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Integrating Augmented Reality in Islamic Education: A Case Study of Al Ma'arif Singosari High School

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Abstract: *This study investigates the implementation of Augmented Reality (AR)-based learning media at Al Ma'arif Singosari High School, an Islamic educational institution undergoing digital transformation. Employing a qualitative case study approach, the research explores the lived experiences, perceptions, and challenges encountered by teachers, students, and administrators. Data were collected through classroom observations, semi-structured interviews, focus group discussions, and document analysis, ensuring methodological triangulation. Findings indicate that AR positively influenced teaching practices, fostering creativity and a shift from content delivery to facilitative instruction. Students reported increased engagement and improved comprehension of abstract concepts across subjects such as Islamic Studies, Biology, and Arabic. However, technical challenges—including device compatibility, limited internet connectivity, and distractions from mobile devices—posed significant barriers. These dual outcomes highlight both the pedagogical potential and operational limitations of AR in Islamic education. The study provides practical implications for institutions considering similar initiatives, emphasizing the importance of teacher training, infrastructure readiness, and institutional support. While offering a replicable framework, this single-site study is limited in scope and duration. Future research should explore the long-term impacts of AR integration, its adaptability across diverse Islamic school contexts, and the development of culturally and pedagogically aligned AR content.*

Abstrak: Penelitian ini mengkaji implementasi media pembelajaran berbasis *Augmented Reality* (AR) di SMA Al Ma'arif Singosari, sebuah lembaga pendidikan Islam yang tengah menjalani transformasi digital. Dengan menggunakan pendekatan studi kasus kualitatif, penelitian ini mengeksplorasi pengalaman nyata, persepsi, dan tantangan yang dihadapi oleh para guru, siswa, dan pengelola sekolah. Data dikumpulkan melalui observasi kelas, wawancara semi-terstruktur, diskusi kelompok terarah (FGD), dan analisis dokumen, guna menjamin triangulasi metodologis. Temuan menunjukkan bahwa integrasi AR berdampak positif terhadap praktik mengajar, mendorong kreativitas, serta menggeser peran guru dari sekadar penyampai materi menjadi fasilitator pembelajaran. Para siswa melaporkan peningkatan keterlibatan dan pemahaman terhadap konsep-konsep abstrak, khususnya dalam mata pelajaran seperti Pendidikan Agama Islam, Biologi, dan Bahasa Arab. Namun, tantangan teknis—termasuk ketidakcocokan perangkat, keterbatasan konektivitas internet, serta distraksi dari penggunaan perangkat seluler—menjadi hambatan yang signifikan. Hasil ini menyoroti potensi pedagogis AR sekaligus keterbatasan operasionalnya dalam konteks pendidikan Islam. Studi ini memberikan implikasi praktis bagi lembaga yang ingin mengadopsi inisiatif serupa, dengan menekankan pentingnya pelatihan guru, kesiapan infrastruktur, dan dukungan institusional. Meskipun menawarkan kerangka kerja yang dapat direplikasi, studi ini terbatas pada satu lokasi dan periode observasi yang singkat. Penelitian selanjutnya disarankan untuk mengkaji dampak jangka panjang dari penggunaan AR, adaptabilitasnya di berbagai konteks sekolah Islam, serta pengembangan konten AR yang selaras secara budaya dan pedagogis.

1. Introduction

Education stands as a fundamental pillar in the development of high-quality[1] human resources,[2] especially amidst the Fourth Industrial Revolution and the Society 5.0 era,[3] which demand massive technological adaptation.[4] The world of education is challenged to transform from conventional methods to more innovative approaches relevant to the needs of the digital generation.[5] A failure to adopt technology can create a significant gap, where the learning process becomes less engaging and effective for students.[6] Therefore, the integration of technology in education is no longer an option but a necessity to create interactive and meaningful learning experiences.[7] One technological innovation with immense potential to revolutionize learning media is Augmented Reality (AR).[8] AR is a technology capable of projecting two or three-dimensional virtual objects into a real-world environment in real-time.[9]

Unlike general interactive media[10], AR offers an immersive experience that allows students to interact with virtual objects as if they were truly present.[11] Numerous studies have demonstrated the positive impact of AR in educational contexts. Research conducted by Wu et al. and Saidin et al. shows that the use of AR can significantly enhance student engagement, intrinsic motivation, and information retention compared to

[1] Abdullah M Al-Ansi et al., "Analyzing Augmented Reality (AR) and Virtual Reality (VR) Recent Development in Education," *Social Sciences & Humanities Open* 8, no. 1 (2023): 100532, https://doi.org/https://doi.org/10.1016/j.ssaho.2023.100532.

