

AUGMENTED REALITY FOR SCIENCE LEARNING IN ELEMENTARY SCHOOL: A LITERATURE REVIEW: ANALYZING THE EFFECTIVENESS

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ABSTRACT

This article discusses the effectiveness of augmented reality media on science learning in elementary schools. Effectiveness is reviewed from the improvement of student learning outcomes in elementary school science learning. For this reason, augmented reality media appears to provide an interactive and interesting learning experience. Through a systematic literature review on Google Scholar on 7 narrative articles from 2021-2025 which were selected through a screening process through the publish or perish application, the criteria were determined: discussing three keywords namely augmented reality media, science learning and elementary school, and feasibility. Eligibility filters several aspects 1) minimum article index sinta 3, 2) availability for download in the form of pdf files. After going through the screening process, the results show that AR media in science learning in elementary schools can significantly improve students' understanding, critical thinking skills, technology skills, learning motivation, and learning outcomes in science learning. This comes from the characteristics of AR media that are easy to integrate with learning models and conventional learning media, besides that augmented reality media is also considered interactive and helps visualize complex images, such as in human organ material, the solar system, landscapes, materials that require visual explanation. Therefore, teachers as educators no longer experience problems explaining material visually, and it is hoped that from this research teachers can also see how effective augmented reality media is in learning science in elementary schools.

A. INTRODUCTION

Augmented Reality is one of the influences of technological development, emerging as the next generation of interactive display technology, to provide a three-dimensional visual experience (Xiong et al., 2021). Not only in technology-based fields, augmented reality is also present to be able to develop technology in the field of education. This immersive technology has successfully become an important part of modern education, thus providing a new interactive learning experience (Kurniawan et al., 2018; Shankar et al., 2023; Yani et al., 2023).

The entry of AR in the world of education has resulted in the development of educators in creating more interesting and interactive learning. This is supported by the statement (Familoni & Onyebuchi, 2024) where AR provides a virtual learning experience, so that students can interact with content directly. The content in question is 3-dimensional model manipulation content, such as

models of digestive system organs, human organs, the solar system, and the like. Through AR, the presentation of the model is presented more effectively and attracts students' attention. In short, the transformation of AR technology in education helps in the development of educators' ability to create an interesting learning environment.

In the context of science learning, augmented reality learning media has a very important task, where science learning is more dominant in learning that requires 3-dimensional visuals, such as in solar system material, organs in the human body, blood vessels, to the structure of human bones (Perdana et al., 2022; Sapira & Ansori, 2024) so that the use of augmented reality learning media is considered very helpful in improving learning outcomes and encouraging students to actively participate in science learning in the classroom.

The statement was followed by several research results, one of which was research conducted by

(Susilaningsih et al., 2023) where researchers implemented AR media on solar system material. The findings obtained in the form of a positive response to augmented reality media, teachers and students as users of augmented reality media explain that augmented reality media is very easy to use and suitable for learning science, especially solar system material. Learning outcomes also showed an increase before and after the implementation of augmented reality learning media. Another explanation of user response is also presented by research conducted by (Wahyuningsih et al., 2024) explaining that students experience an increase in solving a problem given through solar system material using augmented reality media. The ease of students in solving problems brings an increase in student learning outcomes so that it can be concluded that by using augmented reality learning media students experience an increase in learning outcomes, especially in solar system material.

From these two studies, it can be seen that augmented reality media received a good response, with figures showing that students experienced an increase in learning outcomes, it can be concluded that augmented reality learning media can help improve student learning outcomes. Even so, there are some studies that show the shortcomings of augmented reality learning media, as described by (Apriza et al., 2024) where in the study the researcher experienced obstacles from teachers as users of learning media, according to (Apriza et al., 2024) teachers must go through training to learn how technology is developing as a medium today, so teacher training is needed. Another fact is that teachers do not easily learn augmented reality as a learning medium, this happens because teachers lack understanding of current technology integration (Rahman et al., 2024). Another challenge is when trying to implement AR learning media in schools that have limited accessibility (Azrai et al., 2024).

Derived from this statement, it can be concluded that AR learning media is effectively used for science learning, this is evidenced by an increase in learning outcomes and student learning motivation. However, AR learning media is still not optimally applied in some schools, this is due to several internal and external factors. Therefore, research is needed that reviews comprehensive literature to analyze the effectiveness of augmented reality learning media in

science learning in elementary schools. The existence of this review aims to summarize the findings of various previous studies, identify the advantages and limitations of AR in learning practices and the extent to which learning outcomes increase in students before and after AR media is given.

B. RESEARCH METHODS

This study discusses how effective augmented reality learning media is in science learning, where the effectiveness of the media is reviewed from the improvement of learning outcomes of elementary school students. This study was conducted using a systematic literature review (SLR) approach that specifically evaluates the findings in selected articles (Kitchenham & Brereton, 2013). The approach used was the narrative approach.

The narrative approach is an approach that uses narrative stories as the main medium for organizing and presenting findings (Ananti & Wardhana, 2025). This is done with the aim of providing a comprehensive picture to readers regarding the effectiveness of AR learning media, especially in science subjects at the elementary school level, this effectiveness is viewed from how student learning outcomes during the use of AR learning media by users both teachers and other teachers.



