UNDERSTANDING MATHEMATICS TEACHER'S EXPERIENCES OF INTEGRATING DIGITAL TOOLS INTO *PESANTREN* CLASSROOM PRACTICE

Nur Kholis*

Universitas PGRI Wiranegara, Pasuruan, Indonesia,

kholieznuer@gmail.com

OPEN ACCESS

ISSN 2503 3492 (online)

**Correspondence:*

Nur Kholis

Citation:

Kholis, N. (2026). Understanding matematics teacher's experiences of integrating digital tools into *pesantren* classroom practice. *IJILS*, *4*(2). 228-247.

ABSTRACT

The integration of digital technology has transformed mathematics education; however, little is known about how mathematics teachers experience this transformation within Islamic boarding schools (*pesantren*), where technological innovation must be balanced with religious and cultural values. This study aimed to explore a mathematics teacher's lived experiences of integrating digital tools into classroom practice in a private *pesantren* in Pasuruan, East Java, Indonesia. A qualitative narrative inquiry design was employed to capture the participant's professional journey and instructional experiences. The participant was a mathematics teacher who has taught since 2019. Data were collected through three semi-structured, in-depth interviews conducted between May and July 2026 and analyzed using Connelly and Clandinin's narrative inquiry framework, emphasizing temporality, sociality, and place. The findings revealed that digital tools, including GeoGebra, Desmos, Google Classroom, and AI-assisted applications, enhanced students' conceptual understanding, visualization, engagement, and participation in mathematics learning. However, the participant also encountered challenges related to limited technological infrastructure, unequal student digital literacy, rapid technological change, and the need to align digital innovation with *pesantren* educational values. To address these challenges, the teacher adopted strategies such as continuous self-directed professional learning, collaboration with colleagues, gradual implementation of digital applications, and careful selection of technologies appropriate to instructional objectives and institutional culture. The study concludes that successful digital technology integration in *pesantren* mathematics classrooms depends not only on access to technology but also on teachers' pedagogical competence, contextual adaptation, and reflective professional practice. These findings contribute to the growing literature on contextualized technology integration and provide practical implications for teacher professional development and digital transformation within Islamic educational institutions.

Keywords: Digital Technology Integration, Mathematics Education, Narrative Inquiry, Pesantren, Teacher experiences

INTRODUCTION

Digital technologies have increasingly reshaped educational practices worldwide, transforming not only how teaching is delivered but also how students engage with, construct, and apply knowledge. In mathematics education, this transformation is reflected in the growing integration of dynamic mathematics software, learning management systems, virtual manipulatives, artificial intelligence (AI)-supported applications, graphing tools, and online collaborative platforms. These technologies offer opportunities to make abstract mathematical concepts more accessible through visualization, facilitate mathematical reasoning, and support students in developing

problem-solving competencies (Engelbrecht & Borba, 2024). Recent research has further highlighted the potential of technology-enhanced mathematics instruction to foster student engagement, creativity, and higher-order thinking, particularly when digital tools are embedded within purposeful pedagogical designs (Boadu & Boateng, 2024). However, the educational value of these technologies does not arise from their availability or adoption alone. Rather, it depends on how teachers align technological affordances with mathematical learning objectives, instructional strategies, and students' cognitive needs. This distinction underscores the importance of moving beyond technology-oriented instruction toward pedagogically grounded integration, in which digital tools serve as meaningful resources for deepening mathematical understanding and strengthening students' learning experiences.

Consequently, teachers have become central agents in educational digital transformation, particularly in mathematics classrooms where abstract concepts often require visual representation and interactive learning experiences (Hidayat & Firmanti, 2024). The growing emphasis on digital competence has also been reinforced by educational reforms and technological developments over the past decade. The emergence of cloud-based learning environments, mobile learning applications, educational artificial intelligence, GeoGebra, Desmos, and other mathematics-specific technologies has expanded opportunities for teachers to create more interactive and student-centered learning environments (Sofroniou et al., 2025). These innovations align with contemporary educational paradigms that encourage inquiry-based learning, collaborative knowledge construction, and personalized learning experiences. However, successful implementation requires teachers to possess not only technological knowledge but also pedagogical and content expertise that enables them to select appropriate digital tools according to instructional objectives and learners' needs (Harris & Hofer, 2011). The Technology Pedagogical Content Knowledge (TPACK) framework therefore continues to provide an important theoretical foundation for understanding teachers' competencies in technology-enhanced mathematics (Drajati et al., 2023; Fitrah et al., 2024; Koh, 2019).

Despite substantial progress in digital mathematics education, integrating technology into classroom practice remains challenging in many educational contexts. Previous research has consistently reported barriers related to inadequate digital infrastructure, limited professional development, insufficient pedagogical support, teachers' beliefs toward technology, workload, institutional policies, and unequal access to digital resources (Regli et al., 2026; Singun, 2025; Upara & Lee, 2026). These challenges become even more complex in educational environments where strong cultural, religious, and institutional traditions influence instructional practices. Rather than functioning solely as technological issues, technology integration represents a multidimensional process involving pedagogical decision-making, contextual adaptation, professional identity, and institutional culture. Consequently, understanding teachers' lived experiences is essential for explaining why similar technologies may produce different educational outcomes across schools and learning environments (Hidayat & Firmanti, 2024).

One educational context that deserves greater scholarly attention is the Indonesian *pesantren* (Islamic boarding school). Traditionally, pesantren education emphasizes character formation, religious values, close teacher–student relationships, and face-to-face learning through instructional traditions such as *bandongan, sorogan, and halaqah* (Maunah, 2009). While many modern *pesantren* have increasingly adopted digital technologies in response to educational transformation, they continue to preserve their distinctive religious identity and educational philosophy (Zarkasyi, 2015). This dual commitment creates a unique pedagogical environment in which teachers must negotiate between technological innovation and institutional values. The integration of digital technology within *pesantren* therefore cannot simply replicate practices implemented in mainstream public schools but requires contextual adaptation that respects religious culture while maintaining instructional effectiveness (Assiddiqi et al., 2026).

Mathematics teachers working in *pesantren* face particularly distinctive challenges because mathematics instruction often benefits substantially from visualization, simulation, dynamic representation, and immediate feedback provided by digital technologies. At the same time, teachers must consider classroom management,

students' digital literacy, institutional regulations regarding technology use, internet accessibility, and the compatibility of digital learning with *pesantren* educational values (Ramdhani et al., 2023). Consequently, technology integration becomes a process of balancing pedagogical innovation with cultural and religious expectations. Understanding how mathematics teachers experience this balancing process is important because their instructional decisions ultimately influence students' opportunities to develop mathematical understanding alongside responsible digital literacy.

