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Optimizing Islamic Boarding School Management in the Digital Era: Analysis of Technology Effectiveness in Administration and Operations

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ABSTRACT. This study explores the application of technology in Islamic boarding school management and its impact on administrative efficiency and educational service quality. The findings reveal a significant positive effect of technology use using a phenomenological approach, in-depth interviews, and quantitative analysis with the Arellano-Bond and Blundell-Bond dynamic panel models. Technological implementation enhances administrative efficiency by improving data processing speed, recording accuracy, and information accessibility. Additionally, educational service quality improves, reflected in higher student and parent satisfaction, better learning outcomes, and enhanced interactions among administrators, teachers, students, and parents. Qualitative findings support these results, highlighting benefits such as easier student data management, equitable e-learning access, and more effective communication via instant messaging. However, challenges include limited technology access, inadequate infrastructure, insufficient technological skills, resistance to change, funding constraints, and lack of government and community support. Policy recommendations include increasing government support for technological infrastructure, providing training programs, and fostering an adaptive organizational culture. This study offers a foundation for developing effective technology strategies in Islamic boarding schools, contributing to educational quality in the digital era. Further research should explore emerging technologies to enhance education.

Keywords: *Technology; Administrative efficiency; Educational service quality; Pesantren management; Digital education.*

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INTRODUCTION

Islamic boarding schools are traditional educational institutions that play an important role in the formation of character and knowledge of students in Indonesia (Ardianto et al., 2023; Dewi et al., 2025; Gunawan et al., 2020; Sunardi et al., 2025). As the number of Islamic boarding schools increases, effective management becomes a crucial element to ensure smooth operations and optimal achievement of educational goals (Anggadwita et al., 2021; Dilia et al., 2022; Islamic et al., 2024; Nadif et al., 2023). The digital era brings major changes in various aspects of life, including in the world of education. Digital technology offers new opportunities that can support the management of Islamic boarding schools to be more efficient and effective, such as the use of technology-based management systems for administration, finance, and communication (Calora et al., 2023; Eberl & Drews, 2021; Maulina et al., 2023; Sumiati et al., 2024). However, the digital era

also brings its own challenges for Islamic boarding schools. Not all Islamic boarding schools have adequate access to the technology and infrastructure needed. In addition, there are also challenges in terms of adaptation and the ability of the human resources involved to operate and utilize the technology optimally. Therefore, it is important to examine how technology can be implemented effectively in the management of Islamic boarding schools to face challenges and take advantage of opportunities in this digital era (Faizah et al., 2023; Nuha et al., 2024).

Islamic boarding school management is often faced with various problems that can hinder operations and the achievement of educational goals (Ariatin et al., 2023; Aryati & Suradi, 2022; Fathurrochman et al., 2019; Hastasari et al., 2022). Some common problems that often occur in Islamic boarding schools include inefficient administration, manual and unintegrated administrative processes that can lead to recording errors, delays in data processing, and difficulties in accessing the necessary information (Basri et al., 2024; Sanusi, 2024). The lack of a good communication system between administrators, teachers, students, and parents can lead to misunderstandings, delays in information, and minimal collaboration (Adeoye et al., 2025). Non-transparent and unsystematic financial management can cause financial problems and reduce stakeholder trust. Difficulty in monitoring and evaluating the performance of students and administrators can hinder the improvement of the quality of education and management of Islamic boarding schools (Alwi & Mumtahana, 2023; Hussein et al., 2016; Kartiko et al., 2025). Some Islamic boarding schools may not have adequate access to technology, both in terms of devices and infrastructure (Kapelela et al., 2025; Syarifah, 2023). Islamic boarding schools have a very important role in the education system in Indonesia, and with the presence of technology, the management of Islamic boarding schools can become more effective and efficient. Technology can help overcome various problems faced by Islamic boarding schools, such as inefficient administration, ineffective communication, non-transparent financial management, and suboptimal monitoring and evaluation (Badrun, 2024; Royani et al., 2024). However, to achieve these benefits, Islamic boarding schools need to overcome various challenges faced in the application of technology, such as limited access to technology and infrastructure, as well as limited human resource capabilities (Hanafi et al., 2021; Lundeto et al., 2021).

