

Digital Transformation of Islamic Elementary Education: Opportunities and Challenges of IoT and Digital Learning Integration

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ABSTRACT

This study examines the integration of the Internet of Things (IoT) and digital learning resources in Islamic Elementary School Asshomadiyah. It aims to explore the forms and implementation of IoT and digital platforms in classroom learning, identify supporting and inhibiting factors, and examine their initial contribution to learning quality. A descriptive qualitative approach was employed, with data collected through observation, interviews, and documentation. The findings indicate that the school utilizes various technological tools, including laptops, projectors, smart televisions, YouTube, PowerPoint, Canva, and instructional videos. The integration of these technologies contributes to students' motivation, attention, classroom interaction, and engagement while providing more varied and interactive learning experiences. However, implementation is constrained by unstable Wi-Fi networks, limited digital devices, suboptimal technology utilization, and differences in teachers' and students' digital literacy and competencies. These challenges influence the effectiveness and sustainability of technology integration. The study concludes that optimizing digital learning in Islamic elementary education requires strengthened technological infrastructure, continuous teacher professional development, improved digital literacy, and effective technology management to create engaging, adaptive, and meaningful learning environments.

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INTRODUCTION

Education is a series of learning activities aimed at enhancing an individual's knowledge, skills, values, and attitudes. It is not limited to the school environment but encompasses various forms of

lifelong learning, whether formal or informal (Akbar, 2017). The Society 5.0 era we currently face demands adaptation and innovation across various dimensions of life, including the realm of education, which is witnessing significant innovative developments. One such major advancement is the adoption of the Internet of Things (IoT) in learning methodologies. By facilitating device connectivity and communication via the internet, IoT unlocks diverse potential for optimizing the effectiveness and efficiency of the teaching and learning process. However, the implementation of IoT within the context of Islamic education has not yet been fully utilized and requires further in depth study. The relationship between technology and education has long been established. Currently, online or distance education systems are in use; learning materials that previously relied on paper are now being shifted to electronic files distributed to students online a situation that has persisted over the last few years due to the global COVID 19 pandemic. (Z. Mustofa; A. Mukminin, 2023) Furthermore, multimedia is considered one of the technologies capable of enhancing the quality of distance or online education, motivating learners, and sustaining their interest in continued learning (G. Sankey, 2011).

Amidst rapid global advancements, the landscape of Islamic education in Indonesia is currently transitioning from the Industrial Revolution 4.0 toward a new period known as "Society 5.0" an era that prioritizes technology usage and integrates it with the physical realm. Educational stakeholders must thoroughly prepare for this era to avoid falling behind the times. Society 5.0 envisions a lifestyle integrated with information technology. In this era, technology is utilized to optimize mastered competencies and skills, aligning them with the potential found in the surrounding environment (Ariska et al., 2025). Originating in Japan, the Society 5.0 concept is deemed capable of facilitating the fulfillment of human needs by leveraging modern, technology-based knowledge. This technological framework encompasses Artificial Intelligence (AI), the Internet of Things (IoT), and robotics. While the Industrial Revolution 4.0 emphasized concepts that simplified human life primarily through AI, Society 5.0 relies on modern technology while keeping humans at the core (Setiawan et al., 2023). According to official sources from the Japanese Cabinet Office (CAO), Society 5.0 is expected to resolve various social issues and challenges by utilizing innovations from the Industrial Revolution 4.0 era. This concept represents a refinement of earlier models. In this era, the internet serves not merely as a tool for communication and data analysis; rather, the internet and computers become integral to the very conduct of daily life. Consequently, a balance between the human role within society and the utilization of technology becomes inevitable. (Riswanto Dkk, 2024). Experimental results demonstrate that the proposed Python-based system achieves a high accuracy rate of 98.5%. (Tian, J., & Liu, Z, 2026).

Educators must utilize three key elements of Industry 4.0 and Society 5.0 the Internet of Things (IoT), virtual or augmented reality (VR), and AI to determine students' learning needs. Educators also need to possess modern skills such as communication, digital literacy, emotional intelligence, leadership, teamwork, global citizenship, and problem solving. At this stage, the Internet of Things internet based automated technology facilitating information exchange functions as a more effective production channel for manufacturing processes (smart factories) and value chain management. Given this reality, it is crucial for children to learn how to interact with various forms of digitalization. Digital technology based learning in schools is one way to achieve this. Changes in current learning systems have been driven by the COVID 19 pandemic. These shifts have introduced technology into learning activities through tools such as e learning platforms, Google Classroom, WhatsApp, and Zoom. Among the technologies employed, the Internet of Things (IoT) stands out; it can be developed and utilized to enhance the student learning experience, particularly given that most students in Indonesia own smartphones that can be used for educational purposes (Charmonman, Mongkhonvanit, & Kim, 2015). Bockhen, Short, Rana, and Evans (2014) state that the Internet of Things (IoT) can significantly impact education specifically learning activities and that educational challenges can be resolved by leveraging this technology (F. P. Astria et al., 2021). The Internet of Things (IoT) enables users to manage and optimize their electronic devices. We are now in the era of Society 5.0. This concept extends beyond

manufacturing factors, serving also as a solution to social issues through the application of the Internet of Things and virtual spaces. (Skobelev dan Borovik, 2017).

