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The Use Of IoT Technology To Support Interactive Learning And The Management Of Infrastructure Facilities In Islamic Educational Institutions

Abstract

This study aims to analyze the use of Internet of Things (IoT) technology in supporting interactive learning and the management of facilities and infrastructure in Islamic educational institutions. The application of IoT in the educational environment is expected to create a more dynamic learning experience, allow teachers and students to interact in real-time, and facilitate efficient supervision and management of school infrastructure. Using a qualitative descriptive type literature methodology, this study examines various relevant literature on the development of IoT in the context of education, especially in Islamic-based educational institutions. The results of the study show that the integration of IoT in the learning management system (LMS) is able to increase student participation and involvement in the learning process, while the management of IoT-connected infrastructure facilities can improve the efficiency of asset monitoring and resource saving. In addition, the use of IoT has the potential to support transparency and accountability in the operational management of educational institutions. This study provides an overview that the application of IoT in Islamic educational institutions opens up new opportunities for innovation in learning and management, which is in line with the needs of education in the digital era.

Keywords: Internet of Things (IoT), Interactive Learning, Infrastructure Management, Islamic Education

Introduction

In the era of the Industrial Revolution 4.0, technology is developing rapidly and has changed various aspects of life, including the education sector. One of the technologies that is the center of attention in the development of the education system is the Internet of Things (IoT). IoT is a network of devices that are interconnected through the internet and allow various physical devices or objects to communicate and share data with each other without direct human interaction. (Buyya dan Dastjerdi 2016) In the world of education, IoT has great potential to increase the effectiveness of learning and make it easier to manage infrastructure, especially in Islamic educational institutions that have special characteristics and needs. (Kumar dkk. 2024)

The application of IoT in educational institutions, especially Islamic-based ones, allows the realization of a more interactive, effective, and efficient learning environment. In Islamic educational institutions, which often integrate general science with religious teachings, the use of IoT technology can play an important role in maintaining the sustainability of educational programs and helping to manage facilities and infrastructure that support learning. (Abed, Alyahya, dan Altameem 2020) For example, IoT can be used to integrate security systems in

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school or pesantren environments, optimize the use of electrical energy in public facilities, or even help manage student attendance in real-time.

In addition, IoT can play a role in interactive learning that allows students to have a more immersive and enjoyable learning experience. IoT devices such as smart whiteboards, wearable devices to monitor physical activity, to cloud-based learning applications that are connected to various digital resources, can provide a richer and integrated learning experience.(Sholeh 2023) Through this technology, learning can become more adaptive to student needs, so that the teaching methods used by teachers can be adjusted to the development of individual students.

However, the use of IoT technology in Islamic educational institutions also presents a number of challenges, such as data security issues, implementation costs, and limited knowledge of managers or teachers about the technology.(Ali, t.t.) Islamic educational institutions, especially Islamic boarding schools or madrasas, generally have limited budgets and experts to implement relatively new technologies such as IoT. In addition, there are challenges in maintaining the traditional values embraced by Islamic educational institutions when applying modern technology. Thus, a wise approach is needed so that the use of IoT remains in line with existing religious and cultural values.

This paper aims to analyze the potentials and challenges associated with the use of IoT technology in Islamic educational institutions. The discussion will cover two main aspects: *first*, how IoT technology can support interactive learning in accordance with the Islamic education curriculum, and *second*, how IoT technology can be applied in the management of infrastructure to create a more efficient and safe educational environment. IoT-based interactive learning is expected to help students develop digital competencies and increase their involvement in the learning process. Meanwhile, in terms of infrastructure management, IoT can provide smart solutions such as security monitoring, energy management, and facility control more effectively.

From this study, it is hoped that it can provide new insights for managers of Islamic educational institutions, especially in understanding how IoT technology can be integrated with their education system. With the use of IoT technology, Islamic educational institutions are expected to be more responsive to technological developments and more competitive in the midst of the challenges of this digital era. Even so, the application of IoT technology must be accompanied by efforts to increase technological literacy among teachers, administrative staff, and students so that this technology can be used optimally and sustainably.