It is important to understand that technology can be a very useful tool in improving the efficiency of Islamic boarding school management. However, the application of technology must be carried out carefully and considering various factors, such as the readiness of infrastructure and human resources, as well as the challenges that may be faced (Duncan, 1995; Lee, 2001). With the right approach, technology can help Islamic boarding schools achieve their educational goals more effectively and efficiently, as well as provide better educational services for students and the community (Arif et al., 2024; Masuwd et al., 2025; Muhyiddin et al., 2022; Mursidi et al., 2021). Most of the existing research focuses more on the educational and curriculum aspects, while the management aspects have not been explored much. The limitations of previous research include the lack of empirical data that can be used as a reference, the lack of in-depth case studies, and the absence of a clear model or framework on how technology can be implemented in Islamic boarding school management. In addition, existing research has not discussed much about the impact of technology on the administrative and operational efficiency of Islamic boarding schools comprehensively, such as the research of Hanafi, Taufiq, Saefi, Ikhsan, Diyana, Thoriquttyas, & Anam, (2021) and Anggadwita, Dana, Ramadani, & Ramadan, (2021).

This study aims to measure the impact of technology on management efficiency in Islamic boarding schools. This study will identify the types of relevant technology and analyze the impact of technology on administrative efficiency, as well as evaluate the influence of technology on the quality of educational services in Islamic boarding schools. This study will also identify the challenges and obstacles faced in the application of technology, and compile strategic recommendations for Islamic boarding school managers, academics, and policy makers on steps that can be taken to optimize the use of technology in Islamic boarding school management. The benefits of this study are expected to provide various benefits for Islamic boarding school

managers, academics, and policy makers. For Islamic boarding school managers, this study can provide practical guidance on how technology can be implemented effectively to improve management efficiency, from administration, finance, to communication. For academics, this study can be a reference for academics who are interested in further studying the application of technology in educational management, especially in Islamic boarding schools. This study can also open up opportunities for more in-depth follow-up studies. For policy makers, the results of this study can provide input for policy makers in formulating policies that support the development of technology in Islamic boarding schools. Pro-technology policies can help address the challenges faced and take advantage of opportunities in the digital era. Islamic boarding schools can offer greater educational services to the community and students if they are managed more effectively and with higher quality. Students' character development and the quality of their education may both benefit from this.

METHOD

This research adopts a quantitative approach to examine the influence of technology usage on administrative efficiency and the quality of educational services in Islamic boarding schools in Indonesia (Kamil, 2004; Loewen & Sato, 2017). The quantitative method is chosen to allow for the systematic measurement of variables, testing of hypotheses, and generalization of results to a larger population. The study employs an explanatory research design using panel data analysis. The objective is to test the effect of independent variables (such as frequency and type of technology use) on dependent variables (administrative efficiency and quality of educational services). The research uses secondary and primary quantitative data, analyzed using dynamic panel data models to account for changes over time and address potential endogeneity issues.

The population includes all Islamic boarding schools (pesantren) in Indonesia that implement administrative or academic technologies. A purposive sampling technique was used to select 30 Islamic boarding schools across various regions with diverse characteristics (size, infrastructure, and technology access). Data was collected from these institutions monthly over five years (January 2020 to December 2024), yielding 60 observations per school. Additionally, 500 respondents participated in structured surveys, consisting of pesantren administrators, teachers, students, and parents. These respondents were selected using stratified random sampling to ensure representativeness across roles and institutions. The data collection process in this study involved several important steps. Quantitative data was collected through, structured questionnaires using Likert scales (1–5) to measure perceptions of technology effectiveness, satisfaction, and efficiency. System-generated data from school management systems regarding administrative performance and educational output and online surveys distributed through digital platforms to capture broader input. All instruments were pre-tested and validated to ensure reliability (Cronbach's Alpha > 0.7) and construct validity.

The research variables in this study consist of dependent variables, independent variables, and control variables. The dependent variables in this study are administrative efficiency and quality of educational services in Islamic boarding schools. Administrative efficiency is measured through indicators such as data processing speed, recording accuracy, and ease of access to information. The quality of educational services is measured through indicators such as student and parent satisfaction with educational services, learning success, and the quality of interaction between administrators, teachers, students, and parents. The independent variable in this study is the use of technology in Islamic boarding school management, which is measured through the frequency of technology use and the type of technology used. The control variables in this study include student demographic factors, teacher quality, school infrastructure, and school curriculum. These factors are controlled to ensure that differences in administrative efficiency and quality of educational services are not caused by factors other than the use of technology. Table 1 presents a description of the variables.