As Indonesia's education sector enters the Industry 4.0 era characterized by the use of the internet as a medium connecting learners and educators it must also prepare for the Society 5.0 era. This transition involves the emergence of new educational technologies that can be utilized without diminishing the educator's fundamental role in imparting moral values and setting a positive example for students. Indonesia faces several challenges in preparing for Society 5.0, particularly regarding the need for equitable infrastructure development and the expansion of internet access to all corners of the country. Furthermore, human resources within the education sector must possess technological skills and creative thinking abilities, while the government must strive to create job opportunities that align with the fields of study of university graduates. Successful improvement of educational quality requires contributions from the Indonesian public alongside these preparations (Z. Mustofa, 2024).

This study conducts a literature review to identify the forms of IoT integration and adaptive learning platforms at Asshomadiyah Islamic elementary school, describe the implementation process and the utilization of technology in learning activities, evaluate the factors supporting or hindering the integration of IoT and adaptive learning and examine the initial impact of technology integration on the quality of digital learning at the Islamic elementary school.

METHODS

This study employs a descriptive-qualitative method. The research subjects consist of the school principal, teachers, and students from grades one through four. Data collection was conducted through interviews, observation of learning activities, and document collection. The data analysis process involved data reduction, data presentation, and drawing conclusions. A descriptive-qualitative approach was adopted because the study aims to gain a detailed understanding of how the Internet of Things (IoT) and digital learning platforms are implemented at Asshomadiyah Islamic Elementary School, as well as to describe student responses, supporting factors, obstacles, and the impact on learning (John W. Creswell, 2018).

The research design utilizes a descriptive-qualitative approach aimed at revealing phenomena in a natural and detailed manner without variable manipulation. This method was selected to obtain a comprehensive understanding of the integration of IoT and digital platforms, the implementation process, supporting and inhibiting factors, and the impact of technology usage on the quality of learning. Research Subjects and Location. The research was conducted at Asshomadiyah Islamic Elementary School. The subjects included the madrasa principal, classroom teachers (grades 1–4), and students in grades 1–4. Purposive sampling was used to select informants deemed most knowledgeable about the use of IoT and digital learning platforms at the school.

Data Collection Methods, three methods were employed: observation, interviews, and documentation. Observations were conducted to directly monitor the use of IoT devices (such as laptops, projectors, and smart TVs) and digital platforms (such as YouTube, PowerPoint, Canva, and instructional videos), as well as teacher-student interactions and classroom dynamics during technology use. Moderate participant observation was utilized to allow the researcher to understand the learning context naturally. Semi-structured interviews were conducted with the principal regarding digitalization policies; with teachers regarding technology usage, obstacles, and digital competence; and with students regarding their learning experiences using digital media. Semi-structured interviews allowed researchers to explore information with greater flexibility and depth, guided by the informants' responses. Documentation was obtained from photographs of learning activities, lesson plans (RPP), instructional media used, school records regarding ICT facilities and infrastructure, evaluation results, and activity logs from digital learning platforms. Data Analysis Technique, data were analyzed using the interactive model developed by Miles and Huberman and further refined with Saldaña, involving

the processes of data condensation, data display, and conclusion drawing and verification. Data condensation was carried out by selecting, focusing, simplifying, and organizing data obtained through observation, interviews, and documentation to identify relevant patterns and themes. Data display involved the use of narratives, tables, or charts to facilitate the interpretation of IoT implementation, student responses, supporting factors, and obstacles. Conclusions were drawn after identifying patterns, relationships, and meanings within the analyzed data. These conclusions were subsequently verified by cross-referencing them with the original data.

Data Validity, triangulation techniques were employed to enhance credibility and ensure the trustworthiness of the research data. The triangulation methods used included time triangulation (collecting data at different times to assess information consistency), source triangulation (comparing information obtained from the school principal, teachers, and students), and technique triangulation (comparing findings from interviews, observations, and documentation). Research Procedure. The research procedure was conducted in several stages: defining the research focus and developing observation instruments and interview guidelines; conducting preliminary observations of IoT-based learning and digital media; interviewing school administrators, teachers, and students; gathering documentation regarding technology usage; analyzing data using the Miles and Huberman model; formulating conclusions based on the research findings; and systematically compiling the report (Matthew B. Miles: 2014).

