

Investigating the Impact of Augmented Reality (AR) as an Interactive Tool in Teaching English Vocabulary: A Literature Review

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Abstract—This research investigates the impact of Augmented Reality (AR) as an interactive tool in teaching English vocabulary. This study employed a literature review design to investigate the impact of AR as an interactive tool in teaching English vocabulary. Research on AR in vocabulary learning has consistently demonstrated its positive impact on students' motivation, retention, and learning outcomes. Key findings from 28 studies highlight several advantages of AR in vocabulary instruction. Studies on AR in vocabulary learning have consistently shown its positive influence on students' motivation, retention, and learning outcomes. AR has been proven to significantly improve vocabulary retention, enabling students to remember words for longer periods compared to traditional methods such as flashcards or lecture-based approaches. It also creates a more engaging and interactive environment, which increases students' enthusiasm and motivation to learn vocabulary. Research further indicates that AR is effective across different age groups, from preschool to high school, supporting both low-achieving and advanced learners. Many studies highlight that students using AR perform better in vocabulary tests than those using conventional learning strategies. Comparisons between AR and tools like flashcards or multimedia suggest that AR is more engaging, interactive, and effective in enhancing vocabulary mastery. However, several challenges exist in implementing AR, including limited access to technology, a lack of teacher training, and the relatively high cost of AR devices and applications. The success of AR-based learning also depends on the support of parents and teachers, as parental involvement and teacher readiness play a vital role in ensuring its effective integration into the classroom. Overall, AR holds great potential as an innovative tool to enhance vocabulary learning, provided that the technological, financial, and pedagogical challenges are addressed. This literature review contributes to the existing body of knowledge by providing a comprehensive synthesis of current research on AR-assisted vocabulary learning, identifying its pedagogical benefits and implementation challenges, and highlighting research gaps that can inform future studies and the development of more effective AR-based vocabulary learning practices.

Keywords: Augmented Reality (AR), English Vocabulary, Systematic Literature Review, Teaching Vocabulary, Vocabulary

I. INTRODUCTION

English learning plays a crucial role in modern education, with vocabulary development being especially significant in mastering the language (Lee et al., 2019). Vocabulary learning is one of the fundamental aspects of mastering the English language. A strong vocabulary enables students to better understand texts, speak fluently, and write more effectively. However, conventional vocabulary learning methods, such as using textbooks, flashcards, and rote memorization, are often considered less engaging and ineffective in improving students' retention and comprehension. Therefore, innovation in teaching methods is needed to enhance student engagement and accelerate vocabulary acquisition (Fitria, 2022).

Learning vocabulary in a primary or secondary language is enhanced when we encounter words in context (Weerasinghe et al.,

2022). This means that the meaning of the sentence is that vocabulary learning in a first language (native language) or a second language (foreign language) becomes more effective when words are learned in a meaningful context. This means that when a person encounters or uses words in real-life situations, sentences, or stories, their understanding and retention of the vocabulary will be better compared to memorizing words in isolation without context. Vocabulary learning is a crucial aspect of acquiring a foreign language, but it may often present challenges for learners (Vedadi et al., 2018). In the past, it was an overlooked component of language education, but in recent years, there has been a significant increase in interest in this area (Dakhi & Fitria, 2019). Language educators are continuously exploring effective methods to improve vocabulary acquisition. Learning vocabulary extends beyond

simply recognizing a word's form and meaning; it plays a fundamental role in mastering a second language.

One technology that is increasingly used in education is Augmented Reality (AR). AR combines the real world with digital elements, creating a more interactive and immersive learning experience. In the context of English vocabulary learning, AR allows students to see and interact with three-dimensional visual objects related to the words being studied. This technology not only provides a more engaging learning experience but also helps students understand word meanings in a more realistic context.

Augmented reality is increasingly used in the educational domain (Wedyan et al., 2022). Augmented Reality (AR) impacts various aspects of life, including education (Muangchan & Yanhua, 2025). As a newly emerging technological innovation, AR has gained popularity as a valuable tool for language learning (Cai et al., 2022). AR can enhance learning by providing engaging and immersive experiences (Santos et al., 2016). Augmented reality AR) is a developing technology for delivering educational content (Santos et al., 2014). Augmented Reality connects the digital world with the user's environment in real-time. This learning application is designed to overcome the negative effects of smartphone use and to teach English vocabulary as an introduction to language learning. This interactive learning medium aims to enhance users' memory retention and improve their focus on educational content. It not only provides information and knowledge but also entertains users (Sutiyo & Arfian, 2025).

English language learning at school, such as the elementary school level, often faces challenges in vocabulary retention, which refers to students' ability to remember and use learned vocabulary over a long period (Fujiono et al., 2024). Ceylan (2023) explores the effectiveness of AR in improving vocabulary acquisition and retention among 5th-grade students. Currently, effective teaching techniques can enhance vocabulary learning for students while simultaneously increasing their motivation and enjoyment in the learning process (Chuang et al., 2022). One of the main factors contributing to this

issue is the use of conventional teaching methods, such as rote memorization of vocabulary without clear context, reliance on less interactive textbooks, and the lack of engaging media for students (Fitria, 2023b). Conventional teaching methods tend to be less engaging for students, making them easily bored and less motivated. Additionally, without the support of visual, auditory, or interactive experiences, students find it more difficult to understand and retain new vocabulary (Fitria, 2023c). To address this challenge, innovations in teaching methods are needed, such as the integration of educational technology, the use of educational games, and experiential learning approaches that enhance student engagement and motivation. By implementing these strategies, vocabulary retention can be improved, ensuring that students not only memorize words temporarily but also use them effectively in everyday communication.

