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Total Quality Management (TQM) Based on Digital Technology in a Rural Madrasah: Teachers' Technostress and Its Implications for Student Achievement at MI Muhammadiyah Al Manar Demak

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Abstract

This study aims to analyze the implementation of digital technology based Total Quality Management (TQM) in a rural madrasah, examine teachers' experiences of technostress, and identify its implications for learning processes and student achievement. This study employed a qualitative approach with a case study design at MI Muhammadiyah Al Manar, Demak, Indonesia. Data were collected through semistructured interviews, observations, and documentation involving four teachers, the principal, and the school operator, with students and institutional documents providing additional information. The findings show that Digital TQM has been integrated into planning, implementation, monitoring, evaluation, and decision making through e RKAM, EMIS, RDM, CBT, and digital learning media. Teachers experienced technostress through increased digital workloads, technical problems, system changes, and adaptation demands. However, the intensity varied among teachers and did not automatically disrupt learning. The findings can be applied by rural madrasahs through teacher training, technical assistance, peer support, adequate digital infrastructure, and workload management as part of sustainable quality improvement. The study contributes to the Digital TQM literature by integrating digital quality management with teachers' experiences of technostress in a rural madrasah context. Its novelty lies in explaining how digital systems, teacher adaptation, organizational support, learning processes, and student achievement interact within a rural Islamic elementary education setting.

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Keywords: Total Quality Management (TQM), Digital TQM, Teacher Technostress, Rural Madrasah, Student Achievement

INTRODUCTION

Digital transformation has changed the way educational organizations plan, implement, monitor, and evaluate educational services. This transformation involves not only the use of technological devices but also changes in quality management systems. From the perspective of Total Quality Management (TQM), quality is developed through the involvement of organizational members, process orientation, information based decision making, and continuous improvement (Kaiseroglou & Sfakianaki, 2020). The development of digital technology has created opportunities for more integrated quality management through the rapid and systematic use of data. Palumbo et al. (2021) emphasize the importance of digital orientation in quality management, while Akhmatova et al.2022) demonstrate that the integration of digital systems can strengthen quality management processes. Therefore, digitalization in TQM should be understood as a transformation of the management system rather than merely the addition of technological applications.

In education, the implementation of TQM has characteristics that differ from those of business organizations. Schools and madrasahs manage learning processes, teacher development, student needs, and relationships with parents and communities. Studies on TQM in schools indicate that successful implementation requires the involvement of school members and consistency in improvement processes (Kaiseroglou & Sfakianaki, 2020). Chen et al. (2021) explain that the development of TQM has expanded from conventional quality control toward a broader quality management approach that emphasizes continuous improvement and organizational processes. In Indonesia, strengthening quality management in madrasahs has become increasingly important because educational institutions are expected to maintain educational quality while responding to technological changes. Hidayah et al. (2025) identify quality management strategies as an important component of educational resilience in the era of Society 5.0. These conditions indicate that digital transformation requires integration among quality management, leadership, human resources, and organizational culture.

The issue becomes more complex in rural madrasahs. Regional characteristics, socioeconomic conditions, availability of facilities, and human resource capacity may influence educational transformation. Asrohah & Idayatni, (2020) demonstrate that rural madrasahs have distinctive social characteristics that need to be considered in educational management. Moeis,

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(2022) also emphasizes that the quality of madrasah education needs to be examined in relation to human resources and institutional conditions. Roshid & Haider, (2024) demonstrate that rural schools face challenges in implementing twenty first century learning skills. Aditia & Széll, (2025) indicate that educational context and inequality can be associated with student achievement in Indonesia. These findings demonstrate that digital transformation in rural madrasahs cannot be separated from the local context in which educational institutions operate.

At the same time, digitalization creates new demands for teachers. Teachers are not only required to use technology for instructional purposes but also need to adapt to various systems for administration, reporting, assessment, and communication. These demands may generate technostress, which refers to stress associated with the demands of using and adapting to technology. Chou & Chou, (2021) demonstrate that technological factors can be associated with teachers' experiences of technostress. Mushtaque et al., (2021) also identify a relationship between technostress and teachers' willingness to use online teaching technologies. Bourlakis et al. (2023) examine the relationship between technostress and employee performance in educational work environments, while Gabbiadini et al. (2023) emphasize the importance of organizational support in dealing with technostress. Khlaif et al. (2023) demonstrate that technological characteristics can become a source of stress in educational technology use. More recent studies suggest that technostress should be understood in a more complex manner because technology related experiences are not always negative. Nascimento et al., (2024) introduce the concept of techno eustress, which refers to the positive side of technological demands when individuals are able to respond adaptively. Pagán-Garbín et al. (2024) also demonstrate the importance of resilience in understanding teachers' experiences of stress and technostress.

