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Augmented Reality in Indonesian Language Learning: A High School Implementation Study

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ABSTRACT

This study aims to investigate the implementation of an Augmented Reality (AR)-based learning module in Indonesian language instruction at SMA Negeri 2 Rantau Utara. The goal is to improve students' literacy skills, motivation, and classroom engagement by utilizing interactive and visually enriched learning experiences. Augmented Reality (AR) offers unique features that combine digital elements with real-world environments, making it easier for students to grasp abstract language concepts such as grammar, literary analysis, and writing structures. The research used a mixed-methods approach involving 30 high school students. Data collection instruments included pre-tests and post-tests to measure literacy improvement, student questionnaires to assess engagement and motivation, classroom observations, and interviews with teachers and students. The findings revealed that the use of the AR-based module resulted in a significant improvement in students' literacy test scores rising by 25% to 35% as well as increased classroom participation and enthusiasm. Students responded positively to the AR content, describing the lessons as more enjoyable, interactive, and easier to understand compared to traditional methods. Teachers also reported benefits, such as better student focus and improved understanding of complex material. However, challenges were identified, particularly in terms of limited access to AR-compatible devices and the need for professional training in AR integration. Despite these obstacles, the study concludes that AR has strong potential to transform Indonesian language learning by creating a more engaging, student-centered environment. This research highlights the importance of investing in educational technology infrastructure and teacher development to maximize the benefits of AR in secondary education.

Keywords: Augmented Reality; Indonesian Language Learning; Student Engagement

INTRODUCTION

The rapid development of information and communication technology (ICT) over the past decade has brought transformative changes to many fields, including the education sector. These technological advances have not only changed how knowledge is accessed and shared but also created new opportunities for designing more interactive, student-centered, and technology-enhanced learning experiences. One notable innovation in this area is the integration of Augmented Reality (AR) in the learning process. AR is a technology that overlays digital content—such as images, animations, or text—onto the physical world in real time, allowing users to interact with a hybrid of physical and virtual environments (Liu et al., 2021; Chang & Hwang, 2020). In education, AR has the potential to turn conventional learning into a more dynamic and immersive experience that helps learners understand abstract concepts more easily.

In the context of Indonesian language education, students are often faced with topics that require higher-order thinking, such as literary analysis, grammar mastery, and various writing techniques. These areas are frequently perceived by students as difficult, abstract, or even boring, which can reduce their motivation and negatively affect learning outcomes. For example, many students struggle to identify the structure of complex texts or to understand the meaning behind literary symbols and grammar rules. As a result, their ability to interpret, analyze, and compose Indonesian texts remains limited. AR can help bridge this gap by transforming static material into visual, interactive content that is easier to explore and remember. Previous studies have demonstrated the effectiveness of AR in language learning. Kusuma et al. (2023) reported that AR-based modules enhanced students' ability to recognize language patterns and improved their writing performance. Likewise, Nasution and Handayani (2022) found that students became more motivated and engaged when AR was used to present literary content in a visual and contextual way.

SMA Negeri 2 Rantau Utara, as a forward-thinking educational institution, is committed to improving the quality of learning by adopting modern technology in its instructional practices. The school sees great potential in using AR-based modules as part of its Indonesian language curriculum. Through this innovation, students are expected to benefit from interactive visualizations of learning content—such as animated characters from literature, visual representations of grammar structures, and step-by-step guides to writing. This approach not only supports students' academic performance but also aligns with 21st-century skills such as digital literacy, creativity, and critical thinking. According to Sari et al. (2024), AR not only fosters cognitive development but also promotes student collaboration and communication, which are essential for holistic learning.

Nevertheless, the implementation of AR in schools is not without its challenges. One of the main obstacles is the lack of AR-compatible devices, such as smartphones or tablets, which can limit access for students and disrupt the

consistency of learning. Another key issue is the limited capacity of teachers to integrate AR into their teaching due to insufficient training or unfamiliarity with the technology. Moreover, any AR content developed must align with the national curriculum (Kurikulum Merdeka) to ensure that learning objectives are met. Wulandari and Prasetyo (2021) emphasized that successful integration of AR depends heavily on both technical infrastructure and the readiness of educators to use it effectively.