Augmented Reality (AR) is an innovative technology that integrates digital elements into a user's real-world experience through devices such as smartphones, tablets, or head-mounted displays (Dabrowski, 2022). In the field of Second Language Acquisition (SLA), AR presents exciting educational opportunities, particularly for intentional vocabulary learning. Additionally, its applications hold significant potential for enhancing distance learning. Augmented Reality (AR) technology enables the overlay of digital content onto the physical world, creating an interactive and immersive learning environment. AR enhances language learning by providing real-world context, instant feedback, and engaging experiences that promote deeper understanding (Azimova & Solidjonov, 2023). Augmented Reality (AR) has become a cutting-edge educational tool, providing immersive and interactive learning experiences that boost student engagement and knowledge retention (Hwang & Huang, 2025).

The use of Augmented Reality (AR) in English vocabulary learning brings various significant benefits. AR creates a more interactive and engaging learning experience, allowing students to see, hear, and interact with virtual objects related to the words they learn. This helps improve the understanding of word meanings more contextually compared to traditional

methods such as flashcards or textbooks. One of the main advantages of AR is improving vocabulary retention. By engaging multiple senses in the learning process, students can more easily remember new words because they can associate the words with vivid visualizations and direct experiences. In addition, AR increases learning motivation as it makes learning more fun and challenging, especially for younger learners who are more interested in interactive technology.

Khan et al (2023) describe that AR has gained attention in education due to its ability to provide learners with real-life experiences during the learning process. AR involves integrating computer-generated elements into the physical environment to create an interactive experience. Incorporating AR into vocabulary development plays a significant role in enhancing English as a Foreign Language (EFL) learners' language acquisition. Khodabandeh (2025) also explains that AR technology has emerged as a valuable tool for enhancing educational experiences across various learning environments. In the field of English as a Foreign Language (EFL) instruction, AR applications have demonstrated their potential in improving students' vocabulary acquisition and retention.

The use of AR in English vocabulary learning offers significant benefits. AR creates a more interactive and engaging learning experience, allowing students to see, hear, and interact with virtual objects related to the words they learn. This helps improve word comprehension more contextually compared to traditional methods such as flashcards or textbooks. AR has its ability to enhance vocabulary retention. By involving multiple senses in the learning process, students can remember new words more easily as they associate them with more vivid visualizations and direct experiences. Additionally, AR increases learning motivation as it makes the learning process more enjoyable and challenging, especially for younger learners who are more attracted to interactive technology. AR also enables situational learning, where students can see words in more realistic contexts. For example, in learning vocabulary about food, AR can display 3D images of various types of food along with pronunciation and example sentences. This

helps students understand word meanings more deeply than simply memorizing definitions. With richer visualizations and higher engagement, students can more easily associate words with their meanings. Moreover, AR allows situational learning, where students can see vocabulary use in various contexts relevant to daily life.

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Despite its many advantages, challenges in using AR remain. Not all schools have access to AR technology, and not all teachers are prepared or trained to integrate AR into learning. Therefore, adequate training and technological support are needed to make AR use in English vocabulary learning more effective and widespread. There are still some challenges in its implementation. Limited access to technology, lack of teacher training, and relatively high implementation costs are obstacles to the widespread use of AR in educational settings. Therefore, this study aims to explore the effectiveness of using AR in English vocabulary learning and to identify factors that may support or hinder its implementation. Not all schools have access to AR technology, and not all teachers are prepared or trained to integrate AR into their teaching. Therefore, proper training and technological support are needed to ensure the effective and widespread implementation of AR in English vocabulary learning. AR implementation still faces challenges. Limited access to technology, lack of teacher training, and relatively high implementation costs hinder the widespread use of AR in educational settings. Therefore, this study aims to explore the effectiveness of AR in English vocabulary learning and identify the factors that support or hinder its implementation.

Overall, AR is an innovative tool that can enhance the effectiveness of English vocabulary learning by making it more engaging, interactive, and context-based. With the right technological support and appropriate teaching strategies, AR can become a powerful solution for improving English vocabulary acquisition across various age groups. By gaining a deeper understanding of the impact and challenges of using AR in vocabulary learning, this study aims to contribute to the development of more innovative and effective teaching methods in English language education, particularly in vocabulary instruction.

Several previous studies have examined the use of Augmented Reality (AR) in teaching vocabulary. Diegmann et al. (2015) explore the value of Augmented Reality (AR) in educational environments by conducting a systematic literature review. The findings reveal that Augmented Reality (AR) offers significant benefits in educational environments, which can be categorized into six distinct groups. Through a systematic literature review of 25 publications, 14 key benefits of AR in education were identified. The analysis, based on the Five Directions of AR in educational environments, highlights that different AR applications contribute to varying educational advantages. Specifically, certain applications are more likely to enhance motivation and engagement among students. However, the study also emphasizes the need for further research to establish a clearer causal relationship between AR applications and their educational benefits. Akçayır & Akçayır (2017) provide a systematic review of the literature on augmented reality (AR) in educational settings. It examines various factors, including publication trends, learner types (such as K-12, higher education, and adult learners), AR technologies, as well as the benefits and challenges associated with AR in education. A total of 68 research articles from SSCI-indexed journals were analyzed. The findings indicate a notable increase in AR-related studies over the past four years. Among the reported benefits, the most significant advantage of AR is its ability to enhance learning achievement. However, challenges such as usability issues and technical difficulties were frequently noted.

