu to Inspire Writing in an Ecuadorian EFL Distance Program (Carrión, Verónica, & Alba, 2023)	This study examined the effectiveness of using the Assemblr Edu platform with AR to improve English as a foreign language (EFL) writing skills in a distance education setting.	AR on the Assemblr Edu platform	Using mixed methods, the study used pre-tests, post-tests, written tasks, and surveys. The findings showed that Assemblr Edu, with its AR elements, enhanced students' writing skills, particularly in paragraph organization, grammar, vocabulary, and punctuation, by providing interactive and multimedia-rich teaching materials.
22	Using Augmented Reality (AR) As An Authoring Tool In EFL Through Mobile Computer-Supported Collaborative Learning (Jose Belda-Medina, 2022)	This study examines the potential of AR as a transformative technology in teacher training programs for second language learning in Spain.	Mobile AR application	While the teacher candidates lacked practical training in AR content creation, they had positive attitudes toward AR as a transformative technology, particularly for student engagement and collaboration. There was also a correlation between positive attitudes and the perceived level of difficulty in AR integration.
23	Using an Augmented-Reality Game-Based Application to Enhance Language Learning and Motivation of Elementary School EFL Students: A	This comparative study aimed to assess the impact of an AR Game-Based Learning application, StemUp, on English learning among rural and urban EFL (English as a	AR game-based application	The research found that both groups significantly improved in English performance and motivation, with rural students showing greater gains. Qualitative data emphasized motivation, enjoyment, gamification, and learning effectiveness. The study concludes that StemUp offers a promising tool for enhancing English language development

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	Comparative Study in Rural and Urban Areas (Liao et al., 2023)	Foreign Language) learners.		and motivation among EFL learners, regardless of their urban or rural background
24	Embedding dialog reading into AR picture books (Chang, Tai, Liu, & Sung, 2023)	This study aimed to enhance parent-child reading through the integration of AR technology into picture books, employing the prompt, expand, evaluate, and repeat (PEER) dialog reading (DR) strategy.	AR application with QR code	The experimental group, who engaged in AR-assisted reading without parental accompaniment, demonstrated significantly higher learning effectiveness compared to the control group, showcasing the positive impact of AR-assisted reading on children's learning.
25	Learning English in Early Childhood Education with Augmented Reality: Design, Production, and Evaluation of the Wordtastic Kids App (Mamani-Calapuja, Laura-Revilla, Hurtado-Mazeyra, & Llorente-Cejudo, 2023)	This study aimed to develop and evaluate the Wordtastic Kids Application, AR application designed for early childhood education to enhance English language learning.	Mobile AR Application	The Wordtastic Kids Application significantly enhanced English vocabulary learning in preschool children, highlighting its potential in early education, requiring teacher preparation, content quality, and tech proficiency.

Discussion

RQ1: What Are The Types Of Platforms Utilized In MAR For Language Learning?

Mobile Augmented Reality (MAR) has gained significant attention in language learning due to its ability to create immersive and interactive experiences. There are various types of platforms and technologies employed in MAR for language learning. In this structured review, some of the common platforms utilized (1) mobile applications, (2) AR-game-based education, (3) browser-based AR, and (4) QR codes and marker-based AR. These platforms are emerged from reviewing the literature and shown in Table 4 with the respective articles used in this study.

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Table 4: Types of Platforms Utilized in MAR for Language Learning

Type	Studies
Mobile application	(Asbulah et al., 2022; Assem et al., 2022; J Belda-Medina & Marrahi-Gomez, 2023; Jose Belda-Medina, 2022; Geetha & Mala, 2022; Hashim et al., 2022; Liu et al., 2023; Mamani-Calapuja et al., 2023; Manna, 2023; Şimşek & Direkçi, 2023; Smith et al., 2023; Yangin Ersanli, 2023; Zapata-Paulini et al., 2023)
AR game-based education	(Khamitova et al., 2023; Khodabandeh, 2023; Lee, 2022; Liao et al., 2023; Petrovych et al., 2023)
Browser-based AR	(Carrión-Robles, Espinoza-Celi, & Vargas-Saritama, 2023; Hussein et al., 2023b; Khan et al., 2023)
QR codes and marker-based AR	(Chang et al., 2023; Dukalskaya & Tabueva, 2022; Hussein et al., 2023b; Yilmaz et al., 2022)