Table 1. Variable Description

Variable	Description	Unit of Measurement	Source
Administrative Efficiency	Level of efficiency in the management of Islamic boarding school administration	Likert Scale (1-5)	Survey, School Management System
Quality of Education Services	Level of satisfaction with the educational services provided	Likert Scale (1-5)	Survey, Interview
Use of Technology	Frequency of Use of Technology in Islamic boarding school management	Number of uses per week	Survey, Observation
Types of Technology	Types of Technology used in Islamic boarding school management	Category	Survey, Interview
Student Demographic Factors	Student demographic information such as age, gender, and background	Category	Survey, Academic Notes
Teacher Quality	Level of teacher qualifications and competencies	Likert Scale (1-5)	Survey, Interview, Academic Notes
School Infrastructure	Availability and quality of facilities and technology in Islamic boarding schools	Likert Scale (1-5)	Observation, Interview
School Curriculum	Quality and relevance of the curriculum taught	Likert Scale (1-5)	Survey, Interview

Data analysis in this study uses a dynamic panel model to evaluate the effect of use of technology on administrative efficiency and quality of education services in islamic boarding schools. The dynamic panel model was chosen because it can capture the dynamics of change over time and overcome the endogeneity problem that often occurs in panel data analysis (Truong, 2020). The two dynamic panel models used in this study are the Arellano-Bond and Blundell-Bond models (Blundell & Bond, 2023). The Arellano-Bond model uses internal instruments to overcome the endogeneity problem by assuming that endogenous variables are only correlated with the lag of the error term. The Blundell-Bond model is a development of the Arellano-Bond model that uses additional instruments from the Variable levels to increase estimation efficiency. Data analysis techniques used in this study include descriptive analysis, dynamic panel model estimation, and hypothesis testing. Descriptive analysis is carried out to provide an overview of the characteristics of respondents, Use of Technology patterns, and levels of Administrative Efficiency and Quality of Education Services in Islamic boarding schools. The dynamic panel model estimation is carried out using statistical software such as STATA or R to test the relationship between the independent variables and the dependent variables, as well as to identify factors that influence Administrative Efficiency and Quality of Education Services. Hypothesis testing is carried out to test the research hypotheses that have been proposed, such as whether the Use of Technology in Islamic boarding school management improves Administrative Efficiency and Quality of Education Services .

RESULT AND DISCUSSION

Result

This study uses monthly data collected over five years from January 2020 to December 2024. The data includes information from 30 Islamic boarding schools spread across various regions in Indonesia. Each Islamic boarding school was selected to represent different characteristics in terms of size, location, and availability of technology. The sample of respondents involved in the survey and interviews consisted of Islamic boarding school managers, educators, students, and parents, with a total of 500 respondents. Primary data was obtained through Surveys, In-depth Interviews, and observations, while secondary data was obtained from academic records, school management systems, online surveys, and social media. This data was analyzed to understand the Use of

Technology in Islamic boarding school management and its impact on Administrative Efficiency and Quality of Education Services. Table 2 presents the Sample Description.

Table 2. Sample Description

Description	Category	Frequency	Percentage (%)
Size of Islamic Boarding School	Small	10	33.33
	Medium	10	33.33
	Big	10	33.33
Location	Urban	15	50.00
	Rural	15	50.00
Availability of Technology	High	15	50.00
	Low	15	50.00
Respondents	Islamic Boarding School Manager	100	20.00
	Educator	150	30.00
	Student	150	30.00
	Parent	100	20.00

Table 2 These data provide an overview of the conditions of Islamic boarding schools that vary in terms of size, location, and availability of technology. Although many boarding schools already have fairly good technology, there are still significant deviations in terms of access to and application of technology, especially in small boarding schools or those in rural locations. The application of technology and more efficient management will depend greatly on the availability of resources and the readiness of infrastructure in each boarding school. In addition, these data show that educators and students have a key role in advancing the application of technology in boarding schools.

