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Augmented Reality (AR) Media for Learning in Elementary Schools

Moses Adeleke Adeoye[1*], I Gusti Ayu Agung Manik Wulandari[2], L Heny Nirmayani[3]

[1]Al-Hikmah University, Nigeria

[2]Universitas Pendidikan Ganesha, Indonesia

[3]STAHN MPU Kuturan Singaraja, Indonesia

*E-mail addresses: **princeadelekm@gmail.com**

A B S T R A K. *Penggunaan media pembelajaran digital di sekolah dasar memiliki banyak manfaat, terdapat beberapa masalah yang perlu diatasi untuk memaksimalkan efektivitasnya. Salah satu tantangan utama adalah pengembangan media berbasis digital. Berdasarkan hal tersebut tujuan penelitian ini yaitu menganalisis Media Augmented Reality (AR) untuk pembelajaran di sekolah dasar. Penelitian ini menggunakan metode Systematic Literature Review (SLR) dengan metode PRISMA. Pengumpulan data dilakukan dengan menganalisis 100 artikel terkait yang terdapat di google scholar. Setelah proses pemilihan selesai, data yang dikumpulkan akan disajikan dalam bentuk narasi. Hasil penelitian ini menggarisbawahi bahwa penerapan Media Augmented Reality (AR) untuk pembelajaran di sekolah dasar memberikan dampak positif terhadap pembelajaran untuk siswa sekolah dasar. Augmented Reality (AR) secara signifikan meningkatkan motivasi siswa, yang pada gilirannya berdampak pada hasil belajar mereka. Augmented Reality merupakan aplikasi yang nyata dan menarik yang dapat meningkatkan hasil belajar siswa. Secara keseluruhan, temuan-temuan ini menegaskan bahwa media pembelajaran berbasis Augmented Reality (AR) dapat meningkatkan motivasi dan hasil belajar siswa sekolah dasar.*

A B S T R A C T. Using digital learning media in elementary schools has many benefits, but several problems must be addressed to maximize effectiveness. One of the main challenges is the development of digital-based media. Based on this, this study aims to analyze Augmented Reality (AR) Media for learning in elementary schools. This study uses the Systematic Literature Review (SLR) method with the PRISMA method. Data was collected by analyzing 100 related articles found on Google Scholar. After the selection process, the data collected will be presented in narrative form. The results of this study emphasize that the application of Augmented Reality (AR) Media for learning in elementary schools has a positive impact on learning for elementary school students. Augmented Reality (AR) significantly increases student motivation, which in turn has an impact on their learning outcomes. Augmented Reality is an interesting application that can improve student learning outcomes. Overall, these findings confirm that Augmented Reality (AR)-based learning media can improve elementary school students' motivation and learning outcomes

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[1] Orcid ID 0000-0003-0755-3532
[2] Orcid ID 0000-0001-7499-1909
[3] Orcid ID 0000-0002-1661-5849

1. INTRODUCTION

The application of digital learning media in elementary schools has many benefits that can improve students' learning experiences. The use of digital learning media is very relevant because it can accommodate the various learning styles of elementary school students (Jannah & Atmojo, 2022; Rajab et al., 2023; Utomo, 2023). Students who prefer visual learning can use learning applications that display images, animations, or videos (Primadewi & Agustika, 2022; Sukarini & Manuaba, 2021; Suyanti et al., 2021). Students who prefer kinesthetic learning can learn through educational games that involve movement or physical interaction. Digital learning media allows teachers to create more interesting, interactive, and dynamic learning materials, which can increase students' motivation to be more active (Anggraeni et al., 2023; Mardiana et al., 2022). In addition, digital media provides various types of resources that can be accessed at any time, providing flexibility to students (Fauziah & Ninawati, 2022; Sukarini & Manuaba, 2021). This supports the concept of lifelong learning, where students can continue to develop their knowledge more independently. Teachers can also utilize digital learning media to monitor students' learning progress in real time (Said, 2023; Surbakti et al., 2022). Digital learning platforms integrated with evaluation features, teachers can immediately find out how far students understand the material that has been taught and provide personalized feedback. This is what makes learning tailored to needs (Anggraeni et al., 2023; Khosiyah & Gunawan, 2019; Mardiana et al., 2022). Digital learning media also facilitates

collaboration between students. This approach supports social and cooperation skills that are very important in the world of work in the future (E. Sukmanasa et al., 2017). The application of digital learning media can also improve technological skills. In this digital era, the ability to use technology wisely and effectively is very important (Ratnaningsih & Jatibaru, 2021; Siregar & Marpaung, 2020).

