# *Pesantren* Technology-Friendly: Enhancing Learning Effectiveness in The Modern Era

Muhammad Najihul Huda[1*], Zulkarnain[2], Syarof Nursyah Ismail[3], Auwalu Shuaibu Muhammad[4]

[1] Universitas Darul Ulum Jombang, Indonesia
[2] STIS Darul Falah Pagutan Mataram NTB, Indonesia
[3] STAI Denpasar Bali, Indonesia
[3] Federal University Gusau, Nigeria

## ABSTRACT

This research explores the integration of technology in Islamic boarding schools (*pesantren*) and its influence on learning effectiveness in the modern era through a Systematic Literature Review (SLR) combined with content analysis, examining data from accredited academic journals. The findings indicate that technology enhances *pesantren* learning through innovations such as e-learning platforms, digitization of *kitab kuning* (classical Islamic texts), modern administrative tools, and expanded *da'wah* outreach while facilitating collaborations with external institutions to strengthen infrastructure. However, challenges such as limited technological resources, low digital literacy, and concerns about the negative impacts of technology on students' character persist. *Pesantren* adopt strategies including digital literacy training, collaboration with external partners, the establishment of internal regulations, and a moderated approach to technology use, ensuring technological advancements align with Islamic values. This study contributes by providing a framework for balancing tradition and modernity, offering practical insights for policymakers and educators to optimize technology use in pesantren, empowering students to thrive in a globalized and interconnected world while preserving their cultural and religious essence.

*Corresponding author*: Muhammad Najihul Huda ✉(najihul.undar65@gmail.com), Universitas Darul Ulum Jombang, Indonesia

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## Introduction

*A*s an Islamic educational institution in Indonesia, *Pesantren* plays a crucial role in shaping a generation of Muslims with noble character (Faruq et al., 2022). In this context, *pesantren* functions not only as a place to learn religious knowledge but also as a social institution that contributes to the character development of society (Apriliana & Junaedi, 2021; Mujahid, 2021). Research indicates that *pesantren* must adapt to the challenges of modernization and globalization, including integrating technology in the learning process (Halimah et al., 2024). *Pesantren* needs to develop new strategies to enhance the quality of education in the Society 5.0 era, which includes fostering creativity, critical thinking, communication, and collaboration (Roidah Lina & Qiyadah Robbaniyah, 2024). This aligns with the view that education in *pesantren* should be oriented towards Islamic values while being able to meet the challenges of the times (Ma'arif, 2018).

The modern era is marked by technological advancements transforming how we learn and access information (Marpelina et al., 2024). Integrating technology in *pesantren* education can enhance the efficiency and effectiveness of the teaching and learning process (Fauzi et al., 2018). Effective management of educational quality development in *pesantren* is crucial to compete in the modern era (Aini, 2021). Furthermore, *pesantren* play a significant role in empowering santri (Pratiwi et al., 2022) through character education relevant to globalization's challenges. This indicates that *pesantren* has the potential to transform into a more progressive and adaptive educational institution that keeps pace with the times.

However, the implementation of technology in *pesantren* is not without challenges. Limitations in infrastructure and human resources often hinder the adoption of technology. The importance of a curriculum based on moral values in *pesantren* education must be maintained, despite the influences of modernization (Rizal et al., 2018). Additionally, the planning of Islamic education curricula must be based on divine values and grounded in Islamic sources, so that education in *pesantren* remains relevant and in line with the objectives of Islamic teaching (Cholid Abdurrohman, 2022).

The application of technology in *pesantren* must also be carried out carefully, considering the potential negative impacts, such as internet misuse. Therefore, well-formed policies are needed to manage the use of technology in *pesantren*. Despite the challenges in applying Islamic values in the modern era, *pesantren* can remain relevant with the right strategies for character development of the santri (Bambang Triyono & Elis Mediawati, 2023). Thus, *pesantren* has excellent potential to leverage technology to

strengthen the effectiveness of learning and expand the horizons of santri, while staying true to the Islamic values that serve as their foundation.

This research explores how *pesantren* can become technology-friendly to enhance learning effectiveness in the modern era. The primary focus of this research is to understand the extent to which technology can be integrated without diminishing the traditional values that form the identity of *pesantren*. By studying the experiences of *pesantren* that have successfully adopted technology, this research hopes to provide strategic recommendations that can be applied more broadly.

