



## **UNDERSTANDING BARRIERS TO DIGITAL TRANSFORMATION IN MADRASAH: A CASE STUDY ON INFRASTRUCTURE, DIGITAL COMPETENCE, AND SERVICE QUALITY**

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### **Abstract:**

Digital transformation is a strategic necessity for madrasas to improve the effectiveness of governance, learning, and the quality of educational services. However, its implementation still faces various obstacles that affect the overall success of digitalization. This study aims to identify and analyze obstacles to digital transformation, focusing on digital infrastructure, human resource digital competence, and the quality of educational services. The study used a qualitative approach with a case study design. Data were collected through in-depth interviews, participant observation, and documentation studies with madrasah principals, teachers, education personnel, operators, and students. Data analysis used an interactive model that included data condensation, data presentation, triangulation of sources and techniques, and member checking. The results show that limited digital infrastructure, low digital competence of teachers and education personnel, and the dominance of an administrative orientation in digitalization are the main obstacles to digital transformation. Furthermore, the integration of Islamic values into digital learning content remains suboptimal, thereby hindering substantive improvement in the quality of educational services. This research offers a new perspective: digital transformation in madrasas must be understood as the integration of technological, human resource, and educational service capacities within a human-centered and value-based framework. These findings have implications for developing digital transformation policies that are more adaptive, sustainable, and oriented toward improving the quality of educational services.

**Keywords:** *Digital Transformation; Madrasah; Digital Infrastructure; Digital Competence; Quality of Educational Services.*

### **INTRODUCTION**

Digital transformation has become a key determinant of the success of the 21st-century education system (Ramdana et al., 2026). Reports from various international institutions show that schools that effectively integrate digital technology tend to provide higher-quality educational services, more transparent governance, and broader access to learning than schools that still rely on conventional systems (Joshi et al., 2025; Okoye et al., 2025). The rapid development of information technology has changed the way educational institutions manage administrative operations, deliver instruction, develop teacher competencies, and provide services to students (Carmo et al., 2025;

McCarthy et al., 2023). This condition makes digital transformation no longer an option but a strategic necessity for every educational institution seeking to maintain its relevance and competitiveness (Kraus et al., 2021; Mhlanga, 2024).

Madrasah, as one of the Islamic educational institutions, has the same responsibility to adapt to these changes (Maryati et al., 2023). Digital transformation in the madrasah environment aims not only to improve administrative efficiency but also to enhance the quality of learning, strengthen governance, and expand access to higher-quality educational services (Mahsusi et al., 2024). The government's education digitalization policy, which is still being developed, recognizes that technology is an important instrument for realizing effective, inclusive, and future-oriented education (Eltaiba et al., 2025). Digitalization also creates opportunities for madrasahs to strengthen the integration of Islamic values with technological innovations in the educational process (Aflah et al., 2025).

This hope has not been fully realized in various madrasahs. Various studies show that implementing digital transformation continues to face complex, multidimensional challenges (Figueredo & Silva, 2026). Firmansyah (2022) stated that digital transformation in madrasahs has not been running optimally, as characterized by limited digital infrastructure, low digital literacy, uneven educational quality, weak technology-based governance, and the need to improve human resource competence. These problems show that the success of digital transformation depends not only on the availability of technology but also on organizational readiness, the quality of human resources, and the effectiveness of educational management (Chirumalla et al., 2025; Seppänen et al., 2025).

The limitations of digital infrastructure are a fundamental obstacle in the transformation process (Shonubi, 2025). Unstable internet access, limited technological devices, and a lack of support for digital facilities hinder the optimal use of technology (Moghayedi, 2025). This situation contributes to the low effectiveness of digital learning, limited innovation in educational services, and an inadequate implementation of technology-based administration (Singun, 2025). When digital infrastructure is inadequate, various digitalization programs designed by the government and madrasahs often cannot be implemented according to the expected targets (Maram & Fanani, 2025).

