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Literature Analysis on the Use of Augmented Reality in Elementary School Social Studies Learning

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Abstract

The development of digital technology has brought various innovations to the world of education, one of which is Augmented Reality (AR). This technology allows the combination of virtual objects with the real environment, thus providing a more interactive learning experience. This paper aims to analyze the literature related to the use of AR in learning Natural and Social Sciences (IPAS) in elementary schools. The method used is a literature review by examining research results from national journals over the past five years. The results of the study indicate that AR can help understand abstract concepts in IPAS more concretely, increase learning motivation, and encourage active student involvement. However, challenges in implementing AR are still found, such as limited devices, lack of educator competence, and the need for AR content that is in line with the curriculum. The conclusion of this study is that AR plays a role as a learning innovation that can support the IPAS learning process in elementary schools, with the note that it must be supported by educator readiness, technological facilities, and appropriate content development.

Keywords: Augmented Reality, IPAS Learning, Elementary School, Learning Innovation, Interactive Learning

A. Introduction

The rapid advancement of digital technology has compelled educational systems to continuously adapt in order to enhance learning quality. Among emerging educational technologies, Augmented Reality (AR) has gained increasing attention for its potential to transform traditional learning environments. AR is defined as a technology that integrates two-dimensional and three-dimensional virtual objects into real-world environments in real time, enabling users to interact simultaneously with digital and physical elements (Marwa et al., 2023). This technological capability positions AR as a powerful tool for creating interactive and immersive learning experiences.

In educational contexts, AR has been shown to support the visualization of abstract concepts while promoting active student engagement. This potential is particularly significant in elementary education, where learners are developing foundational cognitive and conceptual understanding. In Indonesia, the integration of digital technologies such as AR is aligned with the Merdeka Curriculum, which emphasizes inquiry-based and project-based learning, especially in Natural and Social Sciences (Ilmu Pengetahuan Alam dan Sosial/IPAS) (Ministry of Education, Culture, Research, and Technology, 2022). Despite its pedagogical promise, the adoption of AR in elementary schools remains limited, primarily due to constraints related to technological infrastructure, teacher digital competence, and the availability of curriculumaligned AR content.

IPAS learning at the elementary level is essential for fostering students' understanding of natural phenomena, social systems, and their interconnections. However, prior studies indicate that conventional instructional approaches often fail to effectively support students' comprehension of abstract and dynamic concepts, leading to reduced learning motivation (Melindawati, 2021). AR offers a viable pedagogical alternative by enabling the overlay of threedimensional digital representations onto real-world objects through mobile devices, thereby supporting more concrete and meaningful learning experiences.

Empirical evidence suggests that AR-based learning environments contribute to instructional innovation and improved student engagement in IPAS learning. Rachmadtullah et al. (2022) report that AR integration facilitates contemporary, technology-enhanced learning practices that support conceptual understanding. Similarly, Alawiyah et al. (2022) highlight that AR learning media can be designed with diverse interactive features tailored to elementary school students, who are situated within Piaget's concrete operational stage. Consequently, AR represents a pedagogically appropriate and theoretically grounded innovation for enhancing IPAS instruction in elementary schools.

B. Methods

This study employed a literature review approach to systematically examine and synthesize existing research related to the use of Augmented Reality in elementary school IPAS learning. A literature review is a research method that

involves identifying, selecting, evaluating, and analyzing relevant scholarly sources in order to develop a comprehensive understanding of theoretical perspectives, key concepts, and empirical findings associated with the research focus.

The sources analyzed in this study included peer-reviewed journal articles, academic books, research reports, and other scholarly publications that are relevant to the topic under investigation. Through this process, the researchers aimed to critically assess previous studies, identify prevailing trends, and highlight gaps in the existing literature. This approach enables the construction of a strong theoretical foundation and supports the interpretation of educational phenomena based on established scientific evidence.

