



The Effect of Augmented Reality (AR) on the Enhancement of Vocabulary in Elementary School Students: A Literature Review

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Abstract. The study explores the effect of Augmented Reality (AR) on vocabulary enhancement in elementary school students. It aims to identify obstacles in the use of AR in the classroom and strategies used by teachers to overcome them. The systematic review approach, using the SPIDER analysis tool, assesses scholarly articles, conference papers, and relevant studies from 2019 to 2024. The research reveals that AR has significant and effective potential to enhance students' vocabulary understanding through engaging and interactive learning experiences. However, the adoption of AR faces challenges such as limited technology availability, inadequate teacher training, and high costs. Teachers suggest potential solutions such as professional development programs, cost-effective augmented reality tools, and collaboration with technologists. The study proposes recommendations for successful integration of AR in vocabulary instruction, including thorough training for educators, affordable AR software, and ongoing support. The study confirms the potential of AR in transforming language teaching methods in elementary schools, while also addressing practical obstacles.

Keywords: Augmented Reality, Vocabulary Learning, Elementary School, SPIDER

1 Introduction

Vocabulary plays a crucial role in mastering English as a second or foreign language, as it aids in communication and skill development. In line with Tyson (2021), Agazzi (2022) states that vocabulary is the main aspect of language learning, along with pronunciation and grammar, play important in gathering sentences, expressing ideas, and enhancing communication. Moreover, Agazzi (2022) argued that vocabulary learning is crucial for the learner of a foreign language, the instruction of language, and young learners, as it reflects original word connotations in literature and classrooms. Vocabulary is the key to the success of all English skills, such as reading. It is known that Indonesian students' English skills are ranked number 16 out of 81 countries

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participating in the 2023 PISA competition (OECD, 2022). Therefore, focusing on vocabulary while acquiring a language is essential for excellent language acquisition.

Digitalization is revolutionizing education by utilizing innovative technology like Augmented Reality (AR) to enhance knowledge gathering and engage students in learning environments. According to Lausiry & Akmal (2023) emphasize the significant role of technology in enhancing student vocabulary acquisition, like a reading and writing skills in learning English. In line with Alam, Iqbal & Ali (2020), technology significantly affected foreign language training by enhancing skills and making learning more accessible. Augmented Reality technology has been extensively researched for its potential to enhance English vocabulary mastery.

Augmented Reality (AR) can enhance learning environments by connecting 2D and 3D objects with real-world applications, bridging theoretical concepts and revolutionizing the educational system, particularly in English vocabulary learning. Medvedeva et. al. (2021) highlights the use of augmented reality (AR) in education, which uses 3D models to provide comprehensive information and enhance comprehension. Moreover, Majid et al. (2023) said that Assemblr EDU is the one of Augmented Reality software, an application that generates 3D models from written content, offering an engaging educational experience. Studies show that Augmented Reality technology significantly enhances English vocabulary mastery, surpassing traditional methods in student engagement, comprehension, and motivation.

The challenge encountered in learning English vocabulary is that students still use the old method of using English package books and this method is very lagging behind and not up to date. In accordance with the view Puspitarini & Hanif (2019) that the use of books as a source of learning material makes students quickly get bored and students are very difficult to understand the material. According to Belda-Medina & Marrahi-Gomez (2023), learning technology using Augmented Reality is very significant in language vocabulary learning.

Previous research demonstrates the positive impact of augmented reality on language learning, especially in enhancing vocabulary (Puspitarini & Hanif, 2019; Belda-Medina & Marrahi-Gomez, 2023; Binhomran & Altalhab, 2021; Criollo-C, Guerrero-Arias, Guaña-Moya, Samala,, & Luján-Mora, 2024; Zhang, Wang, & Wu, 2020). However, despite these positive findings, there is a significant research gap regarding the challenges and solutions related to the implementation of augmented reality for vocabulary enhancement in elementary education. Research has not thoroughly examined the challenges faced by the teachers, including lack of resources, technical difficulties, and lack AR training for teachers, which can hinder effective integration in practical classroom environments. Furthermore, there is a scarcity of research regarding the adaptation of AR to various learning environments, especially in resource-limited regions where technological access may be limited. Addressing these challenges is crucial for providing the scalability and enduring effectiveness of AR-based interventions. This research aims to address existing gaps by proposing practical solutions and offering insights to assist teachers and administrators in the effective implementation of augmented reality in vocabulary learning. Since this research focuses only on the vocabulary aspect of a language learning, the future studies should concentrate on the other language skills or on evaluating long-term effectiveness and adaptability of AR technology across various educational settings.