Finally, taking into account technological developments as well as the needs and characteristics of Islamic educational institutions, it is important for all relevant parties to take a planned approach in implementing IoT technology. Through the wise use of technology, Islamic educational institutions can play an important role in preparing a generation that not only has academic prowess and digital skills, but also has a strong moral and spiritual foundation.

Methodology

This study uses a *library research methodology* that focuses on the use of Internet of Things (IoT) technology to support interactive learning and the management of infrastructure facilities in Islamic educational institutions. This literature research aims to study and analyze theories and results of previous studies related to the use of IoT in education, especially in institutions that integrate Islamic values in teaching and learning activities.

This research is a type of qualitative descriptive study, in which the researcher seeks to dig deeply into various relevant scientific literature to provide a comprehensive understanding of the topic being studied. The study also uses a thematic analysis approach, in which various themes related to the use of IoT, such as interactive learning and infrastructure management,

are analyzed to understand the relationship between technology and learning effectiveness in the context of Islamic education.

In the context of studying the use of IoT technology in Islamic educational institutions, this literature methodology allows researchers to explore various aspects of IoT application without the limitations of space and time that are usually faced in field research. Through this study, researchers can take advantage of many perspectives from the broad and diverse literature, so that they can get a more comprehensive picture of the potential of IoT as a tool that supports interactive learning and makes it easier to manage infrastructure.

Discussion

Definiton of Internet of Things (IoT)

In language, *the Internet of Things* (IoT) can be interpreted as the "Internet of Everything" or "Internet of Things." The term refers to the concept that various physical devices can be interconnected through the internet, thus allowing them to communicate with each other, exchange data, and perform certain tasks without human intervention. (Buyya dan Dastjerdi 2016) Terminologically, IoT is a network of physical devices equipped with sensors, software, and other technologies that allow these devices to communicate and exchange data over an internet network. These devices can be everyday objects or tools such as cameras, lights, vehicles, to industrial machines, all of which are capable of collecting data and acting according to the instructions sent.

The Internet of Things (IoT) according to experts has several meanings that we can understand as a concept of connectivity that connects various devices through the internet, so that they can communicate with each other and exchange data without direct human interaction. Here are some views from experts:

1. Kevin Ashton is known as the father of IoT. Kevin Ashton, who first coined the term IoT in 1999, defined it as a concept in which objects in the real world can connect to the internet to send and receive data automatically. According to him, IoT allows us to obtain information from various devices that are physically separate but can be integrated into a system, thus supporting smarter decision-making. ("Internet of Things (IoT): A Literature Review," t.t.)
2. Adrian McEwen and Judge Cassimally. In their book 'Designing the Internet of Things' McEwen and Cassimally explain that IoT is a network of devices that allows data to be collected, analyzed, and used in decision-making. For them, IoT is a system consisting of devices that are able to communicate automatically and produce data that can be analyzed for certain purposes. (McEwen dan Cassimally 2013)
3. Hakima Chaouchi, in her book, *The Internet of Things: Connecting Objects*, describes IoT as a technology that allows objects to connect into a single network called an "intelligent system." Through embedded sensors and devices, these objects can collect data, communicate with each other, and respond as needed. (Chaouchi, t.t.)
4. Dr. John Barrett, defines IoT as an ecosystem that combines various devices that are connected to the internet and equipped with sensors to communicate and interact. Barrett highlighted how IoT enables devices to function smarter through sensor capabilities and communication between devices that automate various processes. (Carmelo 2014)

The form of the Internet of Things (IoT) that is often used in daily activities and in the field of education comes in various technologies that can automatically connect and communicate. The following are some common forms of IoT in both contexts:

1. Smart Devices. Smart devices include a variety of electronic devices that are connected to the internet, such as smart televisions (smart TVs), smart speakers, and other household devices. Its use can control this device using an app on the phone or voice

commands, such as turning on the TV or setting music easily. While in Education: Smart devices can be used as learning aids, such as smart televisions in the classroom for the playback of audio-visual materials, increasing student engagement.(Supiyandi dkk. 2023)

