Iseedu
of Islamic Education Thoughts and Practices
Vol. 9 No. 1 May 2025: 91-100
E- ISSN : 2615 – 3335
https://journals.ums.ac.id/index.php/iseedu/index

The Integration of Artificial Intelligence in Islamic Education through the Application of Augmented Reality in STEM Learning

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DOI: https://doi.org/10.23917/iseedu.v9i1.9213
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Received: 01-05-2025
Accepted: 25-05-2025
Published: 29-05-2025

Abstract: Technology has a significant influence on various aspects of life, particularly in education. Artificial Intelligence (AI) emerges as a solution for Digital Learning 5.0 in enhancing innovation, systems, and learning effectiveness. However, this technology must be utilized appropriately through virtual media such as Augmented Reality (AR), which should be designed in innovative and creative ways. Through the integration of Islamic education and STEM learning, there is a strong commitment to apply AI in an adaptive and inclusive learning context supported by AR. The purpose of this study is to explain the role of AI in education, the opportunities and challenges of technology in Islamic education, and the impact of AR in STEM-based learning. This research employs a qualitative method using a comparative analysis approach through library research. The findings reveal that the integration of AI contributes to improving critical thinking skills, character development, and enriching the learning process effectively on a global scale. Nevertheless, this technology cannot stand alone; it requires harmony between science and divine revelation. AR serves as an educational solution that bridges digital and real-world learning experiences. STEM, as an integrative field of knowledge, plays a crucial role in fostering innovation, creativity, critical thinking, and learning effectiveness. Therefore, the integration of AI technology through AR can enhance critical intellectual capacity grounded in Islamic values.

Keywords: Artificial Intelligence, Education, Augmented Reality, STEM

Abstrak: *Teknologi memiliki pengaruh yang signifikan dalam aspek kehidupan, khususnya pendidikan. AI menjadi solusi pembelajaran digital 5.0 dalam meningkatkan inovasi, sistem, dan efektivitas belajar. Namun, teknologi ini harus digunakan dengan baik melalui media virtual seperti AR yang didesain secara inovatif, kreatif. Melalui integrasi pendidikan Islam dan pembelajaran STEM berkomitmen untuk menerapkan Artificial Intelligence dalam konteks pembelajaran yang bersifat adaptif, dan inklusif melalui Augmented Reality. Tujuan penelitian ini yakni untuk menjelaskan terkait peran Artificial Intelligence terhadap pendidikan, peluang dan tantangan teknologi dalam pendidikan Islam dan pengaruh Augmented Reality dalam pembelajaran STEM. Adapun metode penelitian kualitatif menggunakan pendekatan analisis komparatif berbasis library research. Hasil dari penelitian ini yakni integrasi Artificial Intelligence memiliki pengaruh dalam meningkatkan kemampuan berpikir kritis, pengembangan karakter, serta memperkaya proses pembelajaran secara efektif diranah global. Teknologi ini tidak bisa berdiri sendiri, maka perlu adanya keselarasan antara sains dan ilmu wahyu. Augmented Reality menjadi solusi dibidang pendidikan yang memberikan pengaruh dalam sistem pembelajaran dari dua sisi yaitu penggabungan antara dunia digital dan nyata. STEM termasuk integrasi ilmu yang memegang pengaruh dalam meningkatkan inovatif, kreatif, daya kritis dan efektivitas dalam belajar. Jadi, integrasi teknologi AI melalui AR dapat meningkatkan daya intelektual yang kritis berbasis nilai Islam.*

Kata Kunci: Artificial Intelligence, Pendidikan, Augmented Reality, STEM

Introduction

The use of Artificial Intelligence (AI) technology has a significant impact on the development of various aspects of human life. The advancement of Artificial Intelligence opens new potentials in understanding various fields of knowledge, especially in Islamic education (Rizwar and Fikri, 2024). However, excessive reliance on technology can reduce human intellectual creativity in understanding the context of problems. In the field of education, the role of Islamic education is essential in shaping character and moral values to address the social crises of the digital era. In the context of education, Artificial Intelligence can integrate human intelligence through algorithms and data, enabling

machines to adapt, learn, and solve complex problems. Thus, technology not only serves as a tool for innovation and efficiency but can also be utilized as an adaptive and interactive learning medium.

