

## IMPLEMENTATION OF ANDROID-BASED AUGMENTED REALITY IN ENGLISH EDUCATION

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**Abstract:** The aim of this study was to leverage augmented reality (AR) technology in enhancing English language learning, focusing on the development and evaluation of AR-based learning media for educational use, particularly at SD IT Imam Syafe'i. The study encompassed a comprehensive approach, starting with an analysis of existing educational tools to identify the need for AR in language learning, followed by the design and development of an AR framework tailored for English education. This process included expert evaluations and revisions to ensure the quality and effectiveness of the AR tools. The implementation phase involved testing the AR media in an educational setting and analyzing its impact on students' critical thinking and digital literacy through various quantitative methods. Finally, the study evaluated the practicality and user-friendliness of the AR learning media based on student feedback, aiming to provide insights and resources for educators and institutions interested in integrating advanced technology into their teaching practices, with potential applications extending to school-based and Islamic boarding school-based university environments.

**Keywords:** *Augmented Reality; English language learning; educational technology; Research and Development (R&D); ADDIE model; critical thinking skills; digital literacy; learning media development.*

### INTRODUCTION

The swift development of technology and information has become a pivotal aspect of everyday life, profoundly impacting the way individuals engage with the world. As technology continues to evolve, it increasingly influences various sectors, especially education. Syarifuddin (2020) highlights that technological progress is now a benchmark for measuring educational development, signaling a shift in how learning and teaching processes are viewed and implemented.

The role of technology in enhancing human resources is emphasized by Yasin (2019), who points out its importance in preparing individuals to compete on a global scale. The swift development of technology and information in the current digital era makes it possible for students to learn interactively, develop their critical thinking and problem-solving abilities, and gain access to a multitude of resources on a worldwide scale, as noted by Alenezi (2021) and Isa & Julia (2020). This global access to information and resources is transforming the educational landscape, breaking

down geographical barriers and creating a more interconnected learning environment.

The ubiquity of technology in daily life is evident through the widespread use of smartphones and other digital devices. These technologies have simplified and transformed routine activities, ranging from seeking information and communication to more complex tasks like online learning and digital transactions. The surge in smartphone usage across all age groups, including young children, is a testament to technology's deep integration into our lives.

Reflecting this technological integration, the 2013 educational curriculum underscores the significance of familiarizing students with information and communication technology, placing a strong emphasis on digital literacy. In the context of elementary education, digital literacy is utilizing digital technologies responsibly, ethically, and effectively. It goes beyond just knowing how to use them.

. This includes gathering information for learning, solving educational problems, completing assignments, and communicating about various learning activities with others.

Silalahi (2022) finds that digital literacy is essential to pupils' development of critical and creative thinking abilities. It involves more than just the ability to locate information; it requires the capacity to critically assess the validity and relevance of information, discern what is beneficial and appropriate, and then effectively disseminate this information to others. Sukmawati et al. (2019) also echo this sentiment, emphasizing that digital literacy is about the judicious and effective utilization of information. In essence, digital literacy equips students with the skills necessary to navigate the digital world responsibly and effectively, preparing them for the challenges of the modern, interconnected world.

Soepriyanti et al. (2022) provide a comprehensive definition of digital literacy, emphasizing it as not just the capacity to use digital tools, but a multifaceted skill set involving awareness, attitude, and the ability to effectively engage with digital resources. This definition encompasses the processes of identifying, accessing, understanding, integrating, managing, evaluating, analyzing, and synthesizing information. Digital literacy, thus, serves as a foundation for generating new knowledge, fostering effective communication, and driving positive social actions. The seven key elements they outline—digital scholarship, media literacy,

information literacy, learning abilities, teamwork and communication skills, career management, and technology and information literacy—form the cornerstones of this concept.

Lukitasari et al. (2022) add an additional layer of comprehension by segmenting digital literacy into three fundamental domains: the social-emotional, cognitive, and technological. The technical aspect relates to the practical use of information technology; the cognitive aspect involves processing and making sense of information, and the social-emotional aspect focuses on navigating online social environments. These dimensions highlight the breadth and depth of digital literacy, underscoring its relevance in various aspects of life and learning.