Although the use of digital learning media in elementary schools has many benefits, several problems need to be addressed to maximize its effectiveness. One of the main challenges is the development of digital-based media. Many teachers still have difficulty in developing digital learning media (Kurniawan et al., 2018; M Mutoharoh et al., 2022). Not all teachers have sufficient skills or training in using digital media effectively in the learning process, which can hinder the integration of technology with existing teaching methods. Another factor is the lack of a clear curriculum or guidelines for the implementation of digital media in elementary schools, which causes variations in the quality and sustainability of the use of these media in each school. This can cause digital learning media not to be used optimally and can even add to the burden on teachers who are not yet familiar with technology (Abror et al., 2020; Sudarmoyo, 2020).

Augmented Reality (AR) offers an innovative solution to overcome several problems in implementing digital learning media in elementary schools. One of the biggest challenges is the limited devices and infrastructure in schools, especially in remote areas (Akbar & Noviani, 2019; Firdanu et al., 2020). Augmented Reality can be accessed through relatively simpler devices, such as more affordable smartphones or tablets (Firdanu et al., 2020; Mubai et al., 2020). With AR, students can interact with digital content projected into the real world through their device screens, allowing for more engaging learning without the need for sophisticated hardware or high maintenance costs. Augmented Reality can be a solution to improve teachers' technological skills (Nurholisa et al., 2022; Silva et al., 2023). User-friendly Augmented Reality applications can guide teachers in integrating technology into the classroom without requiring high technical skills. Teachers download an Augmented Reality application specifically designed for education and can immediately use it in learning without requiring complicated training (Nurholisa et al., 2022; Silva et al., 2023; Tekedere & Göker, 2016). This makes AR easier to adopt at various levels of teacher technological ability.

Augmented Reality can also overcome problems related to the limitations of the curriculum and clear guidelines. Previous research findings revealed that the use of Augmented Reality allows learning materials to be presented in a visual and interactive form, which makes it easier for students to understand abstract concepts that are difficult to understand with only text or static images (Kaur et al., 2020; Rizkyani & Wulandari, 2022). Other findings also reveal that Augmented Reality can encourage collaboration between students (Kuswinardi et al., 2023; Mulianti et al., 2023). Many Augmented Reality applications allow students to work in groups to complete tasks or solve problems, encouraging them to communicate, share ideas, and collaborate. These activities help develop social and collaboration skills that are very important in the real world. Augmented Reality can reduce the potential for distraction from excessive technology use by combining digital and physical learning in a balanced way. Students can learn through a fun experience that combines the real world and the virtual world, so they stay focused on the learning material while enjoying a more interactive and enjoyable learning process. Based on this, this study aims to analyze Augmented Reality (AR) Media for learning in elementary schools.

2. METHOD

This study applies the Systematic Literature Review (SLR) method with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach. The main objective is to analyze and summarize relevant literature related to Augmented Reality (AR)--based learning media for elementary school students. SLR is a structured and systematic approach to identify, evaluate the quality, and synthesize the results of various existing studies in order to provide a comprehensive picture of the state of available research (Page et al., 2021). In this study, PRISMA was used as a guide to ensure that the review process was carried out with high transparency and clarity and to minimize bias in data selection and synthesis. PRISMA involves identifying studies through database searches, screening articles based on predetermined inclusion and exclusion criteria, evaluating the methodological quality of relevant studies, and retrieving and synthesizing data to produce reliable conclusions (V F Motta & Galina, 2020). By using this approach, this study aims to produce valid and reliable conclusions regarding the topic under study, namely Augmented Reality (AR)-based learning media for elementary school students. The research flow using the Prisma method is presented in Figure 1.

The Systematic Literature Review (SLR) analysis using the PRISMA method conducted in this study is as follows: 1.) Determination of eligibility criteria; at this stage, a detailed literature review preparation procedure is required. The researcher has determined the research topic, namely Augmented Reality (AR)-based learning media for elementary school students. The criteria used include: 1) Searching for articles published between 2017 and 2024 via Google Scholar, with the keywords "Augmented Reality" and "elementary school". 2) Determination of information sources, which begins with searching for eligible items at the planning stage. The requirements set are articles indexed in the Sinta 1-5 journal. 3) Selection of literature, which is based on the criteria for journal publications in the last four years related to Augmented Reality (AR) Media for learning in elementary schools between 2017 and 2024, which is obtained from Google Scholar sources.