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[10] Norma Dewi Shalikhah, "Lectora Inspire Interactive Learning Media as a Learning Innovation," *Warta Lpm* 20, no. 1 (2017): 9–16.

[11] Matt Bower et al., "Augmented Reality in Education–Cases, Places and Potentials," *Educational Media International* 51, no. 1 (2014): 1–15.

traditional learning methods.[12,13] This is supported by Billinghurst, who highlighted AR's ability to foster a constructivist and collaborative learning approach.[14]

In Indonesia, the effectiveness of AR has also been confirmed. For instance, a study by Rini et al. found that using AR media for learning about the respiratory system significantly improved the learning outcomes of high school students.[15] This potential becomes particularly relevant in the context of Islamic education, where many concepts are abstract and difficult to visualize, such as Islamic historical events, worship procedures, or theological concepts. AR technology can bridge the understanding of these concepts by presenting them more concretely and interactively, thereby making the learning process more profound.[16]

Despite ample empirical evidence of AR's benefits, its practical implementation, especially in Islamic-based high schools in Indonesia, still faces various obstacles. Existing research tends to focus on measuring the effectiveness of AR on learning outcomes in limited or experimental settings. A gap exists in the literature concerning in-depth case studies on how the adoption and implementation process of AR technology unfolds in a real school environment. There is a scarcity of research that comprehensively describes the holistic impact—both benefits and challenges—experienced directly by teachers and students during the integration of this technology in the classroom.

Today's students tend to be more attracted to visual and interactive content, so the use of AR-based learning media can be a solution to increase their engagement in the teaching and learning process. However, the main obstacle faced is a lack of teacher understanding and skills in developing and utilizing AR technology in learning.

To fill this gap, this research focuses on a case study of the implementation of AR-based learning media at Al Ma'arif Singosari High School, an Islamic educational institution that has begun adopting this technology. Accordingly, this study specifically aims to describe the impact of the implementation of Augmented Reality (AR) technology-based learning media for teachers and students at Al Ma'arif Singosari High School. By analyzing the experiences, perceptions, and challenges faced by stakeholders, this research is expected to provide practical insights and a realistic depiction of the AR technology adoption process in a high school setting. The contribution of this study is to provide a model and recommendations for other educational institutions, particularly those with an Islamic foundation, in effectively planning and executing similar learning innovations.

2. Method

This study employed a qualitative case study approach to explore the integration of Augmented Reality (AR) in an Islamic educational setting. Rather than focusing on numerical outcomes, the research aimed to understand the lived experiences,

[12] Hsin-Kai Wu et al., "Current Status, Opportunities and Challenges of Augmented Reality in Education," *Computers & Education* 62 (2013): 41–49.

[13] Nor Farhah Saidin, Noor Dayana Abd Halim, and Noraffandy Yahaya, "A Review of Research on Augmented Reality in Education: Advantages and Applications," *International Education Studies* 8, no. 13 (2015): 1–8.

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[16] Ais Isti'ana, "Integrasi Teknologi Dalam Pembelajaran Pendidikan Islam," *Indonesian Research Journal on Education* 4, no. 1 (2024): 302–10.

perceptions, and challenges of educators and students using AR-based learning. Al Ma'arif Singosari High School in Malang, East Java, was selected as the research site due to its progressive use of educational technology. The research was conducted in April 2025.

Participants were selected purposively, involving four teachers from different subjects—Arabic, Indonesian, Biology, and Mathematics—who had implemented AR in their classrooms. Their perspectives were enriched by input from students who directly experienced AR-based learning. Additionally, the school principal was involved to provide an institutional viewpoint regarding the strategic vision and support systems behind the AR initiative.

Data collection utilized multiple techniques to ensure triangulation and depth. The process began with non-participant classroom observations to document real-time learning dynamics, student engagement, instructional strategies, and technical issues. These were followed by semi-structured interviews with teachers, students, and the principal to capture detailed reflections on the impact and challenges of AR. Document analysis was also conducted, including school policies, lesson plans (RPP), and AR materials, to provide curricular and institutional context.