2. **Wearable Technology.** Wearable devices such as smartwatches and fitness trackers that monitor user health and fitness data, such as to make it easier for users to monitor their daily health, for example measuring heart rate, daily steps, or sleep patterns. In education it can be used in sports classes or school health programs to support teaching about body health, by providing students with real-time data.(Association 2018)
3. **Smart Home Automation.** The system includes home devices such as lights, air conditioning, security systems, and door locks that are connected and can be controlled through an app. Its use is to make the home more comfortable and safe, users can control the lighting, temperature, or security of the house remotely. In Education: Provides relevant and practical examples of IoT technologies for students to learn about device interaction, programming, and data security.(“DPUPKP - Smart Home : Pengertian, Konsep, Contoh Dan Cara Membuatnya,” t.t.)
4. **Smart Classroom Tools.** The tools in the smart classroom include smart whiteboards, interactive projectors, tablets or computer devices that are interconnected, and automatic assessment devices. Its use is to improve the learning experience with interactive and multimedia methods. Specifically in education: Help teachers teach material more effectively and make the classroom more collaborative. Smart whiteboards, for example, allow teachers and students to interact directly in the delivery of materials.(Paper 2023)
5. **IoT in Learning Management Systems (IoT-based Learning Management Systems).** IoT-based learning management systems (LMS) connect student data, assignments, and learning activities through connected devices, creating a unified learning experience. In its use, it makes it easier for teachers, students, and parents to monitor learning progress from anywhere. It is on this basis that the use in Education LMS with IoT allows teachers to monitor student participation, assignment progress, and additional support needs. The system also allows for faster feedback for students.(Muthuramalingam dkk. 2019)
6. **Educational Robots.** Educational robots are equipped with sensors and connectivity capabilities that allow interaction with students, such as coding robots or robots designed to teach science concepts. This system develops children's abilities in technology, logic, and programming from an early age. In education, Educational robots help students understand the concepts of coding, robotics, and artificial intelligence in a more practical and engaging way, making the learning experience more hands-on.(“Smart Project Educational Robot (SpaceR) Sebagai Robot Edukasi | Jurnal Aplikasi dan Inovasi Iptek,” t.t.)
7. **Connected Learning Spaces.** Connected learning rooms are classrooms or libraries that utilize IoT to regulate lighting, temperature, and multimedia equipment, making it more comfortable and interactive. This allows for an optimal learning environment with automatic settings according to conditions, such as lighting and temperature that adjust the time or activity. Use in Education: Creating a more conducive learning environment

and supporting student interaction with technology. This connected learning space also provides students with experience on the application of IoT in architecture and environmental management. (Sholeh 2023)

In the world of education, the Internet of Things (IoT) can be implemented to create a more interactive and efficient learning environment. With IoT technology, various devices such as smart whiteboards, interactive projectors, and internet-connected tablets can be used to enrich the student learning experience. Teachers can display digital materials in a more engaging and dynamic way, while students can interact directly through their devices, whether to access learning resources or complete assignments. In addition, IoT allows for more effective classroom management, for example with automated attendance systems and real-time monitoring of student learning progress. IoT implementation also creates comfort in the classroom, such as automatic adjustment of temperature and room lighting as needed. (Radouan Ait Mouha 2021) In this way, IoT plays an important role in building an adaptive learning environment, supporting active participation, and facilitating interaction between teachers and students. Here are some examples of IoT applications in the world of education:

1. Smart Board. Smart whiteboards allow teachers and students to collaborate interactively. This board can display materials from the teacher's mobile device or computer and can store notes digitally. This facilitates the teaching and learning process, especially for collaborative and project-based learning.
2. Attendance Sensor. IoT sensors can be used to automatically record student attendance using devices such as RFID cards. Attendance data is recorded directly in an integrated system and can be accessed by teachers, administrators, or parents.
3. Classroom Environment Monitoring. Some IoT devices allow for the management of temperature, light, and air quality in the classroom. This comfortable learning environment setting will support a conducive and efficient learning atmosphere.
4. Wearable Devices for Physical Education. Devices such as smartwatches or smart bracelets can be used to monitor students' physical activity during sports lessons. The data generated allows teachers to understand the activity level of students and provide appropriate recommendations for their health.

