Proceedings of Forum for University Scholars in Interdisciplinary Opportunities and Networking
Graduate School, Universitas Terbuka
https://conference.ut.ac.id/index.php/fusion

Teacher Perspectives and Classroom Insights on Using Augmented Reality for Vocabulary Instruction in Elementary English Education

Fitria Rahmawati[a], Sittie Noffaisah B. Pasandalan[b], Asfinatu Nurjanah[c]
[a]English Education Department, Faculty of Language Education, Universitas Muhammadiyah Yogyakarta, Indonesia
[b]Department of English, College of Arts and Social Sciences, Mindanao State University-Iligan Institute of Technology, Iligan City, Philippines
[c]Department of English Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

*Correspondence: fitriarahmawati@umy.ac.id

Abstract
The integration of Augmented Reality (AR) into language education has shown promise in enhancing learner engagement and supporting vocabulary development, particularly among young learners. This study investigates how in-service and pre-service elementary English teachers in Yogyakarta, Indonesia perceive and implement Assemblr Edu, an AR-based language learning tool to facilitate vocabulary instruction. Drawing on qualitative data from teacher interviews and classroom observations, this qualitative case study addresses two primary research questions: (1) How do teachers perceive and describe the effectiveness of the AR tool in supporting vocabulary acquisition? and (2) What observable changes in student engagement and vocabulary use emerge when the tool is integrated into vocabulary lessons? Findings reveal that both groups of teachers view AR as a motivating and effective medium for vocabulary learning, noting its potential to support multimodal input and contextualized language use. Classroom observations indicate increased student participation, attentiveness, and meaningful vocabulary use during AR-enhanced lessons. The study contributes to the growing body of research on technology-enhanced language learning by highlighting the instructional value of AR and offering practical insights into its integration within elementary English education. Implications include the need for targeted teacher training on AR integration and the development of pedagogically grounded AR tools that align with language learning objectives in early education contexts. Future research can explore AR use in secondary and tertiary levels.

Keywords:
Augmented Reality, Vocabulary Acquisition, Elementary English Education, Teacher Perceptions, Classroom Engagement

1. Introduction

Vocabulary acquisition is an important component in second language (L2) learning, especially in the early stages of language development [1]. In English language education, this is a fundamental development for young learners to be able to understand, communicate, and interact effectively through new linguistic structures [2]. Research consistently shows that vocabulary mastery correlates with improved language fluency, reading comprehension, and consistent academic achievement [3]. However, for some young learners, understanding and applying vocabulary continues to present significant difficulties. Factors such as limited exposure to meaningful contexts, short attention spans, and lack of engagement often hinder students' ability to internalize and meaningfully use new vocabulary [4].

To address this challenge, digital technology is being integrated to enhance language teaching [5]. Within the scope of the ever-evolving educational technology, Augmented Reality (AR) has emerged as a promising technology in the field of language acquisition. Augmented reality places digital content into the physical world, fostering an immersive educational environment that integrates real and virtual

experiences [6]. In language education, augmented reality can present vocabulary in a multimodal format, integrating text, images, sound, and animation, to enhance understanding and engagement [7].

The application of augmented reality in basic English classes is very interesting because it aligns with the cognitive nature and development of young students [6]. Young learners in primary education benefit from visually engaging and enjoyable educational experiences [8]. The interactive features of augmented reality can stimulate curiosity, maintain attention, and encourage deeper vocabulary processing through experiential learning [9]. Moreover, the increased accessibility of augmented reality applications through mobile devices and tablets has facilitated the integration of this technology into traditional educational environments for schools and teachers.

Although Augmented Reality (AR) technology is becoming more available, its pedagogical effectiveness in vocabulary teaching for elementary school students is still underexplored. A bibliometric analysis of AR in Indonesia education reports strong connections between AR and concepts related to STEM such as 3D animation and geometry [10] which highlight the lack of research on AR and its use in English language learning. There are also several limitations in understanding how teachers assess and utilize AR in real-world challenges such as time constraints, curriculum alignment, student readiness, and technological infrastructure. These factors greatly influence the success of AR integration in vocabulary learning.

The use of Augmented Reality (AR) in education shows a positive impact on student motivation, engagement, and learning outcomes [11] [12]. In the context of English vocabulary learning, although the number of studies is still limited, initial research shows that AR can support vocabulary retention through multimodal learning [13] [14] [15]. The role of teachers is crucial in the successful integration of AR in the classroom, as their perceptions and practices significantly influence the effectiveness of this technology [16].

Although there is a growing interest in the use of Augmented Reality (AR) to enhance vocabulary in language education, there is still a significant research gap in how AR is actually implemented and mediated in real classroom contexts, with a focus on young learners at the elementary school level. Most existing studies primarily emphasize learning outcomes or focus on the technical development and usability of AR applications. These studies often overlook the teaching process and the crucial role of teachers as facilitators of AR-based learning. Additionally, there is a lack of studies that combine teachers' perspectives with direct classroom observations, which are crucial for gaining a holistic understanding of how AR supports, or challenges, vocabulary teaching in elementary English education. Therefore, there is an urgent need for context-based practical research that explores both the pedagogical benefits and the barriers to AR integration, highlighting how in-service teachers who are employed and actively teaching in a classroom and pre-service teachers who are students and training to become a teacher navigate these tools in authentic teaching contexts.