FINDINGS AND DISCUSSION

Based on an in-depth analysis of the concepts, implementation, religious moderation values, supporting and inhibiting factors, and the impact of applying ecotheology theory in Asshomadiyah Islamic elementary schools in Sidoarjo Regency, several key findings have been identified. First, ecotheology theory has been understood and adaptively implemented within the Islamic elementary schools educational environment. This theory serves not merely as a subject for abstract theological discussion but has been integrated into the Islamic Religious Education learning process, thematic materials, and school culture. Students' understanding of the relationship between God, humanity, and the universe is shaped through an integrative approach that links concepts such as stewardship, responsibility, and mercy to the worlds directly with environmental conservation practices. These findings demonstrate that ecotheology acts as both a theological and educational foundation within the context of basic Islamic education.

Second, the implementation of ecotheology contributes substantially to strengthening values of religious moderation among students. Values such as tolerance, balance, justice, social responsibility, and a balanced perspective are fostered through environmentally oriented learning activities and habits. Collaborative activities including cleanliness management, planting vegetation, and resource conservation shape inclusive and practical religious behavior. Consequently, religious moderation is not confined to the cognitive realm but is reflected in the students' social and ecological actions.

Third, the effectiveness of applying ecotheology is influenced by the interplay between supporting elements and obstacles. Key supporting factors include the dedication of educators and Islamic elementary schools leadership, the incorporation of "Green Islamic Education" values into the curriculum, and parental participation. Conversely, challenges arise from a lack of integrated teaching materials, heavy teacher workloads, and the influence of the external environment and consumerist lifestyles. This situation indicates that the implementation of ecotheology requires enhancing teacher competence, innovating the curriculum, and fostering a sustainable school culture.

Fourth, the impact of applying ecotheology theory is evident in the holistic shaping of students' religious-ecological character. Learners demonstrate heightened spiritual awareness that aligns with

environmental concerns and social ethics. Attitudes of empathy, solidarity, and appreciation for human and natural diversity develop harmoniously. These findings confirm that ecotheology-based Islamic education is effective in fostering comprehensive religious moderation, simultaneously encompassing spiritual, social, and ecological dimensions.

Concepts and Understanding of Ecotheology Theory in Islamic Elementary Schools

The concept and understanding of ecotheology in Islamic elementary schools in Sidoarjo Regency are implemented through the integration of Islamic teachings that emphasize a balanced relationship between humans, nature, and Allah SWT. Ecotheology is understood as a teaching that positions humans as stewards on earth, responsible for protecting and preserving the environment; this concept is conveyed through Islamic Religious Education, thematic learning, and the cultivation of environmentally conscious character habits (Gade, 2019).

The application of this concept is realized through various school programs such as environmental awareness movements, cleanup activities, tree planting, and waste management that are linked to values of worship and moral responsibility as Muslims (Gunagraha et al., 2025). Ecotheology is a theological discourse focused on efforts to protect and preserve God's creation particularly nature for the sake of human life, viewing it as an interconnected and living system Encyclopedia of Science and Religion, 2025. The term derives from the Greek roots household, God, and science or teaching, etymologically, it refers to the study of the organization of living spaces and interactions among living organisms (Ernst Conradie, 2023).

The term "ecotheology" gained popularity in the late 20th century, particularly within Christian circles. Its emergence was a direct response to the widespread recognition of an environmental crisis threatening the future of human life (Encyclopedia of Science and Religion, 2025). The fundamental principles of ecotheology namely, concern for the environment are not exclusive to any single religion. Various forms of ecotheology can be found in other theistic traditions, including Islam (Ernst Conradie, 2023). Ecotheology, or Environmental Theology, represents a response or reflection by religious figures regarding societal issues, particularly those related to environmental concerns (Zumaro, 2020). The urgency of an ecotheological approach was articulated by Sayyed Hossein Nasr (1976) in his book *Man and Nature: The Spiritual Crisis of Modern Man*. According to Nasr (1976), religious values and moral wisdom which he termed "Ecotheology" are essential for maintaining the Earth's balance and sustainability. Ecotheology, or environmental theology, is defined as a way of "bringing God into" every aspect of human activity, including the utilization of natural resources and environmental management (Ilyas, 2011). In more academic terms, theology can be understood as a framework for thought and action connected to the Divine, who both created and governs humanity and nature the environment. Thus, there are three focal points in this discussion God, humanity, and nature which together form a unified relationship that is not merely functional but also spiritual. Consequently, theology can be interpreted as a concept guiding human thought and action regarding the environment by integrating the physical realm nature, including humans with the non-physical and non empirical realm namely, God (Ilyas, 2011). In practical terms, theology serves as a normative guide for human behavior and interaction with nature and the environment.