The urgency of investigating mathematics teachers' experiences in *pesantren* classrooms has increased following the accelerated digital transformation triggered by post-pandemic educational reforms and the growing availability of artificial intelligence and digital mathematics applications. Although digital technologies continue to evolve rapidly, many teachers remain uncertain about selecting appropriate instructional tools, adapting technology to diverse student characteristics, and maintaining meaningful teacher–student interactions during digitally supported learning. Furthermore, national educational policies increasingly encourage digital innovation, yet empirical evidence regarding how teachers experience these expectations within religious educational institutions remains limited. Without understanding teachers' perspectives, policymakers and educational leaders may struggle to design professional development programs that address teachers' actual needs and contextual challenges.

Recent empirical studies have increasingly examined technology integration in mathematics education from different perspectives. A mixed-method study by Dockendorff and Zaccarelli (2025) evaluated mathematics teachers' digital competencies and technology management practices, demonstrating that teachers' digital skills significantly influenced the effectiveness of technology integration while highlighting persistent challenges related to infrastructure and professional support. Hidayat and Firmanti (2024), through a systematic review, concluded that technology integration in mathematics education has expanded considerably; however, research remains heavily concentrated on learning outcomes, technological effectiveness, and curriculum implementation rather than teachers' contextual experiences. More recently, Almarashdi et al. (2024) found that students frequently used ChatGPT, Photomath, and GeoGebra during mathematics learning, emphasizing that structured teacher guidance is essential for ensuring meaningful and ethical technology use. Kul et al. (2026) further demonstrated that generative AI positively contributes to pre-service mathematics teachers' TPACK development while simultaneously requiring pedagogically informed integration strategies rather than purely technological competence. Likewise, Md Sabri et al. (2024) reported that although digital technologies substantially increased students' engagement, improvements in conceptual understanding remained inconsistent, suggesting that teachers' instructional practices play a decisive role in determining technology effectiveness.

Although these studies provide valuable insights into digital mathematics education, several important research gaps remain. First, existing studies predominantly investigate technology integration in mainstream schools, higher education, or pre-service teacher education, while empirical evidence from *pesantren* remains extremely limited. Second, previous research generally focuses on students' achievement, technology acceptance, digital competence, or TPACK, with relatively little attention given to mathematics teachers' lived experiences during technology integration. Third, studies conducted within Islamic educational institutions typically examine general digital transformation rather than mathematics-specific classroom practices. Finally, little is known about how mathematics teachers negotiate the interaction between technological innovation, pedagogical considerations, and *pesantren* cultural values during everyday classroom instruction. These limitations indicate the need for an in-depth qualitative investigation capable of capturing teachers' perspectives within their authentic instructional contexts.

Accordingly, the novelty of this study lies in three significant contributions. First, it explores mathematics teachers' lived experiences of integrating digital tools within the distinctive socio-cultural and religious context of Indonesian *pesantren*, an educational setting that remains underrepresented in international mathematics education literature. Second, rather than emphasizing technological effectiveness or students'

learning outcomes, this study foregrounds teachers' experiences, perceptions, challenges, adaptation strategies, and professional decision-making processes during classroom technology integration. Third, the study contributes contextual knowledge regarding how digital innovation can coexist with religious educational traditions, thereby extending current understandings of technology integration beyond conventional school settings. The findings are expected to enrich theoretical discussions on contextualized technology integration, inform teacher professional development programs, and provide practical recommendations for strengthening digital mathematics education within Islamic educational institutions. Based on these considerations, this study addresses the following research questions, consist of; (1) How does mathematics teacher experience the integration of digital tools into classroom practice in *pesantren*? (2) What challenges do mathematics teachers encounter when integrating digital tools into mathematics instruction in *pesantren* classrooms? (3) What strategies do mathematics teachers employ to integrate digital tools while maintaining effective mathematics instruction and aligning with *pesantren* educational values?

METHODS

This study employed a qualitative narrative inquiry design to explore mathematics teachers' lived experiences of integrating digital tools into classroom practice in an Islamic boarding school (*pesantren*). Narrative inquiry is particularly appropriate for investigating how individuals construct meaning from their experiences through stories situated within specific social, temporal, and cultural contexts (Connelly & Clandinin, 1990). Rather than examining technology integration as a set of observable behaviors, this approach seeks to understand how teachers interpret, negotiate, and reconstruct their professional experiences over time. Narrative inquiry is grounded in the assumption that human beings understand and communicate their experiences through stories, making it a suitable methodology for examining teachers' professional identities, instructional decision-making, and contextual practices.

The study was guided by the three-dimensional narrative inquiry framework proposed by Connelly and Clandinin (1990), which emphasizes temporality, past, present, and future experiences, sociality, personal and social conditions shaping experiences, and place, the specific context in which experiences occur. These dimensions enabled the researchers to explore how the participant's experiences of digital technology integration evolved over time, were influenced by interactions with students and institutional culture, and were situated within the unique educational environment of a *pesantren*.

The participant in this study was a mathematics teacher employed at a private Islamic boarding senior high school (*pesantren*) in Pasuruan, East Java, Indonesia. He has been teaching mathematics since 2019 and continues to serve in the same institution. The selection of a single participant is consistent with the principles of narrative inquiry, which emphasizes in-depth exploration of individual lived experiences rather than statistical generalization. The participant's narratives offered rich and contextualized insights into the complexities of integrating digital tools into mathematics instruction while negotiating the religious, cultural, and educational values embedded within the *pesantren* context. To ensure participant confidentiality and adhere to ethical research standards, the participant's identity was protected through the use of a pseudonym, "Sandi," throughout this study.

Data were collected between May-July 2026 through semi-structured, in-depth narrative interviews. Three interview sessions were conducted, each lasting approximately 60–90 minutes. The interviews encouraged the participant to recount personal stories related to their experiences of integrating digital tools into mathematics instruction. Open-ended questions invited reflection on their teaching journey, motivations for adopting digital technologies, classroom practices, perceived benefits, encountered challenges, institutional support, and strategies for adapting digital innovations within the *pesantren* context.

All interviews were conducted in Bahasa Indonesia, audio-recorded with the participant's informed consent, and subsequently transcribed verbatim. To enhance the credibility of the findings, the researcher also maintained reflective field notes documenting contextual observations, non-verbal expressions, and preliminary analytical reflections during and immediately after each interview. Following transcription, member checking was conducted by returning the interview transcripts and preliminary narrative interpretations to the participant to confirm the accuracy and authenticity of the represented experiences (Bell, 2002).