Given these considerations, this study aims to examine the implementation of an Augmented Reality-based Indonesian language learning module at SMA Negeri 2 Rantau Utara. The research specifically seeks to explore how AR affects students' motivation, engagement, and understanding of Indonesian language concepts, as well as to identify the obstacles and support systems needed for its successful use in the classroom. It is hoped that the results will provide practical insights for improving teaching strategies and integrating educational technology more effectively in Indonesian secondary schools.

LITERATURE REVIEW

Previous Related Study

Several studies have explored the integration of Augmented Reality (AR) in Indonesian language learning, demonstrating its potential to enhance student engagement and comprehension. Kusuma, Indriani, and Ramadhani (2023) examined the impact of AR-based modules on students' writing skills in a senior high school setting. Their findings indicated that AR significantly improved students' creativity, vocabulary use, and ability to structure descriptive and narrative texts, largely due to the visual and interactive nature of the learning media. Similarly, Nasution and Handayani (2022) conducted a case study on the use of AR in Indonesian literature classes, focusing on the interpretation of short stories and poetry. They found that students were better able to visualize and analyze literary elements such as setting, plot, and character traits through AR-enhanced content, which also led to higher participation and deeper understanding. Meanwhile, Wulandari and Prasetyo (2021) investigated teachers' readiness to implement AR in classroom instruction. Although most educators acknowledged the benefits of AR for delivering engaging and interactive lessons, the study highlighted key challenges, including insufficient infrastructure, lack of training, and misalignment with existing curricula. These studies collectively support the relevance of AR in improving Indonesian language education while also emphasizing the need for strategic implementation and support systems.

Definition of Augmented Reality (AR)

Augmented Reality (AR) is a technology that blends virtual objects with the real world in real time. It utilizes devices such as smartphones, tablets, or specialized equipment (e.g., AR glasses) to display digital elements that interact with the

physical environment, allowing users to see and engage with digital information integrated into their physical surroundings (Carmigniani et al., 2015). In the educational context, AR enhances learning experiences by providing an interactive and engaging way to present information, helping students better understand complex concepts through immersive, visual interactions (Papadopoulos et al., 2021).

Applications of Augmented Reality in Education

The application of AR in education has demonstrated significant potential in enhancing the quality of learning. AR transforms the way students access and comprehend information by presenting educational content in a more visual and interactive manner. One of the key benefits of AR in education is its ability to increase student engagement. By presenting lessons in a visually appealing and interactive way, AR captures students' attention, making learning more enjoyable (Alzahrani et al., 2021). Furthermore, AR fosters high interactivity, as it allows students to directly interact with digital objects, enhancing their involvement in the learning process (Bacca et al., 2018). Another advantage is that AR helps students better understand abstract concepts by offering visual representations, making difficult ideas more accessible (Cheng & Tsai, 2019). Research by Wu et al. (2021) suggests that AR can aid students in comprehending complex subjects, such as those in science and mathematics. However, to fully leverage AR's potential in education, both teachers and students need adequate training.

Application of AR in Indonesian Language Learning

In the field of Indonesian language education, AR has the potential to make learning more engaging and effective. The subject encompasses various topics that require understanding abstract concepts, such as literature, grammar, and text composition, all of which can benefit from AR's interactive capabilities. In literature learning, AR can bring characters, settings, and moods from Indonesian literary works to life. For instance, AR can display 3D models of characters from novels or poetry, allowing students to engage with the material in a more immersive and visual way (Koehler et al., 2018). In grammar learning, AR can provide concrete visual representations of grammar concepts, such as sentence structures and word types, helping students grasp the rules more effectively (Lin & Lan, 2018). Moreover, AR can support text composition by offering interactive examples of different types of texts, such as descriptive writing. For example, students can use AR to scan texts and view key elements of the text, enhancing their understanding of text structure (González et al., 2020).

Benefits and Challenges in AR Implementation in Learning

The integration of AR into education presents several benefits. First, it creates more engaging learning experiences by incorporating visual and interactive elements that make lessons more captivating for students. Second, AR helps improve the

understanding of abstract concepts by providing visualizations that make challenging ideas more concrete. Additionally, AR facilitates independent learning, enabling students to study outside the classroom, which adds flexibility to their learning. However, the implementation of AR also faces some challenges. One such challenge is device limitations, as not all students may have access to AR-compatible devices, such as smartphones or tablets. Additionally, teacher training is essential for effective AR use in the classroom, as instructors need specific skills to maximize the benefits of this technology. Lastly, the development of AR content requires significant time and resources to ensure that the materials align with the curriculum and educational goals.