Data analysis followed Miles and Huberman's (2014) interactive model, beginning with data reduction through thematic coding. Themes such as "learning impact" and "implementation challenges" were identified, organized into matrices, and analyzed to draw conclusions. Ethical considerations were central throughout the study. Informed consent was obtained, and all participants' identities were anonymized. Credibility was strengthened through triangulation, where interview findings were cross-checked with observational and documentary data. This approach provided a comprehensive understanding of AR's potential and limitations in an Islamic school context.

3. Results

This section presents the key findings of the study on the implementation of Augmented Reality (AR)-based learning media at Al Ma'arif Islamic Senior High School in Singosari. The data were obtained through qualitative triangulation, involving in-depth interviews with teachers and students, participatory classroom observations, and document analysis. The presentation of results is structured thematically and descriptively, aligned with the study's objective of illustrating the impact of AR implementation on both teachers and students, without further interpretation or discussion. The findings are organized according to the main research focus: identifying the impact of AR implementation on two key groups—teachers and students—within the specific context of Islamic education.

3.1. Impact of AR Implementation on Teachers

Data indicated that AR technology significantly influenced teachers' instructional experiences, both positively and in terms of encountered challenges.

3.1.1. Shifts in Perception and Instructional Design Practices

Interview data and lesson plan analysis revealed a positive transformation in how teachers designed and delivered content. AR was perceived as a tool that transformed static material into dynamic, interactive experiences. One Islamic Religious Education (PAI) teacher reflected:

> *"Previously, I could only explain the Hajj rituals or Islamic civilization through textbook images or YouTube videos. With AR, I can project a 3D model of*

the Kaaba in the classroom. Students can view it from different angles. It changes my role from a lecturer to a learning facilitator."[17]

Observations during teacher training sessions confirmed these shifts. Photo documentation (see Figure 1) showed enthusiastic engagement as teachers explored Assemblr EDU to create AR content. The integration of AR was not limited to Islamic Studies but extended to Biology, Arabic, and Islamic Cultural History. Lesson plan (RPP) analysis revealed designated sections for AR usage, including QR codes and interaction scenarios with 3D objects. The vice principal for curriculum added an institutional perspective:

"We supported this innovation as it aligns with our vision of integrating faith, piety, and science. Initially, there was hesitation, but after teachers created their own AR materials for topics like tajweed and prophetic stories, their perceptions shifted. They saw it as an opportunity, not a burden."[18]

3.1.2. Technical and Pedagogical Challenges

Despite the generally positive reception, interviews and observations revealed several challenges. The most common were technical limitations and pedagogical adjustments. A teacher of Arabic noted:

"The main issue is with the devices. Not all students' smartphones are compatible or powerful enough to run AR smoothly. Also, the school Wi-Fi struggles to support 36 students at once, making the loading process slow."[19]

Observations during a Biology class confirmed this, where 4 out of 36 students experienced technical issues like app crashes or scanning failures. Teachers had to allocate extra time to assist affected students, reducing instructional time. Pedagogical challenges were also noted, particularly regarding classroom management. One teacher remarked:

"Creating AR content takes time outside teaching hours. In class, I have to ensure students are actually using their phones for learning, not for other apps. So clear rules and extra supervision are necessary."[20]

3.2. Impact of AR Implementation on Students

From the students' perspective, AR learning offered a new experience that enhanced engagement and conceptual understanding.

3.2.1. Increased Engagement and Comprehension of Abstract Concepts

Focus group discussions (FGDs) with students from grades X and XI consistently showed that AR-based lessons were more engaging and enjoyable than conventional methods.

"Learning feels like playing a game. In our Fiqh class, we could view 3D animations of the correct wudu sequence right on our desks. It's much easier to remember than just reading from a textbook."[21]

This was supported by observations in Arabic class, where students scanned AR cards to visualize classroom objects (e.g., chairs, tables) labeled in Arabic. They eagerly shared results and repeated pronunciations from integrated audio. Another student added:

"In Biology, seeing a beating 3D heart was so cool. Now I understand where the atria and ventricles are. A flat diagram never made it that clear."[22]

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[17] Interview, PAI Teacher, May 2, 2025
[18] Interview, Curriculum Vice Principal, May 3, 2025
[19] Interview, Arabic Teacher, May 4, 2025
[20] Interview, Biology Teacher, May 2, 2025
[21] FGD, Grade X Student, May 6, 2025
[22] FGD, Grade XI Student, May 6, 2025

3.2.2. Accessibility Issues and Distraction Potential

Similar to teachers, students also faced technical limitations. Some reported using older smartphones that could not run AR smoothly:

> *"My phone lags or crashes when I open the app. I have to look at a friend's screen. Also, internet quota is a problem if the school Wi-Fi is slow."*[23]

Students also acknowledged being tempted by distractions:

> *"Sometimes, when a notification pops up, I lose focus. You really need self-discipline to stay on the learning app."*[24]

Classroom observations supported this, as teachers occasionally had to redirect off-task students using phones for unrelated apps.