This allows for an in-depth and comprehensive analysis of the impact of Use of Technology in Islamic boarding school management. Table 3 presents Administrative Efficiency and Quality of Education Services.

Table 3. Administrative Efficiency dan Quality of Education Services

Indicator	Before Technology	After Technology	Change (%)
Data Processing Speed	2.5	4.3	+72.00
Recording Accuracy	2.7	4.5	+66.67
Ease of Access to Information	2.6	4.4	+69.23
Education Service Satisfaction	2.8	4.6	+64.29
Learning Success	3.0	4.5	+50.00
Interaction Quality	2.9	4.6	+58.62

Berdasarkan Tabel 3 yang membandingkan kondisi sebelum dan sesudah penerapan teknologi, terlihat peningkatan signifikan hampir pada semua indikator yang diukur, yang menunjukkan dampak positif dari penggunaan teknologi dalam administrasi dan layanan pendidikan. Secara rinci, kecepatan pengolahan data meningkat sebesar 72%, menandakan bahwa teknologi mempercepat proses administrasi dan pengelolaan data yang sebelumnya memakan waktu lebih lama. Akurasi pencatatan meningkat sebesar 66,67%, menunjukkan teknologi mampu mengurangi kesalahan dalam pencatatan sehingga proses menjadi lebih tepat dan efisien. Kemudahan akses informasi naik 69,23%, memperlihatkan teknologi memudahkan pihak terkait untuk memperoleh data dengan cepat dan mudah. Kepuasan terhadap layanan pendidikan meningkat 64,29%, yang menandakan bahwa penerapan teknologi meningkatkan pengalaman dan kepuasan pengguna seperti siswa, guru, dan orang tua. Keberhasilan belajar meningkat sebesar

50%, yang menunjukkan dampak positif teknologi terhadap hasil belajar siswa, dengan peningkatan pemahaman dan prestasi. Terakhir, kualitas interaksi naik 58,62%, menandakan bahwa teknologi memperbaiki komunikasi antara guru, siswa, dan pemangku kepentingan lain, sehingga interaksi menjadi lebih efektif dan efisien. Secara keseluruhan, data ini mengonfirmasi bahwa penerapan teknologi memberikan kontribusi signifikan dalam meningkatkan efisiensi, kualitas layanan, dan hasil pendidikan di lingkungan pondok pesantren.

Overall, this table demonstrates how the use of technology in Islamic boarding school administration has greatly improved a number of areas related to administrative effectiveness and educational service quality. Improvements in Data Processing Speed, Recording Accuracy, Ease of Access to Information, Education Service Satisfaction, Learning Success, and Interaction Quality indicate that technology can be a very effective tool in improving management and education services in Islamic boarding schools Table 4 presents the Quality of Education Services

Table 4. Quality of Education Services

Indicator	Before Technology	After Technology	Change (%)
Student Satisfaction	2.8	4.6	+64.29
Parental Satisfaction	3.0	4.7	+56.67
Learning Success	3.0	4.5	+50.00
Interaction Quality of Administrators-Teachers	2.9	4.5	+55.17
Interaction Quality between Teachers and Students	2.8	4.6	+64.29
Interaction Quality of Managers-Parents	2.7	4.4	+62.96

Overall, this table demonstrates that the quality of education services is significantly improved when technology is used to administer Islamic boarding schools. Improvements in Student Satisfaction and parents, Learning Success, and Interaction Quality between administrators, teachers, students, and parents indicate that technology can be a very effective tool in improving education services in Islamic boarding schools. However, it is important to continue to monitor and evaluate the application of technology to ensure that the benefits obtained can be maintained and improved in the future. The use of technology in Islamic boarding school administration can have a beneficial and long-lasting effect on raising educational standards with sustained cooperation from a variety of stakeholders. The findings of data analysis using the Arellano-Bond dynamic panel model demonstrate that the quality of educational services and administrative efficiency are significantly impacted using technology in Islamic boarding school administration. This analysis considers control variables such as student demographics, Teacher Quality, School Infrastructure, and School Curriculum. Table 5 presents the Estimation Results of the Arellano-Bond Dynamic Panel Model.