One common option for providing augmented reality language learning experiences is through mobile applications. Installing these applications on tablets and smartphones enables language learners to access language content at any time and from any location. They frequently provide interactive language courses by superimposing AR elements over the real world using the device's camera and display. The results from these 13 studies (Asbulah et al., 2022; Assem et al., 2022; J Belda-Medina & Marrahi-Gomez, 2023; Jose Belda-Medina, 2022; Geetha & Mala, 2022; Hashim et al., 2022; Liu et al., 2023; Mamani-Calapuja et al., 2023; Manna, 2023; Şimşek & Direkçi, 2023; Smith et al., 2023; Yangin Ersanli, 2023; Zapata-Paulini et al., 2023) reported a similar notion, whereby using AR through mobile application platforms encouraged better comprehension of language learning.

The study by (Simsek & Direkçi, 2023) explored the use of AR storybooks on tablets to enhance reading comprehension, showing that AR significantly improved students' performance in various comprehension aspects. In another study, (Zapata-Paulini et al., 2023) developed an AR application for teaching Quechua to preschool children, leading to a substantial improvement in their learning compared to traditional methods, highlighting the effectiveness of AR in language acquisition and cultural preservation. Additionally, (Hashim et al., 2022) addressed the challenges faced by children with autism spectrum disorder by using AR to enhance English vocabulary learning. Their AReal-Vocab application not only improved engagement and language learning but also served as a valuable tool for leisure learning, enhancing pronunciation and articulation skills. These studies collectively underline the potential of AR to revolutionize education and offer tailored, engaging learning experiences.

Gamification creates engaging and interactive experiences for users by utilizing a variety of game contexts and game design features. Gamification platforms typically consist of the following components: badges and points. Positive outcomes from game-based learning have also been observed, especially in terms of encouraging language acquisition (Khamitova et al., 2023; Khodabandeh, 2023; Lee, 2022; Liao et al., 2023; Petrovych et al., 2023). In (Lee, 2022), mobile augmented reality games and printed games were compared for language acquisition purposes. Findings revealed comparable attitudes and levels of involvement, with print reading being viewed as being more beneficial. AR games with a storyline are encouraged

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by the study. Mobile games were described as stimulating and demanding in a different study (Liao et al., 2023) and kept language learners engaged. The same study concludes that StemUp presents a viable instrument for boosting EFL learners' motivation and English language development.

Another type of platform utilized in MAR in this structured review is a browser-based AR. Browser-based is a Web-based AR technology. It is increasingly used for language learning. Learners can access AR language content through a web browser without the need for dedicated applications or installations. This approach offers flexibility and wider accessibility. Both studies (Carrión-Robles et al., 2023; Khan et al., 2023), incorporated browser-based AR in their language learning. The study by (Carrión-Robles et al., 2023) found that Assemblr Edu's AR platform improved EFL writing skills, enhancing paragraph structure, grammar, vocabulary, and punctuation. It allows educators and students to create, explore, and interact with AR content. Likewise, (Khan et al., 2023) explored AR's impact on EFL vocabulary using the Nearpod platform. T-test analysis revealed AR positively influenced vocabulary skills, supported by learners' favorable perceptions of AR in English learning.

Aside from browser-based AR, QR code and marker-based AR are utilized as platforms of MAR. QR codes and markers can be placed on printed materials, textbooks, or posters. Scanning these markers with a mobile device's camera can trigger AR language content, making printed resources interactive and engaging. In one study, Hussein et al.'s study (2023), the incorporation of QR code-based tracking Web AR application into school materials was intended to align teaching with technological advancements. However, the research revealed that students required a substantial adaptation period. Another study by (Chang et al., 2023), explored the learning processes and student's engagement in reading AR-based picture books. The results showed the positive impact of AR-assisted reading on children's learning.

RQ2: What Are The Language Proficiencies Focused On MAR Applications?

In the second research question, we examined the language proficiencies focused on MAR application. The integration of AR technology into language education has been a subject of growing interest in recent years. Various language proficiencies, including vocabulary, reading, writing, and overall language competency, as evidenced by recent studies. Table 5 below shows the language proficiencies focused on MAR for language learning.