TABLE 1 / Interviews' Guideline

Theme	Semi-Structured Interview Questions
Background	1. Could you tell me about your experience as a mathematics teacher in this pesantren?
	2. How did you begin using digital tools in your mathematics teaching?
Experiences of Integrating Digital Tools	3. Can you describe how you use digital tools during your mathematics lessons?
	4. Can you share an experience that was particularly successful or challenging when using digital tools in your classroom?
Perceived Benefits	5. In your opinion, what benefits do digital tools provide for teaching and learning mathematics?
Challenges	6. What challenges have you encountered when integrating digital tools into your mathematics teaching?
	7. Are there any unique opportunities or challenges related to using digital tools in a pesantren context?
Strategies	8. How do you overcome the challenges of integrating digital tools into your teaching?9. How have you developed your skills and knowledge in using digital technology for mathematics instruction?
Reflection	10. How has integrating digital tools influenced your teaching practices and professional development as a mathematics teacher?
	11. What advice would you give to other mathematics teachers who want to integrate digital tools in pesantren classrooms?
Closing	12. Is there anything else about your experience of using digital tools in mathematics teaching that you would like to share?

The data were analyzed using the narrative inquiry procedures proposed by Connelly and Clandinin (1990), involving an iterative process of living, telling, retelling, and reliving participants' experiences. The analysis consisted of four stages. First, all interview recordings were transcribed verbatim and repeatedly read to gain familiarity with the participant's stories. Second, meaningful narrative episodes related to digital technology integration were identified and organized chronologically to preserve the continuity of the participant's experiences. Third, the narratives were interpreted through the three commonplaces of narrative inquiry, temporality, sociality, and place, to understand how personal experiences evolved over time, how social interactions and institutional contexts influenced instructional practices, and how the *pesantren* environment shaped technology integration. Finally, the researchers reconstructed the participant's experiences into coherent narrative accounts and identified overarching narrative themes that represented the participant's professional journey of integrating digital tools into mathematics teaching. Throughout the analysis, the researchers continuously moved between the original field texts and the emerging research texts to ensure that the final narratives accurately reflected the participant's lived experiences while maintaining contextual richness and interpretive rigor.

To ensure the trustworthiness of the findings, this study adopted the criteria of credibility, transferability, dependability, and confirmability. Credibility was established through prolonged engagement with the participant, member checking, and maintaining reflective field notes throughout the research process. Transferability was enhanced by providing rich descriptions of the participant, research setting, and instructional context, enabling readers to determine the applicability of the findings to similar educational settings. Dependability was supported through a clear documentation of the research procedures and analytical decisions, while confirmability was strengthened by maintaining an audit trail and engaging in continuous researcher reflexivity to minimize personal bias during data interpretation.

RESULTS AND DISCUSSION

Becoming a Digital Mathematics Teacher in a Pesantren

Sandi's narrative revealed that his journey toward becoming a digital mathematics teacher was neither linear nor driven solely by technological advancement. Instead, it represented a gradual process of professional growth shaped by personal reflection, institutional expectations, students' learning needs, and the distinctive educational culture of the *pesantren*. When he first began teaching mathematics in 2019, his pedagogical practices reflected a conventional teacher-centered approach that emphasized direct instruction, board explanations, textbook exercises, and paper-based assessments. At that time, digital technology was viewed primarily as a supplementary presentation tool rather than an integral component of mathematics instruction. His limited experience with educational technology, coupled with concerns about technical difficulties and uncertainty regarding its pedagogical value, made him reluctant to adopt more advanced digital applications.

Reflecting on his early years of teaching, Sandi explained that his confidence in using technology was relatively low because he lacked formal training in educational technology during his teacher preparation program. Most of his technological knowledge was acquired independently through online tutorials, professional communities, and personal experimentation. Consequently, he initially relied on familiar applications such as Microsoft PowerPoint and YouTube videos to illustrate mathematical procedures and provide additional examples for students. Although these resources made lessons more visually engaging, he believed that they did not fundamentally transform students' mathematical understanding. As he explained:

"At first, I only used PowerPoint and YouTube videos because I was not confident with other applications. But after several years, I realized that digital tools could help students understand abstract mathematical concepts much faster."

This quotation illustrates an important turning point in Sandi's professional development. Rather than perceiving digital technology merely as a means of presenting information, he gradually recognized its pedagogical potential to facilitate conceptual understanding. He described that topics such as functions, geometry, trigonometry, and graph transformations often presented difficulties when explained through static diagrams on the whiteboard. Students frequently memorized formulas without fully understanding the relationships between mathematical concepts. The introduction of interactive digital applications enabled him to demonstrate mathematical changes dynamically, allowing students to observe patterns, manipulate variables, and immediately visualize mathematical relationships. According to Sandi, these experiences convinced him that digital technology could support conceptual learning rather than simply making lessons more attractive.

The transition became more apparent during the COVID-19 pandemic, which fundamentally altered instructional practices throughout Indonesia. Like many teachers, Sandi was required to conduct online learning despite having limited prior experience with digital instruction. Initially, this transition was accompanied by uncertainty and frustration. He recalled spending considerable time learning how to operate online platforms, preparing digital learning materials, and responding to students' technical difficulties. Nevertheless, the pandemic unexpectedly became a catalyst for his

professional learning. Continuous exposure to digital teaching environments encouraged him to experiment with various educational technologies, gradually strengthening both his digital competence and pedagogical confidence.

As face-to-face instruction resumed, Sandi did not abandon the technological practices he had developed during online learning. Instead, he adopted a blended instructional approach that combined conventional explanations with digital visualization, online assignments, and interactive learning activities. He emphasized that technology should not replace the teacher's role but rather complement instructional practices by providing learning experiences that would otherwise be difficult to achieve through traditional methods alone.

Then, he reflected:

"After the pandemic, I realized that I did not want to return completely to the old way of teaching. Some digital tools had become part of my teaching because students learned better when they could see mathematical concepts dynamically."

Another significant aspect of Sandi's narrative was the influence of the *pesantren* environment on his professional development. Although *pesantren* education is widely recognized for preserving Islamic traditions and emphasizing moral and character education, Sandi described the institution as supportive of educational innovation provided that technology was used responsibly and aligned with Islamic values. Rather than discouraging digital technology, school leaders encouraged teachers to improve instructional quality while maintaining ethical standards and appropriate classroom discipline. This institutional support reduced his initial anxiety about adopting unfamiliar technologies and motivated him to continue developing his digital teaching practices.

Sandi explained that integrating technology within a *pesantren* required thoughtful pedagogical judgment. Unlike some mainstream schools where technology was sometimes used extensively throughout lessons, he carefully selected digital applications according to instructional objectives, students' readiness, and school regulations. Applications such as GeoGebra and Desmos were employed primarily to visualize mathematical concepts, while Google Classroom facilitated assignment distribution and communication beyond classroom hours. More recently, he also explored artificial intelligence-assisted platforms to generate practice questions, explain alternative problem-solving strategies, and provide additional learning resources. However, he consistently emphasized that these technologies served as instructional support rather than substitutes for teacher guidance, like he stated:

"Technology is only a tool. Students still need explanations, discussions, and guidance from the teacher. Especially in a pesantren, we are responsible not only for teaching mathematics but also for guiding students' attitudes and learning ethics."