Figure 1. Documentation of AR Media Development Training at Al Ma'arif Islamic Senior High School

The image shows teachers collaboratively experimenting with AR content creation using laptops and smartphones, guided by an instructor in an engaging and interactive training environment. To summarize the findings across data sources, the following table maps the emerging themes:

Table 1. Summary of Thematic Findings from Interviews, Observations, and Documentation

Respondent Category	Emerging Themes	Data Sources
Teachers	1. Positive Perceptions & Role Shift – AR as powerful visual tool – Role shift from lecturer to facilitator – Enhanced creativity in lesson planning	Interviews (PAI Teacher, Vice Principal), Lesson Plan Analysis (RPP), Training Observations
	2. Implementation Challenges – Device and internet limitations – Extra time needed to create content – Classroom management concerns	Interviews (Arabic & Biology Teachers), Classroom Observations
Students	1. Increased Engagement & Understanding – Fun and interactive learning – Better comprehension of abstract concepts – Improved memory retention	FGDs, Classroom Observations
	2. Technical & Non-technical Barriers – Device compatibility issues – Internet dependency – Distraction from personal devices	FGDs, Classroom Observations

Table 1 summarizes the key thematic findings derived from interviews, classroom observations, and document analysis. It highlights how teachers experienced a shift in pedagogical roles and increased creativity through AR integration, while also facing

[23] FGD, Grade X Student, May 6, 2025
[24] FGD, Grade XI Student, May 6, 2025

technical and classroom management challenges. For students, AR enhanced engagement and conceptual understanding but presented issues related to device compatibility and distractions. This thematic mapping illustrates the multifaceted impact of AR implementation, showing both its educational benefits and practical limitations within the Islamic school context. The triangulated data ensure a balanced, evidence-based representation of stakeholder experiences

4. Discussion

This discussion section aims to interpret the findings concerning the implementation of Augmented Reality (AR)-based learning media at Al Ma'arif Singosari Islamic High School. By referencing the research objectives and relevant literature, this section examines the significance of the obtained results, compares them with previous studies, and formulates their practical and theoretical implications. The study originates from the central research question regarding the impact—encompassing experiences, perceptions, and challenges—of AR technology implementation within an Islamic educational institution. The existing literature has widely confirmed the potential of AR to enhance learning engagement and visualize complex concepts, particularly in Science, Technology, Engineering, and Mathematics (STEM) fields.[25,26] Nevertheless, a significant research gap persists concerning the application of this technology within the context of humanities and religious education, specifically Islamic Religious Education (PAI). This study addresses this gap by exploring the phenomenon of AR adoption at Al Ma'arif Singosari Islamic High School.

The primary findings of this research present a balanced picture. On one hand, the implementation of AR was found to have a significant positive impact. Both teachers and students demonstrated highly positive perceptions, viewing AR as a successful tool for making learning more interactive, engaging, and tangible. This was evident from the students' enthusiasm, who reported that learning felt "like playing a game," and their enhanced ability to understand abstract concepts, such as the procedures for *wudhu* (ablution) or the anatomy of the heart, through 3D visualization. For teachers, AR facilitated pedagogical innovation, shifting their role from mere information transmitters to facilitators of immersive learning experiences. On the other hand, another crucial finding was the identification of tangible challenges, which were categorized into two domains: technical (e.g., device compatibility, internet network stability) and pedagogical (e.g., the time required for content creation, classroom management to minimize distractions).

When compared with previous studies, the findings regarding increased student engagement and conceptual understanding align with the general conclusions in AR literature.[27,28] The students' testimony that a 3D heart model was easier to comprehend than a two-dimensional image constitutes empirical evidence supporting the claims of Koehler et al. regarding AR's suitability for visual and kinesthetic learning styles.[29] Similarly, the technical challenges and the need for teacher training identified at Al

[25] Juan Garzón, "An Overview of Twenty-Five Years of Augmented Reality in Education," *Multimodal Technologies and Interaction* 5, no. 7 (2021): 37.

[26] Kangdon Lee, "Augmented Reality in Education and Training," *TechTrends* 56 (2012): 13–21.