By utilizing various types of IoT devices, educational institutions can improve the quality of learning and operational efficiency. IoT opens up new opportunities for the world of education to develop learning methods that are more adaptive, interactive, and relevant to technological developments.

The Utilization of the Internet of Things (IOT) in Islamic Education

The use of the Internet of Things (IoT) in Islamic education presents new opportunities to create a more interactive and effective learning environment. With IoT technology, various devices such as smart whiteboards, environmental sensors, and automated attendance systems can be integrated to support a more dynamic and collaborative teaching and learning process. This allows for better data management related to student attendance, classroom environmental conditions, and the delivery of more varied and interactive materials. Through the use of IoT devices, educators can create immersive learning experiences for students by leveraging technology to support hands-on engagement, interaction, and understanding of the material.

Apart from learning, IoT also plays an important role in the management of educational facilities and infrastructure. In the environment of Islamic educational institutions, the application of IoT can help managers in monitoring the condition of facilities such as classrooms, libraries, and dormitories in real-time. With this technology, the automatic monitoring system is able to detect the need for maintenance or repairs early, thus ensuring that the facility is always in optimal condition. In the context of Islamic education, efficient

management of facilities also has a positive impact on the comfort and productivity of all members of the institution, creating an environment conducive to learning and memorization.

1. Interactive Learning

The use of the Internet of Things (IoT) in the world of education, especially for interactive learning, has become one of the important innovations in accelerating the teaching and learning process. IoT, or the Internet of Everything, is a network of devices that are connected and able to communicate over the internet to exchange data automatically. This technology offers great potential in supporting more adaptive, personalized, and efficient learning.(Gubbi dkk. 2013)

The use of IoT in education refers to the use of devices connected to the internet network that can monitor, analyze, and send data in real-time. For example, devices such as sensors, cameras, and wearables can be used in classrooms to monitor student activity, interactions between students, and their involvement in the learning process. Through the data collected, educators can analyze student learning patterns as well as identify areas that need more attention.

In general, interactive learning powered by IoT focuses on active student engagement with learning materials, as well as prioritizing a more contextual and collaborative learning experience. This learning allows students to interact with real objects and phenomena directly, which are simulated through IoT devices. For example, in science lessons, temperature or humidity sensors can be used to understand climate change concepts, while in sports lessons, motion sensors can be used to analyze movement and posture.

In addition to being able to increase direct student interaction, IoT can also create an adaptive and personalized learning environment. Adaptive learning is an approach in which the curriculum is tailored to the individual needs and abilities of students. With IoT devices that collect data on student performance, learning systems can adjust the difficulty level of the material, suggest additional exercises, or provide immediate feedback. This certainly increases the effectiveness of learning by paying special attention to the weaknesses or strengths of each student.(Jamaluddin 2012) For example, IoT devices used in language learning can monitor students' speaking skills. By using voice analysis, these devices can provide feedback on pronunciation and intonation in real time, allowing students to improve their skills more quickly and effectively. Thus, learning becomes more flexible and adjusted in real-time based on student performance.

Through an adaptive learning environment, with the help of IoT is able to play an important role in improving collaboration between students. IoT devices allow students to work in groups, despite being in different locations. In this context, IoT applications can be integrated into online learning platforms that support discussions and group work. For example, in a joint research project, students can use sensors to collect data in different locations, then synchronize that data through a collaborative platform.(“Internet of Things in Education: A Brief Overview | International Journal on Integrated Education,” t.t.) In addition, IoT can also help educators in monitoring interactions between students, such as through sensors that detect noise levels in the classroom. By monitoring noise levels, educators can find out if students are actively discussing or if they tend to be passive. Thus, educators can design more effective learning strategies to encourage student participation.