Table 5: Language Proficiencies Focused on In MAR For Language Learning

Language proficiencies	Studies
Vocabulary	(J Belda-Medina & Marrahi-Gomez, 2023; Hashim et al., 2022; Khan et al., 2023; Smith et al., 2023; Yilmaz et al., 2022)
Reading	(Chang et al., 2023; Şimşek & Direkçi, 2023)
Writing	(Carrión-Robles et al., 2023)
All skills (language competency)	(Asbulah et al., 2022; Assem et al., 2022; Dukalskaya & Tabueva, 2022; Khamitova et al., 2023; Khodabandeh, 2023; Liu et al., 2023; Zapata-Paulini et al., 2023)

Multiple studies, including those conducted by (J Belda-Medina & Marrahi-Gomez, 2023; Hashim et al., 2022; Khan et al., 2023; Smith et al., 2023; Yilmaz et al., 2022)**,** have delved into the effectiveness of AR in enhancing vocabulary acquisition. These studies demonstrate

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that AR can significantly improve learners' vocabulary skills, making it an invaluable tool for language instruction. AR, with its interactive and multimedia-rich content, can engage students and facilitate effective vocabulary retention.

The authors (Şimşek & Direkçi, 2023) focused on the impact of AR on reading comprehension. Their study revealed that AR-assisted storybooks on tablets could significantly enhance students' reading comprehension, particularly in areas like reorganization, inferential comprehension, evaluation, and appreciation. AR's potential to immerse learners in textual content makes it a promising avenue for improving reading skills.

Similarly, the prompt, expand, evaluate, and repeat (PEER) dialogue reading approach was used in (Chang et al., 2023) study to create a picture book that used augmented reality (AR) technology. With the use of a mobile device, augmented reality information is taken directly from the book to assist kids in PEER-based reading. The statistics indicated that, in terms of learning efficacy, the experimental group did better than the control group. There was a noticeable sequence of behavioral shifts that went like this: "scanning with a mobile device → viewing augmented information → responding to the questions on the mobile device →" This cycle demonstrates how the kids' engagement with the picture book, mobile device, and kids themselves enhanced their learning outcomes.

The study conducted by (Carrión-Robles et al., 2023) examined the influence of AR on writing skills. Their research indicates that AR can inspire and improve writing skills in language education. The immersive and interactive nature of AR technology provides learners with a more engaging and creative platform for honing their writing abilities.

Several studies, including those by (Asbulah et al., 2022; Khamitova et al., 2023; Khodabandeh, 2023; Liu et al., 2023; Zapata-Paulini et al., 2023), assessed AR's impact on overall language competency. These studies collectively emphasize that AR is a potent tool for enhancing language skills holistically. It enables students to engage with language content in an interactive and immersive manner, facilitating comprehensive language development.

The incorporation of AR in language education has shown remarkable promise in improving vocabulary acquisition, reading comprehension, writing skills, and overall language competency. These studies collectively highlight the transformative potential of AR in reshaping language education by making it more interactive, immersive, and enjoyable. As technology continues to advance, the application of AR in language education is expected to grow, offering educators and learners new horizons for language acquisition and development.

RQ3: What Are The Impacts Of MAR Applications On Language Instruction And Learning?

The third research question addresses the impacts of MAR applications on language instruction and learning. Based on the findings it was reported that there are many advantages to incorporating AR technology into language instruction and learning. The affordances of this technology include the language proficiency, learning satisfaction, situated learning, collaborative learning, and personalized learning. Table 6 below shows the impacts of MAR applications on language instruction and learning.

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Table 6: The Impacts of MAR Applications on Language Instruction and Learning

Impacts of MAR applications on on language instruction and learning	Studies
Language proficiency	(Asbulah et al., 2022; Jose Belda-Medina, 2022; Khamitova et al., 2023; Khan et al., 2023; Liao et al., 2023; Zapata-Paulini et al., 2023)
Increased learning satisfaction	(Assem et al., 2022; J Belda-Medina & Marrahi-Gomez, 2023; Dukalskaya & Tabueva, 2022; Geetha & Mala, 2022; Khodabandeh, 2023; Liao et al., 2023; Liu et al., 2023; Petrovych et al., 2023)
Situated learning	(Chang et al., 2023; Şimşek & Direkçi, 2023)
Collaborative learning	(Jose Belda-Medina, 2022)
Personalized learning	(Huertas-Abril et al., 2021; Hussein et al., 2023a; Mamani-Calapuja et al., 2023)