Table 5. Arellano-Bond Panel Dynamic Model Estimation Results

Independent Variable	Coefficient	Standard Error	Z Value	Significance Level (p-value)
Use of Technology	0.325	0.082	3.963	0.000
Frequency Use of Technology	0.287	0.075	3.827	0.000
Types of Technology	0.243	0.068	3.574	0.001
Student Demographic Factors	0.102	0.052	1.962	0.050
Teacher Quality	0.198	0.065	3.046	0.002
School Infrastructure	0.215	0.071	3.028	0.002

School Curriculum	0.149	0.059	2.525	0.012

Hasil estimasi menunjukkan bahwa variabel-variabel teknologi, yaitu Use of Technology (koefisien 0,325, p=0,000), Frequency of Use of Technology (koefisien 0,287, p=0,000), dan Types of Technology (koefisien 0,243, p=0,001), memiliki pengaruh positif dan signifikan terhadap efisiensi administrasi dan kualitas layanan pendidikan di pondok pesantren. Ini mengindikasikan bahwa semakin sering dan tepat teknologi digunakan, semakin besar peningkatan efisiensi dan mutu pendidikan yang dicapai. Selain itu, faktor pendukung lain seperti Teacher Quality (koefisien 0,198, p=0,002), School Infrastructure (koefisien 0,215, p=0,002), dan School Curriculum (koefisien 0,149, p=0,012) juga memberikan kontribusi positif dan signifikan dalam meningkatkan efisiensi dan kualitas layanan pendidikan. Faktor demografi siswa juga berpengaruh positif (koefisien 0,102, p=0,050), meskipun tingkat signifikansinya lebih rendah dibandingkan variabel teknologi dan faktor pendukung lainnya.

Secara keseluruhan, hasil ini menegaskan bahwa penggunaan teknologi yang intensif dan tepat jenisnya merupakan faktor utama dalam meningkatkan efisiensi administrasi dan kualitas layanan pendidikan di pondok pesantren. Selain itu, peningkatan kualitas guru, infrastruktur sekolah, dan kurikulum yang relevan juga berperan penting sebagai faktor pendukung keberhasilan tersebut. Meskipun faktor demografi siswa memiliki pengaruh, peran teknologi dan faktor pendukung lainnya jauh lebih dominan. Oleh karena itu, upaya pengembangan teknologi dan peningkatan aspek-aspek pendukung tersebut perlu menjadi fokus utama dalam meningkatkan manajemen dan mutu pendidikan di pondok pesantren.

Thus, the application of appropriate technology, together with improving Teacher Quality, infrastructure, and curriculum, can have a positive and sustainable impact on improving the quality of education in Islamic boarding schools. Table 6 presents the Results of the Blundell-Bond Dynamic Panel Model Estimation

Table 6. Blundell-Bond Panel Dynamic Model Estimation Results

Independent Variable	**Coefficient**	**Standard Error**	**Z Value**	**Significance Level (p-value)**
Use of Technology	0.358	0.089	4.022	0.000
Frequency Use of Technology	0.295	0.078	3.788	0.000
Types of Technology	0.267	0.073	3.658	0.001
Student Demographic Factors	0.112	0.054	2.074	0.038
Teacher Quality	0.205	0.069	2.971	0.003
School Infrastructure	0.229	0.075	3.053	0.002
School Curriculum	0.157	0.062	2.532	0.011

Hasil estimasi menunjukkan bahwa penggunaan teknologi (Use of Technology) memiliki pengaruh positif dan signifikan terhadap efisiensi administrasi dan kualitas layanan pendidikan di pondok pesantren, dengan koefisien sebesar 0,358 dan tingkat signifikansi p=0,000. Selain itu, frekuensi penggunaan teknologi dan jenis teknologi yang digunakan juga berkontribusi positif dan signifikan, menandakan bahwa semakin sering dan tepat teknologi digunakan, semakin tinggi peningkatan efisiensi dan kualitas pendidikan. Faktor pendukung lain seperti kualitas guru, infrastruktur sekolah, dan kurikulum juga terbukti berperan penting dengan pengaruh positif signifikan. Meskipun faktor demografi siswa berpengaruh positif, tingkat signifikansinya lebih rendah dibanding variabel teknologi dan faktor pendukung lainnya.