Figure 1 Research Stages

The stages of literature review research in figure 1 are systematically explained into 3 stages, according to (Suretdawati, 2022) the three stages are planning, conducting, and reporting, with an explanation, namely 1) Planning, where at this stage the researcher determines the main topic of the article to be searched, 2) Conducting, at this stage includes searching for relevant articles according to the main topic that has been determined, until then the articles will be filtered according to predetermined criteria, namely adding 3 keywords "augmented reality media" "science learning" and "elementary school", using the latest articles in the 2021-2025 period, 3) Reporting, at this stage the researcher begins to write the results of the article that has been found after the data filter process, until

finally drawing conclusions from the results of the article review, whether AR media is effectively used in science learning.

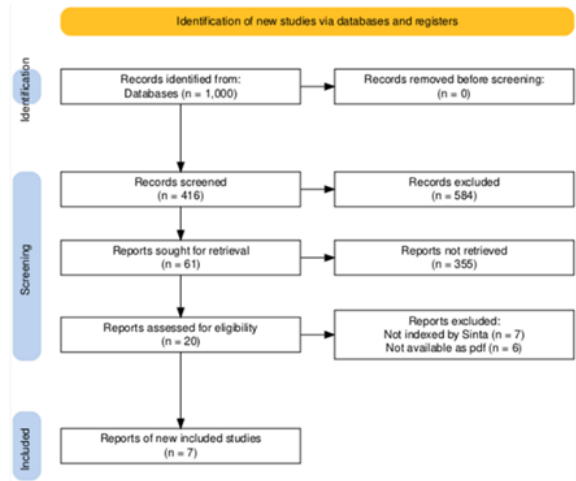


Figure 2 Article Search Process in Google Scholar (Haddaway et al., 2022)

Figure 2 shows the next step, namely determining the criteria for searching articles through the prism flow diagram website, with the aim of getting articles that are in accordance with the topic raised, the researchers used several keywords, namely “augmented reality media” with the results of google scholar sources through the publish or perish intermediary application, found as many as 1000 articles that discuss augmented reality learning media in the period 2021-2025. Then added the second keyword, namely “science learning” found as many as 416 articles in the same period, then, in the last keyword, namely “elementary school” found 61 articles. Of the 61 articles, researchers sorted the articles according to identification and eligibility so as to get 7 articles that were suitable for further review. Eligibility reviews the index of articles that are in the sinta 3 to sinta 1 range, the availability of articles for download, and discusses topics regarding the effectiveness of augmented reality media.

C. RESULTS AND DISCUSSION

The systematic literature review was carried out with the help of the prism flow diagram website with the source of articles from google scholar and also publish or perish, while the results of this review are divided into 4 parts namely identification, screening, eligibility, and inclusion. Coming from these four stages, the findings of articles that match the

keywords are obtained (n = 7), and then a narrative analysis of the 7 findings is carried out so that conclusions can be drawn from the results of each finding in the form of table 1 below:

Tabel 1. The Results of the Analysis of These 7 Articles

No	Title of Article and Author	Article Identity	Research Results
1	(Anggraeni et al., 2024) Development of Augmented Reality Learning Media to Improve Mastery of Human Respiratory System Material in Class V Science Learning Sdn Serdang Kulon IV	Elementary School: Jurnal Pendidikan dan Pembelajaran ke-SD-an. Volume 11 Nomor 1 Januari 2024	The findings obtained are how students experience improved learning outcomes in terms of pretest and posttest results, researchers also review how students respond to AR media during the learning process and end up with positive student responses, according to (Anggraeni et al., 2024) AR media can also help students in mastering the concept of the human respiratory system.
2	(Sapira & Ansori, 2024) Development of Science Learning Media Based on Augmented Reality Book with	Jurnal Penelitian Pendidikan IPA. Volume 10, Issue 6, 3249-3260	This research was conducted by developing an AR-based book, with the final result finding that AR-based media can

	Problem Based Learning Model to Improve Learning Outcomes of Third Grade Students		improve the learning outcomes of grade 3 students, besides that AR media also teaches students how problem solving and increases active participation in the learning process. AR media shows high effectiveness, where students experience an increase in science learning, especially in organ material, this increase is evidenced by the results of the pre-test and post-test scores. AR also helps students to simplify the visualization of human body parts in an interactive and interesting way.	Improve Critical Thinking Skills on IPAS Material	learning outcomes, but can also significantly improve students' critical thinking skills, especially in science learning.
3	(Rizqiyah et al., 2024) Development of Augmented Reality Book Learning Media Based on Assemblr Edu on Body Organs Material in Elementary Schools	Edubase: Journal of Basic Education. Volume 5 No. 1 (2024) Pages 50 – 64		5 (Hafizhah & Setyasto, 2024) Augmented Reality-Assisted Scrapbook Media Development in Natural and Social Science Learning	The findings produced in the form of pretest and posttest data with pretest results 54.22 and posttest 84.22 from this increase in learning outcomes, it can be concluded that AR media is effective for use by grade 4 students at SDN 1 Lambur.
4	(Pamorti et al., 2024) Effectiveness of Augmented Reality Based Learning Media to	Jurnal Penelitian Pendidikan IPA. Volume 10, Issue 5, 2211-2219	The findings obtained from this study are how the effectiveness of AR media is not only shown through improved	6 (Yusa et al., 2023) Development of Augmented Reality (AR) Learning Media to Increase Student Motivation and Learning Outcomes in Science	In this study, it was also explained that students experienced a significant increase in learning outcomes, researchers also explained that AR media provided learning motivation to students, and had a positive impact