Next, the data collection process was carried out, where approximately 100 articles were found on Google Scholar. Based on the established criteria, articles that did not meet the requirements were eliminated, leaving 50 articles that met the library selection criteria. To assess the suitability of the article topic with the research objectives, 50 articles

found during the data collection stage were then selected by quickly reading the entire contents of the article. In the next stage, each part of the article was analyzed to see if it was relevant to the research objectives, and articles that did not match the research objectives, including the title, abstract, methods, and conclusions, were eliminated. After the selection process was complete, the data that had been collected would be presented in narrative form. After 10 articles were deemed appropriate and relevant through Path analysis, the researcher then reviewed and analyzed them to ensure they were appropriate to the research objectives.

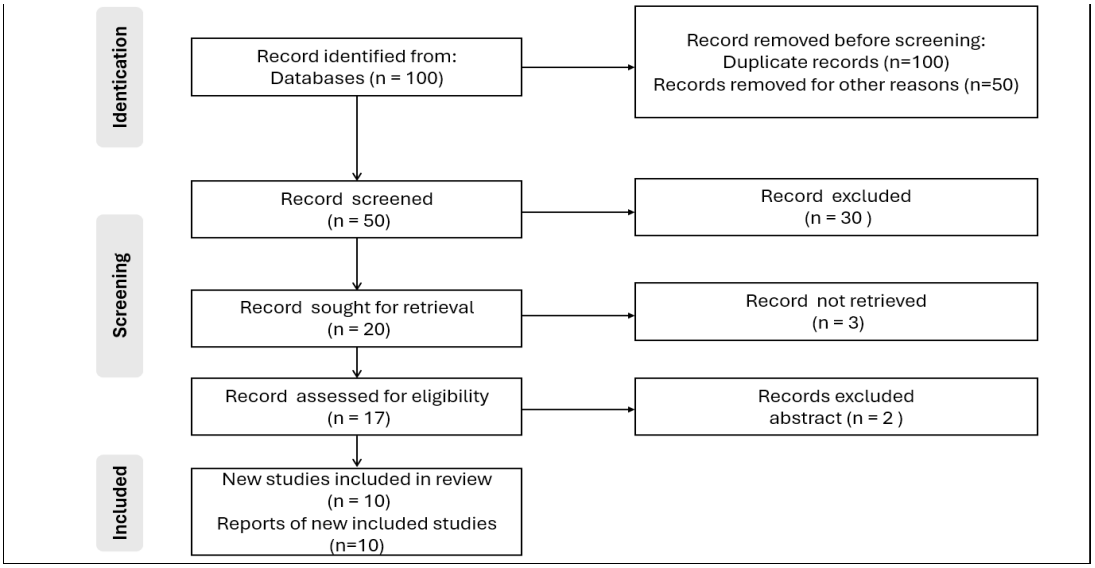

Figure 1. Research Flow Using the Prism Method

3. RESULT AND DISCUSSION

Result

Innovative learning media that teachers can use is Augmented Reality (AR)-based learning media. The application of AR in learning can transform the classroom into a more enjoyable and motivating environment, creating a learning experience that is not only educational but also entertaining. The application of AR makes the learning process more enjoyable and not limited to theory or text in books. This media encourages students to actively engage with the subject matter more thoroughly, making learning a more enjoyable and meaningful experience. In this more interactive educational environment, students not only develop knowledge but also other important skills, such as creativity, problem-solving, and the ability to work together. Thus, AR opens up many opportunities to improve the interactivity and quality of learning in elementary schools, making students more involved and motivated to learn. The results of the analysis found 10 articles from Google Scholar that met the eligibility criteria according to the objectives of this study. The results of the article analysis are presented in Table 1.