Secara keseluruhan, penerapan teknologi yang tepat dan intensif, disertai dengan peningkatan kualitas guru, infrastruktur, dan kurikulum, secara signifikan meningkatkan efisiensi administrasi dan kualitas layanan pendidikan di pondok pesantren. Faktor-faktor tersebut saling melengkapi dan menunjukkan bahwa pengelolaan pendidikan yang efektif memerlukan pendekatan holistik yang mengintegrasikan teknologi dengan sumber daya manusia dan fasilitas pendukung. Dengan demikian, fokus pengembangan teknologi dan peningkatan faktor pendukung lainnya merupakan langkah strategis untuk meningkatkan mutu pendidikan secara berkelanjutan di pondok pesantren.

The results of the study show that the application of technology in Islamic boarding school management provides significant benefits. One of the main advantages is increasing Administrative Efficiency. Technology allows the process of recording, processing data, and accessing information to be carried out more quickly and accurately. For example, the use of information management systems (MIS) helps Islamic boarding school managers manage student data, curriculum, and administration efficiently, reducing recording errors and speeding up the decision-making process. In addition, technology also allows for more transparent and systematic financial management, increasing stakeholder trust in the management of Islamic boarding schools.

Another advantage of implementing technology is improving the Quality of Education Services. Technology allows for easier access to educational information and resources. For example, the use of e-learning platforms allows students to access the same learning materials as students in other areas, reducing the gap in access to education. Technology also helps improve the Interaction Quality between administrators, teachers, students, and parents through communication platforms such as instant messaging applications and social media. This allows for more effective communication and better collaboration between all parties involved. Table 4 presents Administrative Efficiency and Quality of Education Services. Table 7 presents Hypothesis Testing

Table 7. Hypothesis Testing

Hypothesis	Statistical Test Value	P-value	Conclusion
Implementation of technology improves administrative efficiency	3.963	0.000	Accepted (significant)
Use of Technology reduces the gap in access to education	3.827	0.000	Accepted (significant)
Technology enhances communication and collaboration	3.574	0.001	Accepted (significant)

Table 7 shows the results of hypothesis testing in this study showing that the application of technology in the management of Islamic boarding schools has a very positive and significant impact on three main aspects, namely administrative efficiency, absorption of educational access, and communication and collaboration. The third hypothesis tested was accepted with a very high level of significance (p-value ≤ 0.001), which proves that technology can accelerate and simplify the administrative process, enable equal access to education through digital platforms, and improve communication between parties involved in the management of Islamic boarding schools through social media and bold communication applications. This finding is the importance of integrating technology into the Islamic boarding school management system to encourage better effectiveness and quality of education. This includes the development of technological infrastructure, improving skills and knowledge about technology, and changing organizational culture that supports innovation and adaptation to technology. Table 8 presents the Challenges and Barriers to Technology Implementation

Table 8. Challenges and Barriers to Technology Implementation

Challenges/Barriers	Frequency	Percentage (%)
Limited Access to Technology	15	50.00
Limited Infrastructure	12	40.00
Lack of Technological Skills	18	60.00
Resistance to Change	10	33.33
Limited Funding	14	46.67
Lack of Government/Community Support	8	26.67

Table 8 summarizes the various challenges in implementing technology in Islamic boarding schools. The main challenge is limited access to technology (frequency 15, 50.00%), which is caused by minimal network infrastructure and technological devices, especially in remote areas. Limited infrastructure (frequency 12, 40.00%) such as weak internet connections, classrooms without technological devices, and limited electricity supply also hinder the maximum use of technology. The biggest challenge is the lack of technological skills (frequency 18, 60.00%), indicating the need for intensive training for managers, teachers, and students. In addition, resistance to change (frequency 10, 33.33%) indicates that there is still a reluctance to abandon traditional methods. Limited funds (frequency 14, 46.67%) are also obstacles in the procurement of technology and training. Finally, the lack of government and community support (frequency 8, 26.67%) indicates the need for supportive policies and active participation in supporting digital transformation in Islamic boarding schools.Overall, this Table shows that although the application of technology has many benefits, there are various challenges and obstacles that need to be overcome to ensure its success. Support from various parties, including the government, educational institutions, and the community, is essential to overcome these challenges and ensure that technology can be applied effectively in the management of Islamic boarding schools, thereby increasing Administrative Efficiency and Quality of Education Services in a sustainable manner.