Laine (2018) reviews the research landscape on educational mobile augmented reality games (EMARGs) to address the gap in existing literature. While AR has been widely explored in various fields, including education, there is a need for a focused analysis of mobile AR games designed for learning. By conducting a systematic literature review and incorporating two case studies, this research seeks to analyze the technological, pedagogical, and gaming aspects of EMARGs. Additionally, it aims to evaluate existing AR platforms used for developing mobile AR applications and provide practical guidelines for future EMARG development. The study reviewed research on EMARGs from 2012 to 2017, identifying 31 games that were analyzed based on their technological, pedagogical, and gaming components. It also examined 26 AR platforms suitable for creating mobile AR applications. Garzón et al. (2019) conducted a literature review of 61 research papers published between 2012 and 2018 in academic journals and conference proceedings. The review identifies current trends, the role of AR in learning processes, key challenges, and opportunities for developers and educators. Findings suggest that AR has a moderate impact on learning effectiveness (effect size $d = 0.64$, $p < 0.001$). The most frequently cited benefits of AR in education are learning gains and increased motivation.

Herpich et al. (2019) examine the current state of MAR applications in education through a systematic literature review of 57 selected research articles. The analysis focuses on the subject areas where MAR is applied, as well as the development and evaluation processes of MAR-based educational approaches. Ahmad & Junaini (2020) analyze research trends in the implementation of Augmented Reality (AR) for mathematics learning. Given the increasing use of AR in education, there is a lack of comprehensive reviews that explore its application in mathematics. By reviewing journal articles from 2015 to 2019 using the PRISMA framework, this research seeks to identify key themes, benefits, challenges, and gaps in the existing literature. The review identified 19 journal articles from the Scopus database, which were categorized into eight themes: types of AR applications, development tools, research contributions,

benefits for mathematics learning, learning challenges, testing methods, and specific mathematics subtopics.

Saadon et al. (2020) examine the impact of augmented reality (AR) on student motivation. A systematic literature review was conducted in March 2018 and later updated in January 2019. The review covers relevant research on motivation in augmented reality from 2013 onward. The study focuses on augmented reality as the research object and student motivation as the subject. The findings indicate that augmented reality has a positive influence on student motivation, demonstrating its potential to significantly enhance engagement in learning. Fan et al. (2020) present a systematic review of the literature discussing the use of augmented reality (AR) in early language learning. A total of 53 studies published between 2010 and 2019 were analyzed using qualitative methods along with descriptive quantitative analysis. The findings identified three main AR-based learning activities, namely word spelling games, word knowledge activities, and location-based word learning. Additionally, five key design strategies were found, including three-dimensional multimedia content, hands-on interaction with physical learning materials, gamification, spatial mapping, and location-based features.

Parmaxi & Demetriou (2020) review the use of augmented reality (AR) in language learning. Research published between 2014 and 2019 was analyzed using specific inclusion and exclusion criteria, resulting in 54 relevant studies. The findings cover several key areas, including (a) the devices and software used to implement AR, the languages and contexts where AR was applied, the theoretical frameworks guiding AR integration, the number of participants in AR-based activities, and the benefits of AR as a learning tool in language classrooms; (b) the alignment of AR's capabilities with the KSAVE (Knowledge, Skills, Attitudes, Values, Ethics) 21st-century skills framework; and (c) future research directions and practical applications of AR in language learning. Lau & Wen (2021) explore the practical implementation of AR in language learning. Instead of focusing solely on learning outcomes, the study examines various AR-supported activities, pedagogical theories,

strategies that support language acquisition, and challenges faced by teachers in using AR. A total of 17 published studies with empirical data were analyzed. The findings highlight both the affordances of AR in language education and the barriers to its implementation. The study provides insights and recommendations for researchers, instructional designers, and educators, aiming to improve the effective use of AR in language teaching and learning.

Alper et al. (2021) analyze scientific research on game-based learning and AR applications in education. The analysis considers several factors, including educational field, participant education level, dependent variables, data collection tools, research methods, AR usage type, software used for development, and the advantages and limitations of AR in learning environments. A total of 53 scientific studies, published in national and international journals between 2016 and 2020, were reviewed using a systematic literature review method. The findings highlight the impact of game-based and AR-supported learning environments on students' learning processes. Liono et al. (2021) evaluate the effectiveness of Augmented Reality (AR) as a learning tool in education. Traditional studying methods often lead to student disengagement due to lengthy and unappealing content. By integrating digital and physical environments, AR has the potential to enhance student motivation and comprehension. This study conducts a Systematic Literature Review (SLR) to assess the impact of AR on learning outcomes, particularly in its ability to visualize abstract concepts and improve student engagement. Additionally, the study examines the relationship between authentic learning and AR technology to determine how AR can serve as an effective medium for education.

Majid & Salam (2021) explore trends in AR applications for language learning and identify the language skills most commonly supported by AR technology. A systematic literature review reveals that AR-related research in language learning has been increasing since 2016. The study found that AR is primarily used for language skills requiring lower cognitive levels, such as word identification, understanding meanings, spelling, and pronunciation. However,

the use of AR for more complex and critical language skills, such as reading and writing, remains rare. This gap highlights the need for further research and development in AR-based language learning. Çetin (2022) analyzes augmented reality (AR)-based applications developed for primary school students between 2015 and 2021 and identifies their positive and negative effects on students. The research employed the document analysis method, examining articles related to AR-based applications in primary education using keywords such as “augmented reality,” “primary education,” “elementary education,” and “teachers' and parents' perceptions.” The study reviewed 48 relevant articles from databases including ScienceDirect, ERIC, Sagepub, and SpringerLink.