To achieve that objective, this study examines the following research questions: (1) To what extent the Augmented Reality use in the teaching of English for young learners? (2) What are the obstacles in implementing AR based lessons in learning vocabulary? (3) What are the solutions made by the English teachers? (4) What guidelines can be given based on the App of AR for young learners?. This research reviews existing literature on the use of Augmented Reality (AR) in vocabulary learning for elementary students, identifying its benefits and challenges. It also provides practical recommendations for educators to effectively incorporate AR into their teaching strategies. The study aims to bridge the gap between technological innovation and educational practice, offering valuable insights for researchers and practitioners. The findings can inform future research and enhance the learning experience for young language learners.

2 Review of Literature

Augmented Reality (AR) gained attention as a possible educational technology, namely for enhancing language acquisition among elementary school students. This literature review addresses the history and definition of AR, the extent of AR use in teaching English to young learners, explores obstacles encountered in implementing AR-based lessons, examines solutions provided by teachers, and offers guidelines for AR applications tailored to young learners.

2.1 History and Definition of Augmented Reality (AR)

Since the 1960s, based on O'Connor (O'Connor, 2019) Augmented Reality (AR) designed to help soldiers see and understand better on the battlefield. Furthermore, Bottani & Vignali (2019) highlights the widespread use of AR technology in various industries, including aviation, due to its adaptability, potential in maintenance, training, and product design. According to Mohsan et al. (2023) it has since been widely used in various industries, including aviation, defense, robotics, medical, manufacturing, education, entertainment, assisted driving, maintenance, and mobile assistance.

AR has also been used in the manufacturing sector of Industry 4.0, enhancing tasks' efficiency (Nayyar & Kumar, 2020). It has become increasingly widespread on platforms like gaming, tourism, and education, facilitating comprehensive information delivery through three-dimensional (3D) models (Ghotgalkar & Kubde, 2019). AR applications in education, such as Assemblr EDU, have been shown to enhance content comprehension, foster active student participation, and facilitate collaborative learning (Abdul Majid, 2023). AR technology has transformed traditional learning by transforming physical textbooks into virtual 3D environments, resulting in improved retention of information.

Augmented Reality (AR) is a technology that combines real-world and digital components to create interactive experiences that enhance users' understanding of their surroundings. Tyson (2021) defines "Augmented Reality" (AR) as a technology that enhances users' perception of the physical world by incorporating digital information. It differs from Virtual Reality (VR) due to its use of real-time data and the

superimposition of digital content into a live camera feed (Alalwan, et al., 2020). AR is used in various fields, including gaming, entertainment, education, industrial training, healthcare, and marketing.

It is particularly useful in education, where it enhances comprehension of complex subjects through visual and interactive experiences (Jalaluddin, Darmi, & Ismail, 2021). AR can also foster active student participation and facilitate collaborative learning. In line with Ersanli (2023) AR it also creates an interactive and immersive environment, improving information retention. In education, AR transforms physical textbooks into a virtual 3D environment, creating a more advanced and interactive learning experience (Ali, Sadiq, Albabawat, & Najimaldeen, 2022). Overall, AR has revolutionized traditional learning by providing a visual and interactive way to learn complex subjects.

2.2 Extent of Augmented Reality (AR) Use in Teaching English

Implementing augmented reality (AR) in the teaching of English has demonstrated a notable ability to engage and involve young learners through interactive and immersive learning experiences. Using AR for teaching English vocabulary significantly engages young learners compared to conventional flashcards (Hudaya & Sadikin, 2019). According to Rahman & Wangit (2019) establish that AR applications, such as AR Flashcards and AR Storybooks, provide dynamic and visually engaging approaches for acquiring vocabulary. These tools facilitate students' interaction with vocabulary through dynamic visual and auditory elements, enhancing their comprehension of word meanings.