Infrastructure problems are then closely related to the digital competence of human resources (Bhattacharjee et al., 2026). Teachers, education staff, and madrasah managers are the primary actors in determining the success of digital transformation (Asad et al., 2026). The ability to use digital devices, manage information, use learning platforms, and integrate technology into the work process is an indispensable competency (Cetindamar Kozanoglu & Abedin, 2020). The reality on the ground shows that digital literacy levels still vary, resulting in a gap in technology use. Low digital competence not only affects the quality of learning but also hinders the development of an innovation culture, which is the foundation of sustainable digital transformation.

Another challenge arises in the quality of educational services. Digital transformation primarily aims to improve the quality of services for students, teachers, parents, and all education stakeholders (Marino-Romero et al., 2022). However, service quality often does not improve significantly because technology implementation has not been integrated into the institution's management and governance systems (Aleisa, 2024). Weak technology-based governance results in ineffective decision-making, data management, program monitoring, and performance evaluation processes (Caluwe et al., 2024). This condition indicates that digital transformation requires a more comprehensive approach than merely providing technological devices (Piccoli et al., 2024).

Previous studies have generally discussed digital transformation from the perspectives of the use of learning technology, the development of teachers' digital literacy, or the implementation of educational information systems separately (Kurniawan & Pawirosumarto, 2026; Setyawan et al., 2024). Studies that specifically integrate digital infrastructure issues, the digital competence of human resources, and the quality of educational services in the context of madrasas remain relatively limited. These limitations create an important research space for understanding how these three aspects interact and affect the overall success of digital transformation. A comprehensive understanding of these barriers is needed to produce a more effective and sustainable transformation strategy.

Based on these conditions, this study aims to unravel the obstacles to digital transformation in madrasas by focusing on digital infrastructure, human resource digital competence, and the quality of educational services. This research is important because it can provide an empirical picture of the factors hindering the success of madrasah digitalization while offering a deeper understanding of the relationship among technological readiness, human resource capacity, and the quality of educational services. The results of the research are expected to serve as a basis for policymakers, madrasah managers, and education stakeholders in formulating a more adaptive, inclusive, and quality-oriented digital transformation strategy for madrasah education.

## **RESEARCH METHODS**

This study uses a qualitative approach with a case study design. The qualitative approach was chosen because it provides a deep understanding of digital transformation in madrasas by exploring the experiences, perceptions, and realities of educational actors (Creswell, 2018). The case study design is used to examine, in depth, various obstacles to digital transformation in a real-world educational context, producing a comprehensive understanding of the problems under study (Yin, 2023).

The research was carried out at one of the Private Aliyah Madrasas in North Sumatra Province that implements an education digitalization program. The selection of locations was carried out purposively, considering the characteristics of madrasas that have utilized digital technology in administrative and learning activities but still face various obstacles in their implementation.

The research subjects consisted of eight madrasah heads, deputy madrasah heads, teachers, education staff, madrasah operators, and students who were directly involved in the digital transformation process. Informants were selected through purposive sampling based on their knowledge, experience, and involvement in implementing madrasah digitalization.

Research data were collected through in-depth interviews, participatory observations, and documentation studies to obtain comprehensive data through triangulation of techniques and sources. In-depth interviews were conducted in a semi-structured manner with madrasah heads, deputy madrasah heads, teachers, education staff, and madrasah operators. Each interview lasted 45 to 60 minutes and focused on the experience of implementing digital transformation, infrastructure conditions, digital competencies, obstacles encountered, and their impact on the quality of educational services. Participatory observation was carried out by directly observing the availability of internet networks and technological devices; the use of digital media and learning platforms; the use of digital-based administrative systems; learning processes; and technology-based academic services in madrasas. Documentation studies were carried out on digital transformation programs and policies, activity reports, data on

technological facilities and infrastructure, teacher digital competency training documents, digital administration documents, and service quality evaluation reports to strengthen and verify the results of interviews and observations.

The validity of the data is maintained through source triangulation, triangulation, and member checking. Source triangulation is carried out by comparing information obtained from various informants. The triangulation technique was carried out by comparing the results of interviews, observations, and documentation. Member checking is carried out by reconfirming the findings with the informant to ensure the data are suitable for the actual conditions (Creswell, 2016).