The success of IoT-based interactive learning is highly dependent on efficient data management. The data collected by IoT devices, such as information regarding student participation, learning patterns, and comprehension levels, needs to be analyzed with machine learning algorithms or artificial intelligence. This analysis can be helpful in determining learning trends and predicting the challenges students may face.(Shahroom

dan Hussin 2018) However, the challenges in the use of IoT data cannot be ignored either. Data privacy and information security issues are a serious concern in the application of IoT in education. Student data recorded by IoT devices must be protected from potential cybersecurity threats. Therefore, the implementation of IoT in education requires strict regulation and supervision of data use, to ensure that student information is protected from unauthorized access. With the use of IoT in education, it can increase the effectiveness of learning. With tools that provide direct feedback and allow for contextual interaction, students become more motivated and more focused on the learning process. Interactive learning powered by IoT facilitates deeper exploration of the material and a better understanding of abstract concepts.

In addition, IoT helps educators in designing a more conducive and efficient learning environment. By utilizing devices that detect the needs of the physical environment of the classroom, such as automatic thermostats or light sensors, IoT can create a comfortable atmosphere for students. This indirectly increases students' concentration and learning comfort. While the benefits of IoT in interactive learning are enormous, there are several challenges that need to be addressed. One of them is the relatively high implementation costs, especially for educational institutions that have budget limitations. In addition, the lack of technical skills in most educators can be an obstacle in optimizing the use of IoT in teaching and learning activities.

However, with the rapid development of technology and the decrease in the cost of IoT devices, the use of IoT in education is expected to become more affordable and common in the future. On the other hand, training for educators in understanding and using this technology is also important so that IoT can be applied optimally in education. Thus, IoT integration is expected to encourage the realization of more inclusive, efficient, and adaptive education. The use of IoT for interactive learning provides various opportunities to create a more personalized, collaborative, and effective learning experience. This technology allows real-time data collection that can be used to adjust the learning process according to student needs, improve interaction between students, and create an optimal learning environment. Although there are still challenges in its implementation, IoT has the potential to be the foundation for future education transformation, especially in an effort to create a more adaptive and innovative education system.

2. Infrastructure Management

The use of Internet of Things (IoT) technology in the management of facilities and infrastructure in Islamic educational institutions opens up great opportunities in creating a more efficient and sustainable educational environment. IoT, as a network of devices that are interconnected and exchange data over the internet, can be applied to improve the management of various educational facilities, both physical and administrative. By utilizing IoT, managers of Islamic educational institutions can optimize the use of resources, ensure the sustainability of facilities, and create a conducive and safe learning environment for students.

In the context of Islamic educational institutions, wise energy management is an important part of environmental stewardship which is a core value in Islamic teachings. IoT offers solutions through the deployment of smart devices, such as light sensors and automatic temperature controls, to optimize energy use. Light sensors, for example, can detect the presence of humans in a room and turn lights on or off automatically, thereby reducing energy waste. Likewise, the temperature regulator, which can adjust the room temperature to keep it comfortable when in use and lower it when there is no activity, such as outside of study hours or on holidays. On this basis, there are several benefits that can be optimized in the management of school infrastructure through the use of IoT.

First, water management can also be optimized with IoT devices, such as soil moisture sensors and water use meters. This is especially beneficial for large facilities such as mosques or Islamic educational parks that require regular maintenance. With an integrated monitoring system, managers can identify and address leaks or other problems quickly, leading to cost savings and efficient resource usage. (Talebkhah dkk. 2021)

Second, the management of physical facilities, such as classrooms, dormitories, libraries, and mosques, requires an effective monitoring and maintenance system to remain in optimal condition. IoT provides tools that are able to monitor the condition of facilities in real-time through sensors installed at various critical points. These sensors, for example, can detect damage to building structures, such as cracks in walls or floors, that may compromise student safety. (Kamble dkk. 2018)

Third, IoT devices can also be used to monitor indoor air quality. In Islamic boarding schools or educational institutions that may have crowded rooms, such as halls or mosques, good air quality is essential for the health of students and staff. Air quality sensors can detect pollutant levels, humidity, and CO2 concentrations, and the system can be directly connected to automatic ventilation devices. That way, the air in the room can be recirculated in the event of a decrease in air quality. (Yusuf dan Sodik 2023)

Fourth, security is an important aspect in the management of Islamic educational institutions, which generally have public facilities such as mosques, libraries, and classrooms that need to be properly secured. IoT-based security systems include devices such as surveillance cameras (CCTV) with internet connectivity, automatic locking systems, and alarms that can be activated if unauthorized access is detected. Through facial recognition or card access technology connected to IoT, educational institutions can monitor movement in and out of the school environment or other educational institutions. It not only helps in ensuring physical safety, but it can also be used to monitor the attendance of students and staff automatically. In a school environment, this system can also be implemented to ensure that students follow the discipline rules that have been set. (“Internet of Things-Based Smart Classroom Environment,” t.t.)