The effectiveness of AR in vocabulary learning is further enhanced by its capacity to create contextual learning environments. AR offers an immersive learning experience, allowing students to engage with digital content in the real world, enhancing language learning in areas like vocabulary, pronunciation, grammar, reading, and writing (Azimova & Solidjonov, 2023). Moreover, Agazzi (2022) AR technologies facilitate the creation of learning environments that provide students with the opportunity to observe and engage with vocabulary in a way that is relevant and meaningful. This approach is in line with the Interactionist and Constructivist theories of language acquisition.

Research indicates that incorporating gamification into AR applications boosts student motivation and engagement, making vocabulary learning enjoyable and incorporating elements of competition and rewards. Moreover, Taskiran (2019) found that educational games based on augmented reality (AR) not only increase engagement and motivation, but also make the process of learning language easier and effective. AR applications significantly enhance language gains and motivation in elementary school students, with a small to medium effect on learning (Cai, Pan, & Liu, 2022). The gamified approach enhances students' learning outcomes and vocabulary retention by utilizing their natural inclination towards games.

2.3 Obstacles in Implementing Augmented Reality (AR)

AR implementation in educational settings faces challenges like inadequate infrastructure and compatibility issues. The main obstacles faced by the organization

include inadequate infrastructure, a lack of suitable authoring tools, and compatibility issues (Silva, Roberto, Radu, Cavalcante, & Teichrieb, 2019). Moreover, Al et.al (Al & Lakulu, 2021) said that the primary obstacles in implementing Augmented Reality (AR) in education like technical issues. Schools may lack necessary hardware or software, and technical glitches can disrupt learning, undermining the effectiveness of AR tools.

The integration of AR technology into the curriculum faces a significant obstacle due to a lack of comprehensive teacher training, as many educators are unfamiliar with AR technology and its pedagogical applications, necessitating professional development programs to equip teachers with the necessary skills. According to Alalwan et al. (2020) elementary school teachers face obstacle in utilizing AR due to lack of competency, limited instructional design, and limited environmental resources. Moreover, (Law, 2021) said that the main obstacle to the adoption of Augmented Reality (AR) in education is not the absence of comprehensive teacher training.

The high cost of AR tools and resources poses a significant obstacle for schools, as they can be expensive and difficult to afford, especially in underfunded educational environments. The high cost of AR tools and resources poses a significant obstacle to the adoption of AR in educational settings (Zamahsari, et al., 2024). According to Silva et al. (Silva, Roberto, Radu, Cavalcante, & Teichrieb), despite its potential benefits, the implementation of augmented reality in education faces significant obstacles due to high costs and limited resources.

2.4 Solution Provided by Teachers and Guidelines for AR application for Young Learners

Teachers are implementing Augmented Reality (AR) in their classrooms to overcome challenges. Professional development is crucial for overcoming knowledge gaps associated with AR technology. According to Smith et.al (Smith, Carlo, Park,, & Kaplan, 2023), educators need well-designed training and resources to tackle issues, and their attitudes and motivation significantly impact their willingness to use AR in classrooms. Training programs focus on both technical and pedagogical aspects, helping teachers become proficient in using AR tools. Thus, Diao and Shih (2019) collaboration among educators, technology developers, and researchers is essential for addressing technical issues and improving AR applications. Support networks and forums for sharing best practices can help educators troubleshoot problems and optimize AR use in their classrooms.

AR applications for young learners should be designed with age-appropriate content, focusing on simple interfaces, engaging visuals, and age-appropriate language (Ijjuroti, Sodagudi, Mohammed,, Chinchili, & Kotha, 2022). Usability and technical stability are crucial for student engagement, with user-friendly interfaces and minimal technical difficulties. Applications should be thoroughly tested to identify potential issues before deployment in the classroom. Moreover, Masmuzidin, Aziz & Suharmi (2022) interactive elements and feedback mechanisms, such as quizzes, interactive activities, and instant feedback, can enhance vocabulary retention and provide students with opportunities to practice and apply new words in context. These factors ensure the effectiveness of AR applications for young learners.