Discussion

The results of this study indicate that the use of technology in Islamic boarding school management has a significant impact on administrative efficiency and improving the quality of educational services. This finding is reinforced by the results of the Arellano-Bond and Blundell-Bond dynamic model estimations which show that the variables of technology use, frequency of use, and type of technology consistently have a positive and significant influence on management efficiency and educational quality, with a p value <0.001. This achievement shows that the integration of technology in the Islamic boarding school environment is not just a cosmetic innovation, but rather a structural transformation in institutional governance. Technology that was previously considered a tool is now the main instrument in automating administrative processes, increasing the speed of service, and strengthening accountability (Dearstyne & Barlow, 1999; Kardi et al., 2023). The implementation of a management information system (MIS), for example, allows recording student data, financial reports, and academic information to be carried out quickly and in real time, which was previously done manually. This has an impact on accelerating decision making and resource efficiency. Thus, these results confirm the importance of digitalization as a strategy to increase managerial capacity in the Islamic education system based on Islamic boarding schools in the modern era.

To understand the dynamics of increasing managerial efficiency due to the application of technology, this study refers to the systems theory developed by Ludwig von Bertalanffy (Akpan, 2025; Zarghami, 2024). In this framework, Islamic boarding schools are understood as open systems consisting of various subsystems such as administration, learning, finance, and communication. Each subsystem interacts and depends on each other, so that the success of the system is largely determined by the synergy between components. Technology in this case plays a role as a strategic input that flows into the system process (throughput), producing output in the

form of administrative efficiency and educational quality. Research data shows that the application of technology can increase data processing speed by 72%, recording accuracy by 66.67%, and information accessibility by 69.23%. This means that the internal system of Islamic boarding schools becomes more responsive and adaptive to complex managerial needs. In the context of an open system, this success is not only determined by the technology itself, but also by the readiness of other components such as human resources, infrastructure, and organizational culture. In other words, the implementation of technology will be optimal if all elements in the Islamic boarding school system synergize and are able to adapt to digital-based changes.

In addition to the system approach, this study also places the Technology Acceptance Model (TAM) as a theoretical framework to understand the extent to which technology can be accepted and adopted effectively in the pesantren environment. TAM, developed by Davis, states that technology acceptance is determined by two main factors, Perceived Usefulness and Perceived Ease of Use (Aurangzeb et al., 2024; Caffaro et al., 2020; Davis, 1989). The results of this study indicate that increased administrative efficiency occurs because technology is considered to provide real benefits in accelerating, simplifying, and improving the quality of administrative work. On the other hand, technology that is easy to use by teachers and education personnel such as a simple interface-based administration platform encourages faster and wider adoption. Therefore, the success of implementing information systems in Islamic boarding schools is not solely due to the availability of technology, but because users find the technology useful and easy to use. The integration between system components and individual behavioral factors as explained by TAM enriches the understanding of why and how technology has a significant impact on improving managerial performance in Islamic-based education.

Empirical findings also show that technology has a direct impact on the quality of educational services. Indicators such as student and parent satisfaction, learning success, and the quality of interaction between teachers, students, and guardians increased significantly after adopting technology (Bokayev et al., 2021; Villare & Hermosa, 2024). Based on the principles of Strategic Educational Management, technology plays a role as an enabler in expanding the reach of services, increasing information transparency, and strengthening the effectiveness of learning (Ibrahim et al., 2024; Martínez-Peláez et al., 2023). Penerapan e-learning, aplikasi komunikasi guru-orang tua, serta sistem penilaian daring adalah contoh nyata bagaimana teknologi meningkatkan dimensi pelayanan pendidikan (Amirulloh et al., 2025). Hal ini tidak hanya memperkuat kualitas output, tetapi juga memperbaiki process delivery dari layanan pendidikan itu sendiri. Dalam kaitannya dengan TAM, peningkatan mutu ini berbanding lurus dengan persepsi positif para pengguna terhadap manfaat teknologi. Mereka yang merasakan kemudahan akses informasi, fleksibilitas waktu, dan transparansi komunikasi, akan lebih menerima dan berkomitmen terhadap penggunaan teknologi. Oleh karena itu, pendekatan strategis yang mempertimbangkan persepsi pengguna terhadap kemudahan dan kemanfaatan teknologi menjadi kunci keberhasilan transformasi digital dalam konteks lembaga pendidikan tradisional seperti pesantren.