Despite its recognized importance, as evidenced by studies from Banik & Kumar (2019), Abbas et al. (2019), Aboderin & Govender (2022), Limniou et al. (2021), Munawaroh et al. (2022), and Khan et al. (2022), there remains a significant gap in effectively implementing digital literacy in educational settings. One key challenge is the prevalent low level of digital literacy among students. While students are often adept at using digital technologies for entertainment, such as gaming and social media, their skills do not necessarily extend to educational contexts. This gap is attributed to a lack of exposure and guidance in using digital media for learning and information purposes.

In many educational settings, especially in elementary schools, there's a noticeable discrepancy between the potential of digital media and its actual use. As noted by Arsari (2022) and Perdana et al. (2019), schools often restrict the use of digital media in classrooms, thereby limiting students' exposure to and engagement with these valuable learning tools. The limitations imposed in classroom settings, often under the guise of maintaining order, inadvertently hinder students' ability to fully exploit the educational benefits of digital media. This restrictive approach can lead to challenges in integrating digital media into learning processes effectively, as teachers face difficulties in managing classroom dynamics and responding to students' curiosity about digital tools.

In response to these challenges, the development and implementation of Augmented Reality (AR)-based learning applications are seen as a promising solution. Such applications, as described by Shoutthaboualy, Chatwattana & Piriyasurawong (2021), can revolutionize learning

experiences by making them more interactive and engaging. AR technology allows for the blending of virtual information with the real world, using devices such as webcams, computers, smartphones, or specialized glasses. By incorporating AR in education, the aim is to facilitate more memorable and effective learning experiences, particularly in language education like English. The interactive and immersive nature of AR can help bridge the gap in digital literacy, offering students a more dynamic and captivating way to learn and engage with digital media beyond traditional methods.

Augmented Reality (AR) is revolutionizing educational methodologies by offering immersive digital experiences unattainable through traditional teaching methods. As Phakamach et al. (2022) highlight, AR introduces a dimension of interactivity and engagement that conventional classrooms lack. This technology enables educators, as Childs et al. (2021) note, to tailor their instructional strategies to each student's unique learning style, thus personalizing the educational experience in a way traditional methods cannot.

The effectiveness of AR in enhancing student engagement with complex material is underscored by Sun et al. (2022). Unlike traditional lectures and textbooks, AR brings an interactive element to learning, presenting materials such as 3D objects, text, images, videos, and audio in a dynamic format. This interactive nature not only makes learning more enjoyable but also significantly enhances students' understanding of the material. As explained by Nurhasanah, Widodo & Riandi (2019), AR's ease of operation—simply requiring the pointing of a camera towards an object—makes it accessible and user-friendly, encouraging widespread adoption in educational settings.

The impact of AR on critical thinking skills has been the focus of several studies. For instance, Faridi et al. (2020), Fendi, Suyatna & Abdurrahman (2021), Dilmen & Atalay (2021), and Syawaluddin, Gunahardi & Rintayati (2019) have all reported positive results regarding the use of AR in developing these skills. These findings suggest that AR's interactive and engaging nature stimulates higher-order thinking skills, challenging students to analyze, evaluate, and create based on the information presented in a multifaceted format.

In addition to enhancing critical thinking, AR has also been shown to improve students' digital literacy, a crucial skill in the 21st century.

Shouthaboualy, Chatwattana & Piriya-surawong (2021), and Nurhasanah, Widodo & Riandi (2019) have both conducted research affirming the role of AR in advancing digital literacy skills among students. By engaging with AR technology, students not only become adept at using digital tools but also develop the ability to critically assess digital content and use these tools creatively for learning purposes.

Given these benefits, there has been a growing interest in the development of AR-based learning media that meet various educational criteria, including content validity, practicality, and construct relevance. Such media aim to enhance critical thinking skills and digital literacy among elementary school students, preparing them for a future where digital proficiency is paramount. This focus on AR in education reflects a broader shift towards more interactive, personalized, and technologically integrated learning environments.