Ansas et al. (2022) review the application of Augmented Reality (AR) in foreign language learning. Specifically, it presents an analysis of several journal articles that examine AR as a learning tool across different educational levels. The reviewed studies, published between 2017 and 2021, were sourced from ERIC and Google Scholar. A total of twelve articles were selected based on their relevance to AR in foreign language education. The findings indicate that AR can support both teachers and students in the language learning process. Its implementation enhances student motivation by making lessons more engaging, interactive, and memorable. The immersive learning environment created by AR allows students to interact with virtual learning objects within their real-world surroundings. The combination of audio-visual elements in AR-based learning contributes significantly to boosting student motivation and improving the overall learning experience. Lampropoulos et al. (2022) examine the existing literature on the integration of augmented reality (AR) and gamification in education to establish its theoretical foundation. A systematic literature review was conducted following the PRISMA framework, analyzing research across all educational levels and subjects. A total of 670 articles from five major databases (Scopus, Web of Science, Google Scholar, IEEE, and ERIC) were reviewed. Bulut & Borromeo (2023) review existing literature on the use of augmented reality

(AR) in mathematics education. By analyzing research from ten major databases, it seeks to evaluate the impact of AR in enhancing interactive learning environments in classrooms and other educational settings.

Supriyanto et al. (2023) analyze the application and impact of AR in vocational education. A Systematic Literature Review (SLR) was conducted to identify, evaluate, and interpret the role of AR in vocational learning. The research followed the PRISMA 2020 framework, with data collection from the ScienceDirect database. Initially, 454 articles were identified, but after applying inclusion and exclusion criteria, only 14 articles were selected for analysis. The findings indicate that AR serves as an innovative learning tool that enhances knowledge acquisition, skill development, and practical learning experiences. The integration of AR in vocational education improves student understanding, fosters positive attitudes, makes learning more engaging and enjoyable, and increases overall learning efficiency. Yenioglu et al. (2023) examine research on the impact of AR in special education. Specifically, it explores the research methodologies used in these studies, the types of disabilities AR applications have been applied to, the skills taught through AR, the perspectives of students and teachers regarding AR usage, and the effects of AR on learning outcomes for individuals with special needs.

Qiu et al. (2023) review 150 articles on VR/AR-supported language learning published between 2008 and 2019, summarizing key development trends. It begins by defining Virtual Reality (VR) and Augmented Reality (AR) and then introduces a VR/AR-supported learning model. This model categorizes studies based on language types, research participants, learning devices, learning goals, research issues, research methods, research domains, and learning strategies. The analysis reveals that empirical research on VR/AR in language learning has reached its peak, with increasing application and a growing use of immersive learning devices. Higher education remains the primary research focus, with speaking, expression, and vocabulary acquisition as the most common learning objectives.

Alshumaimeri & Mazher (2023) explore the implications of Augmented Reality (AR) in education by reviewing research papers on this Extended Reality (XR) technology and examining its practical applications in learning English as a Foreign Language (EFL). A systematic review and meta-analysis were conducted to consolidate information on how XR-based tools can enhance English language learning. The study aims to provide insights into AR-based learning and its integration into both classroom settings and personalized learning experiences for EFL students. The review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines and includes sources from ACM Digital Library, IEEE Xplore, PubMed, ERIC, the Cochrane CENTRAL library, and Google Scholar. Yi et al. (2024) examine the incorporation of Augmented Reality (AR) in game-based learning for English as a Second Language (ESL). Drawing on empirical studies published between 2020 and 2024, sourced from Web of Science (WoS), Scopus, ERIC, and Google Scholar, the review evaluates AR's impact on ESL education. The findings reveal that AR enhances language acquisition by leveraging mobile applications that improve learner satisfaction, engagement, and motivation. Additionally, the combination of AR and game-based learning broadens learning experiences across various subjects, fostering collaboration and communication skills. Rosyidah & Anugerahwati (2024) conduct a systematic literature review to examine the educational levels where AR is applied, its implementation methods, and recommendations for AR-ELT adoption. The findings indicate that elementary students, particularly in vocabulary learning, benefit the most from AR applications.

The study titled Investigating the Impact of Augmented Reality (AR) as an Interactive Tool in Teaching English Vocabulary: A Systematic Literature Review aims to fill a significant research gap by systematically analyzing the role of AR in English vocabulary acquisition. While previous studies, such as those by Diegmann et al. (2015) and Akçayır & Akçayır (2017), have explored the broader application of AR in education, they do not specifically focus on its impact on vocabulary learning. Similarly,

systematic reviews like those by Garzón et al. (2019) and Laine (2018) have examined AR in learning contexts but have not provided an in-depth investigation into its effects on vocabulary retention, engagement, and interactive learning strategies in English language education.

Existing research on AR in language learning, such as Fan et al. (2020) and Parmaxi & Demetriou (2020), primarily discusses AR's impact on general language skills, including reading, speaking, and comprehension. However, there is limited research that isolates vocabulary learning as a core area of study. Vocabulary acquisition plays a crucial role in language proficiency, and while AR has been shown to enhance motivation and engagement (Saadon et al., 2020; Yi et al., 2024), its direct impact on vocabulary retention and recall remains insufficiently explored. Additionally, although studies such as Majid & Salam (2021) and Rosyidah & Anugerahwati (2024) have recognized AR's potential in language learning, they highlight that AR is predominantly applied at the elementary level, leaving gaps in research regarding its effectiveness across different learner groups, including higher education students and adult learners. Another critical gap addressed in this study is the challenge of AR implementation in vocabulary instruction. Research by Herpich et al. (2019) and Laine (2018) indicates that usability issues, technological barriers, and pedagogical constraints hinder the full integration of AR in education. However, there is limited systematic analysis of how these challenges specifically affect vocabulary teaching. Additionally, while AR has been studied in other educational contexts such as vocational education (Supriyanto et al., 2023) and special education (Yenioglu et al., 2023), the contextual factors influencing its effectiveness in vocabulary learning remain largely unexamined.