The primary objective of the literature review method is to collect credible and relevant information that can serve as the basis for developing the theoretical framework and conceptual understanding of the research topic. As emphasized by Kurniati and Jailani (2023), a literature review constitutes a systematic process of library research that involves reviewing and analyzing books, journal articles, and other academic publications related to a specific theme, ultimately resulting in a focused and coherent scholarly work. Therefore, the literature review method plays a crucial role in providing a robust conceptual and theoretical foundation for this study.

C. Results and Discussion

Overall, the findings consistently indicate that the integration of AR in elementary school learning has a positive impact on instructional quality. Most studies report significant improvements in students' conceptual understanding, learning motivation, and academic achievement. AR plays a crucial role in transforming abstract concepts into concrete and visually observable representations through three-dimensional models, thereby facilitating students' comprehension of complex topics that are difficult to explain using conventional two-dimensional images or verbal instruction alone.

From a media development perspective, several studies, including those by Nurhaliza et al. (2025) and Tias and Purnamasari (2025), demonstrate that ARbased learning media meet the criteria of validity, practicality, and effectiveness for classroom implementation. Notably, Tias and Purnamasari (2025) reported an implementation feasibility rate of 92%, indicating that AR

media can be effectively applied in real instructional settings at the elementary level. These findings highlight the practical potential of AR as an instructional medium that aligns with classroom needs and student characteristics.

In addition to learning effectiveness, student engagement emerged as a prominent theme across the reviewed studies. Habibullah et al. (2025) found that AR-based edutainment learning strategies significantly enhanced students' engagement and enthusiasm during the learning process. The interactive and enjoyable nature of AR encourages active participation, making students more motivated to explore learning content. This finding is consistent with Malihah (2024), who reported that AR-based instruction supports the development of critical thinking skills and fosters students' curiosity in IPAS learning.

Despite these positive outcomes, several studies also identified challenges related to AR implementation in elementary schools. Mufidah et al. (2024) emphasized that major barriers include limited digital literacy among teachers and students, as well as insufficient supporting infrastructure such as ARcompatible devices and stable internet connectivity. These constraints suggest that the successful integration of AR requires not only technological availability but also systematic teacher training and institutional support. Nevertheless, the reviewed literature suggests that these challenges can be mitigated through professional development programs and the design of more accessible and userfriendly AR learning applications.

In summary, the results of this literature review indicate that Augmented Reality holds substantial potential as a 21st-century learning innovation in elementary education, particularly for IPAS instruction. AR not only enhances students' learning outcomes but also promotes more contextual, interactive, and meaningful learning experiences. With adequate policy support, improved technological infrastructure, and strengthened teacher competencies, AR-based learning media can serve as an effective solution for improving the quality of primary education in Indonesia.

Challenges and Solutions in the Use of Augmented Reality (AR)

Despite its considerable potential to enhance IPAS instruction, the implementation of Augmented Reality (AR) in elementary education faces several structural and pedagogical challenges, particularly in relation to technological accessibility and instructional readiness. Previous studies have identified

multiple barriers that may hinder the effective integration of AR in classroom settings (Hariyono, 2023). One of the primary challenges concerns limited access to AR-compatible hardware. The use of AR typically requires smartphones or tablets equipped with adequate processing capabilities, which are not always available in schools with constrained financial resources. In addition, the effectiveness of AR-based learning often depends on stable and high-speed internet connectivity. However, unequal distribution of digital infrastructure across regions remains a significant obstacle, particularly for schools located in rural or under-resourced areas.

Another major constraint lies in the technical complexity of AR applications. Both teachers and students are required to possess a certain level of digital literacy to operate AR tools effectively. Without sufficient prior experience or technical guidance, AR implementation may become superficial or limited to demonstration-based activities rather than being meaningfully integrated into the learning process. Furthermore, the financial costs associated with AR adoption including device procurement, software licensing, and content development pose additional challenges for educational institutions with limited budgets.