Table 1. Augmented Reality (AR) Based Learning Media for Learning in Elementary Schools

No	Name	TITLE	RESULTS
1	(Usmaedi et al., 2020)	"Development of Augmented Reality Application Technology-Based Learning Media in Improving the Teaching Process of Elementary School Students"	The application can be implemented into an Augmented Reality-based learning media application. This learning application is very interactive and easy to use, so that by applying this learning media application it can help improve the teaching process to be more interesting and easy to understand.
2	(Samsiyanawati et al., 2019)	"The Influence of Augmented Reality (AR) Based Learning Media on Elementary School Students' Learning Interests in the Human Digestive System Material"	AR will increase students' understanding in recognizing organs according to the questionnaire that has been given by 36%. This application has succeeded in helping students learn to study the respiratory system and digestive system in the human body using Augmented Reality (AR) technology.
3	(Kristina et al., 2023)	"Development of 3D Media Based on Augmented Reality Using PBL Animal Classification Material to	This media is very valid/very feasible to be used in learning. The results of the hypothesis test show that there is a difference in the results of students' self-esteem using learning that uses augmented reality-

No	Name	TITLE	RESULTS
		Improve Self Esteem of Grade V Elementary School Students"	based media and applies the PBL model. The self-esteem of students who use augmented reality-based media by applying the PBL learning model is better than students who use conventional learning..
4	(Wibowo et al., 2022)	"Development of Augmented Reality-Based Learning Media on Animal Classification Material for Grade V Elementary Schools"	The developed augmented reality-based media obtained a very valid and very practical percentage. The posttest results obtained a classical percentage of 87.5% and met the effective criteria.
5	(Sa'diah et al., 2022)	"Development of Augmented Based Interactive E-Modules"	The interactive e-Module product based on Augmented Reality that has been developed is valid and suitable for use in learning, especially in science subjects in grade VI of Elementary School.
6	(Susetya & Harjono, 2022)	"Development of Augmented Reality-Based Instagram Filter Media as Science Learning Media to Improve Elementary School Students' Learning Outcomes"	The effectiveness of using learning media with a very high category. Student learning outcomes increased from 63.67 to 82.33. It is concluded that learning media products are effective in the learning process and can improve the learning outcomes of grade VI elementary school students in science learning content.
7	(Irfansyah, 2017)	"Animal Recognition Learning Media for Elementary School Students Using Android-Based Augmented Reality"	Learning Media Using Android-Based Augmented Reality can help increase students' interest and understanding in learning.
8	(Wibowo et al., 2022)	"Development of Augmented Reality-Based Learning Media on Animal Classification Material for Grade V Elementary Schools"	Augmented reality-based media obtained a very valid percentage. The student and teacher response questionnaires showed that the media was in the very practical category. The posttest results obtained a classical percentage of 87.5% and met the effective criteria.
9	(Rahman et al., 2017)	"Science Learning Media for Grade 3 Elementary School Using Android-Based Augmented Reality Technology"	The results show that applications created by utilizing the marker detection pattern utilization method can be developed into real and interesting applications and can be implemented more widely in various media.
10	(Fakhrudin & Kuswidyanarko, 2020)	"Development of Elementary School Science Learning Media Based on Augmented Reality as an Effort to Optimize Student Learning Outcomes"	The results of the study show that the Augmented Reality-based media developed is able to optimally improve student learning outcomes in science subjects.

Various studies have shown that Augmented Reality (AR)-based learning media has a significant impact on various aspects of student learning, both in the context of elementary school education. Augmented Reality (AR)-based learning media has been proven effective in learning activities. Previous studies have shown that Augmented Reality (AR) can be implemented into Augmented Reality-based learning media applications because they are very interactive and easy to use, so applying this learning media application can help improve the teaching process to be more interesting and easy to understand (Usmaedi et al., 2020). Other studies support this finding by showing that AR will improve student understanding (Samsiyanawati et al., 2019). Other studies also show differences in student self-esteem results using learning using augmented reality-based media (Kristina et al., 2023). In addition, the use of Augmented Reality-based media must be tested for validity and practicality. This is in accordance with previous findings, which revealed that the augmented reality-based media that was developed obtained a very valid and very practical percentage so that it met the effective criteria (Sa'diah et al., 2022; Wibowo et al., 2022). Student motivation is also an important aspect influenced by Augmented Reality (AR). Previous studies have found that Augmented Reality (AR) significantly increases student motivation, which in turn impacts their learning outcomes (Irfansyah, 2017; Rahman et al., 2017; Susetya & Harjono, 2022). Other studies have also shown that AR is a real and interesting application that can improve student learning outcomes (Fakhrudin & Kuswidyanarko, 2020; Wibowo et al., 2022). Overall, these findings confirm that Augmented Reality (AR)-based learning media can improve the motivation and learning outcomes of elementary school students.