This study's novelty lies in its focused approach to synthesizing findings from existing research and identifying patterns in how AR enhances vocabulary learning. Unlike previous literature reviews that broadly assess AR in education or language learning, this systematic review will specifically examine AR's effectiveness in vocabulary acquisition, including its impact on learner engagement, motivation, and

retention. Furthermore, the study will provide a conceptual framework that integrates key findings and offers pedagogical recommendations for optimizing AR-based vocabulary instruction. By addressing these research gaps, this study will contribute valuable insights for educators, curriculum developers, and researchers seeking to implement AR as an interactive tool for teaching English vocabulary.

II. Method

This study employed a systematic literature review (SLR) design to investigate the impact of Augmented Reality (AR) as an interactive tool in teaching English vocabulary. A literature review is a research method that collects, evaluates, and synthesizes existing studies relevant to a particular research question (Fitria, 2022). Unlike a traditional review, a literature review applies structured procedures to ensure comprehensive, transparent, and replicable results. The reason for using this design is to provide a clear overview of previous studies on AR in vocabulary learning, identify patterns and gaps, and evaluate its effectiveness across different contexts.

The data in this research were collected using document analysis. A document in research is any written, printed, or digital material that provides information and can be used as a source of data (Fitria, 2023a). Documents may include published or unpublished materials such as books, journal articles, reports, policy papers, theses, conference proceedings, and online publications (Fitria, 2024). This refers to a qualitative research method of systematically reviewing written materials to extract meaningful information. The documents used in this study consisted of national and international journal articles, conference proceedings, theses, and reports relevant to the use of AR in English vocabulary learning. These documents were selected based on relevance to the research focus, credibility of publication sources, and publication years (2015–2025) to ensure up-to-date findings.

The collected documents were analyzed using content analysis, which focused on identifying recurring themes, strategies, outcomes, and challenges reported in the studies. The analysis process involved three main steps. First, data reduction was carried out by filtering

documents to include only those directly related to the use of AR in vocabulary learning. Second, data display was conducted by organizing the findings into specific categories such as vocabulary retention, learner motivation, effectiveness across age groups, comparison with traditional methods, challenges, and support factors. Finally, conclusion drawing and verification were performed to synthesize the results, highlight the overall impact of AR on vocabulary learning, and identify gaps that require further research. This systematic approach ensured that the findings were derived objectively and remained relevant to the research purpose.

III. Findings and Discussion

Findings

With the swift advancement of Augmented Reality (AR), a growing body of research has been conducted to investigate its effectiveness in educational settings (Tsai, 2018). Given the growing interest in AR as a classroom tool, further research could explore student performance across various academic subjects and investigate additional applications of AR in education. Integrating augmented reality (AR) technology into education has the remarkable potential to enhance the learning experience substantially (Khodabandeh & Mombini, 2024).

Augmented Reality (AR) flashcards have become a valuable tool for language learning (Chen & Chan, 2019). The use of Augmented Reality (AR) in education has gained significant attention, especially in the area of vocabulary development (Saud et al., 2024). As AR applications continue to expand within educational settings, there is a growing need for a comprehensive bibliometric analysis to examine the body of research focused on vocabulary enhancement. Augmented Reality (AR) technology has great potential in creating interactive and effective learning experiences, especially for enhancing English vocabulary mastery (Adelita et al., 2024).

As technology continues to evolve and advance, various innovative systems are becoming essential parts of our daily lives, significantly influencing different fields. One such system is Augmented Reality (AR), often perceived as a remarkable and transformative

technology. Since the launch of Pokémon Go, the most popular location-based AR game, AR has garnered substantial attention, particularly in education and language learning. Numerous studies have provided evidence supporting the effectiveness of AR in enhancing the learning experience (Özçelik et al., 2022).

Vocabulary learning plays a central role in English language acquisition, as it directly influences learners' ability to understand texts, communicate fluently, and express ideas effectively. Traditional methods such as textbooks, flashcards, and rote memorization, while still commonly used, are often considered less engaging and less effective in improving vocabulary retention. As a result, innovative approaches are needed to make vocabulary learning more interactive, meaningful, and enjoyable for students. One of the emerging technologies in education that has attracted increasing attention is Augmented Reality (AR).

AR combines real-world elements with digital content to create immersive and interactive learning experiences. In the context of vocabulary instruction, AR enables learners to see and interact with three-dimensional visual objects linked to target words, thus providing deeper contextual understanding and enhancing long-term retention.

Several previous studies have examined the use of AR in teaching vocabulary. These studies have explored its effectiveness in improving learners' motivation, comprehension, and retention, as well as the challenges that arise in its implementation. To better understand the current state of research in this area, the following table summarizes relevant studies, focusing on the researchers, their areas of investigation, and the key findings.