Overall, adapting technology by *pesantren* is necessary and an opportunity to demonstrate that this institution can compete and contribute to shaping a competent Muslim generation in the global era. With prudent technology integration, *pesantren* can continue to fulfill its mission as an educational institution based on Islamic values while embracing the inevitable changes of the modern era.

## Method

This research utilizes the Systematic Literature Review (SLR) method combined with content analysis to systematically analyze factual text data from various articles discussing technology integration in *pesantren* and its influence on learning effectiveness in the modern era. The data sources for the literature review consist of accredited academic journals.

### Literature Search

Identifying relevant literature for this study was carried out through several systematic steps. It began with defining the research problem, focusing on the use of technology in *pesantren* and its impact on learning effectiveness (Hinderks et al., 2020). This was followed by conducting a comprehensive search for relevant articles. Afterwards, the articles were filtered and selected based on their alignment with the research theme. The data were then categorized and coded to facilitate analysis. The collected information was analyzed and evaluated to ensure its relevance and accuracy (Pati & Lorusso, 2018; Weißer et al., 2020). Finally, the findings were summarized, and conclusions were drawn to address the research objectives.

### Inclusion and Exclusion Criteria

The literature search began with the identification of keywords, including "technology in *pesantren*," "digital learning," "*pesantren* education," and "technology in Islamic education." Searches were conducted across major academic databases such as Web of Science, Scopus, and Google Scholar using the Publish or Perish tool. The study

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focused on articles published from 2020 to 2025. The next step was to establish the inclusion and exclusion criteria for selecting articles, as detailed in the following table:

*Table 1.Inclusion and Exclusion Criteria*

| Inclusion Criteria | Exclusion Criteria |
| --- | --- |
| Peer-reviewed journal articles | Non-journal sources such as book chapters, books, or reviews |
| Articles published between 2020 and 2025 | Articles not published during this timeframe |
| Studies focused on technology use in *Pesantren* | Studies unrelated to technology in *pesantren* |
| Articles written in English and Indonesia | Articles not written in English and Indonesia |

Table 1 outlines the criteria used to select articles for further review. Full texts of the articles were obtained, and those that did not meet the inclusion criteria were excluded from the study. Articles meeting the criteria were reviewed comprehensively to address the research objectives. Establishing explicit inclusion and exclusion criteria is essential to ensure the study's reliability and validity. The article selection process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Tricco et al., 2018), identifying 30 articles exploring technology use in *pesantren*.
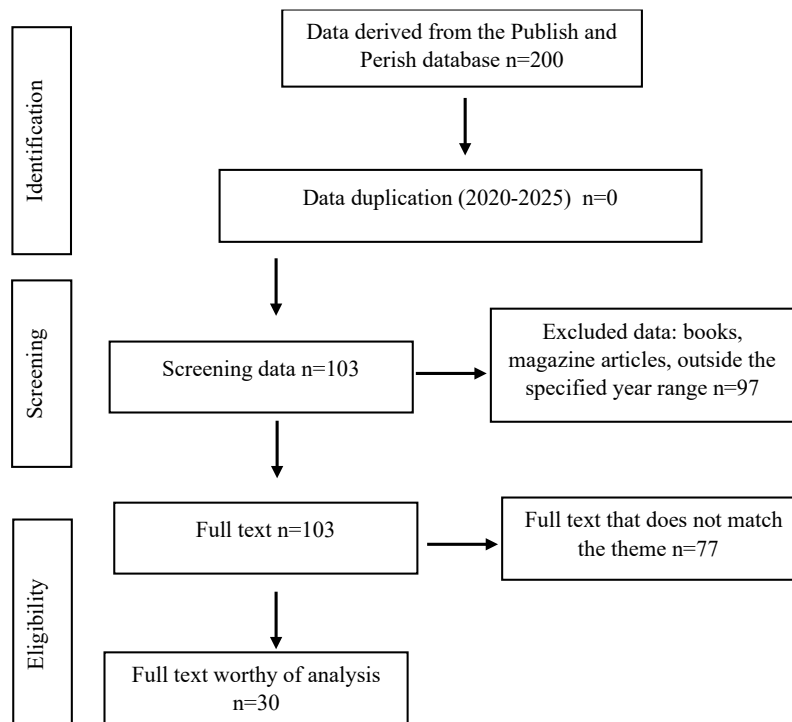
*Figure 1. PRISMA Chart for Technology Integration in Pesantren*