These issues become particularly relevant when TQM and digital transformation are implemented simultaneously. Digital TQM requires accurate data, integrated systems, continuous monitoring, and active human involvement. Barragán et al. (2025) emphasize the importance of data based approaches in monitoring TQM systems in the Industry 4.0 era. However, digitalization also has a human dimension that cannot be ignored. Alieva & Powell, (2022) emphasize the importance of employee behavior and management practices in reducing digital waste during digital transformation. Margherita & Braccini, (2023) also demonstrate that technology and the human dimensions of TQM need to develop together. F. Farida et al. (2021) identify human resource and organizational readiness as important aspects of TQM implementation. Therefore, the success of Digital TQM cannot be assessed solely based on the availability of technological

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applications. It also depends on how organizations manage the technological demands experienced by teachers.

Previous studies have examined TQM, digital transformation, rural schools, and technostress. However, these areas of research have largely developed separately. TQM studies have primarily examined quality systems and organizational performance, whereas technostress studies have frequently focused on teachers' experiences of technological pressure during online learning and technological change. Studies of rural madrasahs have also tended to focus on quality issues, social context, and educational transformation. Research that specifically connects Digital TQM implementation with teachers' experiences of technostress in rural madrasahs remains limited. This gap is important because teachers are the primary actors who translate digital systems into classroom practices. Therefore, this study focuses on teachers' experiences when digital demands become an integral part of madrasah quality management.

This study was conducted at MI Muhammadiyah Al Manar, Wedung District, Demak Regency, Indonesia. The madrasah represents a rural educational institution that has implemented various digital systems in educational management. According to the madrasah document, MI Muhammadiyah Al Manar had an A accreditation status, six classes, 165 students, 12 teachers, and two educational support staff during the 2025/2026 academic year. The madrasah has also integrated e RKAM, EMIS, RDM, and CBT into administrative management, budget planning, learning, and assessment. The principal explained that this integration was intended to establish faster, more transparent, and data based management.

This study aims to analyze the implementation of Digital TQM at MI Muhammadiyah Al Manar, identify the forms and experiences of teacher technostress, and examine its implications for learning processes and student achievement. The study is expected to extend the discussion of Digital TQM by positioning teachers' experiences as an important dimension of digital transformation in madrasahs. Practically, the findings may assist madrasahs in developing digital transformation strategies that consider teacher readiness, organizational support, and the sustainability of learning quality

METHODS

This study employed a qualitative approach with a case study design. The design was selected because the study focused on developing an in depth understanding of Digital TQM implementation and teachers' experiences of technostress within the natural context of the madrasah. A case study enables researchers to examine a phenomenon contextually by

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considering the interaction among digital systems, institutional policies, teachers, and learning processes. The study was conducted at MI Muhammadiyah Al Manar, Wedung District, Demak Regency, Indonesia. The primary data collection was conducted in July 2026.

The participants were selected using purposive sampling. The main informants consisted of four teachers with different teaching experiences. They were Sholich, S.Pd.I. (S), a classroom teacher with 25 years of teaching experience; Ani Afiyah, S.Pd.I. (AA), an Islamic creed and ethics teacher with 18 years of teaching experience; Roinatun, S.Pd.I. (R), a classroom teacher with 23 years of teaching experience; and Wahid Nur Ahkam (WN), a physical education teacher with 22 years of teaching experience. These teachers were selected because they were directly involved in the use of technology for learning and administrative activities. The principal and school operator served as supporting informants to provide information regarding institutional policies, digital system management, and organizational support.