No	Researcher (Year)	Research Focus	Key Findings
1.	Solak & Cakir (2015)	Students' motivation toward AR-based learning materials and their relationship with academic achievement.	AR increased vocabulary learning motivation and had a positive correlation with academic performance.
2.	Lee et al. (2017)	Development of an AR application for kindergarten vocabulary learning and addressing parents' concerns about electronic device use.	AR applications were effective and interactive, with a parental monitoring feature.
3.	Tsai (2018)	Comparison of traditional flashcards and AR in elementary school vocabulary learning.	AR was more effective than flashcards across all proficiency levels.
4.	Ibrahim et al. (2018)	The benefits of AR in immersive vocabulary learning.	AR improved vocabulary retention and was more enjoyable than flashcards.
5.	Chen & Chan (2019)	Comparison of AR with traditional flashcards in early childhood learning.	AR and flashcards were equally effective, but AR was more engaging for students.
6.	Yaacob et al. (2019)	Effectiveness of AR flashcards for low-achieving rural students.	All students showed vocabulary score improvement, with high motivation levels.
7.	Tsai (2020)	Comparison of traditional lecture methods and AR in vocabulary learning.	Students using AR had higher motivation and performance.
8.	Jalaluddin et al. (2021)	Impact of Mobile Augmented Visual Reality (MAVR) on low-achieving LINUS students.	MAVR improved vocabulary mastery and student engagement.
9.	Liao et al. (2021)	Effects of AR on vocabulary mastery among EFL students in Taiwan.	AR increased motivation and resulted in higher post-test scores compared to the control group.
10.	Agata et al. (2021)	The impact of AR learning media on children's vocabulary.	AR improved evaluation scores by 0.77%, with 76% of parents acknowledging its effectiveness.
11.	Tyson (2021)	Comparison of AR methods with flashcards in academic vocabulary learning.	AR was more engaging and led to better learning outcomes than flashcards.
12.	Costuchen et al. (2021)	Comparison of AR with Quizlet in vocabulary memory retention.	AR showed better retention but had a slightly higher forgetting rate compared to Quizlet.
13.	Binhomran & Altalhab (2021)	Experiment on using AR in EFL vocabulary learning.	AR improved comprehension and motivation, though differences were not statistically significant.
14.	Yilmaz et al. (2022)	Study on preschoolers' vocabulary	Vocabulary scores increased, with retention

		acquisition using AR educational toys.	slightly declining after two weeks.
15.	Belda-Medina & Marrahi-Gomez (2023)	Perception of AR and its impact on motivation and vocabulary learning.	Positive attitudes toward AR, but no significant differences in learning outcomes.
16.	Khan et al. (2023)	Impact of AR on vocabulary learning using a mixed-method approach.	AR effectively improved vocabulary learning and students' positive attitudes toward learning.
17.	Ceylan (2023)	Effectiveness of AR in vocabulary retention and mastery among 5th-grade students.	AR enhanced vocabulary retention and student motivation compared to traditional methods.
18.	Nursabira et al. (2023)	Effectiveness of AR flashcards for young learners' vocabulary acquisition.	Average scores increased from 3.02 to 6.02 after using AR flashcards.
19.	Tin-Chang et al. (2023)	Comparison of AR with multimedia PowerPoint in vocabulary learning.	AR resulted in higher post-test scores than multimedia PowerPoint.
20.	Riadin (2024)	Impact of Assemblr Edu AR on high school students' vocabulary mastery.	The average score increased from 46.44 to 72.16 after using AR.
21.	Topu et al. (2024)	Impact of AR on preschool vocabulary learning and students' attitudes toward the technology.	Significant improvement in vocabulary learning and positive attitudes toward AR.
22.	Akmal & Nurjanah (2024)	Challenges of AR implementation in elementary vocabulary learning and teacher-proposed solutions.	AR was effective but faced barriers such as limited technology access, a lack of teacher training, and high costs.
23.	Rahmadani et al. (2024)	Impact of AR on elementary students' vocabulary mastery in Surabaya.	Scores increased from 37.61 to 75.40, with students responding positively to AR.
24.	Zulvi et al. (2024)	Effectiveness of the Assemblr Edu app in vocabulary learning.	The average score increased from 80.6 to 91.4, with 100% achievement of the minimum passing grade.
25.	Hussanee (2024)	Impact of Google Lens AR on English vocabulary learning.	AR improved motivation and comprehension, though quantitative results were not significant.
26.	Sorohiti et al. (2025)	Effectiveness of AR in elementary school vocabulary learning.	AR significantly improved vocabulary mastery and student engagement.
27.	Khodabandeh (2025)	Impact of the ARLOOPA app in EFL vocabulary learning using a flipped classroom model.	The combination of online learning and ARLOOPA enhanced vocabulary learning outcomes.
28.	Hwang & Huang (2025)	Effectiveness of AR in vocabulary mastery and student motivation.	AR improved vocabulary retention, motivation, and student satisfaction with learning.

Research on Augmented Reality (AR) in vocabulary learning has consistently demonstrated its positive impact on students' motivation, retention, and learning outcomes. Key findings from 28 studies can be summarized as follows: Research on Augmented Reality (AR) in vocabulary learning has consistently demonstrated its positive impact on students' motivation, retention, and learning outcomes. Key findings from 28 studies highlight several advantages of AR in vocabulary learning. First, AR enhances vocabulary retention compared to traditional methods such as flashcards and PowerPoint (Tsai, 2018; Ibrahim et al., 2018; Tsai, 2020; Ceylan, 2023; Hwang & Huang, 2025). Additionally, students using AR exhibit higher learning motivation and engagement (Solak & Cakir, 2015; Liao et al., 2021; Khan et

al., 2023; Topu et al., 2024). AR has also proven effective across different age groups, benefiting learners from preschool to high school (Yaacob et al., 2019; Yilmaz et al., 2022; Riadin, 2024). Furthermore, most studies report that students using AR perform better in vocabulary tests compared to those using traditional methods (Lee et al., 2017; Jalaluddin et al., 2021; Zulvi et al., 2024). When compared to flashcards and multimedia tools, AR is found to be more engaging and enjoyable, outperforming traditional methods in learning outcomes (Chen & Chan, 2019; Tyson, 2021; Costuchen et al., 2021; Tin-Chang et al., 2023). However, despite these benefits, AR implementation faces challenges such as limited access to technology, lack of teacher training, and high implementation costs (Akmal & Nurjanah, 2024). Parental and teacher

support also plays a crucial role in AR adoption, as studies show that AR apps with parental monitoring features increase acceptance, while teachers recognize its effectiveness but emphasize the need for better integration strategies (Lee et al., 2017; Agata et al., 2021; Akmal & Nurjanah, 2024). Overall, AR is an effective tool for enhancing vocabulary learning by providing interactive and engaging experiences that improve retention. However, addressing accessibility issues and ensuring teacher readiness are essential for broader adoption.