To achieve that objective, this study examines the following research questions:

1) How do in-service and pre-service elementary English teachers perceive and describe the effectiveness of the augmented-reality language-learning tool in supporting young learners' vocabulary acquisition?
2) What observable changes in students' engagement and vocabulary use emerge in elementary classrooms when in-service and pre-service teachers integrate the augmented-reality tool into their vocabulary lessons?

This research aims to rigorously examine the significance of augmented reality (AR) technology in facilitating English vocabulary acquisition at the elementary school level. The careful selection and application of pedagogically sound instructional tools are essential for designing learning activities that provide meaningful and equitable access to knowledge. In this context, the present study evaluates the effectiveness of AR-based visual media in enhancing young learners' vocabulary development. Further, the comparison of in-service and pre-service teachers generates insights on continued professional development needs of teachers to improve delivery of instruction. The findings are expected to yield substantive contributions for both teachers and students, with the overarching objective of advancing the quality and outcomes of English vocabulary instruction.

1.1 Vocabulary Acquisition in Elementary Language Learning

Vocabulary learning is essential for young learners in basic English education as it serves as a foundation for language development [17]. Vocabulary knowledge has been shown to be a stronger predictor of reading comprehension than other factors like word decoding and reading fluency [18]. For young learners, vocabulary is a crucial component of language learning and teaching [17]. The challenge lies in selecting which words to teach, given the vast number of words in the English language [19]. In addition, vocabulary teaching in elementary school settings often faces challenges such as limited student attention spans, low motivation, and abstract word meanings that are difficult to understand without context [20].

Traditional vocabulary teaching methods like flashcards and rote memorization, while effective for retention, often fail to engage students or promote practical application [21]. Modern approaches, such as contextual learning and technology-assisted methods, can enhance vocabulary acquisition and application skills [22]. Digital flashcards, combining visual imagery with spaced repetition, offer an interactive learning experience that improves retention and engagement [21].

1.2 Technology-Enhanced Language Learning

The integration of digital tools in language education has transformed vocabulary teaching by providing a multimodal learning environment [23]. Digital technology-mediated instruction has a large positive impact on foreign language vocabulary learning [24]. Multimedia resources, mobile applications, and gamification platforms are now commonly used to support vocabulary acquisition and enhance learning motivation [23]. Technology supports personalized learning, visual representation, and immediate feedback, which are very beneficial for younger learners [24].

Empirical studies show that technology-assisted instruction can lead to significant improvements in vocabulary learning outcomes [25]. Technology-assisted instruction enhances both immediate vocabulary learning and long-term retention, with mobile devices and on-the-move learning showing particular advantages [22]. However, the effectiveness of these tools often depends on the teacher's expertise, pedagogical alignment, and classroom implementation.

1.3 Augmented Reality in Education

Augmented Reality (AR) is defined as a technology that superimposes digital content (e.g., images, sounds, text) onto the real-world environment, offering an immersive and interactive learning experience [6]. In educational contexts, AR has gained traction for its ability to create engaging, multisensory environments that appeal to diverse learning styles [12]. AR applications can enhance student engagement and learning satisfaction, with differences between active and passive learners [14]. AR-enabled learning environments with multimedia elements can improve student learning by providing high interactivity and immersion [9].

Studies have shown that AR can significantly enhance learner engagement, motivation, and retention, particularly when integrated into thematic or story-based language instruction [7]. In vocabulary learning, AR applications have been used to bring abstract terms to life, connect words to tangible objects, and provide real-time interactions. For example, Binhomran and Altahab [15] found that elementary students using AR-based English vocabulary tools demonstrated increased motivation and vocabulary retention compared to traditional methods. AR applications have been used to support vocabulary, reading, speaking, and writing in language learning [7].

On the other hand, the use of AR is met with challenges especially technical difficulties faced by its users [26] in addition to connectivity issues causing lags and delays that hinder realism of experience [27]. The high cost of AR hardware and software applications also hinder its use in education [26]. But probably the greatest challenge is designing materials that enhance productive skills like productive vocabulary knowledge [25] that will improve interactions between teachers and students. Meanwhile, teachers need familiarity with technology to use AR effectively [27] thus the requirement of ongoing professional development rather than single workshops for successful integration.

1.4 Teacher Perspectives and Classroom Practices

Teachers play a pivotal role in facilitating learning in technology-rich classrooms through adapting their practices, collaborating with colleagues, and taking on a learner role [28]. Teachers have positive attitudes towards integrating AR in education, but lack confidence in creating, using, and managing AR resources and experiences [29]. Research on in-service and pre-service teachers reveals

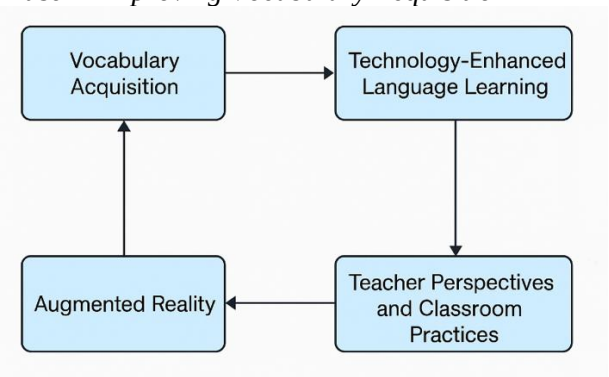
a mix of enthusiasm and hesitation toward emerging educational technologies, with concerns centering around usability, time investment, and curricular relevance [30].