3 Method

The following section provides a detailed research method adopted by the researcher. This section addresses the discussion relating to search strategy.

3.1 Type of Research

This research makes use of the systematic review with used the SPIDER search strategy tools, which included the sample (S), phenomena of interest (PI), design (D), evaluation (E), and research type (R) (Cooke, Smith, & Booth, 2012). SPIDER is a framework to formulate eligibility criteria in qualitative systematic reviews (Amir-Behghadami, 2021). Thus, Higgins et al. (Higgins & Green, 2019) the main objective of this review was to find out the goal, methodology, and inclusion criteria used to evaluate the validity of conclusions.

3.2 Search Strategy

A systematic literature search for this study was done from several online databases such as ERIC, JSTOR, SpringerLink, Semantic Scholar, ProQuest, ScienceDirect. The researchers also used Google Scholar as a manual search to detect additional literature. The search terms or keywords used are Augmented Reality enhance vocabulary, AR use in teaching English to young learners, obstacles in implementing AR, examines solutions provided by teachers, and offers guidelines for AR applications for young learning. Some searches revealed a large amount of recent research, so the authors restricted the search by choosing surveillance that focused on Augmented Reality enhance vocabulary in young learners or elementary school students published between 2019 and 2024.

4 Results and Discussions

The search that the researchers have done in the systematic survey identifies the results of 110 articles found between 2019 and 2024 with as many as 21 articles meeting the criteria for this research focus. Data analysis is then done to see and investigate the effectiveness of augmented reality software in enhance vocabulary. Here are the results of the article selected by the SPIDER method.

4.1 Sampling(s)

Results in table 5 show that sampling of twenty-one studies existing there are several grades that have been found namely from first grade to sixth grade on the use of Augmented Reality in vocabulary learning in elementary schools. Researchers found results for samples at first grade are 7 studies (Korosidou, 2024; Nursabra, Syamsinar, Nurchalis, & Nuralima, 2023; Agata, Yuniarti, & Adison, 2021; Yaacob, 2019; Chen & Chan, 2019; Lai & Chang, 2021; Yilmaz, Topu., & Takkaç Tulgar, 2022) . Researchers found results for samples at second grade (Jalaluddin, Darmi, & Ismail,

2021; Liao, Wu, Gunawan, & Chang, 2023; Hasbi & Yunus, 2021; sadikin, 2020) continued with Hsu (2019) taking samples from students in third grade. Some researchers (Liao, Tin-Chang, & W.-C., 2023; Tsai, 2020; Song, Zhou, & Yang, 2023) took samples with the student category in fourth grade. In the study Ersanlin (2023) took samples in the fifth grade. In addition, the researchers Binhomran & Altalhab (2021), Hudaya & Sadikin (2019), Aldossari & Alsuhaibani (2021) took the sample in the sixth grade. Then researchers Umiera, Yunus & Norman (2022) took samples in the first to sixth grade and Ji & Shin (2019) took the samples of students in the fourth until sixth. Below are the percentage results per sampling presented in Table 1:

Table 1. Percentage of studies analyzed per sampling

Sampling	Number of Studies	Percentages (%)
First grade	7	33.33
Second grade	4	19.05
Third grade	1	4.76
Fourth grade	3	14.28
Fifth grade	1	4.76
Sixth grade	3	14.28
First to sixth grade	1	4.76
Fourth until sixth grade	1	4.76

4.2 Phenomenon of Interest

Results on phenomenon of interest on table 5 trend research in 2019-2024 found by researchers with limitations focusing on Augmented reality and vocabulary. The researchers found several studies with similar specific topics related to Augmented Reality enhance vocabulary (Hudaya & Sadikin, 2019; Nursabara, Syamsinar, Nurchalis, & Nuralima, 2023; Yaacob, 2019; Chen & Chan, 2019; Liao, Wu, Gunawan, & Chang, 2023). This supported by other researchers focusing on Augmented reality that enhance vocabulary (Jalaluddin, Darmi, & Ismail, 2021; Ersanli, 2023; Agata, Yuniarti, & Adison, 2021; Lai & Chang, 2021; Yilmaz, Topu., & Takkaç Tulgar, 2022; Liao, Wu, Gunawan, & Chang, 2023; Hasbi & Yunus, 2021; sadikin, 2020).