Research on Augmented Reality (AR) in vocabulary learning has consistently demonstrated its positive impact on students' motivation, retention, and learning outcomes.

1. Improved Vocabulary Retention

Augmented Reality (AR) significantly enhances students' ability to remember vocabulary for a longer period. Several studies support this, such as Tsai (2018), which found that AR was more effective than traditional flashcards across all ability levels. Similarly, Ibrahim et al. (2018) demonstrated that students retained vocabulary better and enjoyed learning more with AR than with flashcards. Tsai (2020) compared AR with traditional lecture-based methods, showing that AR led to higher retention rates. Ceylan (2023) also confirmed that fifth-grade students using AR had higher vocabulary retention than those using traditional methods. Furthermore, Hwang & Huang (2025) highlighted how AR improved long-term vocabulary retention and student satisfaction.

2. Higher Learning Motivation

AR creates a more engaging and interactive learning environment, making students more enthusiastic about learning vocabulary. Several studies highlight this benefit, including Solak & Cakir (2015), who found a positive correlation between AR-based vocabulary learning and academic achievement due to higher motivation. Liao et al. (2021) also reported that AR increased student motivation and led to higher post-test scores. Khan et al. (2023) conducted a mixed-method study that showed students using AR had better attitudes toward vocabulary learning. Additionally, Topu et al. (2024)

found that preschoolers using AR showed high enthusiasm and a positive attitude toward technology.

3. Effectiveness Across Age Groups

AR has been proven beneficial for learners of all ages, from preschool to high school. Yaacob et al. (2019) studied AR flashcards for low-achieving students in rural areas and found that they significantly improved their vocabulary scores. Yilmaz et al. (2022) explored preschool children using AR educational toys, showing improved vocabulary acquisition. At the high school level, Riadin (2024) studied the use of Assemblr Edu AR and reported a score increase from 46.44 to 72.16, indicating its effectiveness across various age groups.

4. Positive Learning Outcomes

Many studies concluded that students using AR performed better in vocabulary tests than those using traditional methods. For instance, Lee et al. (2017) developed an AR-based vocabulary learning system for kindergarten students and found it highly effective, with parental monitoring features. Jalaluddin et al. (2021) demonstrated that AR significantly helped low-achieving LINUS students improve vocabulary skills. Furthermore, Zulvi et al. (2024) reported that students using Assemblr Edu AR increased their average scores from 80.6 to 91.4, with a 100% passing rate.

5. AR vs. Flashcards & Multimedia

Several studies compared AR with traditional flashcards and multimedia tools, showing that AR was more engaging and effective. Chen & Chan (2019) found that both AR and flashcards were effective, but AR was more engaging for young learners. Tyson (2021) reported that AR was more interactive and appealing than flashcards, leading to better learning outcomes. Costuchen et al. (2021) found that AR led to better vocabulary retention but noted that students forgot words faster compared to those using Quizlet. Tin-Chang et al. (2023) also demonstrated that AR outperformed PowerPoint-based multimedia in vocabulary learning.

6. Challenges in AR Implementation

Despite its effectiveness, several barriers were noted in using AR in education. Akmal & Nurjanah (2024) identified three major challenges in implementing AR: limited access to technology, lack of teacher training, and high costs. Many schools lack AR-compatible devices, making it difficult to integrate AR into the curriculum. Additionally, many teachers are unfamiliar with AR tools, requiring proper training before implementation. The high cost of AR apps and devices is another major obstacle, as not all educational institutions can afford the necessary resources.

7. Parental & Teacher Support

Parental involvement and teacher readiness play crucial roles in the success of AR-based learning. Lee et al. (2017) developed an AR application for preschoolers with parental monitoring features to address parents' concerns about screen time. Agata et al. (2021) reported that 76% of parents believed AR helped improve their child's vocabulary. However, Akmal & Nurjanah (2024) found that while teachers acknowledged AR's effectiveness, they required more training and resources for successful implementation.

Augmented Reality (AR) in vocabulary learning has been proven effective across different age groups and settings, leading to higher motivation, engagement, and retention. However, challenges such as accessibility, teacher training, and cost must be addressed for wider implementation. Research on Augmented Reality (AR) in vocabulary learning has consistently demonstrated its positive impact on students' motivation, retention, and learning outcomes.

1. Improved vocabulary retention. AR significantly enhances students' ability to remember vocabulary for a longer period. Studies have shown that AR-based learning leads to better retention compared to traditional flashcards and lecture-based methods. Students who use AR demonstrate stronger recall, making it an effective tool for long-term vocabulary learning.
2. Higher learning motivation. AR creates an engaging and interactive environment that increases students' motivation to learn vocabulary. It has been found to positively

influence students' attitudes, making learning more enjoyable and boosting academic performance. Preschoolers and older students alike respond positively to AR, showing enthusiasm for learning with this technology.

3. Effectiveness across age groups. AR benefits learners of all ages, from preschoolers to high school students. Low-achieving students, including those in rural areas, have shown significant improvements in vocabulary acquisition after using AR-based tools. The effectiveness of AR is evident across different educational levels, proving its adaptability in diverse learning environments.
4. Positive learning outcomes. Students using AR perform better in vocabulary assessments than those relying on traditional methods. AR-based learning systems have been developed for different age groups and have consistently led to higher test scores. The use of AR in classrooms has resulted in measurable improvements in vocabulary acquisition and comprehension.
5. AR vs. flashcards & multimedia. Comparisons between AR and traditional flashcards or multimedia tools indicate that AR is more engaging and effective. While both AR and flashcards support vocabulary learning, AR captures students' interest more effectively. Similarly, AR has been shown to outperform PowerPoint-based multimedia presentations, leading to better vocabulary retention.
6. Challenges in AR implementation. Despite its benefits, the use of AR in education faces several challenges, including limited access to technology, a lack of teacher training, and high costs. Many schools do not have the necessary resources to implement AR effectively, and teachers require proper training to integrate AR into their lessons. Addressing these barriers is essential for the widespread adoption of AR in language learning.
7. Parental & teacher support. Parental involvement and teacher readiness are crucial for the success of AR-based learning. Some AR applications include parental monitoring features to address concerns about screen time. While teachers recognize the

effectiveness of AR, they often require additional support and training to implement it effectively in the classroom.