Teacher perspectives on integrating AR in the classroom remain underexplored, as teachers lack the necessary skills and resources to adopt the technology [31]. Teachers often lack knowledge and experience with mobile, AR, and game-based learning, highlighting the need for training to support effective use of these technologies [32]. Moreover, Augmented Reality (AR) in education offers engaging learning experiences and interactive teaching methods, enhancing student understanding of complex concepts.

The familiarity with technology influences success of AR adoption. Teachers who were more technically savvy and had greater personal use of technology were better able to solve technical issues and integrate AR effectively [27]. The familiarity of technology puts pre-service teachers at an advantage in the use of AR in education. However, a comparative study between in-service and pre-service teachers revealed differences on how AR is utilized by both groups. In-service teachers seek deep and meaningful learning over technicalities and enjoyment while pre-service teachers focus more on technical features and visual aspects, desiring to attract attention [33]. This highlights the lack of pedagogical experience of pre-service teachers.

Figure 1 illustrates framework model in the use of AR in improving vocabulary acquisition. In elementary language learning, vocabulary acquisition is foundational yet challenging. This is due to young learners' limited attention spans and the abstract nature of many English words especially for EFL learners. The learners of today are digital natives who have been greatly exposed to technology and its engaging features. Therefore, traditional teaching methods are found to be boring necessitating a shift towards technology-enhanced pedagogy that offer multimodal, personalized, and interactive experiences. Augmented Reality (AR) stands out by immersing learners in contextualized environments that boost motivation and retention, particularly when vocabulary is linked to tangible objects and story-based instruction. However, AR's effectiveness depends on teacher readiness, pedagogical design, and access to resources. Teachers generally support AR integration but face barriers in technical skills, confidence, and curriculum alignment, highlighting the need for sustained professional development and thoughtful implementation.

Figure 1
A Framework Model of AR use in Improving Vocabulary Acquisition



Augmented Reality (AR) in education has largely been used in science, technology, engineering, mathematics, as well as in the arts and geography. This is attested by the number of AR materials available on the disciplines. The use of AR in language teaching with the goal of increasing vocabulary acquisition is not widely explored. In fact, some English teachers are not aware of the use of AR to teach language. Bridging the gap on use of AR in education is the aim of this study by exposing in-service and pre-service teachers to utilize AR in English classrooms.

1.5 Theoretical Framework

Sociocultural Theory (Vygotsky)

Vygotsky's Sociocultural Theory posits that learning is inherently a socially mediated process, emphasizing the importance of interaction, scaffolding, and cultural tools [34]. In this framework, Augmented Reality functions as a mediational artifact that bridges the gap between a learner's current

abilities and potential development, what Vygotsky termed the Zone of Proximal Development (ZPD) [30].

AR can support learning by providing dynamic, contextual cues that scaffold understanding, especially in vocabulary learning where visual and experiential elements enhance meaning-making [15]. The teacher's role as a facilitator becomes even more crucial, guiding learners in navigating AR content and co-constructing knowledge through interaction [29].

Multimodal Learning Theory

Multimodal Learning Theory asserts that learning is deepened when information is presented across multiple sensory modes, including visual, auditory, kinesthetics, and textual [35]. AR, by its very nature, supports multimodal learning environments where learners can see, hear, and interact with vocabulary items in rich, meaningful contexts [12]. This aligns with cognitive research indicating that multimodal input increases comprehension, recall, and learner engagement, especially in young learners whose cognitive development is still evolving [13]. AR's capacity to combine physical interaction with visual and auditory feedback positions it as a powerful tool for vocabulary instruction [23].

Combining Sociocultural Theory and Multimodal Learning Theory show that AR is not only a technological enhancement to teaching but rather an alternative pedagogical tool that supports both socially mediated learning and multisensory cognitive processing. In an AR environment, teachers can scaffold learning more effectively thereby providing learners with multimodal experiences that reinforce meaning-making. The intersection of Vyogtsky's and Mayer's theories provides a strong theoretical foundation for integrating AR into vocabulary instruction and broader educational practice in English classrooms.

2. Method

2.1 Qualitative Case Study Approach

This study uses a qualitative case study design. The qualitative approach is used to explore and understand the meanings given by individuals or groups to a problem, especially when the goal is to obtain descriptive insights [36]. In line with this, Cohen, Manion, and Morrison [37] emphasize that qualitative case studies are also used to investigate phenomena according to the respondents' experiences.

This research is situated within the context of elementary English language education and aims to explore teachers' perspectives and classroom experiences in integrating Augmented Reality (AR) for vocabulary teaching. This qualitative case study design allows for an in-depth and holistic examination of how AR is applied, interpreted, and experienced by English teachers in actual classroom settings. Through this approach, the study will reveal the complex interactions between beliefs, pedagogical strategies, and contextual dynamics that shape the use of AR in the vocabulary development of young students.