		during the learning process.
7	(Zaid et al., 2022) Effectiveness of STEAM-based Augmented Reality Media in Improving the Quality of Science Learning in Elementary Schools	Jurnal Pembelajaran IPA Terpadu: PELITA. Volume 2, Nomor 2, 59-68 The findings obtained in this study are how AR-based interactive multimedia can provide effective learning quality. This AR-based media is considered interactive, interesting, and presents more real content.

The analysis of the seven articles that have been reviewed by researchers shows findings that underline the effectiveness of AR media in science learning, it is found that all of the above studies (n = 7) state that the use of AR media is effective for use in science learning in elementary schools, this statement comes from how researchers get a significant increase in learning outcomes in pretest and posttest. The study also found that the use of AR media was able to increase motivation, as well as students' thinking skills. These findings complement each other and form a complete picture of the contribution of AR in improving the quality of science learning.

Research by [\(Anggraeni et al., 2024\)](#) highlights that AR media has a very important role where through AR media students can understand abstract concepts of science learning, for example in the human respiratory system, with AR media students can visualize respiratory organs in 3-dimensional form. Agreeing with [\(Anggraeni et al., 2024\)](#) that AR media is effective for science material that is difficult to visualize conventionally, research conducted [\(Rizqiyah et al., 2024\)](#) also utilizes AR media for learning science material on human organs, researchers get a significant increase in learning outcomes.

In addition to learning outcomes, research conducted by [\(Pamorti et al., 2024\)](#) also shows that

AR media can develop students' critical thinking skills. According to researchers, the interaction presented in the media can allow students to analyze information to draw conclusions, this research is related to research conducted by [\(Zaid et al., 2022\)](#) which combines AR media with the STEAM learning model, resulting in more thorough learning in cognitive, psychomotor, and affective aspects. Coming from the two studies above, it can be concluded that AR media is considered effective for use in science learning in elementary schools.

Another finding comes from research conducted by [\(Maulidannisa & Ansori, 2024; Sapira & Ansori, 2024\)](#) which shows the effectiveness of AR media combined with the PBL (Problem Based Learning) learning model in this study AR not only acts as a medium for conveying material, but also as the main support in the problemsolving process, such as when students are asked why there is rain on this earth? Or what is the process of rain falling like? AR media was developed with water cycle material, so that students can see in 3 dimensions how rain falls to earth, then what the next process is after water falls to earth and so on, so that from the exposure through AR students can be asked about a problem, then students can give the right answer. This is where the role of AR is needed. The integration of innovation in other AR media is also applied in research conducted by [\(Hafizhah & Setyasto, 2024; Sudarmayana et al., 2021\)](#) which is similar to previous researchers, namely developing AR-based book media with a more personalized and creative approach, students become more emotionally involved and show high motivation in learning science.

Another increase in learning outcomes was found in research conducted by [\(Yusa et al., 2023\)](#) where in this study AR was seen as able to create a pleasant learning atmosphere and encourage active exploration from students. Through visual displays that attract students' attention and are equipped with interactive features, it helps students feel closer to the material being studied, resulting in increased motivation which has a direct impact on learning outcomes.

Coming from the findings that have been presented, it can be concluded that the effectiveness of augmented reality learning media lies in how the media can present concrete, interactive, and

meaningful learning experiences. Although each finding has differences in material and different approaches, it shows the same relationship with improving learning outcomes where from the students' interest in AR media, students will be motivated to learn to recognize the material more deeply so as to obtain significant learning outcomes. Thus, AR is not just a visual aid, but an integral component in the transformation of science learning that is more contextual, modern, and future-oriented.

D. CONCLUSION AND SUGGESTION

Based on the review of the 7 findings that have been carried out, it can be concluded that augmented reality learning media is effective in learning science in elementary schools, effective here is seen from how augmented reality learning media can help in improving student learning outcomes, especially in science learning. For this reason, each finding has a different way of developing AR media, such as combining AR with books, so that it can attract students' attention and produce significant learning outcomes, or for example in other findings that use STEAM-based AR media, in the end students will be interested in how AR media works interactively and innovatively, this response can help improve student learning outcomes. In addition, augmented reality learning media is also considered relevant to the development of the current era.

In order for the utilization of augmented reality learning media to take place smoothly, it is recommended that teachers and schools begin to learn this augmented reality learning media, supported by training and also adequate infrastructure. Media developers are also expected to provide media that is in accordance with the characteristics and curriculum set. Further research should explore the long-term impact of using AR, including on affective and psychomotor aspects.

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