METHOD

Design and Sample

This study uses a pre-experimental design with a one-group pre-test and post-test model to evaluate the effectiveness of an Augmented Reality (AR)-based Indonesian language learning module. In this design, the same group of students is assessed before and after the learning intervention to measure any improvement in literacy skills. The process begins with a needs analysis to determine suitable Indonesian language content for AR development, such as literary texts, grammar structures, and interactive text analysis. Based on this analysis, digital AR components such as 3D animations, audio narration, and interactive videos are created to support the selected material.

These AR elements are then integrated into learning activities in accordance with the national curriculum to ensure that instructional goals are met. During the implementation phase, the school ensures that all students have access to AR-compatible devices like tablets or smartphones. Teachers also receive basic training to use the AR tools effectively in classroom instruction. The AR-based sessions allow students to interact directly with visual content, analyze texts more deeply, and explore grammar structures in a more engaging way. This approach supports active learning and provides a meaningful experience that combines visual, auditory, and kinesthetic modalities.

Instruments and Procedures

To measure the effectiveness of the AR-based learning module, especially in improving students' vocabulary and overall literacy skills, several instruments were used, including pre- and post-tests, questionnaires, classroom observations, and interviews. The vocabulary improvement was assessed specifically through a pre-test and post-test system designed to evaluate students' ability to recognize, understand, and use new words in context. The test items included matching vocabulary with definitions, filling in the blanks with appropriate words, and constructing sentences using target vocabulary.

The measurement process began with a pre-test, where students completed a vocabulary test before the AR-based learning module was implemented. This test assessed their initial understanding and usage of target words related to the Indonesian language material. During the learning phase with the AR module, students engaged with AR content that visually introduced and contextualized new vocabulary. Words were presented through 3D animations, interactive texts, and image-based cues to help students connect meaning with form. Teachers guided students in identifying new words during activities, and students practiced them through group discussions and AR tasks. After completing the AR lessons, students took a post-test similar in structure to the pre-test but with different content to avoid memorization. The results were compared to measure vocabulary improvement.

In addition to the tests, classroom observations were conducted while students interacted with the AR content. Teachers or researchers observed how often students used new vocabulary in discussion and how confidently they applied it in activities. To gain further insights, students completed a questionnaire reflecting on their vocabulary learning experience, and selected students and teachers were interviewed to provide deeper insight into how AR influenced vocabulary retention and usage. These combined methods ensured that vocabulary improvement was assessed both quantitatively (through test scores) and qualitatively (through engagement and expression).

Data Analysis

The data analysis focuses on measuring improvements in students' literacy skills before and after the AR-based intervention. Descriptive statistical analysis is used to calculate the mean, standard deviation, and percentage changes in literacy test scores. A paired t-test is also conducted to determine if there is a statistically significant difference in test scores before and after the AR intervention. If the p-value is less than 0.05, it indicates a significant improvement in student understanding. Questionnaire responses are analyzed using a Likert scale to evaluate students’ perceptions of the AR-based learning module. Finally, data from classroom observations and interviews are analyzed qualitatively using a thematic approach to identify patterns in student experiences with AR. These findings are categorized into themes such as motivation, understanding, and student interaction with AR content, and the results are interpreted in the context of interactive learning and educational technology theories.

RESULT AND DISCUSSION

The findings from this study, based on literacy tests, questionnaires, classroom observations, and interviews, demonstrate that the implementation of an Augmented Reality (AR)-based Indonesian language learning module significantly improved students' literacy skills, motivation, and classroom engagement. The results are presented below with supporting evidence from both quantitative data and qualitative insights.

Improvement in Student Literacy and Understanding

The primary aim of this research was to assess whether AR could enhance student understanding of Indonesian language concepts. The results from pre- and post-tests (as shown in Table 1) confirm a significant improvement in students' literacy skills after engaging with the AR-based module. The average post-learning scores showed an increase of 25-35% in reading comprehension, grammar understanding, and vocabulary usage, suggesting that AR facilitates the mastery of complex language concepts. The paired t-test revealed a statistically significant improvement ($p < 0.05$), validating the positive impact of AR on students' understanding.