## Results

**Technology Integration in the Learning System of Islamic Boarding Schools**

Islamic boarding schools (*pesantren*) play a strategic role in Islamic education in Indonesia, serving as centers for religious knowledge and institutions that shape character and instill noble values (Badrun, 2024; Huda, 2024). With a long history as institutions of Islamic education, *pesantren* have become crucial pillars in preserving traditional Islamic values while preparing students (santri) to contribute to societal life (Apriliana & Junaedi, 2021; Hakim, 2023). Their widespread presence across Indonesia makes *pesantren* vital in fostering a generation of Muslims who possess not only deep religious knowledge but also broad insights and commendable character.

However, in this modern era, *pesantren* face significant challenges due to rapid technological advancements, changing mindsets among the younger generation, and increasing competition in education. The current generation, deeply familiar with technology, demands a learning approach that is both relevant and innovative (Milidar, 2024). Consequently, integrating technology into the *pesantren* learning system has become unavoidable (Wijaya et al., 2024). Technology supports teaching and learning

processes, enhances management efficiency, and extends the reach of *pesantren*'s mission (dakwah) while maintaining Islamic values as the primary foundation (Muid et al., 2024).

A technology-friendly *pesantren* can adaptively utilize technology across various aspects, such as education, management, and religious outreach *da'wah* (Susyanto, 2022). By leveraging digital devices, learning applications, and online platforms, such *pesantren* can meet the needs of the digital generation without compromising their traditions. This integration allows *pesantren* to remain relevant amidst modern challenges while strengthening their role as educational institutions capable of producing technology-savvy Muslims who are morally upright and ready to compete globally.

This transformation is crucial to ensuring the continued relevance of *pesantren*, as it enables them to provide education that meets contemporary needs while preserving their core values. By embracing technological advancements, *pesantren* can demonstrate how traditional institutions can evolve without losing their cultural and religious essence (Soleh, 2024). With balanced technology integration, *pesantren* have the opportunity to lead and shape a generation equipped with spiritual guidance and modern competencies, contributing positively to an ever-developing world.

Therefore, the challenge and opportunity lie in how *pesantren* can harness technological advancements to enhance their educational processes and social contributions. By utilizing technology to support their academic objectives and religious missions, *pesantren* will ensure their ongoing relevance and empower students to thrive in an increasingly globalized and technology-driven world while remaining rooted in Islamic principles. This adaptability will ensure that *pesantren* continues to produce graduates who are faithful, virtuous, but also skilled, and competitive in a complex and interconnected world.

## Implementation of Technology in Learning Processes

### E-Learning in Pesantren

Implementing e-learning in *pesantren* enables the learning process to occur online using various digital devices (Ghafur, 2021). Traditionally presented as textbooks, learning modules can now be delivered in digital formats, making them accessible to students anytime and anywhere (Kumar Basak et al., 2018). With interactive videos and online quizzes, teaching materials can be presented more engagingly and interactively,

increasing students' interest in learning (Zainuddin et al., 2020). Educational videos can showcase lectures, demonstrations of worship practices, or scientific discussions that can be replayed repeatedly, while online quizzes provide opportunities for immediate and enjoyable comprehension testing.

The primary advantage of e-learning implementation lies in its flexibility. Students are no longer bound to specific times and places, allowing them to study beyond the formal teaching hours at the *pesantren*. This creates opportunities for students to learn independently and at their own pace. Additionally, technology-driven teaching enables instructors to deliver richer and more varied content, including multimedia usage, making learning more effective and enjoyable.

### Digitization of Kitab Kuning

A distinctive feature of *pesantren* education is the use of *kitab kuning*, which is a classic Islamic text often written in Arabic that serves as a primary teaching reference. Through digitizing *kitab kuning* via mobile applications, *pesantren* can make these texts more easily accessible to students (Ibda et al., 2023). Digital *kitab kuning* applications are typically equipped with search functions, allowing students to quickly find specific words or phrases in the text, thereby simplifying locating references or answering questions posed during learning. Moreover, features like commentary and explanations within these applications provide deeper insights for students who may not fully comprehend the content of the texts.