Data were collected through semistructured interviews, observations, and documentation. Interviews with teachers focused on the types of technology used, experiences with technology, digital workload, experiences of technostress, system changes, adaptation strategies, organizational support, and the relationship between technology use, learning, and student achievement. Interviews with the principal focused on Digital TQM policies, leadership, quality planning, decision making, and teacher support. Interviews with the school operator focused on digital systems, data management, technical problems, and teacher assistance. The operator explained that the madrasah used RDM and EMIS for data and assessment management, CBT for learning assessment, and e RKAM for budget planning.

Observations focused on the use of technology in learning activities and madrasah management. Documentation was used as supporting evidence and included madrasah program documents, digital system records, teacher training documents, RDM records, student achievement records, and activity documentation. The observations indicated the use of digital media, projectors, internet resources, digital assessment, and feedback activities in learning.

Data trustworthiness was established through source and method triangulation. Information obtained from teachers was compared with information from the principal and school operator and was further supported by observations and documentation. Data analysis was conducted interactively through data condensation, data display, and conclusion drawing. The interpretation was conducted contextually so that teachers' experiences of technostress were examined in relation to organizational conditions, institutional support, and technological use.

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RESULTS AND DISCUSSION

Implementation of Digital TQM in a Rural Madrasah

The findings demonstrate that the implementation of Digital TQM at MI Muhammadiyah Al Manar goes beyond the use of digital applications. Digitalization has become part of the madrasah quality management system. The principal explained that TQM was understood as a shared commitment to building a quality culture. According to the principal, improving educational quality was not solely the responsibility of the principal but involved teachers, educational staff, students, and parents.

Digital TQM implementation was reflected in the integration of several digital systems. The principal identified e RKAM, EMIS, RDM, and CBT as systems used for administration, budget planning, learning, and assessment. These systems were intended to accelerate monitoring and support data based decision making.

Quality planning also utilized digital data. The principal explained that planning began with the analysis of data from the Education Report and EDM. The data were used to identify indicators that required improvement. The results were then discussed with the quality team and incorporated into budget planning through e RKAM.

These findings indicate that technology functions as part of the quality management cycle. Data are not merely stored for administrative purposes but are used to determine program priorities. This finding is consistent with Chen et al. (2021), who explain that TQM has developed from conventional quality control toward a broader approach that emphasizes systematic quality management and continuous improvement. It also supports Barragán et al. (2025), who highlight the importance of data in quality monitoring within increasingly digital organizational environments.

The school operator confirmed this practice. Student, teacher, facility, and assessment data were managed through digital systems. Digital documents were also stored through the institutional Google Drive and official systems such as RDM. The operator was responsible for ensuring that data remained valid and synchronized.

Therefore, the implementation of Digital TQM in the madrasah has three main characteristics. First, technology is integrated into management. Second, data are used in planning and evaluation. Third, human involvement remains essential for maintaining system continuity. This finding supports Farida et al. (2021), who identify organizational and human resource readiness as important components of TQM implementation.

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Digital Learning and Assessment

Digital TQM was also reflected in classroom practices. Teachers used different technologies according to instructional needs. Sholich used laptops or computers, WhatsApp groups, and PowerPoint. He stated that technology helped him deliver learning materials and communicate with students and colleagues.

Ani Afiyah used instructional videos from YouTube. She considered technology very helpful for delivering learning materials. Her main difficulty occurred when she had to create her own instructional video content.

Roinatun used a laptop and WhatsApp. She considered technology helpful because it made administrative work and learning activities faster and more practical. Wahid Nur Ahkam used Google and ChatGPT as part of his learning activities. He considered technology helpful for both indoor and outdoor learning.

These findings demonstrate that digital learning has multiple functions. Teachers used technology to deliver learning materials, communicate, search for learning resources, develop instructional media, and support classroom activities. Technology use was also connected to assessment through CBT and RDM. Thus, Digital TQM connects learning processes with assessment and quality management.

This finding is consistent with Chen et al. (2021), who demonstrate that TQM dimensions can support organizational innovation. However, the present study shows that innovation in a madrasah does not necessarily require sophisticated technology. Innovation can involve the use of accessible technologies that correspond to teachers' and students' needs. Therefore, digital transformation should be assessed based on its contribution to work processes and learning rather than the number of applications adopted.

Teacher Technostress in Digital TQM Implementation

Although technology provided benefits, it also created pressure for some teachers. The nature and intensity of this pressure varied among the informants.