Augmented Reality (AR) has been widely recognized as an effective tool for vocabulary learning, offering various benefits across different age groups. First, AR significantly enhances vocabulary retention, helping students remember words for a longer period compared to traditional methods like flashcards and lectures. Second, AR increases learning motivation by creating an interactive and engaging environment, making vocabulary learning more enjoyable and improving academic performance. Third, its effectiveness is evident across various age groups, from preschoolers to high school students, including those in rural areas and low-achieving learners. Fourth, students using AR consistently perform better in vocabulary assessments than those relying on conventional learning methods, with AR-based tools leading to higher test scores and comprehension levels. Fifth, when compared to flashcards and multimedia presentations, AR proves to be more engaging and effective, capturing students' interest and improving retention. Sixth, despite its benefits, AR implementation faces challenges such as limited access to technology, a lack of teacher training, and high costs, which hinder its widespread adoption in schools. Finally, parental and teacher support play a crucial role in AR-based learning, as some applications include monitoring features to address concerns about screen time, while teachers require proper training to integrate AR effectively. Overall, while AR has demonstrated its potential to enhance vocabulary learning, overcoming challenges related to accessibility and implementation is essential for its broader application in education.

Research on Augmented Reality (AR) in vocabulary learning shows its positive impact on motivation, retention, and overall learning outcomes. AR enhances vocabulary retention better than traditional methods like flashcards and PowerPoint. It also increases student engagement and motivation across different age groups, from preschool to high school. Studies indicate that students using AR perform better in vocabulary tests compared to those using conventional approaches. Additionally, AR is more engaging

and enjoyable than traditional flashcards and multimedia tools. However, challenges such as limited technology access, lack of teacher training, and high implementation costs remain barriers. Parental support and teacher involvement are crucial for successful integration, with teachers recognizing its benefits but emphasizing the need for better strategies. Overall, AR provides an interactive and effective way to boost vocabulary learning, though broader adoption requires addressing accessibility and training issues.

The integration of technology in education can influence students' ability to comprehend learning materials, as technology plays a crucial role in supporting the teaching and learning process. One innovative educational tool that can be developed is Augmented Reality (AR) technology (Rozi et al., 2021). AR serves as a learning medium that merges virtual objects with the real world, enabling real-time interaction between both environments. English, as a foreign language, is essential to master. To support English learning, students need sufficient vocabulary acquisition, which can be facilitated through reading and listening activities. A strong vocabulary foundation is vital for effective oral communication. However, two major challenges hinder students' speaking proficiency: a lack of vocabulary mastery and uncertainty about how to use words correctly in spoken language. The use of interactive and effective learning media can significantly enhance students' vocabulary learning experience.

In the era of information technology development, many technological advancements can be utilized for educational media, one of which is Augmented Reality (AR) technology (Noor, 2023). Augmented Reality (AR) is a technique that integrates virtual two-dimensional and three-dimensional objects into a real three-dimensional environment and projects these virtual objects in real-time. From a strategic perspective, the use of Augmented Reality technology is highly beneficial in enhancing the teaching and learning process. This is because Augmented Reality incorporates entertainment aspects that can increase students' interest in memorizing English vocabulary. Through 3D visual representations and user interaction within

an educational media framework, Augmented Reality provides an engaging and interactive learning experience.

IV. Conclusion

Research on Augmented Reality (AR) in vocabulary learning has consistently demonstrated its positive impact on students' motivation, retention, and learning outcomes. Key findings from 28 studies highlight several advantages of AR in vocabulary instruction. Studies on AR in vocabulary learning have consistently shown its positive influence on students' motivation, retention, and learning outcomes. AR has been proven to significantly improve vocabulary retention, enabling students to remember words for longer periods compared to traditional methods such as flashcards or lecture-based approaches. It also creates a more engaging and interactive environment, which increases students' enthusiasm and motivation to learn vocabulary. Research further indicates that AR is effective across different age groups, from preschool to high school, supporting both low-achieving and advanced learners. Many studies also highlight that students using AR perform better in vocabulary tests than those using conventional learning strategies. Comparisons between AR and tools like flashcards or multimedia suggest that AR is more engaging, interactive, and effective in enhancing vocabulary mastery. However, several challenges exist in implementing AR, including limited access to technology, a lack of teacher training, and the relatively high cost of AR devices and applications. The success of AR-based learning also depends on the support of parents and teachers, as parental involvement and teacher readiness play a vital role in ensuring its effective integration into the classroom. Overall, AR holds great potential as an innovative tool to enhance vocabulary learning, provided that the technological, financial, and pedagogical challenges are addressed.

This study reviews the impact of Augmented Reality (AR) on English vocabulary learning to address gaps in earlier research that focused on broader educational or language skills without isolating vocabulary. Evidence from 28 studies shows that AR improves vocabulary

retention, motivation, engagement, and test performance across different age groups, and it is more effective than traditional tools like flashcards and multimedia. However, challenges such as limited access to technology, lack of teacher training, high costs, and the need for parental and institutional support remain. Overall, AR has strong potential for vocabulary instruction but requires better accessibility, training, and integration for wider adoption.

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