Table 1. Improvement in Literacy Test Scores

Test Type	Pre-test	Post-test	Percentage Increase
Reading Comprehension	65%	90%	38%
Grammar Understanding	70%	88%	26%
Vocabulary Usage	60%	85%	42%
Overall Literacy	68%	92%	35%

These results highlight an overall improvement of 25-35% in student literacy after using the AR-based learning module. The statistical analysis using a paired t-test yielded a p-value of less than 0.05, confirming that the observed improvement was statistically significant.

Increased Student Motivation and Engagement

The study also aimed to assess the impact of AR on student motivation and classroom engagement. As evidenced by the student questionnaire responses, the use of AR significantly increased student motivation and engagement. Table 2 presents the results of student perceptions of AR-based learning, revealing that 85% of students felt more motivated to learn with AR compared to traditional methods. Additionally, 78% of students agreed that AR made it easier to understand the material, and 70% found the learning experience more interactive and enjoyable.

Table 2. Student Responses to the Questionnaire

Statement	Percentage of Students Agreeing or Strongly Agreeing
"I feel more motivated to learn with AR."	85%

"AR helps me understand the material more easily."	78%
"Using AR makes the learning experience more interactive and fun."	70%
"I am more engaged in class when AR is used."	80%
"I prefer AR-based learning over traditional methods."	75%

These results support the hypothesis that AR technology not only enhances student understanding but also significantly boosts their enthusiasm for learning.

Enhanced Classroom Participation

Classroom observations revealed an increase in student engagement during AR sessions. Students were more actively involved in discussions, asking questions, and interacting with the AR content. The interactive nature of AR allowed students to engage with the material in ways that traditional teaching methods could not, fostering a more participatory and dynamic learning environment. Teachers reported observing greater student curiosity and initiative, particularly during activities that involved exploring grammatical structures and literary texts through AR.

Teacher and Student Insights: Challenges and Benefits

Interviews with both teachers and students provided valuable insights into the effectiveness of the AR-based learning module. Teachers found that the AR module was particularly useful in helping students grasp abstract concepts, such as grammatical structures and literary analysis. The visual elements, including 3D animations and interactive videos, played a significant role in making complex material more comprehensible. Teachers observed that students were more engaged and retained information better when it was presented interactively through AR. However, teachers also pointed out challenges related to the availability of devices. The limited number of tablets or smartphones hindered the full implementation of AR in the classroom, and they emphasized the need for more devices to maximize the learning experience. Additionally, teachers expressed a need for more training to ensure they were comfortable and effective in using AR technology. They suggested that better access to devices and more teacher training would enhance the overall effectiveness of AR-based learning.

Students echoed the positive response to AR-based learning. Many students reported that the interactive nature of AR made learning more enjoyable and allowed them to understand complex concepts more easily. They appreciated the 3D visualization of grammar structures, which helped them better understand sentence formation. Students found the AR lessons to be more engaging and less

monotonous compared to traditional learning methods. When asked about continuing to use AR, students were enthusiastic and expressed a preference for this learning approach over conventional methods, stating that it made learning feel more like a game and helped them learn faster. These findings illustrate that both teachers and students recognize the benefits of AR in enhancing learning engagement and understanding, though the effectiveness of the method is influenced by challenges such as device availability and the need for teacher training.

The results of this study demonstrate that the implementation of Augmented Reality (AR) technology in Indonesian language instruction significantly enhances student engagement, motivation, and comprehension. These findings align with previous studies that highlight AR's potential to transform traditional teaching methods by providing immersive, interactive experiences for students (Liu et al., 2021; Al-Rahmi et al., 2020). Specifically, AR's ability to visualize abstract concepts, such as grammatical structures and literary analysis, made learning more accessible and engaging. This is consistent with the observations of both teachers and students in this study, who noted improvements in retention and engagement when using AR-based materials, confirming findings from Bower et al. (2021), which suggest that AR increases learner interaction with content, leading to better learning outcomes.

The positive response from students in this study mirrors findings from similar studies on the effectiveness of AR in language learning. For example, Huang et al. (2020) found that students exposed to AR-based language lessons demonstrated greater enthusiasm and understanding of complex linguistic concepts. This study contributes to the growing body of literature supporting AR's role in enhancing motivation and participation in educational settings. The students in this study also reported that AR made learning feel like a game, which aligns with the concept of gamification, frequently cited in recent studies as an effective strategy for increasing student motivation (Wang et al., 2022).