Data analysis using an interactive model encompasses four stages: data collection, data condensation, data presentation, and conclusion drawing and verification. The analysis process was conducted continuously from the beginning of data collection until the study's completion, allowing researchers to identify patterns, themes, relationships between categories, and factors hindering digital transformation in madrasas in depth and systematically.

## **RESULTS AND DISCUSSION**

### **Barriers to Digital Infrastructure in the Implementation of Digital Transformation in Madrasah**

The researcher's observations show that one of the most fundamental obstacles to the digital transformation of madrasas is limited infrastructure. In many madrasas, especially in remote areas, access to hardware, internet connectivity, and an adequate electricity supply remains a serious obstacle. This condition creates a real digital divide between madrasas and other public schools.

One of the informants stated:

*"Actually, we have a lot of enthusiasm to move forward. But yes, the network here is often intermittent, especially when it rains. Sometimes the teacher is ready to teach using video, but suddenly the signal disappears. We are often disappointed."* (Informant 1)

This limited infrastructure not only hinders the learning process but also makes it difficult to conduct online exams and access learning materials in real time. Teachers and students often have to find alternative ways halfway through.

One of the informants stated:

*"Children who take online exams often complain to me, 'Mom, the signal at home is bad, I can't enter. Finally, we gave relief, but yes, the quality of the exam is not the same from one student to another.'" (Informant 2)*

Budget factors also aggravate this condition. As institutions under the Ministry of Religious Affairs, madrasas receive only a small portion of the funding allocation compared to public schools, so equipment procurement and network repairs are slow.

One of the informants stated:

*"We have always wanted to have a decent computer lab. But the budget that has dropped is not much. Finally, we used the self-help method and the cooperation of students' parents. But yes, it's not enough for all needs."* (Informant 3)



**Figure 1. Teachers Use Digital Devices in the Teaching and Learning Process**

On the other hand, the use of students' and teachers' personal devices is an emergency measure, though not ideal. This shows that uneven infrastructure forces madrassas to improvise to keep their digital services running.

One of the informants stated:

*"We allow students to bring their own cellphones, but we are also worried because not all parents can buy a good cellphone, and we can't control what they access outside of study hours."* (Informant 4)

Obstacles to digital infrastructure in madrassas include limited devices, unreliable internet connectivity, and limited budgets. This condition forces madrassas to improvise, which contributes to uneven service quality. Without equitable infrastructure strengthening, the digital transformation of madrasas will be difficult to run optimally.

### **Obstacles to Human Resource Digital Competency in Madrasah Digital Transformation**

The researcher's observation shows that obstacles to the digital competence of human resources constitute a second, very crucial challenge. Teachers and education staff in madrassas still face a significant digital literacy gap, which affects their ability to integrate technology into the learning and administrative process.

One of the informants stated:

*"I have been teaching for 25 years. If I use books, I am good. But once I was told to use an application or platform, I was confused. Sometimes it takes a long time to get into the system."* (Informant 5)

This low digital competence is observed not only among senior teachers but also among some young teachers who are unfamiliar with the online learning platforms used in madrasas.

One of the informants stated:

*"I think I am already technologically literate because I often use social media. But it turns out that teaching using digital platforms is different. You have to know how to make interactive quizzes, enter grades, give online assignments. That's what I'm still learning."* (Informant 6)

Training has indeed been held, but it is still incidental and has not reached all teachers equally. Time, cost, and remote training locations are often a hindrance.

One of the informants stated:

*“Training from the office or the Ministry of Religion is sometimes only one or two days. Too short. After that, we returned to the madrasah, forgetting again because it was rarely used. There should be periodic assistance.” (Informant 7)*



**Figure 2. Teachers Participate in Digital-Based Workshops**

In addition, there is still an assumption among teachers that technology is only a tool, not a teaching method that must be mastered. This attitude slows technology adoption.

One of the informants stated:

*“In my opinion, teaching is about the heart and example, not about gadgets. But I am also aware that today’s children are different. I have to learn, so I don’t miss out and still be close to them.” (Informant 8)*

Obstacles to human resource digital competence stem from low technological literacy among teachers, a lack of continuous training, and a still-conventional teaching culture. Strengthening teachers’ capacity through regular mentoring and practical training is needed to ensure digital transformation is not just a ceremonial program.