This statement highlights Sandi's understanding of technology as a pedagogical resource rather than an autonomous instructional solution. Throughout his narrative, he repeatedly emphasized that meaningful mathematics learning depends on the interaction between teacher expertise, student participation, and appropriate technological support. Digital tools were considered effective only when integrated intentionally into well-planned instructional activities rather than being used merely to follow educational trends.

Sandi also reflected that becoming a digital mathematics teacher required continuous professional learning rather than mastering a fixed set of technological skills. Because digital technologies evolve rapidly, he believed teachers must remain open to learning, experimenting, and adapting their instructional practices. He frequently explored online webinars, educational YouTube channels, teacher discussion forums, and social media communities to discover new applications and teaching strategies. This self-directed professional development enabled him to refine his digital pedagogy despite the limited availability of formal institutional training.

Looking back on his professional journey, Sandi viewed his development as an ongoing process of balancing innovation with educational values. He acknowledged that technology had significantly enriched his mathematics instruction by making abstract concepts more accessible, increasing student engagement, and expanding learning opportunities beyond the classroom. Nevertheless, he remained committed to preserving the distinctive identity of the *pesantren*, where academic achievement is inseparable from character development, discipline, and religious values. For Sandi, becoming a digital mathematics teacher did not mean abandoning traditional teaching principles; rather, it involved thoughtfully integrating digital innovation into an educational philosophy that continues to prioritize meaningful learning, ethical responsibility, and holistic student development. This narrative illustrates that digital transformation in mathematics education within a *pesantren* is best understood not as technological adoption alone, but as a continuous process of professional identity reconstruction in which teachers negotiate pedagogical innovation, institutional culture, and religious values to create meaningful learning experiences.

The findings demonstrate that becoming a digital mathematics teacher is a gradual process of professional identity development rather than a simple adoption of educational technology. Sandi's experiences indicate that meaningful technology integration emerged through continuous reflection, self-directed learning, and adaptation to changing instructional contexts, particularly during and after the COVID-19 pandemic. This finding supports the narrative inquiry perspective that teachers continuously reconstruct their professional identities through lived experiences and contextual interactions. It also aligns with the Technology Pedagogical Content Knowledge (TPACK) framework, which emphasizes that effective technology integration requires the intersection of technological, pedagogical, and content knowledge rather than technological competence alone (Tseng et al., 2022; Zhang & Li, 2025). Furthermore, the findings are consistent with previous studies showing that mathematics teachers often begin with basic digital tools before gradually adopting more sophisticated applications as their confidence and pedagogical understanding develop (Dockendorff & Zaccarelli, 2025; Kul et al., 2026). Rather than viewing technology as an end in itself, Sandi recognized its value in supporting students' conceptual understanding through dynamic visualization and interactive learning, reinforcing previous research that digital tools can enhance mathematical reasoning when integrated through appropriate pedagogical strategies (Hidayat & Firmanti, 2024; Md Sabri et al., 2024).

Another significant finding is that technology integration within a *pesantren* is shaped by the need to balance educational innovation with religious and institutional values. Unlike many studies conducted in mainstream educational settings that primarily emphasize technological effectiveness, this study highlights that teachers' instructional decisions are strongly influenced by the cultural and moral context in which learning occurs. Sandi intentionally selected digital applications that supported mathematics learning while preserving the *pesantren*'s emphasis on character education, discipline, and teacher guidance. This finding extends previous literature by demonstrating that successful digital transformation in Islamic educational institutions depends on contextual adaptation rather than unrestricted technology adoption. It also supports earlier research suggesting that teachers play a central role in ensuring that digital technologies are used ethically and pedagogically to facilitate meaningful learning (Almarashdi et al., 2024; Kiryakova & Kozhuharova, 2024). Therefore, the findings suggest that digital innovation and religious educational traditions are not inherently contradictory; instead, they can coexist when teachers exercise thoughtful pedagogical judgment and continuously adapt technology to their learners' needs and institutional values.

Digital Tools Enhanced Students' Mathematical Understanding and Engagement

One of the most prominent themes emerging from Sandi's narrative was his belief that digital technology significantly improved both students' mathematical understanding and their engagement in the learning process. Throughout the interviews, he consistently emphasized that mathematics is often perceived by students as a difficult and abstract subject because many concepts cannot be observed directly. Traditional instructional methods, such as verbal explanations, textbook examples, and static drawings on the whiteboard, were sometimes insufficient to help students develop deep conceptual understanding. Consequently, he viewed digital tools not merely as technological innovations but as pedagogical resources capable of transforming abstract mathematical ideas into concrete and interactive learning experiences.

Sandi explained that one of the greatest challenges in mathematics teaching is helping students move beyond memorizing formulas toward understanding the underlying relationships among mathematical concepts. In his early years of teaching, he frequently observed that students could solve routine exercises after following worked examples, yet struggled when confronted with unfamiliar problems that required conceptual reasoning. This experience led him to reconsider his instructional approach and search for methods that would allow students to explore mathematical concepts more independently. According to Sandi, digital applications such as GeoGebra and Desmos provided opportunities for students to visualize mathematical patterns dynamically, enabling them to construct their own understanding through observation and experimentation rather than relying solely on teacher explanations.

He recalled one classroom experience that fundamentally changed his perception of technology integration:

"When I explained quadratic functions using only the whiteboard, many students became confused. But when I used GeoGebra, they immediately saw how the graph changed when the equation changed. They became excited and started asking questions."

This experience represented an important pedagogical realization for Sandi. He observed that the dynamic visualization offered by GeoGebra enabled students to connect algebraic equations with graphical representations in ways that conventional teaching methods could not easily achieve. Instead of imagining how changing the coefficient affected the shape of the parabola, students could manipulate the variables themselves and instantly observe the results. According to Sandi, this immediate visual feedback reduced misconceptions and encouraged students to formulate their own mathematical explanations. He noted that students who had previously remained silent during lessons became more confident in asking questions because they were able to directly observe mathematical phenomena before discussing them with the teacher.

Sandi further explained that digital technology fundamentally changed the nature of classroom interaction. Before integrating digital tools, most mathematics lessons followed a teacher-centered pattern in which he explained concepts, demonstrated procedures, and assigned practice exercises while students listened and copied notes. Although this approach enabled efficient content delivery, he felt that many students became passive recipients of information.

The introduction of interactive digital applications gradually shifted the classroom atmosphere toward a more student-centered learning environment. Rather than simply observing the teacher solve mathematical problems, students actively manipulated graphs, explored geometric constructions, tested hypotheses, and discussed alternative solutions with their peers.

Reflecting on these changes, Sandi stated:

"Students are usually more enthusiastic when technology is involved. They like experimenting with the graphs themselves instead of only watching me solve problems."