The integration of technology in Islamic education using Augmented Reality (AR) systems presents significant opportunities and challenges (Isti'ana, 2024). These include the development of easier access to information, analyzing problems in-depth, and improving learning according to needs to enhance more interactive education. However, dependency challenges within it can lead to reduced effectiveness in thinking. The integration of Artificial Intelligence in Islamic education influences the improvement of critical thinking skills, character development, religious understanding in addressing social challenges in the digital era, and enriching the learning process in an ethical and effective manner. The existence of technology has a global impact on various aspects of education and serves as a pillar of educational transformation in the era of digitalization.

The goal of Islamic education is to serve as the identity of a Muslim to understand concepts based on Islamic values globally. Islamic education acts as a pillar for facing complex challenges with critical thinking skills, understanding the context of problems, and serving as a foundation for addressing various issues. Therefore, there is a need for a platform to develop the ability to use Artificial Intelligence as a component to face challenges in the global realm. One form of AI application in Islamic education is through Augmented Reality (AR). AR technology can bridge the real world and the digital world, making learning more concrete and interactive. Artificial Intelligence (AI) plays a role in accelerating the progress of inclusive and high-quality education in line with Indonesia's goal of achieving Sustainable Development Goal (SDG) 4.

UNESCO has agreed to support countries utilizing the potential of technology to achieve comprehensive goals in line with the principles of inclusion (Fajrillah, Muhammad Razali, 2024). The impact of the Augmented Reality learning system on education is to analyze problems using concepts, enhance interactive knowledge, and develop competence-based skills. The application of AI with AR can be synergized with the STEM approach (Science, Technology, Engineering, and Mathematics). This approach emphasizes an interdisciplinary system of knowledge, including science, technology, engineering, and mathematics, to foster critical, innovative, and creative thinking skills and create interactive learning experiences. When combined with Islamic values, the STEM approach supported by AR, using this system, not only trains technical intelligence but also forms a solid foundation in education.

The integration of Islamic education through Artificial Intelligence and Augmented Reality with the STEM approach creates learning that is not only adaptive and innovative but also grounded in Islamic values. Islamic education provides a moral foundation so that the use of AI and AR is not merely technical but is directed toward shaping character and addressing social challenges. Thus, all four elements form an Islamic education model that is relevant to the digital era, aligned with the goals of Sustainable Development Goals (SDGs), and the need to compete globally.

Therefore, this research will discuss the role of AI in the development of Islamic education, the opportunities and challenges of implementing AR in the context of learning, and the impact of the integration of AI, AR, and STEM on Islamic education learning in the global realm. The integration of technology in education has a significant impact on the STEM learning system and other fields of knowledge.

Metodology

The research method used is qualitative research through comparative analysis. This is because the study provides a comprehensive description of the facts related to the analysis of Artificial Intelligence in education. The data obtained is a combination of Artificial Intelligence through Augmented Reality and education through STEM. This study uses Augmented Reality as an application within the STEM learning system. Data was collected through literature studies using sources such as Google Scholar, ResearchGate, and SINTA for secondary data. The data collection method used in this research is library research, which involves reviewing and citing various literature from both national and international journal publications. Data processing involves several selection steps, such as gathering references relevant to the research problem. Then, the data is classified based on accurate and valid information required. Finally, the references are combined to facilitate the analysis of the research object.

Result and Discussion

The Role of AI in Enhancing Education in the Digital Era

In the context of Islamic education, traditional methods focus on memorization and learning religious texts. However, with technological advancements and the increasing integration of Artificial Intelligence (AI) in education, there are growing opportunities to transform Islamic education into something more dynamic and personalized for students. This shift makes Islamic education more innovative in teaching and learning, fostering deeper understanding of Islamic principles and practices, while also encouraging critical and creative thinking skills. Additionally, AI can create engaging and interactive lessons that cater to the individual learning styles and needs of each student. The Islamic education system focuses on the development of quality, innovation, networks, and regional autonomy. Pesantren (Islamic boarding schools) aim to produce a religious generation by emphasizing the learning of Islamic beliefs and values. Islamic education has evolved over time (Das et al., 2016; Lubis et al., 2011).