4.3 Design

The researchers found some of the 21 articles mostly using experimental designs and mixed methods on table 5. There are some researchers involving elementary school students on experimental groups to see the effectiveness of Augmented Reality in enhance vocabulary (Binhomran & Altalhab, 2021; Jalaluddin, Darmi, & Ismail, 2021; Ersanli, 2023; Hudaya & Sadikin, 2019; Nursabara, Syamsinar, Nurchalis, & Nuralima, 2023; Nursabara, Syamsinar, Nurchalis, & Nuralima, 2023; Chen & Chan, 2019; Hasbi & Yunus, 2021; Hsu, 2019; Liao, Wu, Gunawan, & Chang, 2023). Then, there are some

research other articles that use mixed method design in research (Korosidou, 2024; Agata, Yuniarti, & Adison, 2021; Yaacob, 2019; Lai & Chang, 2021; Yilmaz, Topu,, & Takkaç Tulgar, 2022; Liao, Wu, Gunawan, & Chang, 2023; Song, Zhou, & Yang, 2023; Aldossari & Alsuhaibani, 2021; Ji & Shin, 2019). However, there is one research article that uses qualitative design, namely the research by Umiera, Yunus & Norman (2022). Below are the percentage results per design as presented in Table 2:

Table 2. Percentage of studies analyzed per design

Design	Number of Studies	Percentages (%)
Experimental design	12	57.14
Mixed method	8	38.09
Qualitative	1	4.76

4.4 Evaluation

Table 2 shows the evaluation of the selected studies. The evaluation category refers to the measurement instruments and criteria for measuring linguistic skills in research. There are some researchers involving pre-tests and post-tests on experimental groups and control groups to see the effectiveness of Augmented Reality in enhance vocabulary (Nursabra, Syamsinar, Nurchalis, & Nuralima, 2023; Chen & Chan, 2019; Lai & Chang, 2021; Hasbi & Yunus, 2021; sadikin, 2020; Liao, Tin-Chang, & W.-C., 2023; Tsai, 2020). Then, there are some research articles that use questionnaires, interviews, and pre-test and also post-test (Korosidou, 2024; Agata, Yuniarti, & Adison, 2021; Yaacob, 2019; Yilmaz, Topu,, & Takkaç Tulgar, 2022; Liao, Wu, Gunawan, & Chang, 2023; Song, Zhou, & Yang, 2023; Ji & Shin, 2019). However, there is one research article which just uses interviews (Umiera, Yunus, & Norman, 2022). Below are the percentage results per evaluation presented in Table 3:

Table 3. Percentage of studies analyzed per evaluation

Design	Number of Studies	Percentages (%)
Pre-test and Post-test	12	57.14
Questionnaire and Test	8	38.09
Interview	1	4.76

4.5 Research Type

Table 5 shows the research types used in research in the trend 2019-2024. These research types cover a methodological approach. There are some researchers who use research type quantitative because to see the effectiveness of Augmented Reality in improving vocabulary (Binhomran & Altalhab, 2021; Nursabra, Syamsinar, Nurchalis, & Nuralima, 2023; Hsu, 2019; Liao, Tin-Chang, & W.-C., 2023; Tsai, 2020). Then

there are some research articles using quantitative and qualitative methodologies (Korosidou, 2024; Agata, Yuniarti, & Adison, 2021; Yaacob, 2019; Liao, Wu, Gunawan, & Chang, 2023; Song, Zhou, & Yang, 2023; Ji & Shin, 2019). However, there is one research article whose research type is different, namely that of qualitative (Umiera, Yunus, & Norman, 2022). Below are the percentage results per research type presented in Table 4:

Table 4. Percentage of studies analyzed per research type

Design	Number of Studies	Percentages (%)
Quantitative	12	57.14
Qualitative and Quantitative	8	38.09
Qualitative	1	4.76

Here is the table of Summaries of SPIDER based on the results found by the researchers in 21 papers:

Table 5. Summaries of SPIDER

Author(s), Year	Sampling (S)	Phenomenon of Interest (PI)	Design (D)	Evaluation (E)	Research Type (R)
Aldossari & Asuhaibani, (2021)	72 Saudi EFL in the sixth-grade elementary students and 80 EFL teachers.	AR in language learning	Mixed method	Questionnaire and Test	Quantitative and Qualitative
Tin-Chang, Liao, & Hsun-Hui, 2023	51 fourth - grader students	AR Instruction enhance vocabulary	Experimental design	Pre-test and Post-test	Quantitative
Chuang et al. (2022)	23 second-grade students	AR combined with thematic English vocabulary learning	Mixed method	Questionnaire, Pre-test, and Post-test	Quantitative and Qualitative
Tsai (2020)	60 fourth grade students	AR for English vocabulary learning	Experimental design	Two group using pre-test and post-test	Quantitative
Hsu (2019)	20 third-grade students	AR learning system on English vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative

Korosidou (2024)	26 first-grade students	Effect AR in vocabulary	Mixed method	Questionnaire, Pre-test, and Post-test	Quantitative and Qualitative
Hashim, Yunus, & Norman (2022)	6 students first-grade until six-grade	AR English Vocabulary Mobile App	Qualitative approach	Interview	Qualitative
Binhomran and Altalhab (2021)	73 six-grade students	Implementation AR in vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative
Nursabra et al. (2023)	64 first-grade students	AR flashcard enhance vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative
Agata, Yuniarti, & Adison (2021)	12 first-grade students	AR learning media for vocabulary	Mixed method	Questionnaire and Test	Qualitative and Quantitative
Yaacob et al. (2019)	10 first-grade students	AR flashcard enhance vocabulary	Mixed methos	Questionnaire, Pre-test, and Post-test	Qualitative and Quantitative
Shong, Zhou, & Yang (2023)	72 fourth-grade students	AR Apps for learning vocabulary	Mixed methos	Questionnaire, Interview, Pre-test, and Post-test	Qualitative and Quantitative
Ersanlin (2023)	56 fifth-grade students	AR with storytelling for learning vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative
Ji and Shin (2019)	38 fourth until sixth-grade students	AR based vocabulary learning	Mixed methos	Interview, Pre-test, and Post-test	Qualitative and Quantitative
Chen and Khan (2019)	98 first-grade students	AR flashcard enhance vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative
Lai and Chang (2021)	47 first-grade students	AR Apps for learning vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative
Yilmaz, Topu and Tulgar (2022)	39 first-grade students	AR technology for vocabulary learning	Mixed methos	Interview, Pre-test, and Post-test	Qualitative and Quantitative
Hudaya and Sadikin (2019)	29 sixth-grade students	AR enhance vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative

Hasbi and Yunus (2021)	14 second grade student	AR for vocabulary learning	Experimental design	Two group using pre-test and post-test	Quantitative
Jalaluddin, Darmi & Ismail (2021)	45 second grade students	Mobile Augmented Visual Reality for vocabulary learning	Experimental design	Two group using pre-test and post-test	Quantitative
Sadikin and Martyani (2020)	30 second grade students	AR for Teaching Vocabulary	Experimental design	Two group using pre-test and post-test	Quantitative