### **Obstacles to Improving the Quality of Education Services in the Era of Digital Transformation**

The researcher’s observation indicates that the obstacles to improving the quality of educational services in the digital era are not only technical but also concern the substance and values of education. Digital transformation often focuses on administrative and efficiency aspects, while pedagogical and moral aspects receive less attention.

One of the informants stated:

*“Now everything is online, presence, administration, grades. It is indeed neater and faster. But I sometimes wonder, does this really improve the quality of children’s learning, or does it just make administrative work easier?” (Informant 6)*

Excessive focus on technical and administrative aspects often distracts from the meaningful learning process. Teachers become busy entering data, while educational interactions with students are reduced.

One of the informants stated:

*“I used to be able to talk at length with students before or after class hours. Now that the bell rings, I’m immediately busy on my laptop, filling out reports and uploading assignments. It feels like my distance from the children has become farther.” (Informant 3)*

In addition, the integration of Islamic values in digital learning still feels superficial. Much of the digital content does not address the aspects of character and moral education that are hallmarks of madrasahs.

One of the informants stated:

*“We use videos from outside, good materially, but the Islamic values do not enter. I had to add my own explanation of religion in between video playbacks. But yes, sometimes time is not enough.” (Informant 7)*



**Figure 3. Interaction between Teachers and Students in Learning with Digital Media**

Madrasah actually has a great opportunity to develop distinctive digital content, but limited human resources and time make this effort not optimal. Finally, the digital services provided tend to be uniform and do not address the madrasah’s specific needs.

One of the informants stated:

*“Children are happy to learn using educational applications and games. But I don’t have the time and ability to create my own Islamic content. In the end, we used the existing ones, even though they were sometimes not suitable.” (Informant 1)*

Obstacles to improving the quality of educational services stem from a digital transformation that tends to be administration-oriented, limited integration of Islamic values into digital content, and reduced human interaction between teachers and students. Madrasahs need to develop a digital approach that is not only efficient, but also humanistic and characterful, so that the quality of educational services really improves substantially.

## DISCUSSION

The study’s results show that obstacles to digital transformation in madrasahs are systemic. These obstacles do not stand alone but arise from the

interdependencies among the limitations of digital infrastructure, the low digital competence of human resources, and the lack of high-quality educational services. These findings reinforce the view that digital transformation is not just a process of technology adoption, but organizational change that involves aspects of technology, people, governance, and institutional culture (Butt et al., 2024; Reisberger et al., 2025; Van Roekel et al., 2025). Thus, the success of digital transformation in madrassas cannot be achieved only through the provision of technological devices, but requires the readiness of the organization as a whole (Wedi et al., 2025).

The initial findings show that limitations in digital infrastructure remain the main obstacle to implementing digital transformation. The instability of the internet network, the lack of digital devices, and budget limitations have prevented technology from being used optimally. This condition results in the digital learning process, electronic-based administration, and the implementation of learning evaluations not running consistently. These findings are consistent with research by Du & Wang (2024) and Mohammed et al. (2025), which emphasize that infrastructure is the primary foundation for building an educational digital ecosystem. When such foundations are inadequate, digital innovation tends to be partial and to produce only limited sustainable organizational change (Cao et al., 2025; Le et al., 2026).

Nevertheless, the results of this study expand on the findings of previous research. Previous studies have generally framed infrastructure as a technical issue, whereas this study shows that infrastructure limitations also affect the equity of educational services. Unequal access to the internet and digital devices leads to different learning experiences, resulting in unequal quality of educational services (Enciso-Huamani et al., 2025). In other words, the infrastructure gap is evolving into a service gap (Wang et al., 2024). These findings show that digital infrastructure development must be understood as a strategic investment to ensure the equitable distribution of quality educational services, not just as the procurement of technological facilities.