Fifth, the efficiency of the use of facilities, IoT can help in managing the schedule of using public facilities, such as halls or mosques, which are usually used for routine activities such as congregational prayers, studies, or other learning activities. IoT applications connected to mobile devices allow for space scheduling management, thus avoiding schedule clashes and ensuring room availability as needed. With an automatic scheduling system, users can find out the schedule of using facilities in real-time and book the space needed without experiencing problems. This IoT system also allows monitoring of room capacity, which is very important in certain situations, such as the implementation of health protocols during a pandemic. With the number of people sensor and distance detection technology, educational institutions can keep the room from exceeding safe capacity and ensure sufficient distance between students. (Terzieva, Ilchev, dan Todorova 2022)

Sixth, inventory management and logistics in Islamic educational institutions can be improved through the use of IoT devices that are able to monitor the use and availability of goods. For example, RFID (Radio Frequency Identification) devices can be applied to learning equipment or books in libraries. With RFID, managers can know the location, status, and last user of each item, helping to reduce the risk of loss or damage. In fact, IoT devices can help in managing the supply of groceries in the kitchen of the pesantren or school canteen. IoT sensors connected to logistics applications can alert when grocery stocks start to run low or are approaching expiration dates. Thus, logistics management can become more efficient, reduce waste, and maintain the quality of service for students and staff. (S. Jayanth, M.P. Sunil, dan M.B. Poorvi, t.t.)

Although the benefits of IoT in the management of Islamic educational facilities and infrastructure are quite large, there are several challenges that must be considered. High implementation costs are one of the main obstacles, especially for educational institutions that have budget limitations. In addition, the lack of technical knowledge on how to operate and maintain IoT devices can also be an obstacle to the optimal implementation of these systems. Therefore, training for responsible staff and technicians is necessary to ensure the smooth use of this technology. In addition, the existence of clear policies and procedures regarding data privacy and security is also crucial, especially in managing student information recorded by IoT devices. With a comprehensive approach, the use of IoT in Islamic educational institutions can be more effective and have a positive impact on operational sustainability.

The use of IoT in the management of facilities and infrastructure in Islamic educational institutions offers various significant benefits, such as optimizing energy use, monitoring facilities, improving security, and efficiency in logistics management. Despite the challenges in terms of costs and technical skills, with good planning, this technology has great potential to improve the quality of management of Islamic educational facilities. In the end, the implementation of IoT is expected to be able to support the creation of a safe, comfortable, and effective learning environment.

Internet of Things (IoT) in Islamic Education: Preparing the Muslim Generation with Technological Literacy and Islamic Values

The Internet of Things (IoT) has become an important innovation in various aspects of life, including education. IoT refers to a network of devices that connect and communicate with each other, utilizing the internet to collect, exchange, and analyze data in real-time. In the context of education, IoT opens up opportunities to create an interactive and more adaptive learning environment. In Islamic education, especially in preparing a generation of Muslims who integrate with technology but still adhere to Islamic values, IoT has significant potential. The use of IoT in Islamic education can help create a more efficient, engaging, and relevant learning environment, promote technological literacy, and integrate religious values into learning. (Musa, Hamid, dan Ishak 2021)

In this digital era, the Muslim generation needs to have adequate technological literacy. Technology literacy is not only a basic skill in using devices, but also an understanding of how technology works and its impact in daily life. IoT in Islamic education can provide access to a wide range of relevant educational resources, including learning apps designed to improve skills in understanding Islamic values. For example, the use of smart devices, such as internet-connected interactive tablets or whiteboards, allows access to Islamic learning materials from a variety of sources around the world. IoT also enables more effective distance learning through technologies such as video conferencing platforms, which can connect students in different places with teachers who are competent in the field of religion. This is especially important in remote areas where access to Islamic education is still limited. With IoT, students can learn from Muslim scholars or scholars through a globally connected online platform, making learning more inclusive and open. (Engkizar dkk. 2017)