2.2 Sampling

Participants

This study involves six participants, consisting of two experienced elementary school classroom English teachers and four pre-service teachers. The inclusion criteria are: (a) previous experience teaching vocabulary in English, (b) willingness to integrate AR tools into their lessons, and (c) current placement or training in teaching at the elementary school level. The diversity of experience between currently serving teachers and those in training aims to offer a broad spectrum of perspectives.

Sampling Technique

The study utilized purposive sampling strategy to ensure that the selected participants meet the inclusion criteria especially having relevant teaching backgrounds. Further, it is also to ensure representation of diverse classroom contexts. This method is suitable for gathering rich and context-specific insights from individuals directly involved in teaching English vocabulary using AR.

Context and Setting

This research was conducted in a public elementary school in Yogyakarta, Indonesia where English is taught as a foreign language. Observation and data collection were focused on the 4th grade. The students in this environment are usually 9–10 years old, with English proficiency ranging from beginner to intermediate. Class size is 25 students.

2.3 Data Collection Methods

To gain a comprehensive understanding of teacher perspectives and classroom implementation of AR tools, the study used two primary data collection methods:

Semi-Structured Interviews

Semi-structured interviews were conducted with six English language teachers who integrated AR tools into their vocabulary instruction. This method allowed the researchers to explore teachers' perceptions regarding the effectiveness, usability, and challenges associated with AR tools. Additionally, the interviews probed into teachers' pedagogical beliefs, instructional strategies, and their views on vocabulary development among young learners. The use of open-ended questions fostered flexibility, encouraging participants to provide in-depth and reflective responses. According to Cohen, Manion, and Marison [37] semi-structured interviews are particularly effective in uncovering participants' meaning-making processes, enabling researchers to explore emerging themes while maintaining a structured focus on key research questions.

Classroom Observations

To complement interview data and provide contextual validation, non-participant classroom observations were carried out during English vocabulary lessons where AR tools were implemented. The twice a week observation were carried out in one month. Observations focused on students' behavioural engagement, verbal interactions involving target vocabulary, and their responses to AR-integrated activities. This method provided real-time insights into how AR influenced students' participation and vocabulary acquisition within the natural classroom environment. As Creswell [36] notes, observation is a crucial technique in qualitative research that allows for direct documentation of behaviours and interactions as they unfold, thereby enhancing the credibility and richness of the data.

Ethical Considerations

Prior to the start data collection, the consent of the school as research area was sought through the schoolmaster. Once participants were identified, their permission were obtained. They were ensured of confidentiality and pseudonyms were used in qualitative data analysis. The participants were informed that they can withdraw from the study at any time.

2.3 Tools and Instruments Used

Interview Protocol

To explore teachers' instructional practices and perceptions of augmented reality (AR) in vocabulary instruction, a semi-structured interview protocol was meticulously developed. The interview guide consisted of open-ended questions and follow-up prompts aimed at eliciting in-depth narratives from participants regarding their decision-making processes, pedagogical strategies, and the perceived affordances and limitations of AR in the classroom. The use of open-ended questions allowed for the emergence of unanticipated themes while maintaining alignment with the study's objectives.

Observation Checklist and Field Notes

To triangulate interview data and capture observable indicators of student engagement and vocabulary use during AR-integrated instruction, an observation checklist and field note template were employed. Field notes served as a complementary tool for capturing contextual insights, including classroom atmosphere, teacher-student interactions, and spontaneous learner reactions to AR features. This dual approach enabled the researchers to systematically monitor both overt behaviours and contextual nuances, strengthening the validity of the observational findings.

AR Vocabulary Learning Tool Description

The technological intervention employed in this study was Assemblr Edu, an immersive educational platform that has both web-based and a mobile-based platform. Assemblr Edu has free subscription to use all its features but with limitations. However, their partnership with *belajar.id* allows users to access premium features for free which makes it very convenient and cost-effective for teachers. For the study, the participants were made to use the mobile-based AR application and to specifically design materials to support English vocabulary learning among young learners.

Prior to implementation, participating teachers attended a brief training session on integrating the AR tool into instruction. Each teacher incorporated the application into at least two vocabulary-focused

lessons. This integration was intended to provide a consistent context for evaluating the impact of AR on learner engagement and vocabulary acquisition.

2 Results and Discussion

The study expands the scope of AR in education research by moving beyond its dominant applications in STEM and the arts to explore AR's potential in language education, specifically vocabulary acquisition among elementary EFL learners. By demonstrating that AR can effectively scaffold vocabulary learning, the study provides empirical evidence that AR is not limited to scientific or artistic concepts and content-heavy disciplines but can also enrich language learning environments.

The study showed how AR functions as a mediational tool that supports learning within the Zone of Proximal Development through guided interaction and teacher facilitation. At the same time, the study reinforces Multimodal Learning Theory by presenting how AR's integration of multiple sensory modes enhances meaning-making and memory retention. These deepen theoretical understanding of how AR supports cognitive and social dimensions of learning. Table 1 presents the key findings of the study.