The second finding reveals that the digital competence of human resources is just as important a factor as infrastructure. Teachers and education staff have difficulty integrating technology into the learning process due to limited digital literacy, a lack of continuous training, and a strong conventional work culture. This condition shows that digital transformation is more influenced by human readiness than the sophistication of available technology. These findings support the concept of digital literacy as an organizational capability, as articulated by Pengfei et al. (2026) and Ramdana et al. (2026), which holds that digital literacy is an organization's strategic ability to utilize technology productively.

The results of the study also show that incidental training has not produced sustainable changes in teachers' digital behavior. Teachers need ongoing support to integrate technology into their daily pedagogical practices. These findings expand on the research by Alptekin & Taneri (2025) and Shi et al. (2025), which emphasizes the importance of educators' digital adaptation. This research shows that improving digital competency is not enough through technical training alone; it must be accompanied by the formation of an organizational learning culture that supports innovation, collaboration, and continuous learning. Thus, digital competence develops as an institutional culture rather than merely an individual skill (Masoumi & Noroozi, 2025).

The third finding shows that digital transformation has not automatically improved the quality of education services. The digitalization that occurs is more oriented towards administrative efficiency than improving the quality of learning. Teachers admit that various administrative processes are faster, but pedagogical

interaction with students is actually reduced due to the increasing burden of digital administration. This condition illustrates the paradox of digital transformation: technology can increase operational efficiency but does not necessarily improve the quality of the educational process. These findings support Maqbuli & Al-Mahmoudi (2026), who explain that digital transformation will create value when technology is integrated with organizational strategies and human resource development.

This study also found that madrassas face typical challenges, including low integration of Islamic values into digital content. Most digital learning media still rely on external sources, so teachers must make adjustments to suit the character of Islamic education. These findings offer a new perspective compared with those of Abdillah et al. (2025), which emphasize opportunities for digitalization in Islamic education. The results of the study show that the success of digital transformation in madrassas is measured not only by the effectiveness of technology but also by the ability to maintain Islamic identity as the defining character of educational institutions. Therefore, the development of digital content grounded in Islamic values is an important part of the madrasah's digital transformation strategy (Wardoyo, 2025).

If the three findings are analyzed together, it becomes clear that the barriers to digital transformation are interdependent. Limited digital infrastructure hinders the use of technology. The limitations of digital competence prevent the available technology from being used optimally. Furthermore, these two conditions directly contribute to the low quality of educational services. This relationship shows that digital transformation in madrassas occurs within a system comprising three main components: technological, human, and service capacity. Failure of one component will affect the effectiveness of the other component.

The theoretical contribution of this research lies in expanding the digital transformation perspective from a technology-oriented approach to a more holistic, human-centered, and value-based one. In practical terms, the study's results have important implications for madrasah managers and policymakers. The digitalization program is not enough to focus on the procurement of hardware and internet networks. Still, it must be accompanied by investment in developing teachers' digital competencies, the provision of continuous mentoring programs, the strengthening of digital governance, and the development of digital learning content aligned with the character of Islamic education. This approach allows digital transformation not only to improve administrative efficiency but also to strengthen the quality of learning, students' character, and educational services in a sustainable manner.

## **CONCLUSION**

This study shows that the obstacles to digital transformation in madrassas are systemic and interrelated, encompassing limitations in digital infrastructure, low digital competence among staff, and a lack of high-quality educational services. Digital transformation has not improved the overall quality of services because its implementation still focuses on administrative aspects, while strengthening digital competence, learning quality, and the integration of Islamic values remain suboptimal. The novelty of this research lies in expanding the perspective on digital transformation by examining the interconnectedness among technological capacity, human resource capacity, and educational service capacity within a holistic, human-centered, and value-based framework. These findings recommend that the government, the Ministry of Religious Affairs, and madrasah managers develop a digitalization policy that is not only oriented

towards providing infrastructure, but also strengthening digital competence, governance, organizational culture, and the development of digital learning content based on Islamic values. The next research is suggested to develop and test the madrasah digital transformation model in a broader context using a quantitative or mixed-methods approach, to obtain a more comprehensive, adaptive, and sustainable digital transformation model that improves the quality of madrasah education services.

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