Digitizing the *kitab kuning* significantly enhances students' accessibility and understanding (Halimi et al., 2022). Previously, students had to access physical *kitab kuning*, which was often limited in number and hard to find outside the *pesantren*. With digital applications, however, these texts can be accessed anywhere, even on mobile phones or tablets, enabling more flexible and efficient learning. Interactive features such as commentary, audio, or explanations in simpler language help students grasp the sometimes-complex religious texts and delve deeper into their teachings. This digitization mitigates learning limitations and accelerates comprehension for students eager to deepen their knowledge.

### Technology for Pesantren Administrative Management

Technology has become a crucial tool in supporting *pesantren* administrative management (Azhar et al., 2020). One significant innovation is using educational

information system applications designed to manage student data. Such applications allow *pesantren* to store and access information about students more efficiently and securely, such as personal details, academic records, and attendance logs (Dwi Pritama & Hidayat, 2020). Additionally, features like automated reporting and integration with various digital services streamline administration, allowing administrators to focus on educational development and student mentorship.

Efficiency in *pesantren* management is further achieved through the digitalization of attendance, scheduling, and learning evaluation (Bali & Holilah, 2021). Digital attendance systems enable real-time recording of student attendance, instantly accessible to administrators or parents. Digital scheduling systems help organize study hours, extracurricular activities, and lectures more systematically. Meanwhile, technology-based learning evaluations allow administrators to objectively assess students' academic achievements through automated data analysis, enabling prompt corrective actions if necessary.

Adopting such technology positively impacts the time and quality of *pesantren* management. Administrative tasks, previously time-consuming when done manually, are now faster and more accurate. *Pesantren* administrators can allocate more time to spiritual mentorship and curriculum development as the administrative burden decreases. Furthermore, management quality improves as decision-making is supported by well-organized data accessible anytime. Thus, *pesantren* can maintain their Islamic educational traditions while adapting to modern advancements.

*Utilization of Social Media for Da'wah and Communication*

Social media has become an essential tool for supporting Pesantren's internal communication (Muslikatun & Siswanto, 2024). Platforms such as WhatsApp or Telegram are often used to connect students, administrators, and *pesantren* staff for daily updates, activity schedules, or important announcements. The speed and ease of social media access foster more effective and efficient communication. Using dedicated groups or channels, *pesantren* ensures that information reaches all involved parties without being hindered by distance or time.

Additionally, social media is an effective tool for disseminating *da'wah* (Islamic outreach) (Ar-Ridho et al., 2023). Platforms like YouTube, Instagram, and TikTok allow *pesantren* to share *da'wah* content, including lectures, Islamic studies, and engaging and educational short videos. With appropriate creativity, this digital *da'wah* can reach a wider audience, especially the younger generation, which is highly active on social

media. The content delivered can also be tailored to modern communication styles without compromising the essence of Islamic values.

The use of social media also enhances the *pesantren*'s image in modern society. By showcasing positive activities such as educational programs, social initiatives, or student achievements, *pesantren* can highlight their role as dynamic institutions relevant to contemporary developments. This not only strengthens public trust in *pesantren* but also attracts prospective students and supports the preservation of Islamic educational traditions in the digital era.

*Collaboration with External Institutions*

Collaboration with external institutions has become a vital strategy for *pesantren* to enhance education quality and management (Halimah et al., 2024). Partnerships with educational institutions, such as universities or colleges, allow students to access additional academic programs, scholarships, or exchange programs. Collaboration with technology companies supports procuring digital devices, educational applications, or technical training. Meanwhile, partnerships with religious organizations strengthen *da'wah* networks and support spiritual development programs for students.

Through such collaborations, *pesantren* can offer digital skills training relevant to current needs, such as graphic design and digital marketing. These skills are beneficial in the professional world and support students in creatively disseminating *da'wah* on digital platforms. External partners with expertise in their fields often facilitate these training programs, ensuring students receive quality and directed learning.

The benefits of such collaborations significantly enhance students' competitiveness in the modern world (Putri et al., 2024). Students are equipped not only with profound religious knowledge but also with practical skills relevant to various industries. As a result, they have greater opportunities to contribute in diverse fields, whether as professionals or as *da'i* (Islamic preachers) who effectively utilize technology. These collaborations also bolster the image of *pesantren* as adaptive educational institutions ready to meet the challenges of the digital era.