Table 1
Key Findings on the Use of Augmented Reality for Vocabulary Instruction in Elementary English Education

No	Theme	Theoretical Link	Key Findings	Supporting Data
1	AR as Mediating Tool	Sociocultural	Enhances ZPD, scaffolds vocabulary	Teacher quotes
2	Multimodal Engagement	Multimodal Learning	Visual, auditory, and kinaesthetic modes boost engagement	Observations
3	Teacher Facilitation	Sociocultural	Guided interaction essential for success	Lesson transcripts
4	Contextual Vocabulary Use	Both	Real-life scenarios support use and transfer	Student behaviours
5	Professional Reflection	Sociocultural	Teachers evolved in tech integration and pedagogy	Interview data

3.1 The Effectiveness of the Augmented-Reality Language-Learning Tool

Augmented Reality as a Mediating Tool for Vocabulary Learning

The findings indicate that both in-service and pre-service teachers consistently perceive Augmented Reality (AR) as an effective technological tool for teaching English vocabulary in elementary schools. AR is regarded as capable of providing visual and interactive experiences that facilitate students' concrete understanding of new words, particularly in the context of teaching physical nouns and action verbs [9]. Teachers observed that students were able to recall and comprehend vocabulary more rapidly because they could "see" and "experience" the meaning of the words directly through AR simulations. In addition, teachers noted that AR "made the word come alive" and helped students "see and say" vocabulary terms without translation.

Theoretically, these findings align with Vygotsky's sociocultural theory, which posits that learning is mediated by cultural tools that support students within their Zone of Proximal Development (ZPD) [34]. In this context, AR functions as a digital scaffold, enabling students to engage in tasks that exceed their independent learning capabilities [12]. Prior research [14] [15] also supports the claim that AR use in vocabulary instruction significantly enhances students' motivation, comprehension, and retention.

Researchers argue that AR is not merely a visual aid, but a pedagogical innovation that integrates contextualization, experiential learning, and interactivity to support language acquisition. By offering meaningful and immersive visual associations, AR is a multimodal tool that effectively bridges the gap between unfamiliar vocabulary and students' existing knowledge. Therefore, the integration of AR in vocabulary instruction should be considered a key strategy in designing effective, student-cantered English language learning experiences.

Teacher Facilitation and Interaction as Key to Effective AR Integration

The integration of Augmented Reality (AR) in elementary English vocabulary instruction underscores a critical insight, the role of the teacher remains indispensable despite technological innovations. Both in-service and pre-service teachers acknowledged that AR alone could not ensure meaningful vocabulary acquisition without thoughtful facilitation. Teachers' active involvement in guiding learners, reinforcing vocabulary, and linking digital content to real-life language use was viewed as essential [7]. This confirms the sociocultural perspective of Vygotsky [34]. which posits that learning occurs most effectively through mediated social interaction within the learner's Zone of Proximal Development (ZPD).

In-service teachers were observed to adopt structured strategies during AR-based lessons, such as asking guiding questions, contextualizing new words, and scaffolding learner responses. These practices ensured that the immersive features of AR were leveraged pedagogically rather than merely entertaining [16] [29]. Meanwhile, pre-service teachers demonstrated creative uses of AR but often faced challenges in maintaining instructional coherence. Their experimentation, while engaging, sometimes lacked the scaffolding necessary to consolidate vocabulary understanding and highlighting the importance of pedagogical training in AR integration [32]. The difference between the two groups confirms findings of previous studies on pre-service teachers being more focused on the tool's technical features and visual aspects over meaningful learning [33].

While pre-service teachers may be more comfortable with technology, in-service teachers have developed the pedagogical expertise to evaluate technology's educational value and understand implementation challenges. The real classroom experience of in-service teachers helps them recognize what truly facilitates student learning versus what merely appears to be engaging. They are also aware of practical constraints of AR implementation ranging from technical to time management which pre-service teachers have not fully encountered.

Teachers consistently emphasized that AR should serve as a tool not a substitute for instructional engagement. They argued that vocabulary learning through AR reached its potential only when teachers actively mediated students' experiences, clarified meanings, and encouraged peer dialogue. These findings echo sociocultural principles that stress the role of meaningful interaction in knowledge construction. Thus, the success of AR-enhanced vocabulary instruction is contingent not only on the sophistication of the technology but more crucially on the teacher's capacity to guide learning purposefully. Teachers who used AR in tandem with traditional teaching methods (e.g., dialogues, drawing, games) reported more consistent vocabulary gains.

Professional Growth and Pedagogical Reflection Among Teachers

The integration of Augmented Reality (AR) in vocabulary instruction fostered significant professional development and reflective practice among both pre-service and in-service elementary English teachers. Participants reported that engaging with AR-based pedagogy enhanced their awareness of student-centered learning approaches, prompting a shift from traditional teacher-led instruction to more interactive and multimodal strategies. This shift was especially evident among pre-service teachers, who expressed increased confidence and agency in using technology to support diverse learner needs.

For in-service teachers, the implementation of AR served as a catalyst for critical reflection on existing teaching practices. Many began to reconsider the balance between innovation and mandated curriculum objectives, recognizing the need to maintain pedagogical integrity while embracing technological advancements. Several noted the importance of tailoring instruction through differentiated activities, informed by the multimodal nature of AR content and its appeal to various learning styles [31] [32].