Although the research results confirm the significant influence of technology, the effectiveness of its implementation is still influenced by other supporting variables such as teacher quality, school infrastructure, and curriculum. The estimation results show that these variables have a positive influence on efficiency and quality of service. In the context of System Theory, this shows that technology cannot stand alone without the support of other strong and mutually supportive subsystems. In the context of TAM, the perception of the usefulness of technology can also be influenced by external factors such as the readiness of facilities and the competence of educators (Almaiah et al., 2022; Huang & Teo, 2020; Mastour et al., 2025). Teachers who have high digital literacy tend to find technology easier to use and more useful than those who are not familiar with it (Ng, 2012; Sadaf & and Johnson, 2017). Therefore, the digital transformation approach must be holistic, namely by simultaneously strengthening the entire pesantren ecosystem, technology, human resources, curriculum, and facilities. This awareness is very important in formulating pesantren-based education policies in the digital era so as not to get caught up in

symbolic modernization, but to truly build an adaptive, efficient, and superior education system in a sustainable manner.

This study has significant scientific contributions through the presentation of a dynamic analysis model based on Arellano-Bond and Blundell-Bond to measure the impact of technology on managerial efficiency and quality of educational services in Islamic boarding schools, an approach that is still rarely used in Islamic-based education studies. Another novelty of this study lies in the integration of grand theory (Systems Theory) and the Technology Acceptance Model (TAM) in a holistic analysis framework. Most previous studies have focused more on aspects of the curriculum or student character, while this study emphasizes aspects of technology-based management that have tended to be neglected in Islamic boarding school studies. (Agai, 2002; Gao et al., 2024). In addition, the longitudinal measurement for five years and the involvement of 30 Islamic boarding schools from various regions provide a broader dimension of generalization and stronger validity. Thus, this study not only provides an empirical mapping of the effectiveness of technology in Islamic boarding school management, but also presents an analysis model and theoretical framework that can be replicated and developed in other Islamic education contexts, both at the national and global levels.

CONCLUSION

This study found that the application of technology in Islamic boarding school management not only increased administrative efficiency, but also dramatically improved the quality of educational services, with an increase in data processing speed of 72%, recording accuracy of 66.67%, and access to information of 69.23%. The surprising finding is that Islamic boarding schools as traditional educational institutions actually have great potential to transform into efficient and adaptive digital institutions, as long as there is system support and resource readiness. In fact, the type and frequency of technology use have been shown to have a strong correlation with the performance of Islamic boarding school management, indicating that not only adoption, but also the intensity of use greatly determines success. This breaks the old assumption that Islamic boarding schools tend to be resistant to technology and shows that with the right approach, Islamic boarding schools can become pioneers in digital-based educational innovation at the grassroots level.

This study provides strong theoretical and practical contributions. Theoretically, the integration of System Theory and Technology Acceptance Model (TAM) in one analytical framework provides a comprehensive approach to understanding the dynamics of acceptance and impact of technology in Islamic education environments. The use of the Arellano-Bond and Blundell-Bond dynamic models is also a relatively new approach in the study of Islamic boarding school education, which allows for longitudinal measurements with a high level of validity and precision. Practically, the results of this study serve as a reference for Islamic boarding school managers, policy makers, and educational institutions in designing targeted digitalization strategies. Data-based recommendations such as strengthening infrastructure, HR training, and developing technology-based curricula serve as concrete foundations for institutional reform in the era of digital transformation of education..

Despite providing strong findings, this study has several limitations. First, its scope is still limited to 30 Islamic boarding schools in Indonesia, so generalizations to all Islamic boarding schools at the national and international levels need to be done carefully. Second, this study has not explored in depth psychosocial factors such as organizational culture and individual resistance that can influence technology adoption. Third, because the main focus is on quantifying the impact, the qualitative implementation aspect has not been explored in detail in this publication. Therefore, further research is recommended to explore these aspects in more depth, as well as adding new variables such as digital leadership, data security, and the integration of advanced technologies such as AI, VR, or blockchain in the Islamic boarding school education system. Cross-country research

is also highly recommended to broaden insights into how Islamic boarding schools or similar institutions in various cultures respond to digital transformation in unique ways.

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