4.6 Obstacles in Implementing AR Based Lessons in Learning Vocabulary

Table 6 presents various obstacles to the use of Augmented Reality such as traditional methods often lack engagement and effectiveness in vocabulary learning (Aldossari & Alsuhaibani, 2021; Umiera, Yunus, & Norman, 2022; Binhomran & Altalhab, 2021; Agata, Yuniarti, & Adison, 2021; Song, Zhou, & Yang, 2023; Hudaya & Sadikin, 2019; Hasbi & Yunus, 2021; Jalaluddin, Darmi, & Ismail, 2021; Jalaluddin, Darmi, & Ismail, 2021). Moreover, traditional methods have been found to have limited vocabulary retention (Liao, Tin-Chang, & W.-C., 2023; Tsai, 2020; Hsu, 2019; Korosidou, 2024; Nursabra, Syamsinar, Nurchalis, & Nuralima, 2023; Ji & Shin, 2019). Thus, technological integration challenges are significant challenges that need to be addressed to ensure successful integration of various technologies (Aldossari & Alsuhaibani, 2021; Yilmaz, Topu., & Takkaç Tulgar, 2022). Furthermore, Traditional learning methods often lack interactivity and immersion, leading to a lack of effective learning experiences. Traditional vocabulary learning methods, like flashcards and storytelling, struggle with engagement and effectiveness, especially for younger students. Integrating technology like AR can enhance learning outcomes, despite challenges, by providing sufficient interaction and immersion.

Table 6. Obstacle, solution, and summary of key finding.

Author(s), Year	Obstacles	Summary of Key Finding
Aldossari & Asuhaibani, (2021)	The integration of Augmented Reality (AR) technology into traditional language learning presents challenges due to potential confusion between students and teachers.	The study examined the influence of AR on language learning, revealing its positive effects on student engagement and vocabulary retention.

Tin-Chang, Liao, & Hsun-Hui, 2023	Despite the use of traditional teaching methods, students are experiencing limited vocabulary retention.	The study demonstrated that Augmented Reality (AR) can effectively improve vocabulary acquisition among fourth-grade students.
Chuang et al. (2022)	Challenges in thematic vocabulary learning among young students.	The study demonstrated that incorporating AR in thematic vocabulary learning can enhance the engagement and retention of younger learners.
Tsai (2020)	Traditional methods may not be effective or engaging in vocabulary acquisition for younger learners.	The use of AR technology in vocabulary learning significantly enhanced students' retention of vocabulary compared to traditional methods.
Hsu (2019)	The lack of an engaging method for students to learn vocabulary is a significant issue.	The AR learning system effectively improved students' English vocabulary learning, as evidenced by enhanced post-test results.
Korosidou (2024)	Traditional methods of teaching vocabulary to first-grade students are proving challenging.	The study revealed that Augmented Reality (AR) significantly enhances vocabulary learning among first-grade students, leading to enhanced test scores and increased student motivation.
Hashim, Yunus, & Norman (2022)	Traditional vocabulary learning methods are being less utilized, particularly among young students of different grade levels.	The study analyzed the use of an AR mobile app for English vocabulary learning, revealing that it significantly increased students' interest and engagement.
Binhomran and Altalhab (2021)	Traditional methods of vocabulary learning are proving challenging to engage	The study revealed that the use of Augmented Reality (AR) significantly enhanced vocabulary learning among sixth-

	sixth-grade students effectively.	students	grade students, as evidenced by the test results.
Nursabra et al. (2023)	The study reveals that traditional flashcards are not effective in improving vocabulary retention.		AR flashcards demonstrated efficacy in enhancing vocabulary learning among first-grade students, resulting in enhanced post-test scores.
Agata, Yuniarti, & Adison (2021)	Traditional classroom vocabulary learning media may lack interactive elements to effectively engage students.		The study revealed that AR learning media significantly enhanced vocabulary acquisition and student motivation, utilizing both qualitative feedback and quantitative test results.
Yaacob et al. (2019)	Traditional flashcards may not offer an engaging learning experience for first-grade students.		The study found that AR learning media significantly improved vocabulary acquisition and student motivation, based on both qualitative feedback and quantitative test results.
Shong, Zhou, & Yang (2023)	Limited engagement and retention in vocabulary learning through conventional methods.		The use of AR apps significantly enhanced vocabulary retention among students, leading to increased motivation and improved test scores.
Ersanlin (2023)	Traditional storytelling methods may not fully engage students in vocabulary learning.		The study revealed that AR storytelling significantly enhanced vocabulary learning, with students in the AR group outperforming those in the control group.
Ji and Shin (2019)	The study investigates the difficulties in vocabulary retention among students in first to sixth grades using conventional methods.		The study found that AR-based learning significantly enhanced vocabulary acquisition and student engagement, as supported by interview data and test results.
Chen and Khan (2019)	Traditional flashcards are found to be insufficiently		The use of AR flashcards significantly enhanced