MAR applications have shown a significant impact on language instruction and learning, as evidenced by various studies. One of the noteworthy effects is the improvement in language proficiency, as reported by researchers such as (Asbulah et al., 2022; Jose Belda-Medina, 2022; Khamitova et al., 2023; Khan et al., 2023; Liao et al., 2023; Zapata-Paulini et al., 2023). AR applications provide an immersive and interactive environment that can enhance language learning experiences.

Furthermore, students tend to exhibit increased learning satisfaction when using AR, as observed in studies by (Assem et al., 2022; J Belda-Medina & Marrahi-Gomez, 2023; Dukalskaya & Tabueva, 2022; Geetha & Mala, 2022; Khodabandeh, 2023; Liao et al., 2023; Liu et al., 2023; Petrovych et al., 2023). The studies underscore AR's role in boosting engagement and motivation in language learning. The interactive nature of AR applications and the gamification elements often integrated into AR experiences make learning more enjoyable, thus enhancing students' motivation and participation.

Another significant effect is the promotion of situated learning, a concept highlighted by (Chang et al., 2023; Şimşek & Direkçi, 2023), which enables students to apply knowledge in real-world contexts, making their learning more relevant and practical. Collaborative learning, as indicated by (Jose Belda-Medina, 2022), benefits from AR applications by fostering group interactions and knowledge sharing. Moreover, AR enables personalized learning, as emphasized by (Huertas-Abril et al., 2021; Hussein et al., 2023a; Mamani-Calapuja et al., 2023), tailoring educational experiences to individual needs and preferences. In conclusion, the incorporation of AR applications in education has proven to enhance language proficiency, boost learning satisfaction, promote situated and collaborative learning, and offer personalized learning experiences for students, ultimately contributing to a more effective and engaging learning environment.

Conclusions

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This structured review has reviewed papers related to MAR in language instruction and learning. Two databases, namely the Web of Science (WoS) and Scopus were used. 25 final articles were included in this review based on the inclusion and exclusion criteria above. The main findings highlight three aspects of the trends in MAR for language instructional and learning, as follows:

1. There are four types of platforms and technologies employed in MAR for language instructional and learning in this review: mobile applications, tablets and smartphones, browser-based AR, and QR codes and marker-based AR.

2. The language proficiencies focused on MAR applications in this structured review include vocabulary, reading, writing, and overall language competency.

3. AR applications in education have been found to significantly enhance language proficiency, increase learning satisfaction, promote situated and collaborative learning, and offer personalized learning experiences, ultimately creating a more effective and engaging learning environment, as supported by a variety of studies.

To optimize the use of AR technology for younger students, it is recommended that parents and teachers work together, that different learning plans be combined, and that teachers' technological proficiency be developed. The report calls for further extensive studies that last a long time to look at how AR technology is used and how students feel about it. It also calls for comparative studies to be carried out to assess the benefits of gamified learning based on augmented reality in both indoor and outdoor language classrooms. Finally, while resolving pedagogical and technological challenges will be necessary for AR technology to be effectively adopted, it has immense potential to change education. More research on this exciting subject is made possible by the comprehensive review, which provides useful information.

Limitations

Even though AR technology is developing quickly, not much research has been done on how it may be used to teach language. This leads to some limits that may be drawn from the research. To prevent potential prejudice, for example, the selection criteria for publications may not be as strict. For example, only empirical studies that focused on language learning instruction and were published in the English language in the last two years (2022–2023) were included in the review. 25 publications covering diverse subject levels and learning backgrounds were found in the search results. Thus, the conclusion may not be strict and highly generalizable for other research in other learning situations because of the diversity in the study's characteristics and the small number of included studies. Furthermore, there may be limited access to certain high-impact publications that concentrate on educational technology and language instruction, which could lead to the exclusion of some excellent studies. It could lead to the most recent research on AR applications being left out. As a result, this study strongly suggests adding studies from fields other than language instruction to the limits. Furthermore, adding non-empirical studies could improve the results and give a more thorough explanation of how this technology is used.

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