[27] Billinghurst, "Augmented Reality in Education."

[28] R Rahayu, S Iskandar, and Y Abidin, "Inovasi Pembelajaran Abad 21 Dan Penerapannya Di Indonesia Restu Rahayu 1 , Sofyan Iskandar 2 , Yunus Abidin 3," *Jurnal Basicedu* 6, no. 2 (2022): 2099–2104.

[29] Matthew J. Koehler, Punya Mishra, and William Cain, "What Is Technological Pedagogical Content Knowledge (TPACK)?," *Journal of Education* 193, no. 3 (2013): 13–19, https://doi.org/10.1177/002205741319300303.

Ma'arif Singosari Islamic High School echo the implementation barriers also identified by Kaufmann nearly two decades ago, indicating that infrastructure and human resource readiness remain persistent issues in the adoption of educational technology.[30]

However, what distinguishes this study and constitutes its primary significance is its context. The explanation for the positive perceptions of its success lies not only in the novelty of the technology but also in its ability to address the specific needs of Islamic Religious Education. Many subjects within PAI, such as the history of Islamic civilization, the rituals of Hajj, or even creedal concepts, are abstract and historical. AR offers a bridge to make these concepts tangible and virtually experiential for students. The ability of the PAI teacher to render a 3D visualization of the Kaaba in the middle of the classroom is a concrete example of how this technology can foster *'ainul yaqin* (the certainty of sight) on a micro-scale, moving beyond mere *'ilmul yaqin* (the certainty of knowledge). This suggests that the success of AR depends not only on its technical features but also on the pedagogical ingenuity of teachers in integrating it with contextually and spiritually relevant material. A cautious interpretation of these findings is warranted; the success at Al Ma'arif Singosari Islamic High School is a result of a combination of supportive school leadership, the enthusiasm of pioneering teachers, and a school culture open to innovation. These results may not be directly generalizable to other schools without considering such contextual factors.

The implications of these findings are twofold. Practically, this study offers a model for other Islamic-based schools wishing to adopt similar technologies. The recommendations are clear: success depends not merely on procuring devices but on investing in human resources through systematic and continuous training, providing adequate network infrastructure, and fostering a professional learning community among teachers to share self-created AR content. Furthermore, a clear policy on device usage must be formulated to balance innovation with the potential for distraction. Theoretically, this research contributes to the educational technology literature by demonstrating that AR's potential is not confined to the STEM domain. It paves the way for further research into the application of immersive technologies in the humanities, social sciences, and religious education, fields often considered "dry" or difficult to visualize. Future quantitative research could objectively measure the impact of AR on PAI learning outcomes, comparing an experimental group with a control group to validate the qualitative findings of this study.

5. Conclusion

This study set out to explore the implementation of Augmented Reality (AR)-based learning media at Al Ma'arif Singosari High School, an Islamic educational institution undergoing digital transformation. The primary objective was to examine the impact of AR integration on both teachers and students, and to provide a realistic account of the opportunities and challenges faced during this process. The findings reveal that AR integration brought about significant pedagogical shifts. Teachers experienced a transition from traditional content delivery to more facilitative and creative roles, leveraging AR to transform static subjects into interactive and engaging experiences. Students, in turn, reported heightened motivation and improved conceptual understanding, especially for abstract or procedural content in subjects such as Islamic studies, biology, and Arabic. However, these advancements were tempered by notable barriers. Both teachers and students encountered technical issues, such as device

[30] Hannes Kaufmann, "Collaborative Augmented Reality in Education," *Institute of Software Technology and Interactive Systems, Vienna University of Technology*, 2003, 2–4.

incompatibility and insufficient internet access, as well as classroom management concerns stemming from the personal nature of mobile devices. These results underscore the dual nature of AR as both a pedagogical enhancement and a logistical challenge. The study contributes to the growing body of literature on digital innovation in Islamic education by providing empirical evidence of how AR can enrich learning while simultaneously highlighting the prerequisites for effective implementation. Practically, the findings offer a replicable framework for Islamic schools seeking to adopt similar technologies. Key success factors include ongoing teacher training, robust infrastructure, and institutional support to foster innovation. Nevertheless, the study is limited by its single-site focus and the short duration of observation. Broader generalizations should be approached with caution. Future research should investigate long-term impacts of AR use, comparative studies across different school contexts, and the development of AR content that is both pedagogically sound and culturally responsive to Islamic educational values.

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