	engaging first-grade students, resulting in limited vocabulary retention.	vocabulary learning in first-grade students, as evidenced by their post-test results.
Lai and Chang (2021)	The traditional methods of vocabulary learning are proving to be challenging to engage students effectively.	The study demonstrated that AR apps effectively aid first-grade students in vocabulary acquisition, resulting in superior post-test results compared to conventional learning methods.
Yilmaz, Topu and Tulgar (2022)	Traditional vocabulary learning methods struggle to effectively incorporate technology, resulting in difficulties in vocabulary retention for first-grade students.	The study, involving both quantitative tests and qualitative interviews, found that AR technology significantly improved vocabulary acquisition and engagement among first-grade students.
Hudaya and Sadikin (2019)	The study reveals that sixth-grade students show limited engagement in traditional vocabulary learning methods.	The study revealed that Augmented Reality (AR) significantly improved vocabulary learning among sixth-grade students, as evidenced by enhanced post-test results.
Hasbi and Yunus (2021)	Traditional learning methods are causing difficulties in vocabulary retention among second-grade students.	The use of AR technology in vocabulary learning significantly enhanced the acquisition of vocabulary among second-grade students, as evidenced by their improved test scores.
Jalaluddin, Darmi & Ismail (2021)	Traditional vocabulary teaching methods are insufficiently interactive and immersive, thereby hindering students' vocabulary acquisition.	The study demonstrated that Mobile Augmented Visual Reality significantly enhances vocabulary learning among second-grade students, as evidenced by significant improvements in post-test results.
Sadikin and Martyani (2020)	Standard vocabulary teaching methods are not effectively addressing the engagement	The application of Augmented Reality (AR) in teaching vocabulary significantly enhanced the learning process, as

needs of students.	second-grade	evidenced by the improved post- test scores of second-grade students.
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4.7 The Effectiveness of Augmented Reality (AR) to Enhance Vocabulary

Based on Table 6 the present summary of key finding and one that showed the use of Augmented Reality (AR) has been shown to significantly enhance student engagement and motivation (Umiera, Yunus, & Norman, 2022; Korosidou, 2024; Yaacob, 2019; Song, Zhou, & Yang, 2023; Ji & Shin, 2019; Yilmaz, Topu., & Takkaç Tulgar, 2022). However, Augmented Reality (AR) has been proven to significantly enhance vocabulary retention and acquisition. Most studies indicate that augmented reality substantially improves vocabulary retention and acquisition among students from first to sixth grade. Moreover, numerous studies highlight that augmented reality (AR) enhances learning outcomes while simultaneously increasing student motivation and engagement, rendering vocabulary acquisition more effective and interactive than conventional methods. Augmented reality technology seems to be an effective instrument for fostering an interactive educational atmosphere and enhancing language learning.

5 Conclusion

Augmented reality (AR) has been shown to considerably improve vocabulary learning among elementary school kids across various grade levels, according to the findings of this comprehensive evaluation of 21 studies conducted between 2019 and 2024. In the research, the effectiveness of augmented reality (AR) is consistently demonstrated using experimental and mixed-method designs. The research also uses various evaluation instruments, including pre-tests, post-tests, and interviews. The adoption of augmented reality (AR) confronts hurdles, including expensive costs, restricted access, and insufficient instructor understanding, although technology has the potential to be used. Addressing these challenges through targeted training, guaranteeing reliable connectivity, and adhering to rules for age-appropriate and engaging augmented reality content can significantly increase the incorporation of augmented reality in vocabulary instruction. Augmented Reality (AR) in vocabulary learning offers interactive and engaging teaching methods for teachers, but requires ongoing professional development in educational technology. AR boosts motivation and engagement for students, providing personalized learning experiences. Future researchers can explore AR's long-term impact, develop accessible tools, and assess its pedagogical integration in education.

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