Pre-service teachers, in particular, highlighted the empowering nature of the experience. Exposure to AR during practicum and coursework not only demystified educational technology but also provided tangible strategies for classroom application [29]. These teachers articulated a clearer vision for how to implement engaging, meaningful learning experiences that respond to the needs of 21st-century learners [32]. The use of AR fostered collaborative learning among teachers as well, supporting a reflective teaching practice.

Nevertheless, both groups expressed the need of institutional support to utilize AR in their classrooms. Continued trainings are deemed to assist the teachers in improving their instruction. These

sentiments are similarly reported in previous studies which underscores the importance of continued professional development [27]. With continued development of technology, future teacher trainings should include topics on the use of AR and other technological tools to improve teaching and learning. Similarly, education curriculum needs to include topics on the use of AR and technology in general to better prepare future teachers.

3.2 The Observable Changes in Students' Engagement and Vocabulary Use

Enhanced Learner Engagement Through Multimodal Stimuli

Drawing on the Multimodal Learning Theory, which posits that learning is more effective when multiple sensory modalities visual, auditory, and kinaesthetic are activated [35]. These findings underscore the significant role AR plays in enhancing vocabulary instruction in elementary English classrooms. Data from teacher interviews and classroom observations consistently revealed a marked increase in learner engagement during AR-integrated lessons. Animated visuals, immersive sound effects, and interactive digital elements collectively created a dynamic learning atmosphere that captivated students' attention far more effectively than traditional methods [14]. From the observation, students often mimicked actions from the AR content or repeated vocabulary words spontaneously, suggesting embodied learning.

Teachers noted that students demonstrated heightened verbal participation, such as repeating new words and initiating questions, particularly during AR-based activities. This increased interaction also extended to peer-to-peer communication, with learners spontaneously discussing AR objects and vocabulary terms [29] [32]. The integration of kinesthetics elements like tapping, rotating, or zooming 3D models, further helped anchor word meanings in students' memory, which aligns with claims in multimodal learning literature that embodied interaction facilitates deeper cognitive processing [38].

Furthermore, teachers expressed that AR not only motivated students but also fostered inclusivity. Students with varying learning preferences and needs were equally drawn to AR content, suggesting that multimodal stimuli can bridge attention gaps and support differentiated instruction. These findings support the theoretical assertion that learning environments enriched with diverse sensory input can improve both engagement and retention. In sum, AR's multimodal affordances present a pedagogical advantage that extends beyond novelty, offering a grounded, theory-backed approach to making vocabulary learning more engaging and meaningful for young learners.

AR Encourages Contextual and Functional Use of Vocabulary

The implementation of AR in vocabulary instruction significantly encourages the use of contextual and functional language among elementary school students [14]. Through interviews and classroom observations, teachers consistently emphasized that AR scenarios, such as interactive virtual farming, kitchens, or classrooms, enable students to engage with vocabulary in situational contexts. Instead of learning words in isolation, learners are immersed in environments where they can visually and interactively link new terms with relevant actions and objects, in line with the principles of situational learning and meaningful use through interaction.

Teachers reported significant changes in classroom discussions. Students used vocabulary more spontaneously and accurately during AR sessions, and most importantly, these words reappeared in subsequent class discussions and assignments. Some participants shared examples where students reused vocabulary from the AR lessons during unrelated class activities or even during free play. This behavioral transfer indicates that the vocabulary has become embedded at a functional level, going beyond mere memorization [16] [31].

These findings affirm that AR-based vocabulary instruction not only enhances retention but also promotes active language use, supporting both the cognitive and sociocultural dimensions of language learning. The authentic contexts provided by AR seem to encourage deeper understanding, increased motivation, and greater transferability of language knowledge.

4. Conclusion, Limitations, and Implications

The study examines the significant potential of AR to enhance vocabulary instruction in elementary English education. Findings from both in-service and pre-service teachers reveal that AR is widely perceived as a powerful tool that enhances vocabulary acquisition among young learners. Teachers recognize AR as a scaffold that supports understanding, engagement, and memory retention.

Classroom observations further confirm that AR positively impacted students' engagement, active participation, and vocabulary application in meaningful, context-rich situations. However, the success of AR implementation relied heavily on the teacher's role as a facilitator, emphasizing the importance of creative pedagogical strategies. More importantly, sustained support for the use of AR must be ensured through continuous professional development and robust infrastructure. This includes not only ongoing teacher training that builds confidence and pedagogical competence, but also the provision of reliable hardware, updated software, and stable connectivity. Without these foundational elements, teachers may struggle to integrate AR meaningfully into instruction, limiting its potential impact on learning. Strengthening both human and technological capacity is therefore essential for the long-term, scalable adoption of AR in educational settings.

The results of the study contribute to Sociocultural Theory by showing how AR operates as a mediational tool within the Zone of Proximal Development. Further, it highlights that AR's visual, auditory, and kinesthetics features enhance learning outcomes, thereby reinforcing Multimodal Theory. Overall, the study underscores AR's promise as an instructional innovation while emphasizing the need for sustained teacher training and pedagogical support to ensure its effective and meaningful use in the classroom.