Sholich experienced difficulties when processing and integrating student assessment data from several platforms. He also encountered internet connectivity problems and application errors. His workload increased when several web based reporting systems had to be completed simultaneously outside teaching hours. He reported experiencing pressure when the internet connection was slow or application servers were unavailable.

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Roinatun experienced pressure primarily when the internet connection was slow or applications malfunctioned. The use of WhatsApp and email also resulted in work coordination outside working hours, reducing her time for rest. She experienced fatigue after prolonged screen exposure. Frequent changes in digital systems also caused confusion because application menus and procedures sometimes changed.

Ani Afiyah experienced a relatively lower level of pressure. Her main difficulties involved entering data into EMISGTK and creating instructional video content. She addressed these difficulties by asking experienced colleagues for assistance.

Wahid Nur Ahkam experienced pressure because instructional methods and media continued to change. The need to follow technological developments required additional preparation time and financial resources. He also experienced pressure when developing instructional media under time constraints.

These four experiences demonstrate that technostress does not have a single form. For some teachers, pressure originated from technical problems. For others, it resulted from system changes, administrative workload, communication outside working hours, or the expectation to continuously develop technological competence.

This finding is consistent with Chou & Chou, (2021), who identify technological factors as being associated with teacher technostress. It also supports Bourlakis et al. (2023), who examine the relationship between technostress and performance in educational work environments. However, the present study provides additional contextual evidence showing that technostress can emerge not only from digital learning but also from the integration of administrative and quality management systems.

Organizational Support as an Adaptation Mechanism

An important finding of this study is the role of organizational support in addressing technological demands. Teachers did not face technostress individually. They received support from the principal, school operator, and colleagues.

Sholich received support in the form of Wi Fi facilities and permission to participate in digital training and socialization activities. Roinatun received internet access, computer facilities, and direct assistance from the school operator when problems occurred. Ani Afiyah received assistance through monthly work meetings and support from more experienced colleagues. Wahid Nur Ahkam relied on colleagues and training activities to improve his technological skills.

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The school operator also played an important technical role. When RDM or CBT experienced problems, the operator prepared a local server as an alternative and adjusted data entry schedules to avoid periods of high system traffic. The operator also provided direct assistance to teachers experiencing difficulties with assessment entry or CBT configuration.

These findings support Gabbiadini et al. (2023), who emphasize the importance of organizational support in managing technostress. Organizational support does not only involve technological facilities. Assistance, training, communication, and peer support are also important elements of teacher adaptation.

This support is particularly important in rural madrasahs. Digital infrastructure can experience technical problems, while teachers may have different levels of technological competence. Madrasah documents indicate that teachers have diverse educational backgrounds and experiences but actively participate in capacity development through scientific forums and training activities. This condition demonstrates that teacher development needs to occur alongside technological development.

Technostress Does Not Automatically Hinder Learning

The findings indicate that technostress does not automatically result in lower learning quality. Teachers responded differently to technological pressure depending on their experience, adaptation strategies, and available support.

Sholich stated that technological problems had affected his preparation and implementation of learning activities. Wahid Nur Ahkam also stated that technological adaptation demands affected the learning process.

However, Roinatun developed a backup strategy. When technology was unavailable, she used textbooks so that technological problems did not substantially disrupt learning. Ani Afiyah also stated that technological difficulties did not interfere with her preparation and learning implementation because support was provided through monthly work meetings.

This finding is important because it demonstrates that the relationship between technostress and learning is contextual. Technology can become a source of pressure, but teachers can develop adaptive mechanisms. This finding is consistent with Nascimento et al. (2024), who demonstrate that technological experiences may also have a positive dimension when technological demands can be managed adaptively.

Therefore, this study does not provide evidence that technostress directly causes lower student achievement. Instead, the findings indicate that the practical implications of technostress

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for learning depend on the intensity of technological pressure, teachers' adaptive capacity, organizational support, and the availability of alternative instructional strategies.

Digital TQM and Student Achievement

The contribution of Digital TQM to student achievement was understood through learning processes, assessment, data management, and follow up activities. Teachers viewed technology as an important component in supporting student development. Sholich stated that technology use and teacher competence were closely related to learning quality and student achievement. Ani Afiyah also considered technology use and teacher adaptation important for student achievement. Roinatun considered technology useful for making learning more modern, effective, and efficient.