**Challenges and Strategies for *Pesantren* in the Digital Era**

Although digital technology offers various benefits for education, the implementation of technology in *pesantren* faces several unique challenges:

*Technological Infrastructure Limitations*

The digital era offers numerous benefits for education, yet *pesantren* face unique challenges in adopting digital technologies, particularly due to inadequate infrastructure (Soleh, 2024). Many *pesantren*, especially those in remote areas, lack reliable and sufficient internet access, making it challenging to utilize digital resources effectively. In some regions, internet connectivity is unavailable, limiting *pesantren*'s ability to adopt online-based learning tools, administrative management systems, or external communication platforms.

Many *pesantren* have insufficient devices such as computers, laptops, or tablets, often using outdated equipment incompatible with modern applications or software (Anwas, 2015). Many *pesantren* have insufficient devices such as computers, laptops, or tablets, often using obsolete equipment incompatible with modern applications or software. This hinders teachers and students from maximizing the potential of technology for learning and other activities.

In addition, geographical challenges compound these issues for *pesantren* in remote areas (Junaidi et al., 2023), where basic infrastructure like stable electricity or communication facilities is often lacking. Cultural barriers also emerge as local communities may not fully understand the importance of integrating technology into education, creating resistance to its adoption. Consequently, *pesantren* experience a digital divide compared to educational institutions in urban settings.

These infrastructure limitations slow down the digital transformation process in *pesantren*. They struggle to compete in a globalized era without adequate technology, particularly in delivering quality education relevant to contemporary times. To address this issue, *pesantren* must collaborate with governments, social organizations, and technology companies to secure infrastructure support and digital training. Strategic partnerships can enable *pesantren* to harness technology while preserving the Islamic values foundational to their education.

*Lack of Digital Literacy in Pesantren*

Another significant challenge is the low level of digital literacy among educators and students within *pesantren*. Many teachers lack the skills to effectively utilize digital

tools for teaching and administrative purposes, which is compounded by the absence of structured training programs focused on digital literacy (Rhain et al., 2024; Safitri, 2020). Although students are part of a generally tech-savvy generation, their engagement with technology often revolves around social media and entertainment rather than educational applications (Setiawan, 2024). This lack of technical proficiency affects learning outcomes and hampers administrative efficiency, as many tasks remain manual and time-consuming (Muklason et al., 2019). Furthermore, inadequate digital literacy increases vulnerability to the misuse of technology, exposing students to inappropriate content and undermining the moral values that *pesantren* strive to uphold (Nisa et al., 2024).

*Concerns About the Negative Impacts of Technology*

Integrating technology into *pesantren* raises significant concerns regarding its potential adverse effects on students' morality and character. The unrestricted access to digital content can lead to distractions and foster negative behaviors, such as gadget addiction, which detracts from academic and religious commitments (Ja'far, 2019). Additionally, the inability of students to discern beneficial from harmful content, exacerbated by low digital literacy, poses a risk of external influences that contradict the educational mission of *Pesantren* (Syobah et al., 2024). There is also apprehension that reliance on technology may disrupt traditional learning methods, which emphasize direct interaction between students and teachers, potentially eroding the values of discipline and respect central to *pesantren* education (Murdianto, 2021; Ridwan Maulana Rifqi Muzakky et al., 2023).

In conclusion, while the digital era presents opportunities for *pesantren* to enhance their educational offerings, significant challenges remain. Addressing these issues requires a multifaceted approach that includes improving technological infrastructure, enhancing digital literacy, mitigating the negative impacts of technology, and navigating cultural adaptation challenges. By fostering strategic partnerships and embracing innovative practices, *pesantren* can effectively harness technology while preserving their core Islamic values.

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## Discussions

**Pesantren Strategies in Facing the Digital Era**

*Digital Literacy Training for Teachers and Students in Pesantren*

Digital literacy training is one of the strategic solutions that *pesantren* can implement to enhance the abilities of teachers and students in facing the challenges of the digital era (Anugraheni et al., 2025). Digital literacy goes beyond merely understanding technological devices; it also encompasses the ability to use them productively and under Islamic values. Such training programs are essential to ensure that technology is adopted and optimally utilized to support learning processes and the management of *pesantren*.