This statement illustrates that, from Sandi's perspective, digital technology promoted active learning by positioning students as participants rather than passive observers. He explained that students became increasingly willing to investigate mathematical relationships independently because the digital applications allowed them to experiment without fear of making mistakes. When students modified variables incorrectly, they could immediately observe the consequences and revise their reasoning. Sandi believed that this process of trial, observation, and reflection fostered deeper conceptual learning than simply memorizing formulas or procedural steps.

Another important aspect of Sandi's narrative concerned the influence of digital technology on students' motivation and classroom engagement. He observed that many students who initially considered mathematics difficult or intimidating gradually developed more positive attitudes toward the subject after interactive technologies were introduced. Lessons became more dynamic because students were curious about how mathematical objects behaved when manipulated digitally. According to Sandi, the visual and interactive nature of digital applications attracted students' attention and sustained their concentration for longer periods compared with conventional lectures.

He explained that increased engagement was reflected not only in students' enthusiasm during classroom activities but also in their willingness to continue learning beyond scheduled lessons. Through platforms such as Google Classroom, students could revisit instructional materials, access additional learning resources, and submit assignments independently. Some students even explored mathematical simulations outside class and returned with questions during subsequent lessons. For Sandi, this demonstrated that digital technology extended learning beyond the physical classroom and encouraged greater learner autonomy.

In addition to improving conceptual understanding and engagement, Sandi believed that digital technology supported collaborative learning among students. During activities involving GeoGebra or Desmos, students frequently worked in pairs or small groups to investigate mathematical problems, compare observations, and discuss possible explanations. He noted that these collaborative interactions encouraged students to articulate their mathematical thinking more clearly and to learn from one another's perspectives. Rather than depending exclusively on teacher explanations, students collectively constructed understanding through dialogue, exploration, and peer feedback.

Sandi also highlighted that digital technology enabled him to differentiate instruction according to students' varying levels of mathematical ability. He recognized that students learned mathematics at different paces, and conventional whole-class instruction sometimes failed to accommodate these differences. By utilizing digital platforms, he could provide additional practice materials, instructional videos, and interactive simulations that students could access according to their individual learning needs. High-achieving students were encouraged to explore more complex mathematical investigations, while students requiring additional support could revisit visual demonstrations repeatedly until they understood the concepts. This flexibility, according to Sandi, made mathematics instruction more inclusive and responsive to diverse learner characteristics.

Beyond immediate classroom outcomes, Sandi viewed digital competence as an essential component of students' future academic and professional development. He believed that mathematics education should not only develop computational and analytical skills but also prepare students to function effectively in an increasingly digital society. Exposure to educational technologies familiarized students with digital problem-solving, information literacy, and responsible technology use—competencies that would become increasingly valuable in higher education and future careers. Nevertheless, he emphasized that these competencies should be developed alongside critical thinking and ethical responsibility.

As he reflected,

"Our students will continue their education or work in a world where technology is everywhere. If they only know mathematics without knowing how to use technology wisely, they will face difficulties later. But technology should support their thinking, not replace it."

This reflection illustrates that Sandi understood digital literacy as extending beyond technical proficiency. He consistently emphasized that students should use digital tools critically, evaluating information, verifying mathematical solutions, and maintaining independent reasoning rather than accepting technology-generated answers unquestioningly. He was particularly attentive to the emergence of artificial intelligence-assisted applications, recognizing both their educational potential and the importance of guiding students to use them responsibly.

Despite acknowledging the substantial educational benefits of digital technology, Sandi maintained that technology alone does not guarantee effective mathematics learning. Throughout his narrative, he repeatedly stressed that meaningful learning depends on thoughtful pedagogical design, active teacher facilitation, and purposeful classroom interaction. Digital tools were valuable because they enabled richer visualization, greater exploration, and increased participation, but their effectiveness ultimately depended on how teachers integrated them into coherent instructional practices. For Sandi, technology functioned as an enabler of meaningful mathematics learning rather than as a replacement for sound pedagogy. His experiences therefore suggest that the educational value of digital tools lies not in the technology itself, but in the ways teachers intentionally employ those tools to foster conceptual understanding, student engagement, collaborative inquiry, and lifelong digital competence within the distinctive educational context of the *pesantren*.

The findings indicate that digital tools enhanced students' mathematical understanding by enabling dynamic visualization, interactive exploration, and student-centered learning. Rather than functioning solely as instructional media, applications such as GeoGebra and Desmos supported students in constructing conceptual understanding through experimentation and immediate visual feedback. This finding aligns with the principles of the Technology Pedagogical Content Knowledge (TPACK) framework, which emphasizes that technology contributes to meaningful learning when integrated with appropriate pedagogical strategies and content knowledge. It also supports the findings of Md Sabri et al. (2024), who reported that digital technologies increase student engagement when teachers design purposeful learning activities. Similarly, Almarashdi et al. (2024) found that digital mathematics applications promote conceptual understanding by allowing students to visualize abstract mathematical ideas and actively explore problem-solving processes. Consistent with these studies, the participant's experiences demonstrate that technology encourages students to move beyond procedural learning toward deeper mathematical reasoning through inquiry, experimentation, and collaborative discussion (Demir & Zengin, 2023).

Furthermore, the findings suggest that the educational value of digital technology depends largely on teachers' pedagogical decisions rather than on the technology itself. Although digital tools increased students' motivation, collaboration, and opportunities for self-directed learning, the participant emphasized that teachers remain responsible for guiding students' learning, facilitating critical thinking, and ensuring responsible technology use. This finding reinforces the argument of Dockendorff and Zaccarelli (2025), who concluded that teachers' digital competence significantly influences the effectiveness of technology integration in mathematics classrooms. Moreover, within the distinctive context of the *pesantren*, digital innovation was carefully balanced with institutional values, highlighting that successful technology integration is a contextual and pedagogical process rather than merely a technical one (Mudarris & Haq, 2026). These findings extend previous research by demonstrating that mathematics teachers can effectively integrate digital tools while preserving the cultural and religious identity of Islamic educational institutions, thereby contributing to a more contextualized understanding of digital pedagogy in mathematics education.

Balancing Digital Innovation with Pesantren Educational Values

A distinctive theme emerging from Sandi's narrative was that integrating digital technology into mathematics instruction within a *pesantren* involved much more than adopting new educational applications. Instead, it required a continuous process of negotiating pedagogical innovation with the religious, cultural, and moral values that define the identity of the institution.

Unlike many mainstream schools where technology integration is often evaluated primarily in terms of efficiency or academic outcomes, Sandi explained that teaching in a *pesantren* demanded careful consideration of how digital tools influenced not only students' cognitive development but also their character, discipline, and ethical behavior. Consequently, every decision regarding technology use was guided by a broader educational philosophy that viewed academic learning and character formation as inseparable components of education.