Despite the recognized potential of technology in education, there is a significant gap in the effective implementation of digital literacy in educational settings, particularly in elementary schools. While students are often familiar with using digital technologies for entertainment purposes, such as gaming and social media, their use of these technologies for educational purposes is limited. This gap is partly due to a lack of exposure to and guidance in using digital media for learning. Additionally, many schools restrict the use of digital devices like smartphones in the classroom, limiting students' opportunities to engage with and benefit from digital learning tools. This situation presents a challenge in integrating digital media into the learning process effectively and capitalizing on its educational benefits.

The novel aspect of this research lies in addressing these challenges by developing and implementing Augmented Reality (AR)-based learning applications. This approach is particularly innovative in the context of language education, such as English learning at elementary school levels. The research introduces AR as a tool to bridge the gap in digital literacy and to provide a dynamic and engaging learning experience. By leveraging AR technology, the study aims to transform traditional learning environments, making them more interactive, personalized, and technologically integrated. The use of AR to enhance critical thinking skills and digital literacy in students is a relatively new area of exploration in educational research, particularly in the context of elementary education. This

study's focus on developing AR-based learning media that meets educational criteria for content validity, practicality, and relevance, and its application in improving critical thinking skills and digital literacy, contributes a novel perspective to the field of educational technology.

## **METHOD**

This study implemented the Research and Development (R&D) ADDIE model, as outlined by Almelhi (2021), which encompasses five phases: Analysis, Design, Development, Implementation, and Evaluation. In the initial Analysis phase, the researcher focused on evaluating the need for new learning media, involving an assessment of the existing media, curriculum, and materials. The subsequent Design phase involved creating a preliminary product design or prototype, informed by the analysis, which included selecting the basic format, framework, and research tools.

During the Development phase, the process included refining the design framework and instruments from the previous phase, followed by an evaluation by experts in media, material, and language. This evaluation aimed to garner critical feedback and suggestions for refining the media. Revisions were then made based on this expert feedback. The Implementation phase involved applying the developed learning media on a small scale, with pretest-posttest evaluations to assess its effectiveness in improving critical thinking skills and digital literacy.

Observation sheets and student response questionnaires were used to obtain input for the last step, evaluation, which included making final revisions to the learning materials.

The research data comprised both qualitative and quantitative elements. Qualitative data included expert feedback from material, media, and language specialists, as well as observational descriptions of responses and learning conditions. This qualitative feedback informed further product revisions. Quantitative data encompassed tests for critical thinking skills, digital literacy questionnaires, media validation questionnaires, and student response questionnaires. Critical thinking was evaluated using open-ended tests, while digital literacy was measured through questionnaire instruments. Normality tests, N-Gain, and independent t-tests on pretest and posttest findings were used to statistically examine how well the learning medium improved digital literacy and critical thinking abilities.

## **RESULTS AND DISCUSSION**

The focus of this research was on developing an augmented reality (AR)-based educational tool for Android devices using the Assemblr application, aimed at supporting learning about the human motion system. The goal was for this media to enhance the learning experience for both educators and students. It was designed to encourage students to engage actively with the material on the human motion system, thereby fostering the development of critical thinking skills and digital literacy, particularly in the use of Android devices.

The initial phase of the research involved an analysis stage, which included examining existing media, the curriculum, and the materials used. Media analysis was conducted through observational methods. Observations revealed that critical thinking skills among students were low, attributed to factors such as the lack of student involvement in learning, teacher-dominated lectures, students' passive roles, and the reliance on traditional teaching methods like blackboard writing and book dictation. Additionally, it was noted that smartphone-based media were not utilized in learning, and students were generally discouraged from bringing smartphones to class. Interviews indicated that while most students frequently used their smartphones for gaming, only a few used them for academic research.

The analysis also extended to the curriculum and materials, focusing on identifying suitable science topics that could be effectively integrated with AR technology. This led to the selection of various science topics for fifth-grade students, which could benefit from being visualized through AR. These themes covered the planet and its surrounds, the water cycle, natural occurrences, the human mobility system, the respiratory system of living things, the human digestive system, and the human circulatory system. The integration of these topics with AR aimed to make abstract scientific concepts more tangible and engaging for students.