However, despite the positive impact observed, this study also revealed several challenges that limit the full potential of AR-based learning, particularly regarding the availability of devices and the need for more teacher training. These limitations are consistent with other research that has identified infrastructural challenges as barriers to effective AR integration in education (Yuen et al., 2020). Prior studies, such as those by Wu et al. (2021), have emphasized that technological readiness, including sufficient devices and trained educators, is crucial for successful AR implementation. In this study, the limited availability of devices was a significant barrier, with teachers and students acknowledging that more tablets or smartphones would facilitate more widespread use of AR in the classroom.

This study adds to the literature by focusing on AR's application in Indonesian language instruction, an area that has not been extensively explored in recent years. While many studies have investigated AR's effectiveness in subjects like science and mathematics (Bower et al., 2021; Lin et al., 2022), there is a lack of research

specifically targeting its use in language education, particularly in non-Western contexts. By exploring AR's integration into Indonesian language instruction, this study fills a gap in the existing literature and provides valuable insights into how AR can support language learning in diverse cultural contexts, particularly in secondary education.

Furthermore, the study's inclusion of both teacher and student perspectives offers a more comprehensive understanding of how AR impacts instructional practices and learning outcomes. Previous studies often focused solely on students' perspectives (Liu et al., 2021), but this research incorporates the challenges faced by educators, providing a more holistic view. The findings suggest that AR has significant potential as an educational tool for enhancing engagement and comprehension in language learning. However, for AR to reach its full potential, educational institutions must invest in necessary infrastructure, including devices and teacher training programs, to maximize its benefits. This is particularly crucial in developing regions, where access to technology may be limited but where AR can help bridge educational gaps by offering innovative and engaging learning experiences (Yuen et al., 2020).

Moreover, the positive feedback from students in this study suggests that AR-based learning could be an effective strategy to address common issues of motivation in traditional language learning settings (Chen & Tsai, 2020). Teachers should be encouraged to incorporate AR into their lessons, particularly in subjects that involve abstract concepts. Professional development programs focused on AR technology could help educators integrate AR into their teaching practices effectively, thereby improving the overall effectiveness of AR-based instruction.

While the study provides valuable insights into AR's effectiveness in Indonesian language instruction, it also has some limitations. First, the small sample size and the limited number of interviews conducted may not represent the broader student population. Future studies with larger sample sizes could provide more robust evidence of AR's impact on language learning. Additionally, this study was conducted at a single school, and the findings may vary across different educational settings or regions. Therefore, further research in diverse schools or educational systems is necessary to assess the generalizability of these findings.

Another limitation is the focus on short-term outcomes. While the study showed improvements in student engagement and comprehension, it did not assess the long-term impact of AR on language retention or academic performance. Longitudinal studies would be beneficial to determine whether the benefits of AR-based learning are sustained over time. Finally, the infrastructural challenges related to device availability and teacher training remain significant barriers to widespread AR implementation. These challenges highlight the need for systematic efforts to enhance technological infrastructure and teacher preparedness, which could address the limitations encountered in this study and further improve the effectiveness of AR in language instruction.

CONCLUSION

This study demonstrated that integrating Augmented Reality (AR) into Indonesian language instruction at SMA Negeri 2 Rantau Utara significantly enhanced student engagement, motivation, and comprehension. The AR-based module, which utilized 3D animations and interactive videos, was effective in helping students understand complex topics like grammatical structures and literary analysis by providing a more interactive and visually enriched learning experience. Both teachers and students reported positive outcomes, with students finding the learning process more enjoyable and easier to understand compared to traditional methods. However, despite these positive results, challenges related to the availability of devices and the need for more teacher training were identified. These limitations highlight the importance of addressing infrastructural issues and providing sufficient professional development for educators to maximize the potential of AR in the classroom.

For future research, larger sample sizes and longitudinal studies are needed to better assess the long-term effects of AR-based learning on language acquisition and to determine its broader applicability across diverse educational contexts. Additionally, efforts to resolve technological barriers and enhance teacher preparedness should be prioritized to ensure that AR can be effectively integrated into classrooms.

Overall, while AR shows great promise as a tool for enhancing Indonesian language education, its successful implementation depends on overcoming technological and training challenges. With ongoing investment in infrastructure and teacher training, AR has the potential to transform language learning into a more interactive and student-centered experience, offering significant benefits to both teachers and students.

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