Digital literacy training in *pesantren* can begin with basic introductions to technological devices, such as computers, laptops, tablets, and relevant software (Sholehuddin et al., 2023). Teachers and students are taught how to operate these devices, access online resources, and use applications beneficial for education, such as classroom management tools, digital libraries, or interactive presentation software. This knowledge helps improve efficiency in both learning and daily activities in the *pesantren*.

Beyond technical skills, this training should also include aspects of digital security. Teachers and students must understand the importance of protecting personal data, avoiding cyber threats such as phishing or malware, and safely utilizing technology (Ayyash et al., 2024). These skills help *pesantren* minimize the risks of technology misuse that could harm the institution or individuals.

Equally important, the training must align with Islamic law (sharia). *Pesantren* can guide students on how to use the internet and technology for beneficial purposes, such as studying religious sciences, accessing digital Islamic texts, or participating in relevant discussion forums (Halimah et al., 2024). This way, both teachers and students not only learn how to use technology but also how to select content aligned with Islamic values.

Through comprehensive digital literacy training, *pesantren* can empower teachers and students to utilize technology to strengthen the educational process (Nurhayati et al., 2024). Additionally, this training helps *pesantren* balance embracing modern technology and preserving Islamic traditions that define its identity. This approach enables *pesantren* to adapt to the digital era while remaining relevant as an institution rooted in Islamic values.

*Collaborating with External Parties to Strengthen Pesantren Infrastructure*

Collaboration with external parties is a fundamental strategy for *pesantren* (Islamic boarding schools) to enhance their technological infrastructure and educational capabilities. Engaging with various stakeholders, such as government entities, technology firms, and non-governmental organizations (NGOs), allows *pesantren* to access essential resources often beyond their internal capacities. Through national programs to improve digital access, government initiatives can provide internet connectivity in remote regions. These efforts are crucial for overcoming geographical limitations that impede technology integration in education, as highlighted by A'La and Rahman, who discuss the importance of government policies in supporting educational institutions, including *pesantren*, within the national education framework (A'la & Rahman, 2022).

Moreover, partnerships with technology companies can significantly benefit *pesantren* by facilitating access to modern educational tools and training. Many companies implement corporate social responsibility (CSR) initiatives focusing on academic development, including donations of hardware, software, and training programs tailored to educational settings. This is supported by the findings of Setyawan, who emphasizes the role of government interventions in enhancing the academic landscape of *pesantren*, suggesting that such collaborations can lead to improved educational outcomes while maintaining the unique characteristics of these institutions (Setyawan, 2019).

NGOs also play a pivotal role in this collaborative framework. They often have programs to support community-based education, including establishing computer labs and digital libraries within *pesantren*. As noted by Anjarsari, while their research focuses on civic education, the involvement of NGOs in educational initiatives can provide critical resources and expertise that enhance the learning environment (Anjarsari et al., 2023). Furthermore, NGOs can offer technical assistance and training, ensuring that the technology implemented is effectively utilized to meet the specific needs of *pesantren*. This aligns with the observations made by Rahmawati and Astuti, who discuss the empowerment role of NGOs in community education (Rahmawati & Astuti, 2019).

*Developing Internal Regulations for Technology Use in Pesantren*

Developing internal regulations is a strategic step for *pesantren* to ensure that technology is used productively and aligned with Islamic values (Maulana, 2024). If not properly regulated, technology can negatively impact students' morality and focus.

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Therefore, *pesantren* need to formulate clear and enforceable rules regarding the use of technology within their educational environment.

One crucial aspect of these regulations is restricting access to certain content to ensure that technology is used ethically, supports digital literacy, character education, and reinforces Islamic values. By controlling the type of information accessible, these regulations protect users, particularly students, from exposure to harmful content such as violence, gambling, or materials irrelevant to education. Furthermore, this restriction ensures that technology is utilized for positive purposes and aligns with Islamic ethical principles, such as avoiding using technology for harmful activities. These regulations also promote the development of digital literacy, enabling users to understand and use technology wisely, while fostering better character formation through exposure to educational and beneficial content. Thus, restricting access creates a digital environment consistent with Islamic teachings and supports the development of a morally upright generation grounded in Islamic values (Sari Hernawati et al., 2024).