Throughout the interview, Sandi emphasized that the purpose of incorporating digital tools was never to maximize technology use or to follow contemporary educational trends. Rather, technology was adopted only when it demonstrably enhanced students' mathematical understanding while remaining consistent with the values promoted by the *pesantren*. He rejected the assumption that greater technology use automatically results in better learning, arguing instead that educational value depends on thoughtful pedagogical integration. According to him, digital innovation should strengthen, rather than weaken, the human relationships that characterize teaching and learning in Islamic boarding schools.

Reflecting on his teaching philosophy, Sandi explained:

"Technology should support learning, not replace the role of the teacher. In our pesantren, character education is still the priority."

This statement illustrates that Sandi perceived the teacher's role as extending far beyond delivering mathematical content. Within the *pesantren* context, teachers are expected to act as educators, mentors, role models, and moral guides who cultivate students' intellectual, spiritual, and personal development simultaneously. While digital applications can effectively present information, visualize mathematical concepts, and provide instant feedback, Sandi believed they cannot replace the interpersonal interactions through which values such as honesty, discipline, responsibility, respect, and perseverance are nurtured. For this reason, he consistently positioned technology as a pedagogical aid rather than an instructional substitute.

Sandi further explained that one of the defining characteristics of *pesantren* education is the close relationship between teachers (*ustadz*) and students (*santri*). Classroom interactions are not limited to academic discussions but also include advice, character building, and the modeling of appropriate attitudes. He expressed concern that excessive dependence on technology could unintentionally reduce meaningful dialogue between teachers and students if digital platforms were allowed to dominate instructional activities. Consequently, he intentionally designed lessons in which digital exploration was always followed by face-to-face discussion, collaborative reflection, and teacher-guided explanation. In this way, technology became one component of a broader pedagogical process rather than the center of classroom instruction.

Another important aspect of Sandi's narrative involved institutional regulations governing technology use. He described the *pesantren* as having clear policies regarding smartphones, internet access, and digital media in order to minimize potential distractions while preserving students' focus on both academic and religious learning. Unlike conventional schools where students may freely access personal devices throughout the day, technology use within the *pesantren* was carefully supervised and restricted to specific instructional purposes. According to Sandi, these regulations were not intended to discourage technological development but rather to cultivate responsible and disciplined digital behavior.

He explained:

"Students are only allowed to use smartphones when the lesson requires them. After the activity is finished, they put the devices away again. This helps them stay focused and prevents unnecessary distractions."

Sandi believed that these structured routines encouraged students to view digital devices as educational tools rather than sources of entertainment. He observed that when technology was introduced within clearly defined instructional boundaries, students

remained focused on mathematical tasks and were less likely to engage in unrelated online activities. Consequently, classroom management became an essential aspect of technology integration, requiring teachers to establish expectations, monitor students' activities, and provide continuous guidance throughout digital learning sessions.

The process of selecting appropriate digital resources also emerged as an important component of Sandi's pedagogical practice. Rather than adopting every available educational application, he carefully evaluated whether digital content aligned with the instructional objectives, students' developmental needs, and the values upheld by the *pesantren*. He explained that some online resources contained advertisements, inappropriate language, or content that might distract students from learning. Therefore, considerable preparation occurred before lessons as he reviewed digital materials, tested applications, and modified resources when necessary to ensure their suitability. As he reflected:

"We have to be selective. Not every digital application is suitable. I always check whether the content is appropriate before using it in class."

This quotation demonstrates that technology integration involved ethical and pedagogical decision-making rather than simply technical competence. Sandi viewed digital literacy as encompassing the ability to evaluate the quality, credibility, and appropriateness of educational resources before introducing them into the classroom. He believed that teachers bear responsibility for protecting students from potentially harmful online content while simultaneously exposing them to valuable technological learning opportunities.

Another challenge that emerged in Sandi's narrative concerned the rapid development of artificial intelligence (AI) technologies. Although he acknowledged that AI-assisted platforms could generate explanations, practice questions, and alternative solution methods efficiently, he expressed caution regarding their classroom use. He observed that some students tended to accept AI-generated answers without critically evaluating their accuracy or attempting independent problem solving. This tendency raised concerns about the potential reduction of students' mathematical reasoning and analytical thinking if AI tools were used uncritically.

To address this issue, Sandi intentionally positioned AI as a supplementary learning resource rather than an answer-generating tool. He frequently encouraged students to solve mathematical problems independently before consulting AI applications to compare solution methods or verify their reasoning. Classroom discussions then focused on analyzing similarities and differences between students' approaches and AI-generated responses, thereby reinforcing critical thinking and mathematical justification. He explained:

"I always tell students not to ask AI for the answer immediately. They should try solving the problem first. After that, they can compare their work with the AI explanation and discuss why the methods are similar or different."

This instructional strategy reflects Sandi's commitment to maintaining students' intellectual independence while embracing technological innovation. Rather than rejecting AI technologies, he sought to integrate them responsibly by ensuring that students remained active constructors of mathematical knowledge. In this respect, digital technology functioned as a catalyst for reflection and discussion rather than a replacement for cognitive effort.

Sandi also described balancing digital innovation with *pesantren* values as an ongoing process of professional reflection rather than a fixed instructional model. Each lesson required him to consider multiple factors, including the mathematical topic being taught, students' readiness, available technological infrastructure, institutional expectations, and potential ethical implications. He acknowledged that effective technology integration demanded flexibility because no single digital application was appropriate for every learning situation. Consequently, he continuously adapted his instructional practices based on students' responses, classroom dynamics, and evolving technological developments.

Looking back on his experiences, Sandi concluded that successful technology integration within a *pesantren* depends less on the quantity of digital tools employed than on the wisdom with which they are used. He believed that educational technology should reinforce the institution's broader mission of developing knowledgeable, morally responsible, and digitally literate individuals. For him, mathematics education was not solely concerned with helping students master formulas and procedures but also with cultivating disciplined habits of thinking, ethical decision-making, and responsible technology use. Digital innovation therefore became meaningful only when it contributed simultaneously to students' academic achievement and character formation.

Then, Sandi's narrative illustrates that integrating digital technology in a *pesantren* is fundamentally a contextualized pedagogical process. Teachers do not simply adopt technological innovations because they are available or popular; instead, they continuously negotiate between instructional effectiveness, institutional culture, religious values, and students' holistic development. His experiences demonstrate that meaningful technology integration is achieved not through technological sophistication alone but through reflective professional judgment that positions digital tools as instruments supporting both mathematical learning and the broader educational mission of the *pesantren*.