In addition to improving technological literacy, Islamic education has a great responsibility in ensuring that Islamic values remain a strong foundation for the young generation of Muslims. IoT integration must be done by paying attention to Islamic ethics and teachings, such as morality, honesty, and social responsibility. IoT can be used to create a learning environment that supports the development of Islamic values-based character, such as by presenting exemplary stories from the Qur'an and hadith through interactive media. IoT-based platforms can also support Islamic moral and ethical learning programs effectively, for example through applications that remind students to perform prayers, give zakat, or even reflect on the meaning of their daily actions in the context of religious values. This technology

can help form a character rooted in faith and piety, where students learn how to practice the teachings of Islam in their daily lives while taking advantage of modern technology.(Umar, Chaerowati, dan Drajat 2023)

One of the key advantages of IoT is its ability to create interactive and collaborative learning experiences. In Islamic education, IoT devices can be used to build a more engaging learning atmosphere and encourage students to actively participate. For example, in learning the Qur'an, IoT technology can be used to track students' progress in memorization and tajweed by using devices that automatically identify and correct errors. IoT also enables a collaborative learning approach by leveraging applications and platforms that support group discussions and cooperation in religious learning projects. For example, the students can work together on Islamic research projects or discussions on religious topics through connected devices. Thus, they not only learn individually, but also develop important social skills, such as communication, collaboration, and respect for the views of others.(Chudzaifah dan Hikmah 2024)

Although IoT brings many benefits in Islamic education, there are some challenges that need to be considered. One of them is data privacy and security, especially since IoT involves the collection and storage of personal data. Islamic educational institutions need to ensure that student data is properly protected and not misused.(Mahmud, Sakka, dan Putra, t.t.) In addition, it is also important to maintain that the use of IoT does not reduce human interaction in the learning process, which is an important part of educating a generation of moral Muslims. IoT must also be guided by ethical principles that are in line with Islamic teachings. The use of technology should be directed for good, not for purposes that are contrary to Islamic values, such as activities that lead to consumptive nature or harm others. Teaching about the ethical and responsible use of technology, as well as an understanding of the impact of technology on social and spiritual life, needs to be part of the IoT-based Islamic education curriculum.

In facing global challenges, the Muslim generation must be able to adapt to rapid technological changes. Islamic education that utilizes IoT can prepare them with relevant skills in the digital era, while equipping them with a strong foundation of Islamic values. The use of IoT in Islamic education not only encourages technological skills, but also fosters awareness of the importance of ethical principles, social responsibility, and constancy in practicing Islamic values. Thus, IoT-based Islamic education has the potential to prepare a generation of Muslims who are not only technologically literate, but also have solid moral and ethical integrity. They are expected to be wise and dignified leaders, who are able to apply technology in a way that supports the benefit of the ummah and strengthens the role of Islam in modern society.

Conclusion

The use of Internet of Things (IoT) technology in Islamic educational institutions provides many significant benefits to support interactive learning and more efficient management of infrastructure. IoT, as a network of devices connected via the internet, can collect, transmit, and analyze data in real-time, creating a more dynamic learning experience. In learning, this technology allows the use of digital devices such as tablets and smart whiteboards that increase student engagement and enrich teaching materials based on Islamic values. In addition, IoT can also facilitate collaborative teaching with digital platforms that allow students to work in groups, develop a deeper understanding of religion, and create an interactive learning atmosphere.

On the other hand, IoT provides a solution in the management of infrastructure in Islamic educational institutions with the use of sensors that monitor and regulate the optimal use of energy, lighting, and the environment. This technology makes facility management more efficient, safe, and comfortable for students and educators, while reducing operational costs. With the integration of IoT, Islamic educational institutions not only adapt to the demands of

technological literacy in the digital era but also prepare a generation of Muslims who have the necessary technological skills as well as strong Islamic character and ethical values.

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