Artificial Intelligence can vary depending on the context and perspective, but generally, it refers to the ability of machines to mimic certain aspects of human intelligence. Because AI can be used to drive more adaptive and quick learning solutions for students with minimal effort, various studies continue to show the significance of AI in education. In the rapidly changing digital era, Artificial Intelligence is one of the most significant discoveries with immense potential to improve education.

One technological innovation with great potential is Artificial Intelligence in the learning process of education technology students from the 2023 cohort (Bukhori, 2024), through adaptability, personalization, and efficiency. As many as 54% of students acknowledge that AI usage greatly assists in the learning process and completing assignments. While there are negative impacts, such as reducing creativity, dependence, and fostering laziness, its relevance to education lies in its ability to adapt to student needs, improve teacher effectiveness, and enhance overall educational outcomes. Through adaptive learning systems, education can tailor lesson materials according to the individual needs of each student. Moreover, AI tools like chatbots and virtual assistants provide learning support anytime. AI-based tools such as virtual tutors and self-learning apps offer interactive guidance and real-time feedback. By utilizing analytics, AI can monitor student progress and identify areas needing more attention (Maulana, 2024).

In education, technology is an inseparable part of its implementation, both offline via applications such as QR codes and Android apps, and online by integrating internet-based systems that can increase student interest and enthusiasm for learning (Oktavian, Aldya, and Arifendi, 2023). In this context, educational transformation involves innovative thinking and continuous renewal in response to dynamic changes in the digital era. Educational transformation highlights technological advancements, the development of relevant curricula, and changes in teacher and student behavior. It also aims to improve collaboration among all stakeholders, including the government, educational institutions, individuals, and the general public.

Artificial Intelligence integrates various technologies, especially in the development of computer programs or applications. AI consists of a set of rules that govern how computers, applications, or programs can function as intelligently as humans. The development of AI has had a significant impact on various aspects of human life, including education. Students often use it to help them find references and complete assignments. Students tend to use freely available AI platforms on various websites, such as ChatGPT, Google AI Platform, Perplexity AI, and Smodin AI. Each of these AI platforms serves functions that assist students in their daily academic tasks (Rusman and Qadrianti, 2024).

Artificial Intelligence (AI) is a digital platform that requires handling privacy issues, algorithmic concerns, and ensuring transparency, which can be difficult to control. Educators, administrators, and policymakers must anticipate potential risks. Educational disparities, where access to and the quality of education are inconsistent across regions and social groups, also exist. In some countries, children from low-income families or smaller communities often have less access to high-quality education. Additionally, rapid technological advancements and labor market changes force educational systems to adapt and update curricula to align with current trends (Isdayani, Thamrin, and Milani, 2024).

The future of education is closely tied to the development of digital technology, and the use of Artificial Intelligence can open up new challenges and opportunities in both management and processes for students. Among these challenges is that AI reduces social interaction, causing students to become more focused on their individual gadgets. Therefore, it can be said that AI will perform better if used as a tool, not as a teacher in the learning process. The role and proposition of AI can be utilized as a tool, not as a replacement for teachers in teaching and learning processes (Iqbal Anas, 2024).

There are many responses regarding Artificial Intelligence's help with college tasks, making reference searches easier, and enabling students to complete assignments more quickly and accurately. This also makes it easier for students to understand difficult academic material (Zakiyah et al., 2024). In other words, this transformation provides an opportunity to improve the quality of education. To increase study time, teachers can use digital resources including interactive simulations, educational videos, and collaborative platforms. Additionally, personalized education allows teachers to adjust their teaching methods to meet the needs and comprehension levels of each student. Global collaboration through internet connections provides students the opportunity to learn from international experiences and perspectives.

Opportunities and Challenges of AI Technology in Islamic Education

The rapid advancement of technology has led to significant transformations in the field of education. What was once a supplementary tool is now becoming a key driver in shaping education. This progress has opened new doors, providing more personalized and adaptive educational opportunities in pedagogical approaches, including Islamic education. (Jamil, 2022) Technological advancements offer a great potential to make learning easier, more interactive, and engaging. The emergence of Artificial Intelligence (AI) holds immense potential to enhance the quality of education. The formulation designed in Islamic education aims to train and develop each Muslim individual to be proficient in Islamic knowledge and experience.