The findings demonstrate that integrating digital technology into mathematics instruction in a *pesantren* is not merely a technical process but a contextualized pedagogical practice shaped by religious, cultural, and institutional values. Consistent with the Technology Pedagogical Content Knowledge (TPACK) framework, effective technology integration depends on teachers' ability to align technological resources with pedagogical goals and subject content rather than simply adopting digital applications (Fitrah et al., 2024). Sandi's emphasis on using technology to complement, rather than replace, the teacher's role also supports previous studies showing that successful digital integration relies on teachers' pedagogical judgment and instructional guidance (Dockendorff & Zaccarelli, 2025). Unlike research conducted in mainstream educational settings, this study highlights that technology adoption within *pesantren* requires continuous negotiation between instructional innovation and the institution's broader mission of fostering students' moral, spiritual, and intellectual development. These findings extend previous literature by demonstrating that contextual factors, including religious values and institutional culture, significantly influence teachers' decisions regarding technology integration in mathematics classrooms.

Furthermore, the participant's cautious approach toward artificial intelligence (AI) reinforces recent research emphasizing that AI should function as a learning support rather than a substitute for students' independent thinking (Almarashdi et al., 2024). By encouraging students to solve mathematical problems before consulting AI-generated explanations, Sandi promoted critical thinking, mathematical reasoning, and reflective learning, thereby reducing the risk of overdependence on digital technologies. This finding aligns with studies suggesting that teachers remain central in facilitating responsible and ethical technology use while ensuring that digital tools enhance rather than diminish meaningful learning experiences (Kul et al., 2026; Md Sabri et al., 2024) Therefore, this study contributes to the growing body of knowledge on contextualized digital pedagogy by illustrating that meaningful technology integration in *pesantren* depends not on the quantity of digital tools employed but on teachers' reflective professional judgment in balancing technological innovation with educational values, character formation, and students' holistic development.

Challenges in Integrating Digital Mathematics Tools

Although Sandi consistently emphasized the educational benefits of digital technology, his narrative also revealed that integrating digital tools into mathematics instruction was accompanied by numerous challenges that extended beyond technical considerations. Rather than describing technology integration as a straightforward process, he portrayed it as a continuous professional journey requiring flexibility, resilience, and ongoing learning. These challenges were interconnected, involving technological infrastructure, student readiness, teacher competence, instructional planning, and the unique educational environment of the *pesantren*.

Consequently, successful technology integration demanded not only access to digital resources but also the ability to adapt pedagogical practices in response to constantly changing classroom conditions.

One of the most immediate and recurring obstacles identified by Sandi was the limitation of technological infrastructure. Although the school had gradually improved its digital facilities, internet connectivity remained inconsistent, particularly during periods when multiple classrooms accessed online resources simultaneously. Because several of the applications he used, including GeoGebra Classroom, Google Classroom, and AI-assisted platforms, relied heavily on stable internet access, disruptions often interrupted the flow of instruction. Sandi explained that lessons carefully designed around interactive digital activities occasionally had to be modified unexpectedly because students were unable to access online materials.

Reflecting on these experiences, he stated:

"Sometimes the internet suddenly becomes slow, and the lesson cannot continue as planned. We must immediately switch back to the whiteboard."

This quotation illustrates that technology integration required considerable instructional flexibility. Sandi explained that every digitally supported lesson needed a contingency plan in case technical problems occurred. Rather than depending exclusively on digital applications, he always prepared conventional teaching materials, including printed worksheets and whiteboard explanations, to ensure that learning objectives could still be achieved. Although this preparation increased his workload, he believed it was necessary because effective teaching should not be compromised by technological limitations. His experiences demonstrate that successful technology integration depends not only on technological innovation but also on teachers' capacity to respond quickly to unforeseen classroom circumstances.

Closely related to infrastructure issues was the unequal availability of digital devices among students. Sandi explained that although most students possessed smartphones, their devices differed considerably in processing capacity, storage space, and compatibility with educational applications. Some applications operated smoothly on newer devices but became slow or unstable on older smartphones, creating unequal learning experiences within the same classroom. Consequently, teachers were often required to modify instructional activities to accommodate these differences.

He reflected that this situation occasionally created feelings of frustration among students who were unable to participate fully in technology-based learning activities. To overcome this issue, he frequently organized collaborative learning groups in which students shared devices and worked together to complete mathematical investigations. While this approach promoted cooperation and peer learning, Sandi acknowledged that it also reduced opportunities for every student to independently manipulate digital mathematical representations. Thus, unequal access to technology remained an important challenge despite creative classroom adaptations.

Another major challenge emerging from Sandi's narrative concerned variations in students' digital literacy. Contrary to the common assumption that younger generations naturally possess advanced digital skills, Sandi observed that students demonstrated highly diverse levels of technological competence. While some students quickly understood how to operate educational applications, explore mathematical simulations, and solve technical problems independently, others struggled with even basic digital procedures such as installing applications, creating accounts, or navigating software interfaces. According to Sandi, these differences significantly influenced the pace of mathematics instruction because technological guidance often became a prerequisite for conceptual learning. He explained:

"Students have different abilities in using technology. Some learn very quickly, while others need step-by-step assistance before they can even open the application."

This experience led Sandi to recognize that integrating technology into mathematics classrooms requires teachers to simultaneously address two forms of

learning. In addition to teaching mathematical concepts, teachers must also support students in developing the digital competencies necessary to use educational technologies effectively. As a result, classroom time was often divided between explaining mathematical ideas and providing technical assistance. While this process occasionally slowed lesson progression, Sandi believed it was an essential investment because students' digital confidence gradually increased through repeated exposure and guided practice.

Sandi further explained that differences in digital literacy were influenced by students' previous educational experiences and access to technology outside school. Some students had extensive experience using digital devices for educational purposes before entering the *pesantren*, whereas others had primarily used smartphones for communication or entertainment. Consequently, students entered mathematics classrooms with varying levels of readiness for technology-enhanced learning. Recognizing these differences, Sandi intentionally introduced new digital applications gradually, beginning with simple activities before progressing to more complex mathematical explorations. He emphasized that successful technology integration requires patience and differentiated instructional support rather than assuming that all students possess equal digital competence.

Beyond student-related challenges, Sandi acknowledged that teachers themselves face continuous demands to update their technological knowledge. He described educational technology as an area characterized by rapid innovation, where new applications, software updates, and artificial intelligence tools emerge frequently. Although these developments create valuable educational opportunities, they also generate pressure for teachers to continually learn and adapt. Sandi admitted that keeping pace with technological change sometimes felt overwhelming because mastering one application often coincided with the introduction of newer technologies offering additional features. As he explained:

"Technology changes very fast. Sometimes I feel that I have just learned one application, and then another one becomes popular."

This statement reflects the dynamic nature of digital teaching. Rather than viewing professional development as a series of isolated training sessions, Sandi described it as a lifelong learning process requiring continuous curiosity, experimentation, and self-improvement. He frequently learned through online tutorials, webinars, professional communities, and discussions with colleagues because formal institutional training could not always keep pace with technological developments. While this self-directed learning strengthened his professional competence, it also required substantial personal commitment beyond regular teaching responsibilities.