Application of Ecotheology Theory in the Learning Process

The implementation of ecotheology theory in the learning process at Islamic elementary schools in Sidoarjo Regency is carried out by integrating Islamic values that emphasize a harmonious relationship between humans, nature, and Allah SWT. Ecotheology is interpreted not merely as environmental education but also as a pedagogical approach that fosters values of religious moderation such as balance, justice, and the avoidance of excess in one's attitude toward nature (Meraj, 2016).

In classroom practice, Islamic elementary schools teachers incorporate ecotheological values into Islamic Religious Education subjects and thematic learning using a contextual approach aligned with Independent Curriculum. Concepts such as trust/stewardship, vicegerent/steward, and mercy for all worlds are understood as Islamic teachings that emphasize compassion and responsibility toward all of Allah's creation (Solichin, 2017). The application of ecotheology is also realized through habituation and environment based activities, such as environmentally conscious madrasah programs, tree planting, and waste management. These activities serve as practical learning opportunities to instill attitudes of mutual cooperation, tolerance, and shared responsibility as part of religious moderation (Gunagraha et al., 2025). Furthermore, ecotheology-based learning encourages the development of a religious attitude that balances ritual and social aspects. Students are guided to understand that caring for the environment is an act of worship and a manifestation of moderate and inclusive religious practice (Kumaidin & Hadi, 2025).

Overall, the study results indicate that ecotheological values have been intensively integrated into the students' spiritual lives. Islamic education in the Islamic elementary schools of Sidoarjo Regency focuses not only on fostering ritual observance but also on raising strong ecological awareness through holistic learning methods (Gunagraha et al., 2025). Study findings reveal that ecotheological values are successfully instilled within the madrasah education system, both through formal learning processes and routine daily activities. Practices such as maintaining environmental cleanliness, conserving water, planting vegetation, and managing waste are understood as elements of faith and of the human duty to act as God's representative on earth (Gade, 2019). Therefore, ecotheology based Islamic education not only fosters spiritually devout students but also cultivates an ethical responsibility toward the sustainable preservation of the environment (Solichin, 2017).

Values of Religious Moderation Instilled

The application of ecotheology theory in instruction at Islamic elementary schools plays a crucial role in instilling values of religious moderation in students from an early age. Ecotheology integrates Islamic theological teachings with ecological awareness, thereby fostering a religious attitude that is balanced, inclusive, and responsible toward both the environment and other living beings. Implementing ecotheology theory in Islamic elementary schools instruction contributes significantly to strengthening religious moderation values among students. This approach enables students to understand religious teachings not merely within a normative framework but also through social practices relevant to their daily lives. One value of religious moderation fostered through the application of ecotheology is tolerance. This value is instilled through various environment-based activities designed collaboratively, involving all students regardless of their social or cultural backgrounds. Through these shared activities, students learn to respect one another, cooperate, and cultivate empathy for others. In addition to tolerance, the value of balance serves as a key principle emphasized in ecotheology based instruction. Students are guided to understand that their relationship with God, social interactions with fellow human beings, and responsibilities toward nature must be maintained in a balanced and proportionate manner in their daily lives. Islamic education oriented toward moderation positions balance as a vital foundation for character building. Emphasizing harmony among spiritual, social, and ecological aspects is considered capable of fostering a religious worldview that is inclusive rather than extreme (Zuhdi, 2018).

Values of justice and social responsibility are also cultivated through the habitual practice of fairness in the use of school facilities and a collective awareness regarding the maintenance of cleanliness and environmental sustainability. Such responsible attitudes help students understand that individual actions impact the common good. Previous research indicates that instilling values of justice and social responsibility from an early age is effective in preventing the development of intolerant attitudes (Muttaqin & Rahman, 2020).

Thus, ecotheology theory serves as a strategic approach to instilling values of religious moderation in a contextual and practical manner. Through real-world learning experiences, students not only grasp the concept of moderation cognitively but are also able to put it into practice in their daily behavior within both the school environment and the wider community.