AI can be ethically applied in Islamic education, supporting the learning process and stages while maintaining ethical standards that align with religious values and other norms. Artificial Intelligence can be used as a tool for explanations, summaries, translations, or understanding other concepts, but it should not replace the teacher. AI should also be directed to trustworthy sources such as the Qur'an, Hadith, and other authentic texts, ensuring that valid sources are filtered to provide knowledge that is true. With its ease of use, AI must be utilized wisely and responsibly to avoid full dependence, as AI is ultimately a tool and not an absolute source of truth (E. Haikcal Firdan El-Hady and Zenrif, 2024).

The ever-developing AI technology has a positive impact for users who apply it well, such as the development of technological skills, curriculum development, and the enhancement of social and spiritual skills. The positive opportunities in AI development open new potentials in the context of religious understanding, which can influence critical thinking with advanced analytical tools. AI becomes a valuable tool in facilitating deeper understanding of religion and brings significant ongoing impacts. (Purnomo, 2024) This opens new opportunities for the transformation of Islamic education.

The first opportunity is that religious education becomes more accessible; the use of AI in Islamic education is considered more accessible. The formation of a strong theological understanding can be used to provide extensive and deep educational resources, such as information about religious concepts, Islamic history, and in-depth understanding. AI can help adapt and enhance interactivity, allowing students to gain significant and concrete understanding. (Sarinda and Noviani, 2023)

The second opportunity in education is making it easier to access the development of potential and competencies. The use of AI technology provides significant opportunities for personal development, such as accessing various information related to knowledge, religious studies, and motivations from teachers and scholars. With AI, students can more easily determine and organize the knowledge they need in Islamic learning and resolve problems they want to address.

The third opportunity is increasing inclusivity and accessibility in Islamic education. Artificial Intelligence offers creative ways to enhance accessibility, effectiveness, and efficiency in Islamic learning. Critical and creative thinking can be nurtured with a curriculum that equips students with practical, relevant, and dynamic skills. (Susanti et al., 2024) This can expand learning resources in systems that accommodate students with different learning styles, and enable access to quality education across remote areas, providing global educational reach. Furthermore, AI technology helps analyze and understand Islamic law principles found in the Qur'an and Hadith. In Islam, a deep understanding of jurisprudence principles is key to practicing the religion correctly.

The integration of AI technology in Islamic education helps improve the quality of lessons and enhances the efficiency of Islamic education, creating strong interconnected aspects based on technology. However, adopting advanced technologies like AI presents major challenges in assisting analysis, data processing, and improving the efficiency and effectiveness of education. Risks include decreased social interaction, the reduction of empathy and social skills, and the impact of AI on Islamic character development (Hakim, Fadlillah, and Rofiq, 2024). Studies in Islamic education raise concerns about the use of AI in education, highlighting challenges in the era of globalization.

The first challenge is the risk of reduced social interaction. The use of AI reduces intimate human interaction. The negative impact on the development of empathy and social skills creates an imbalance in the use of technology, which can affect the quality of education and pose a significant challenge in teaching Islamic values such as patience, gratitude, and reliance on God. In traditional Islamic education, the teacher is the primary source of knowledge and the central figure. However, in modern Islamic education, learning no longer centers around the teacher but on the students themselves. As a result, the role of the teacher shifts to that of a facilitator (Zakir, 2022).

The second challenge is the excessive dependence on AI. Overuse of Artificial Intelligence can reduce human intellectual creativity in understanding and interpreting religious teachings. In essence, this leads to changes in human life. Unknowingly, the use of digital technology becomes addictive (Munir, Syar, and Raya, 2021). The key to addressing this challenge is the need for a transformational educational paradigm that fosters change without dependence, incorporating aspects of life such as feelings, thoughts, emotions, and personal values that drive improvements in Islamic education in the digital era.