Sandi further observed that the rapid emergence of artificial intelligence created new pedagogical dilemmas for mathematics teachers. Although AI applications could generate explanations, solve mathematical problems instantly, and provide alternative solution methods, he worried that students might become excessively dependent on these technologies if they were used without appropriate guidance. He noted that some students preferred obtaining immediate answers from AI rather than engaging in the cognitive effort required to solve mathematical problems independently. He reflected:

"Sometimes students want quick answers. If they rely on AI without thinking first, they may get the correct answer but not understand why it is correct."

This concern highlights that technological challenges extend beyond hardware and software to include broader educational questions regarding critical thinking and intellectual independence. Sandi believed that mathematics education should cultivate reasoning, logical analysis, and problem-solving abilities rather than simply producing correct answers. Therefore, he deliberately structured classroom activities so that students attempted mathematical problems independently before consulting AI-generated explanations. In doing so, technology became a resource for reflection rather than a substitute for thinking.

Time management also emerged as a practical challenge in Sandi's narrative. Preparing technology-enhanced mathematics lessons required considerably more effort than traditional instruction. Before each lesson, he tested software functionality, checked internet connectivity, prepared backup teaching materials, and anticipated potential technical difficulties. These additional responsibilities increased lesson preparation time, particularly when introducing unfamiliar applications. Furthermore, classroom activities involving technology frequently required more instructional time because students needed opportunities to explore digital tools, discuss findings, and resolve technical problems.

Despite these challenges, Sandi did not perceive technology integration as an additional burden to be avoided. Instead, he regarded these obstacles as opportunities for professional growth and pedagogical reflection. Each challenge encouraged him to become more flexible, creative, and responsive to students' needs. He explained that overcoming technical problems, adapting lessons spontaneously, and continuously learning new technologies strengthened his confidence as a teacher and expanded his instructional repertoire.

Looking back on his experiences, Sandi concluded that effective technology integration depends less on technological sophistication than on teachers' adaptive expertise. Digital innovation inevitably introduces new challenges, but these challenges can be managed through careful planning, continuous professional learning, reflective practice, and a willingness to modify instructional strategies according to contextual realities. His narrative therefore suggests that technology integration is fundamentally a process of ongoing professional adaptation rather than the simple adoption of digital tools. For mathematics teachers working in *pesantren* settings, success lies not in eliminating every technological obstacle but in developing the resilience and pedagogical flexibility required to transform those challenges into meaningful learning opportunities while remaining faithful to the institution's educational mission.

The findings demonstrate that integrating digital tools into mathematics instruction is a multidimensional process influenced by technological, pedagogical, and contextual factors rather than simply the availability of digital resources. Consistent with previous studies, inadequate infrastructure, unequal access to digital devices, and varying levels of students' digital literacy remain significant barriers to effective technology integration. These findings support the systematic review by Hidayat and Firmanti (2024), which identified infrastructure, institutional support, and teacher competence as persistent challenges in digital mathematics education. Similarly, the participant's experience aligns with the work of Dockendorff and Zaccarelli (2025), who reported that successful technology integration depends not only on teachers' digital competence but also on the availability of adequate technological infrastructure and continuous professional support. However, the present study extends these findings by illustrating how such challenges become more complex within the *pesantren* context, where teachers must simultaneously address technical limitations while ensuring that digital practices remain consistent with religious and institutional values. This suggests that technology integration should be understood as a contextualized pedagogical practice rather than a universally applicable instructional model.

Another important finding concerns the participant's emphasis on continuous professional learning and responsible technology use. Rather than perceiving rapidly evolving digital technologies and artificial intelligence as obstacles, the teacher regarded them as opportunities to strengthen professional competence through self-directed learning, collaboration with colleagues, and reflective practice.

This finding resonates with the study by Kul et al., which concluded that effective technology integration requires pedagogically informed digital competence rather than technological knowledge alone. Likewise, the participant's concern about students' overreliance on AI supports the findings of Almarashdi et al. (2024) who emphasized that teacher guidance is essential to ensure ethical and meaningful use of AI in mathematics learning. By encouraging students to solve problems independently before consulting AI-generated explanations, the participant reinforced the teacher's role as a facilitator of critical thinking and mathematical reasoning. Therefore, this study highlights that effective digital transformation in mathematics education depends on teachers' adaptive expertise, reflective decision-making, and the ability to balance

technological innovation with the educational philosophy and cultural values of the *pesantren*.

CONCLUSION

This study explored the lived experiences of a mathematics teacher integrating digital tools into classroom practice within a private Islamic boarding school (*pesantren*) in Pasuruan, East Java, Indonesia, through a narrative inquiry approach. The findings demonstrate that digital technology has become an important pedagogical resource for enhancing mathematics instruction while simultaneously presenting contextual challenges that require thoughtful adaptation. Rather than replacing conventional teaching, the participant perceived digital tools as complementary resources that support conceptual understanding, visualization, student engagement, and interactive learning. Applications such as GeoGebra, Desmos, Google Classroom, and AI-assisted platforms enabled students to better understand abstract mathematical concepts and promoted greater participation during mathematics lessons.

However, the study also reveals that technology integration within a pesantren context extends beyond technical implementation. The participant continuously negotiated the balance between pedagogical innovation and the religious, cultural, and institutional values that characterize pesantren education. Challenges including unstable internet connectivity, unequal student access to digital devices, varying levels of digital literacy, and the rapid development of educational technologies required ongoing professional adaptation. These findings suggest that successful technology integration depends not only on the availability of digital resources but also on teachers' pedagogical decision-making, contextual sensitivity, and professional competence.

To address these challenges, the participant adopted several adaptive strategies, including continuous self-directed professional learning, collaboration with fellow teachers, gradual introduction of digital applications, and careful selection of technologies that aligned with instructional objectives and *pesantren* values. These strategies illustrate that effective digital integration is an evolving professional journey requiring reflective practice and lifelong learning. The participant's experiences further demonstrate that teachers remain central to the learning process, serving as facilitators who guide students in using technology critically and responsibly rather than allowing technology to dominate classroom instruction.

Finally, this study contributes to the growing literature on technology integration in mathematics education by providing an in-depth understanding of teachers' lived experiences within the underexplored context of Indonesian Islamic boarding schools. The findings extend current discussions on contextualized digital pedagogy by highlighting how educational innovation can coexist with religious traditions through appropriate pedagogical adaptation. Practically, the study suggests that policymakers, school leaders, and teacher education providers should design professional development programs that strengthen teachers' digital pedagogical competence while recognizing the distinctive cultural and institutional contexts in which technology is implemented. Future research may expand this work by involving multiple mathematics teachers from different pesantren or employing longitudinal narrative inquiry to examine how teachers' digital integration practices evolve over time.

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