Supporting and Inhibiting Factors

The application of ecotheology theory to instill values of religious moderation in elementary Islamic elementary school students in Sidoarjo Regency is influenced by a number of interconnected supporting and inhibiting factors. Regarding supporting factors, the commitment of teachers and Islamic elementary school leadership plays a key role. Experience within Islamic educational institutions demonstrates that teacher dedication acting as role models along with the support of the Islamic elementary school head and a religious school culture, can create a learning climate conducive to the internalization of character and spiritual values. In the context of ecotheology, integrating Green Islam Education values into the curriculum also strengthens students' spiritual and ecological dimensions, as learners are encouraged to understand that environmental stewardship is an act of worship and a trust inherent to their faith. Furthermore, parental involvement and synergy between the school and the family play a crucial role in sustaining the values instilled at the Islamic elementary school. However, there are inhibiting factors that require serious attention. Internal obstacles include heavy teacher workloads and varying levels of student awareness, which hinder the optimal supervision and nurturing of these values. Externally, influences from the environment outside the school, social media exposure, and a modern consumerist lifestyle often introduce values that conflict with the character and spiritual principles taught at the Islamic elementary school.

Additionally, the scarcity of teaching materials integrating ecology with Islamic teachings, combined with a national curriculum that tends to emphasize cognitive aspects, poses a challenge to the systematic implementation of ecotheology. These conditions highlight the need for teacher training, curriculum updates, and the strengthening of an eco-friendly school culture to ensure that ecotheological values can be internalized more effectively.

The impact of applying ecotheology theory on the attitudes and behaviors regarding religious moderation among elementary *madrasah* students is evident in the strengthening of both spiritual awareness and ecological responsibility. Integrating ecotheology into the curriculum not only enriches learning materials but also shapes students' character, fostering care, responsibility, and an ethical regard for the environment as part of the practice of Islamic teachings. This approach aligns with the principle of mercy to all creation, encouraging students to understand that Islam brings blessings to all living beings and the natural world; this, in turn, promotes a moderate, non exploitative mindset oriented toward balance. Furthermore, this impact is reflected in the development of students' empathy, solidarity, and social ethics. Studies on the internalization of religious tolerance values indicate that value based education enhances appreciation for diversity, strengthens empathy, and fosters sound social ethics in daily interactions. In the context of ecotheology, these values extend to the ecological realm, leading students to be not only tolerant of fellow human beings but also respectful of nature as God's creation. Thus, the application of ecotheology theory contributes to the formation of holistic religious moderation behavior that encompasses spiritual, social, and ecological dimensions.

CONCLUSION

The implementation of IoT technology and digital platforms at Islamic elementary school Asshomadiyah has proven successful in enhancing the quality of learning. This technological integration involves the use of IoT devices such as laptops, projectors, and smart TVs, alongside digital platforms such as YouTube, PowerPoint, Canva, and educational videos. Teachers regularly utilize

these tools to deliver learning materials in varied, interactive, engaging, and easily understandable ways. Key factors facilitating this implementation include adequate teacher competence, device availability, and support from the madrasa principal, while challenges include unstable Wi-Fi connectivity, limited hardware, and the low digital literacy levels of some students. The findings indicate positive outcomes, particularly increased student focus, motivation, and comprehension during lessons. Overall, digital learning at Islamic elementary school Asshomadiyah has significantly improved the quality of the learning process, although further upgrades to internet infrastructure and additional training for both teachers and students are still needed to achieve better results.

Theoretically, this study contributes to the understanding of technology integration in elementary Islamic education by demonstrating that the effective use of IoT devices and digital platforms can support interactive, student-centered, and meaningful learning. The findings reinforce the view that technological integration is not merely dependent on the availability of digital devices but also on teacher competence, institutional support, and students' digital readiness. Thus, this study provides an empirical contribution to the application of digital learning theories within the context of Islamic elementary education.

Nevertheless, this study has several limitations. It was conducted in a single Islamic elementary school, namely Asshomadiyah, which limits the generalizability of the findings to other educational institutions with different technological resources and characteristics. In addition, the study primarily employed qualitative observations and interviews, so the findings do not provide quantitative evidence regarding the extent of improvement in students' learning outcomes. The study also focused mainly on the implementation process and immediate learning responses rather than examining the long-term effects of digital technology integration.

Future research should therefore involve multiple Islamic elementary schools with diverse geographical, socioeconomic, and technological backgrounds to obtain more comprehensive findings. Researchers are also encouraged to employ mixed-methods or quantitative approaches to measure the impact of IoT and digital platforms on academic achievement, student motivation, digital literacy, and learning engagement. Longitudinal studies could further investigate the sustainability and long-term effects of digital learning. In addition, future studies could examine specific digital platforms or IoT-based learning models and explore strategies for improving teachers' and students' digital competencies. Such research would provide deeper insights into how technology can be integrated effectively, sustainably, and equitably into Islamic elementary education.

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