The third challenge is the distortion of religious understanding. AI can disrupt traditional education by replacing the role of the teacher in delivering religious values, norms, and teachings. The use of this technology can diminish personal experiences in learning. Distorted interpretations of religious teachings can have a detrimental effect on users, particularly in Islamic education, as it leads to incorrect interpretations without thorough and concrete analysis.

Thus, AI and Islamic education present extraordinary opportunities to enhance the quality of Islamic education by integrating Islamic ethical principles and emphasizing the importance of modern technology development. Understanding how Artificial Intelligence can assist Islamic education is essential for achieving meaningful advancements.

The Influence of AR Technology in the STEM Learning Concept

The rapid development of technology globally has influenced critical thinking skills in the development of 4C skills, which include creativity, innovation, communication, collaboration, and competencies to foster social awareness and responsibility. One effective and interactive learning system combines the virtual and real worlds. Augmented Reality (AR) has an impact on the learning process, as it is easy to apply across all media, easily accessible without incurring costs, and can visualize abstract concepts for real-time understanding (Salisna et al., 2024). Interdisciplinary studies combine two or more fields of knowledge into one discipline. The approach to problem-solving through various relevant and integrated perspectives of knowledge is essential. The model of integrating scientific knowledge in Islamic higher education is through convergence or the merging of ideas through the transformation of knowledge into a unified whole (Sari and Amin, 2020).

Conventional teaching methods are often less engaging for the younger generation in the digital era when it comes to teaching and learning processes. One of the functions of technology in applying Augmented Reality in Islamic education brings a significant influence on educational processes and development. The integration of AR technology uses a collaborative approach between education practitioners, academics, and technology developers. By presenting more interesting and innovative material, this approach receives positive responses because the media used are highly applicable and effective. This application has been used in teaching Tajwid (the science of Quranic pronunciation) through a marker-based tracking method to display objects. In teaching Fiqh (Islamic jurisprudence), AR is used for visualizing the method of Tayammum (dry ablution) with 3D objects, making it easier for young children to understand (Abdullah and Noor, 2024).

The term STEM was first coined by the NSF in 1990 as an acronym for Science, Technology, Engineering, and Mathematics, which can be described as follows: Science is the concept of studying facts, phenomena, and all existing regularities. Technology is a tool modified through innovation and necessity to satisfy human needs. Engineering involves creating designs by analyzing problems, formulating concepts based on theory, and developing solutions from theory, practice, and experiments used to solve problems. Mathematics is the branch of science that trains critical thinking skills and examines relational patterns from various disciplines (Mulyani, 2019). The STEM approach is a solution to learning integration through problem-based learning to increase interest in learning and solve real-life problems.

According to Law No. 20 of 2003 regarding the National Education System, Article 1 states that education is an effort to actively develop potential. Efforts to improve learning systems with literacy and technology skills as learning media are used to explain learning material concepts. Thus, the influence of technology on enhancing understanding through the development of effective and immersive learning media (Wildan Khusni, 2024) STEM literacy refers to the theory of knowledge, attitudes, and skills in facing real-life problems, explaining conclusions from various phenomena, problem-based learning systems to encourage critical thinking skills, developing curiosity, and analyzing phenomena to solve problems, supporting the development of attitudes, knowledge, and skills competencies, and creating something new.

Augmented Reality (AR) technology is an effective and interactive medium in the STEM learning system (Science, Technology, Engineering, and Mathematics). The integration of AR in the digital world has a significant impact in combining knowledge with technology to make abstract concepts more visual and effective. Thus, material from various disciplines can be more easily understood and clarified. In the context of AR, it provides simulations of scientific experiments, conceptual reinforcement, and practical skills (Lenny Nuraeni, Trisna Rukhmana, 2024). This allows for the analysis of problems in accordance with critical thinking skills to create a more interactive and immersive learning experience. The influence of AR in STEM learning provides opportunities to understand concepts in more concrete visual forms. For example, in subjects such as physics, chemistry, and biology, AR can visualize difficult real-world experiments in practical ways to directly understand scientific principles.