Students need to understand proper etiquette in using technology, such as communicating politely on digital platforms, respecting others' privacy, and using technology to deepen religious knowledge. By instilling these ethical values, students become smart technology users and morally upright individuals. Internal regulations must be effectively socialized among all *pesantren* members, including teachers, students, and staff. To ensure success, *pesantren* should implement an evaluation system and enforce fair discipline for rule violations. With clear and consistent regulations, technology can be a learning tool that strengthens Islamic educational goals without compromising traditional *pesantren* values.

*A Moderated Approach to Technology in Pesantren*

A moderated approach to technology seeks to use technology wisely, enhancing educational and managerial quality in *pesantren* without compromising the Islamic values that serve as its foundation. This approach focuses not only on using technology as a tool for modernization but also on ensuring that its application strengthens the *pesantren*'s role as a center of education based on Islamic principles (Saini, 2024)

One of the core principles of moderated technology use is prioritizing educational benefits. Technology should be directed toward supporting the learning process (Zulfitria et al., 2020), such as using digital learning applications, providing electronic versions of classical Islamic texts, or utilizing interactive media to deepen religious

subjects. In this way, technology becomes not merely a tool for entertainment but also a means to enrich students' learning experiences.

In management, moderated technology can improve operational efficiency. For example, using academic information systems to record student data, schedule activities, and manage administration. Technology can also facilitate communication between *pesantren* and parents, ensuring smoother coordination. With proper implementation, *pesantren* can optimize their resources to achieve better outcomes.

However, moderation in technology also requires control and oversight. *Pesantren* must ensure that technology use does not violate Islamic principles (Sedayu, 2024), such as restricting access to non-educational content and regulating device usage time. Clear internal regulations enable *pesantren* to maintain technology as a tool that strengthens students' character and morals rather than becoming a hindrance.

This approach encourages *pesantren* to selectively integrate technology, adopting only tools and methods relevant to their educational needs. By framing technology within Islamic values, *pesantren* can remain as educational institutions rooted in tradition while responding to modern demands. Moderated technology ultimately helps *pesantren* remain relevant, innovative, and capable of nurturing knowledgeable and morally upright generations

## Conclusion

Pesantren have great opportunities to utilize digital technology to improve the quality of education and enhance their competitiveness in the modern era. However, the success of technology integration depends on the ability of pesantren to address the existing challenges with a well-directed strategy. With proper management, technology can become a tool to strengthen the students' character, morals, and knowledge, while preserving the pesantren tradition as a center for Islamic learning. This research contributes significantly to understanding how pesantren can utilize technology to improve the quality of education without compromising the religious values embedded in pesantren traditions. Furthermore, this research provides insight into the importance of wise management in addressing technological challenges, while emphasizing the need to balance technological advancement and the Islamic principles taught in pesantren.

Future research priorities in technology integration in pesantren focus on the empirical study of mixed methods, collecting primary data from students, teachers, and managers to gain in-depth qualitative insights on implementation challenges,

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pedagogical adaptation, and community perception, as well as quantitative measurement of learning outcomes and digital literacy. In addition, it is important to analyze the long-term impact of technology on the development of students' character, religious attitudes, and morals, ensuring alignment with the core mission of the pesantren. This study recommends comparative studies in different types of pesantren (salaf, khalaf, urban, rural, and with different levels of technological readiness) to provide contextual insights for policymakers and educators, while exploring the role of kiai, organizational culture, and community participation in sustaining technology-based education initiatives. In parallel, research that investigates the intersection of Islamic values and digital ethics in using pesantren technology is crucial to developing a culturally rooted framework, ensuring that technology adoption truly enhances, rather than destroys, the educational, spiritual, and social mission of pesantren programs.

## Author Contribution Statement

Contributions of the authors in this article: Muhammad Najihul Huda and Zulkarnain contributed as the concept developer and drafters; Auwalu Shuaibu Muhammad contributed as the data analyst and interpreter; Syarof Nursyah Ismail contributed to collecting data and critically revising the article. All authors agree to take responsibility for all aspects of this work.

## Disclosure Interest

We have no conflict of interest to declare.

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