The analysis phase of this research, supported by findings from Samsudin et al. (2021) and Mariam (2019), involved crucial steps like problem analysis, setting educational goals, studying student characteristics, reviewing available resources, and conducting a thorough material analysis. This aligns with Salas-Rueda et al. (2020), who noted that the analysis stage of the ADDIE model should focus on assessing student needs, analyzing problems, and task analysis to identify gaps, define student needs, and develop



posttest were used in this phase to evaluate how well the learning materials improved students' digital literacy and critical thinking abilities, with the data from these tests presented in Figure 2.

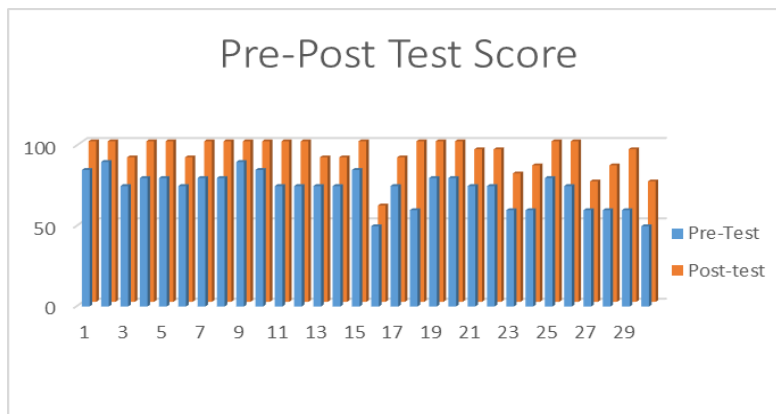


Figure 2. Data on pretest and posttest assessing critical thinking abilities and digital literacy skills

Figure 2 shows that both the experimental and control groups' students' critical thinking abilities significantly improved, with the experimental group's post-test scores significantly higher than the control group's pre-test results.

The present research bolsters the notion put forward by Hsu, Wenting, and Hughes (2018), which suggests that the inclusion of digital literacy in primary education ought to correspond with the cognitive capacities and developmental stages of young learners. It works well to integrate digital literacy using visual aids including pictures, videos, animated information, interactive animations, and animations based on augmented reality.

Primary school pupils has the ability and motivation to participate in interactive education, expanding their knowledge on their own via pleasurable learning opportunities. Additionally, students' major source of familiar information—their smartphones—play a critical part in this learning process. The augmented reality application used in this research required students to scan QR-AR markers with their cellphones, proving that using smartphones in the classroom is a creative and useful method.

As Waliyuddin & Sulisworo (2021) suggest, digital information sources should be utilized appropriately to optimize learning preparation. It's essential that digital-based information is attractively packaged and leverages the full potential of technological advancements, as highlighted by Shouthaboualy et al. (2021) and Nurhasanah et al. (2019).



Figure 3. Implementation and assessment of augmented reality: pretest-posttest approach

The evaluation phase concluded with a final refinement of the developed learning media, incorporating expert and user feedback, as well as insights from student response questionnaires. In the ADDIE model, the evaluation stage aims to gather feedback from product users, leading to revisions based on the outcomes of the evaluation or unmet needs of the product. The ultimate goal of this evaluation is to assess whether the development objectives have been met (Salas-Reuda et al., 2020; Samsudin et al., 2021). Data analysis from expert and user assessments indicated that the developed product was suitable for use and did not require major revisions, though minor improvements were made based on material and media experts' suggestions and inputs. Additionally, after the product was tested on students, its practicality was evaluated using a

student response questionnaire.

The summary of the student responses regarding the practicality of the developed product is outlined in the table below:

Table 1. *Summary of student response assessment on the practicality of the developed product*

No.	Aspect	Percentage	Criteria
1.	Media	90%	Very Practical
2.	Material	89%	Very Practical
3.	Benefit	86%	Very Practical
4.	Interest	90%	Very Practical
	Mean	89%	Very Practical

Based on the data presented in Table 2 above, the mean percentage of student response assessments was 89%, and it can be concluded that the practicality level of the product was included in the very practical category. The study's findings supported Darma et al.'s hypothesis (2021), which stated that the practicality of learning media could be viewed from the implementation of learning media in learning activities and teacher responses to learning media, student responses to learning media.

This research also meant that the media's condition and application were ideal for students.