Limitations

With only six teachers participating in the study, they may not have fully represented the diversity of teaching backgrounds, technological competencies, or instructional approaches found in elementary school settings. Moreover, the study had one school setting which limits perspectives on school administrators support on the use of AR. Despite these limitations, the study provides valuable foundation for future research as it has demonstrated utilization of AR in increasing vocabulary acquisition of elementary EFL. Subsequent studies could include a larger and more diverse teacher populations to validate and expand upon the findings. Comparative studies across different grade levels, school types, or regions would help determine how contextual factors influence AR adoption and effectiveness.

Implications

Pedagogical Implications

The study suggests that Augmented Reality (AR) tools can significantly improve vocabulary acquisition in elementary learners when used effectively. It emphasizes the need for teacher education programs to equip pre-service and in-service teachers with competencies in integrating AR, aligning it with curriculum goals, managing classroom interaction, and scaffolding students' cognitive and affective responses during technology-enhanced learning.

Theoretical Implications

This study explores the use of AR-assisted vocabulary learning in Sociocultural Theory and Multimodal Learning. It demonstrates how AR enhances cognitive processing and vocabulary retention through social interaction and sensory engagement, aligning with the Vygotskian principle of mediated learning. The study emphasizes the importance of socially situated and multimodally rich learning environments.

Practical Implications

Teacher perspectives suggest that educational AR application developers should focus on features that align with classroom realities, such as intuitive interfaces, flexible controls, and content that supports localized curriculum and language objectives. AR developers must consider teacher perspectives on tools' user experience and user interface. The difficulty of using an AR application to develop instructional materials must be kept low in order to encourage teachers to use application. Similarly, readily available graphics and other content must be expanded to include more cultural and demographical nuances suited for elementary learners.

Curriculum Development and Policy Making

The study echoes the use of technology in education. Schools and policymakers should invest in hardware, reliable connectivity, and mentoring for teachers to build confidence and competence in using technological tools, especially AR effectively. Furthermore, education curriculum must be continuously updated to include courses on the use of technology. This is to ensure that learnings and knowledge of pre-service teachers are future-proof.

5. References

[1] D. Sun, Z. Chen, and S. Zhu, "What affects second language vocabulary learning? Evidence from multivariate analysis," Frontiers in Education, vol. 8, p. 1210640, 2023.
[2] D. N. Dwihastuti, "The semantic feature analysis on teaching vocabulary for young learners," Lingua, vol. 18, no. 1, pp. 49–59, 2022.
[3] M. N. Hutabarat and A. Syafar, "The correlation between vocabulary mastery and reading comprehension achievement (A case study)," e-Journal of ELTS, vol. 9, no. 2, pp. 109–119, 2021.
[4] R. Wu, "Teaching strategies for vocabulary acquisition in junior high school English language learning," Frontiers in Educational Research, vol. 7, no. 9, pp. 205–210, 2024.
[5] D. Z. Obidovna and A. A. Rustambekovich, "The role of digital technologies in language education: Tools, approaches, and implications," American Journal of Philological Sciences, vol. 4, no. 11, pp. 18–22, 2024.
[6] I. Schorr, D. A. Plecher, C. Eichhorn, and G. Klinker, "Foreign language learning using augmented reality environments: A systematic review," Frontiers in Virtual Reality, vol. 5, pp. 1–15, 2024.
[7] M. Idul and S. Syaiful, "Augmented Reality in the classroom: Revolutionizing vocabulary teaching for high school language learners," INSPIRING, pp. 201–221, 2024.
[8] Z. Pan, M. López, C. Li, and M. Liu, "Introducing augmented reality in early childhood literacy learning," Research in Learning Technology, vol. 29, 2021.
[9] M. Tyson, "Impact of Augmented Reality on Vocabulary Acquisition and Retention," Issues and Trends in Learning Technologies, vol. 9, no. 1, pp. 3–26, 2021.
[10] R. N. Gunawan et al., "Bibliometric mapping of augmented reality in Indonesian Education: A decade of trends and insights," Journal of Technological Pedagogy and Educational Development, Aug. 2025. [Online]. Available: https://ejournal.jtped.org/ojs/index.php/jtped/article/view/9/9
[11] S. Anuar, N. Nizar, and M. A. Ismail, "The impact of using augmented reality as teaching material on students' motivation," Asian Journal of Vocational Education and Humanities, vol. 2, no. 1, pp. 1–8, 2021.
[12] A. Amores-Valencia, D. Burgos, and J. W. Branch-Bedoya, "The influence of augmented reality (AR) on the motivation of high school students," Electronics, vol. 12, no. 22, p. 4715, 2023.
[13] A. L. Costuchen, S. Darling, and C. Uytman, "Augmented reality and visuospatial bootstrapping for second-language vocabulary recall," Innovation in Language Learning and Teaching, vol. 15, no. 4, pp. 352–363, 2021.
[14] J. Y. Lai and L. T. Chang, "Impacts of augmented reality apps on first graders' motivation and performance in English vocabulary learning," SAGE Open, vol. 11, no. 4, 2021. doi: 10.1177/21582440211047549.
[15] K. Binhomran and S. Altalhab, "The impact of implementing augmented reality to enhance the vocabulary of young EFL learners," The JALT CALL Journal, vol. 17, no. 1, pp. 23–44, 2021.
[16] G. Koutromanos and A. Jimoyiannis, "Augmented reality in education: Exploring Greek teachers' views and perceptions," in Proc. Int. Conf. Technology and Innovation in Learning, Teaching and Education, pp. 31–42, 2022.
[17] N. Kamila, "The implementation of vocabulary enrichment through spontaneous speech activity of English courses of Islamic boarding school in Pasuruan," Ph.D. dissertation, Univ. Islam Negeri Maulana Malik Ibrahim, 2025.
[18] G. Brooks, J. Clenton, and S. Fraser, "Exploring the importance of vocabulary for English as an additional language learners' reading comprehension," in EAL Research for the Classroom, pp. 35–58. Routledge, 2023.
[19] E. H. Hiebert, "The core vocabulary: The foundation of proficient comprehension," The Reading Teacher, vol. 73, no. 6, pp. 757–768, 2020.
[20] I. G. Y. Permana, "Teaching vocabulary for elementary school students," The Art of Teaching English as a Foreign Language, vol. 1, no. 2, pp. 1–4, 2020.
[21] F. Zai, "How subtitles in videos affect Chinese university students' incidental vocabulary learning?," Research and Advances in Education, vol. 2, no. 8, pp. 13–29, 2023.