These perceptions were supported by the madrasah's documented achievements during the 2025/2026 academic year. Achievement records show that MI Muhammadiyah Al Manar obtained first place among elementary madrasahs in Demak Regency in the 2026 Academic Competency Test, conducted on May 22 and 23, 2026. The achievement documents also record other academic and nonacademic accomplishments, including achievements in the District level Science Olympiad and pencak silat competitions.

These records demonstrate that the madrasah had substantial student achievement within the research context. However, these achievements cannot be used to establish a causal relationship between Digital TQM and student achievement. Student achievement is shaped by multiple factors, including learning processes, student characteristics, teacher competence, family support, student development programs, and the broader madrasah environment.

The contribution of Digital TQM is therefore better understood through quality management mechanisms. The use of RDM and CBT allows learning and assessment data to be documented systematically. These data can support teachers and madrasah leaders in identifying student development and determining appropriate follow up activities. Thus, the contribution of Digital TQM lies in providing a management system that supports the cycle of planning, implementation, evaluation, and learning improvement.

This finding is consistent with Hidayah et al. (2025), who position quality management as an important component of madrasah resilience in the Society 5.0 era. It also extends the findings of Aditia & Széll (2025), who emphasize the importance of context in understanding student achievement. In this study, the rural context is not treated only as a limitation. It is also the

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environment in which the madrasah develops digital strategies according to its available resources and educational needs.

Synthesis of Findings

The overall findings demonstrate that Digital TQM at MI Muhammadiyah Al Manar connects leadership, technology, human resources, data, learning, assessment, and continuous improvement.

Table 1. Synthesis of Research Findings

Aspect	Main Finding	Implication
Leadership	The principal develops shared quality commitment and promotes data use	Leadership guides Digital TQM implementation
Planning	Education Report data, EDM, and e RKAM support planning	Planning becomes more data based
Digitalization	e RKAM, EMIS, RDM, CBT, and digital media are used	Management becomes more integrated
Learning	Teachers use laptops, videos, PowerPoint, Google, ChatGPT, and digital media	Learning becomes more flexible
Technostress	Technostress emerges from digital workload, technical problems, system changes, and adaptation demands	Digital transformation requires workload management
Organizational support	Operators, principals, training, facilities, and colleagues support teachers	Organizational support strengthens adaptation
Learning process	Effects on learning differ among teachers	Technostress does not automatically hinder learning
Achievement	Academic and nonacademic achievements were documented during 2025/2026	Digital TQM contributes through support for quality processes

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The synthesis demonstrates that Digital TQM cannot be separated from its human dimension. Technology provides systems. Data provide information. However, teachers, operators, and principals determine how these systems are translated into practice. This finding supportss Alieva & Powell (2022); Margherita & Braccini (2023), emphasize the importance of human factors and management practices in digital transformation

CONCLUSION

This study demonstrates that the implementation of Digital TQM at MI Muhammadiyah Al Manar has been integrated into planning, implementation, monitoring, evaluation, and decision making. The use of e RKAM, EMIS, RDM, CBT, and digital learning media supports data based quality management. The findings demonstrate that Digital TQM is not simply the use of technological applications but a process that integrates technology with quality culture, leadership, and learning practices.

Teachers experienced technostress through adaptation demands, digital administrative workload, internet and application problems, system changes, and the time and financial resources required to follow technological developments. However, these experiences varied among teachers. Support from the principal, school operator, colleagues, training activities, digital facilities, and adaptation strategies helped teachers manage these demands. Technostress also did not automatically hinder learning because some teachers developed alternative strategies when technological problems occurred.

Theoretically, this study extends the discussion of Digital TQM by positioning teachers' experiences as an important component of digital transformation in rural madrasahs. Practically, madrasahs need to develop digital transformation strategies that balance technological demands with human resource readiness. Technical support, continuous training, peer assistance, and workload management should become part of quality improvement strategies. From a policy perspective, digital transformation in madrasahs needs to consider local conditions, teacher capacity, infrastructure sustainability, and learning needs.

Future research may employ a mixed methods approach to examine the relationship among teacher technostress, digital competence, organizational support, learning quality, and student achievement across a wider range of madrasahs.

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