

OPTIMIZING HUMAN RESOURCES THROUGH THE NOTEBOOKLM TRAINING PROGRAM: TRANSFORMING ISLAMIC RELIGIOUS EDUCATION AT MTSN 1 PALEMBANG

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Abstract

Digital transformation in education requires teachers to adapt to technological advancements. However, in practice, some Islamic Education (PAI) teachers still rely on lecture-based methods that are less interactive, despite the availability of digital facilities. This study aims to analyze training in the use of NotebookLM as a strategy to optimize resources in the management and development of educational institutions. This research employed a qualitative approach with a case study design using observation, interviews, and documentation. The findings indicate that the training enhances teachers' digital competencies, optimizes the utilization of human, technological, physical, and organizational resources, and promotes more interactive learning. However, the transformation remains at the level of improving instructional practices and has not yet fully achieved deep learning transformation.

Keywords: digital transformation, digital literacy, NotebookLM, educational resources, Islamic education learning

Abstrak

Transformasi digital dalam pendidikan menuntut guru untuk mampu beradaptasi dengan perkembangan teknologi. Namun, pada praktiknya, sebagian guru Pendidikan Agama Islam (PAI) masih menggunakan metode ceramah yang kurang interaktif meskipun sarana digital telah tersedia. Penelitian ini bertujuan untuk menganalisis pelatihan penggunaan NotebookLM sebagai strategi optimalisasi sumber daya dalam pengelolaan dan pengembangan lembaga pendidikan. Penelitian ini menggunakan pendekatan kualitatif dengan desain studi kasus melalui observasi, wawancara, dan dokumentasi. Hasil penelitian menunjukkan bahwa pelatihan tersebut mampu meningkatkan kompetensi digital guru, mengoptimalkan pemanfaatan sumber daya manusia, teknologi, sarana, dan organisasi, serta mendorong pembelajaran yang lebih interaktif. Namun, transformasi pembelajaran masih berada pada tahap peningkatan praktik dan belum sepenuhnya mencapai perubahan pembelajaran yang mendalam.

Kata kunci: transformasi digital, literasi digital, NotebookLM, sumber daya pendidikan, pembelajaran Pendidikan Agama Islam

INTRODUCTION

The transformation of education in the digital age has shifted the paradigm of learning management from conventional systems toward a more flexible, collaborative, and technology-based approach to learning. These changes not only require the availability of

technological infrastructure but also demand that educational institutions be able to optimize all their resources to ensure that the learning process takes place effectively.

From an educational management perspective, resources encompass all the potential possessed by an educational organization—including human resources, technology, facilities and infrastructure, finances, and organizational systems—that work together to support the achievement of educational goals. Therefore, the successful implementation of learning innovations is determined not only by the sophistication of available technology but also by an institution's ability to systematically manage and integrate all these resources (Bush, 2020).

Bush (2020) explains that the management of educational resources is a strategic process aimed at ensuring that every component of the organization functions synergistically to improve the quality of education. Human resources, particularly teachers, occupy a central position because they serve as both managers and implementers of the learning process. On the other hand, the availability of technology, learning facilities, and organizational support are enabling factors that allow teachers to develop learning innovations. Thus, the management of educational resources cannot be carried out in isolation; rather, it must view all components as a unified system in which each element influences the others.

This systemic approach is increasingly relevant in the digital age, as educational institutions face demands for learning transformation. The OECD (2021) emphasizes that the success of digital transformation depends not only on investment in technology but also on an organization's ability to foster a culture of innovation, enhance educators' competencies, and create policies that support the sustainable use of technology. In other words, digital transformation is a process of organizational change that simultaneously involves people, technology, leadership, and work culture. Therefore, schools or madrasahs that possess digital facilities are not necessarily capable of delivering innovative learning if their human resources lack adequate competencies.

This phenomenon is commonly observed in various educational institutions, including madrasahs. Many institutions already possess digital learning tools such as computers, projectors, internet connections, digital televisions, and educational software; however, their utilization in teaching and learning activities remains relatively low. This situation indicates a gap between the availability of resources and the ability to utilize them effectively. This gap poses a major challenge in modern education management because significant investments in technology will not yield significant results unless they are accompanied by improvements in teachers' competencies as the primary users of educational technology (OECD, 2021).