The use of AR technology also faces challenges in STEM learning, such as limited training for users, limited AR-based educational content, technical issues, and usage, which leads to misalignment with the curriculum. AR-based media provides a solution in education by influencing

the learning system from both sides—the fusion of the digital and physical worlds, resulting in three-dimensional displayed objects. Therefore, engaging content will motivate students and encourage active participation in learning. With the integration of AR in STEM, it enables a contextual approach to understanding phenomena around us through collaboration, communication, and cooperation in the learning process. This can enhance competitiveness, critical thinking, creativity, and innovation through cognitive and interactive learning (Zaid, Razak, and Alam, 2022).

Although there are challenges and obstacles in the application of AR, there are solutions for learning media for visually impaired students through new innovations such as Ru-Ar-B (Augmented Reality and Braille House) using the ADDIE technique—Analysis, Design, Development, Implementation, and Evaluation. This utilizes visual-based technology and animated images to facilitate the learning process (Oviensy and Putri, 2022). An example of this application is also seen in the Qur'an Tafsir learning in Islamic educational institutions, such as modules on the solar system based on the Qur'an through a PBL AR model, religious content cards, posters, and Islamic history museums that are applied to facilitate learning and digital da'wah development (Yusuf, 2024).

AR technology can be used not only in STEM learning but also in various fields of study, depending on the context of the problems being addressed. The interdisciplinary nature of combining and collaborating with other areas of knowledge and technology provides real opportunities to increase interactivity and stimulate curiosity. The influence of AR technology in learning systems promotes the development of problem-solving skills, creativity, and critical thinking. STEM, as an alternative, integrates various disciplines into the learning design, offering opportunities for scientific creativity and experimentation. Advancements in the digital era have impacted education, with Augmented Reality providing accessible, inclusive, and engaging content for the next generation. Learning media that display complex forms through AR technology have advantages such as effective accessibility, applicability in all fields of knowledge, easy operation, and interactivity (Arifin, 2020).

The method of simulation and manipulation of objects to explore and transform them into concrete three-dimensional digital objects is essential. Technology systems cannot stand alone in their usage, requiring an appropriate approach, which is the STEM foundation, to achieve the learning objectives. However, the limitations of AR integration in knowledge include cost limitations for implementing all access, devices to stabilize performance tend to be low, and security issues that remain relatively weak (Rizka Oktaviyanti, Ulum Fatmahanik, 2023). To optimize the use of Augmented Reality in digital learning, outreach through training and understanding of the impact of technology, collaboration with specific parties in content creation, and pilot tests involving surveys and data collection for learning effectiveness are needed.

STEM is a way to encourage creativity, innovation, and knowledge integration to illustrate complex learning concepts through practical, interactive learning via games and simulation design models. (Razak et al., 2023). The influence of technology in education offers opportunities and challenges in realizing effective and realistic learning systems. The integration of knowledge does not diminish the authenticity of the original values from that field of knowledge. STEM, including tools applied in Augmented Reality technology, measures stability in critical thinking and problem-solving. By analyzing phenomena and scrutinizing concepts to form practical designs, it can facilitate the correlation of different fields of knowledge.

Although the influence of technology tends to be significant in complex learning, the integration system between technology and interdisciplinary knowledge can have a positive impact on enhancing creativity, skills, critical thinking, global competitiveness, and contributing to the development of a more realistic learning system. Therefore, the influence of technology plays an important role in driving the chain of change in the future by enhancing practical abilities in solving problems. STEM, as the integration of knowledge, influences innovation, creativity, critical thinking, and learning.

Conclusion

The integration of Artificial Intelligence technology can simplify the learning system, making it adaptive, innovative, and effective. There needs to be alignment between science or knowledge and revelation or Islam in developing critical thinking systems and problem-based learning, which is applied through Augmented Reality. A concrete example of its application is Ru-Ar-B (Augmented Reality and Braille House), learning media for Fiqh, Tajwid, and other Islamic education. Augmented Reality becomes a solution in the field of education, playing a role in the learning system from two sides: the integration of the digital and real worlds. The interdisciplinary concept of knowledge can be applied across all fields of study without exception, so STEM, as an integration of knowledge, plays a role in enhancing innovation, critical thinking, and learning effectiveness. Therefore, both are interdependent in realizing an impulsive and interactive learning system. The integration of AI and AR through the STEM learning system can improve the quality of Islamic education.

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