Pedagogical alignment also represents a critical issue. AR-based learning materials must be carefully designed to align with the existing IPAS curriculum, ensuring that digital content supports intended learning outcomes rather than functioning as an isolated technological add-on. The development of curriculumaligned AR content often requires substantial time, expertise, and collaboration between educators and technology developers. Moreover, continuous professional support for teachers is essential, as many educators require structured training and ongoing assistance to effectively integrate AR into their instructional practices.

Nevertheless, the literature also highlights several strategic solutions to address these challenges. The integration of AR in IPAS learning at the elementary level is widely recognized as a valuable innovation for promoting engaging, contextual, and curriculum-relevant learning experiences in line with the Merdeka Curriculum. AR enables students to visualize abstract IPAS concepts such as the solar system, Earth's layers, ecosystems, and social interactions through interactive three-dimensional representations, thereby fostering deeper conceptual understanding and active learning engagement. Empirical evidence

suggests that AR-based media enhance the connection between theory and practice by allowing learners to interact directly with digital objects (Amalia et al., 2025; Tarmidzi et al., 2025).

To overcome infrastructural constraints, several studies recommend the development of offline AR applications that do not rely on continuous internet access, enabling their use in low-connectivity environments. In addition, schools may adopt device-sharing strategies, whereby students work collaboratively in small groups using shared devices to ensure equitable access to AR experiences. Institutional support from local governments and policymakers is also crucial, particularly through school digitalization programs and partnerships with private-sector technology providers.

Teacher readiness has been consistently identified as a key determinant of successful AR integration. Siki and Leba (2025) emphasize that insufficient pedagogical and technological competence among teachers often limits AR use to a demonstrative function rather than a transformative learning tool. Therefore, systematic professional development programs focusing on instructional design, digital pedagogy, and AR-based learning strategies are essential. Such initiatives can empower teachers to design meaningful, student-centered AR learning experiences.

In summary, optimizing the use of AR in elementary IPAS learning requires a multifaceted approach that includes the development of curriculum-aligned AR content, sustained teacher training and mentoring, strengthened collaboration among educational stakeholders, and continuous evaluation of AR's impact on learning outcomes and student motivation. Consistent with the findings of Rohmani et al. (2023), AR implementation not only enhances cognitive learning outcomes but also supports students' curiosity, critical thinking skills, and social interaction. With adequate policy support, improved infrastructure, and enhanced teacher competence, AR has substantial potential to strengthen IPAS learning and foster scientific, social, and technological literacy from an early age.

D. Conclusions

This study systematically reviewed the existing literature on the use of Augmented Reality (AR) in Natural and Social Sciences (IPAS) learning at the elementary school level. The findings indicate that AR demonstrates substantial potential in enhancing students' understanding of abstract concepts, learning

motivation, and active engagement. By providing three-dimensional visualizations, AR supports more interactive and contextual learning experiences, enabling students to comprehend complex IPAS content that is often difficult to convey through conventional instructional approaches.

Despite these pedagogical advantages, the literature also reveals several limitations in the implementation of AR in elementary education. These include limited access to AR-compatible hardware, inadequate internet infrastructure, and insufficient teacher competence in utilizing educational technologies. In addition, the development of curriculum-aligned AR content remains a significant challenge. These constraints suggest that the adoption of AR cannot be fully generalized without careful consideration of institutional readiness, technological infrastructure, and teacher capacity.

The primary contribution of this study lies in offering a comprehensive synthesis of both the opportunities and challenges associated with integrating AR into elementary IPAS instruction. The findings provide strategic insights for policymakers, educational practitioners, and stakeholders regarding the importance of teacher professional development, supportive educational policies, and improved technological infrastructure. Consequently, this study contributes to the growing body of literature on technology-enhanced learning and offers practical implications for strengthening instructional quality in primary education.

Future research is recommended to conduct empirical investigations across diverse school contexts using larger and more varied samples. Such studies should focus on quantitatively examining the effectiveness of AR-based learning and exploring key factors that influence successful implementation. These efforts are essential to enhance the validity of existing findings and to provide more robust empirical evidence to inform the development and integration of AR in educational practice.

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