In the practical aspect of learning media, several aspects needed to be considered that supported the media. First, the media was seen from the available formats, the time used, and the costs incurred. The second was the suitability of students, namely the suitability of media content with the development and experience of students, and the third was the suitability of educators, namely the suitability of the media with learning carried out by educators and being able to facilitate students to understand the material through the developed media (Darma et al., 2021; Indang, 2020). Figure 3 below displays the data from the pretest-posttest results:

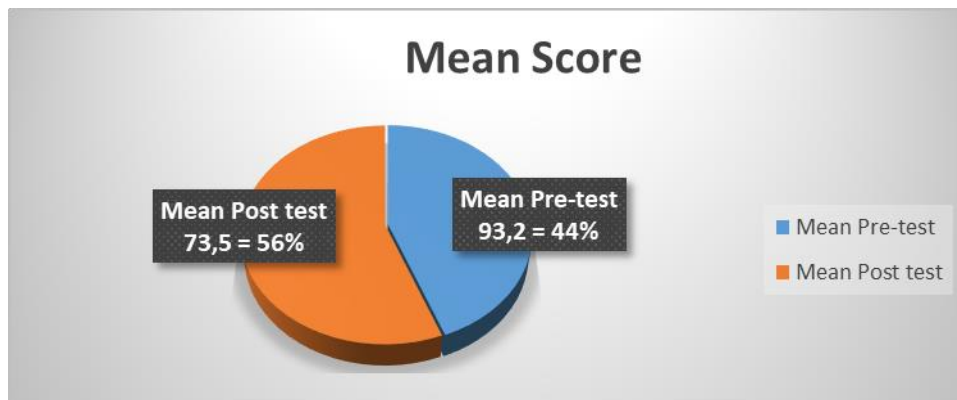


Figure 3. *Average data from pretest and posttest assessing critical thinking abilities and digital literacy skills*

From the data illustrated in Figure 3, it is clear that there was a notable enhancement in the critical thinking skills of students, as observed in both the experimental and control groups. This increase is visually apparent from the comparative analysis of the scores. Specifically, the students in the experimental class demonstrated a significant improvement in their critical thinking abilities, as evidenced by their pretest scores. These scores were substantially higher than those recorded in the post-test for the control group's critical thinking skills.

This trend suggests that the intervention or educational approach applied in the experimental class had a positive impact on the students' critical

thinking capabilities. The fact that the experimental group's pretest scores outperformed the control group's post-test scores implies that the methodologies or tools used in the experimental class were more effective in enhancing critical thinking skills compared to the traditional methods employed in the control class.

The data underscores the potential benefits of the educational strategies implemented in the experimental group, indicating that these approaches could be instrumental in fostering higher-order thinking skills. This improvement is essential in educational settings as critical thinking is a key skill that contributes to students' overall academic success and preparedness for

future challenges. The results highlight the importance of continuously exploring and integrating innovative teaching methods and tools to enhance critical thinking and other cognitive skills in students.

## CONCLUSION

The study's analysis, implementation, and testing of Augmented Reality (AR) in elementary school education have revealed its effectiveness in improving critical thinking skills and digital literacy among students. Notably, AR applications engaged students in a manner that encouraged critical thinking, problem-solving, and better information analysis compared to traditional book-based learning. The significant difference in critical thinking skills between the experimental group, which utilized AR media, and the control group, which relied on books, demonstrates the potential of AR to enhance cognitive development in elementary school students.

The research also highlights the positive impact of AR on digital literacy among students. This suggests that AR not only complements conventional learning but also helps students become more adept at navigating digital tools and resources, a crucial skill in today's technology-driven society. The statistical significance (p-value of 0.029) in the t-test for digital literacy underscores the clear and substantial difference between AR media users and those using traditional books. This emphasizes the case for integrating AR technology into elementary education as a means of enhancing digital literacy.

In the study's final evaluation phase, feedback from experts, users, and student responses was considered. Impressively, 89% of students expressed satisfaction with the AR media, indicating a high level of acceptance and practicality. This suggests that AR-based learning materials are not only well-received but also highly engaging for students. These findings collectively support the notion that Augmented Reality technology has the potential to significantly improve the learning experience in elementary schools, equipping students with essential critical thinking skills and digital literacy for success in the digital age.

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