Discussion

The results of data analysis in previous studies showed that the application of Augmented Reality (AR) Media for learning in elementary schools has a positive impact on learning. Some of the findings are as follows. First, Augmented

Reality (AR) Media can improve the understanding of elementary school students. Augmented Reality (AR) Media has the potential to improve student understanding by creating a more interactive learning experience (Firdanu et al., 2020; Mubai et al., 2020). AR combines the real world with digital elements such as images, sounds, or 3D models, which can be viewed through devices such as smartphones. The use of AR in learning allows students to see and interact directly with information projected into the real world (Firdanu et al., 2020; Mubai et al., 2020; Rusli et al., 2023; Tasrif et al., 2020). This certainly provides a more concrete understanding compared to just looking at pictures in textbooks or listening to verbal explanations. In addition, AR can also make abstract or complex concepts easier to understand (AlGerafi et al., 2023; Firdanu et al., 2020; Mubai et al., 2020). AR brings learning from the usual static and theoretical to more lively and contextual.

Second, Augmented Reality (AR) Media can increase student interactivity in learning. Augmented Reality (AR) Media increases student interactivity in the learning process by dynamically combining real-world and digital elements. Through AR, students not only receive information passively, but they can interact directly with objects (AlGerafi et al., 2023; Silva et al., 2023). This allows students to be more active in exploring information and developing understanding. Direct interaction with virtual objects allows students to understand better the structure and function of the object, which is usually difficult to understand with only two-dimensional images or verbal explanations (AlGerafi et al., 2023; Firdanu et al., 2020; Mubai et al., 2020; Silva et al., 2023). AR supports exploration-based learning, namely students can make their discoveries. By using smartphone devices, students can access digital content that appears in the physical environment (AlGerafi et al., 2023; Nurholisa et al., 2022; Silva et al., 2023). The role of students from just listening to being more active in the learning process, encouraging them to think critically and solve problems in more creative ways. Activities that combine digital elements provide a more immersive experience.

Third, Augmented Reality (AR) Media can improve a fun learning atmosphere. Augmented Reality (AR) Media has great potential to improve a fun learning atmosphere. AR changes the way students interact with learning materials, not only through static text or images but by presenting digital elements that are alive and can be interacted with directly (AlGerafi et al., 2023; Firdanu et al., 2020; Mubai et al., 2020; Tekedere & Göker, 2016). With AR, students can see virtual objects appear in the classroom. AR enables experiential learning that turns the classroom into a space full of exploration possibilities (Kuswinardi et al., 2023; Majeed & ALRikabi, 2022). Students do not only receive information passively, but are actively involved in the learning process in a fun way. This activity eliminates the boredom that often occurs in traditional learning because AR creates a more dynamic atmosphere and healthy competition in completing challenges.

Previous findings also show that the use of AR can increase students' motivation to learn (Carolina, 2023; Silva et al., 2023). Other studies show that when learning materials are presented in a fun and interactive way, students feel more involved and do not get bored quickly (Fiaji et al., 2021; Kaur et al., 2020). Impressive visualizations and direct experience with the content make them more focused and enthusiastic about learning, thereby increasing information retention. AR-based activities also provide opportunities for students to learn in a more relaxed and enjoyable atmosphere. It is concluded that AR functions as a powerful tool to create a more positive learning atmosphere, eliminate the fear of difficult learning materials, and make learning an exploratory experience. In the Systematic Literature Review (SLR) study on Augmented Reality (AR) Media for Learning in Elementary Schools, several limitations need to be considered. One of them is the limitation in the number and type of research that can be included in the literature review. This study implies that although AR has great potential to improve the quality of learning in elementary schools, attention needs to be paid to the various challenges faced in its implementation.

4. CONCLUSION

The results of the data analysis show that the application of Augmented Reality (AR) Media for learning in elementary schools has a positive impact on learning. AR gives students the freedom to explore the subject matter in the way they choose, giving them a sense of ownership of their learning process. They can set the pace of learning as they wish, choose the aspects they want to learn more about and interact with the material in a personal way. The atmosphere created by AR is not only fun but also empowers students to become more independent and creative learners.

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