[22] T. Hao, Z. Wang, and Y. Ardasheva, "Technology-assisted vocabulary learning for EFL learners: A meta-analysis," Journal of Research on Educational Effectiveness, vol. 14, no. 3, pp. 645–667, 2021.
[23] K. Bansong and S. Poopatwiboon, "The effects of multimodal teaching on English vocabulary knowledge of Thai primary school students," Ph.D. dissertation, Mahasarakham Univ., 2023.
[24] I. Molenaar, A. Horvers, R. Dijkstra, and R. S. Baker, "Personalized visualizations to promote young learners' SRL: The learning path app," in Proc. 10th Int. Conf. Learning Analytics & Knowledge, pp. 330–339, 2020.
[25] A. Yu and G. Trainin, "A meta-analysis examining technology-assisted L2 vocabulary learning," ReCALL, vol. 34, pp. 235–252, 2021. doi: 10.1017/S0958344021000239.
[26] M. Wedyan, J. Falah, O. Elshaweesh, S. F. M. Alfalah, and M. Alazab, "Augmented Reality-Based English Language Learning: Importance and state of the art," Electronics, vol. 11, no. 17, p. 2692, Aug. 2022.
[27] A. Ashley-Welbeck and D. Vlachopoulos, "Teachers' perceptions on using augmented reality for language learning in Primary Years Programme (PYP) education," Int. J. Emerging Technologies in Learning, vol. 15, no. 12, p. 116, Jun. 2020.
[28] M. Johler, R. J. Krumsvik, H. E. Bugge, and N. Helgevold, "Teachers' perceptions of their role and classroom management practices in a technology-rich primary school classroom," Frontiers in Education, vol. 7, p. 841385, 2022.
[29] S. A. Nikou, M. Perifanou, and A. A. Economides, "Exploring teachers' competences to integrate augmented reality in education: Results from an international study," TechTrends, pp. 1–14, 2024.
[30] D. Polly, F. Martin, and E. Byker, "Examining pre-service and in-service teachers' perceptions of their readiness to use digital technologies for teaching and learning," Computers in the Schools, vol. 40, no. 1, pp. 22–55, 2023.
[31] C. Wyss and K. Bäuerlein, "Augmented reality in the classroom—Mentor teachers' attitudes and technology use," Virtual Worlds, vol. 3, no. 4, pp. 572–585, 2024.
[32] M. M. Marques and L. Pombo, "Teachers' experiences and perceptions regarding mobile augmented reality games: A case study of a teacher training," in INTED Proc., pp. 8938–8947, 2021.
[33] B. Aso, I. Navarro-Neri, S. García-Ceballos, and P. Rivero, "Quality requirements for implementing augmented reality in heritage spaces: Teachers' perspective," Education Sciences, vol. 11, no. 8, p. 405, Aug. 2021.
[34] L. S. Vygotsky and M. Cole, Mind in Society: Development of Higher Psychological Processes. Cambridge, MA: Harvard Univ. Press, 1978.
[35] R. E. Mayer, "Multimedia learning: Are we asking the right questions?," Educational Psychologist, vol. 32, no. 1, pp. 1–19, 1997.
[36] J. W. Creswell and R. J. Winter, Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, CA: Sage, 2018.
[37] L. Cohen, L. Manion, and K. Morrison, Research Methods in Education. London: Routledge, 2018.
[38] K. A. Mills, L. Scholes, and A. Brown, "Virtual reality and embodiment in multimodal meaning making," Written Communication, vol. 39, no. 3, pp. 335–369, 2022.
[39] A. El Shaban and R. Abobaker, Eds., Policies, Practices, and Protocols for the Implementation of Technology into Language Learning. Hershey, PA: IGI Global, 2021.