In this context, teachers' digital literacy has become one of the competencies that is crucial to the success of learning transformation. Digital literacy is no longer defined merely as the ability to operate technological devices but encompasses the ability to access information, evaluate the quality of information, use technology ethically, and

integrate various digital applications into meaningful learning processes. Teachers are expected to be able to select technologies that align with the characteristics of the subject matter, the needs of students, and learning objectives so that technology truly functions as a medium that enriches the learning experience, rather than merely serving as an administrative supplement to the learning process (Ng, 2021).

Ng (2021) explains that teachers' digital literacy encompasses technical, cognitive, and social dimensions. The technical dimension relates to the ability to use digital devices and learning applications. The cognitive dimension relates to the ability to process information, think critically, and solve problems using technology. Meanwhile, the social dimension relates to the ability to communicate, collaborate, and apply digital ethics within the learning environment. These three dimensions complement one another, ensuring that teachers are not only proficient in using technology but also capable of creating a learning environment that is safe, responsible, and focused on developing students' competencies.

The importance of digital literacy is becoming increasingly evident as technology advances rapidly with the advent of artificial intelligence (*AI*). Various AI-based applications, such as NotebookLM, offer features that help teachers manage learning materials, create summaries, analyze documents, and generate various alternative learning media more efficiently. The availability of such technology opens new opportunities to enhance teacher productivity, while simultaneously requiring higher digital competencies to ensure its use remains aligned with pedagogical principles and educational ethics. Therefore, improving teachers' digital literacy is a vital investment in supporting the success of educational transformation.

The development of teachers' digital competencies is inseparable from the Technological Pedagogical Content Knowledge (TPACK) framework. This framework explains that in the digital age, teachers' competencies require more than just mastery of subject matter (*content knowledge*) or teaching strategies (*pedagogical knowledge*); they must also master technology (*technological knowledge*) and be able to integrate these three aspects harmoniously into instructional practice (Mishra & Koehler, 2021). This integration results in learning experiences that are not only visually engaging but also enhance students' comprehension, critical thinking skills, creativity, and active participation.

According to Mishra and Koehler (2021), technology has no pedagogical value when used in isolation from instructional strategies. Conversely, technology has a significant impact when teachers are able to select applications that align with the characteristics of the subject matter and the needs of their students. Therefore, mastery of TPACK serves as a key indicator of teacher professionalism in the digital age, as it reflects the ability to integrate content, pedagogy, and technology into a cohesive instructional design.

Koehler et al. (2022) note that developing TPACK competencies requires an ongoing process involving training, practice, reflection, and organizational support. Teachers

cannot be expected to immediately master technology integration simply by being provided with the necessary facilities. They require learning opportunities, mentoring, and a professional community that facilitates the exchange of experiences among teachers. Therefore, training in the use of technology such as NotebookLM not only enhances technical skills but also serves as a means to build more comprehensive technology-based pedagogical competencies.

In addition to TPACK, the success of technology integration can also be analyzed using the SAMR model developed by Puentedura (2020). This model explains that the use of technology evolves through four stages: **substitution**, **augmentation**, **modification**, and **redefinition**. At the **substitution** stage, technology merely replaces conventional tools without altering the learning process. At the **augmentation** stage, technology begins to enhance functions, making learning activities more effective. The **modification** stage indicates that technology has significantly altered the design of learning, while the **redefinition** stage illustrates technology's ability to create new learning experiences that were previously impossible without technological support.

The SAMR model provides a framework for evaluating the effectiveness of technology use in learning. Hamilton et al. (2021) explain that many digital learning practices still remain at the **substitution** and **augmentation** stages, meaning that learning transformation has not yet occurred optimally. Therefore, the success of technology implementation is not measured by the number of digital devices used, but by the extent to which technology can transform students' learning experiences to be more active, collaborative, creative, and problem-solving oriented.

In the context of Islamic Religious Education (IRE), the use of technology has distinct characteristics compared to other subjects. IRE is not only aimed at enhancing students' mastery of religious knowledge but also at shaping their character, religious attitudes, and behavior in accordance with Islamic values. Therefore, the use of technology in PAI instruction must remain focused on achieving the holistic goals of Islamic education, rather than merely enhancing students' cognitive aspects (Huda, 2020).

Huda (2020) explains that effective PAI instruction is that which can integrate the cognitive, affective, and psychomotor dimensions in a balanced manner. Digital technology can support these objectives through multimedia-based content, interactive videos, simulations, and digital learning resources that enrich students' learning experiences. The use of digital media makes abstract concepts in religious education more concrete, thereby making them easier for students to understand.

Rahman (2022) also emphasizes that digital media can enhance learning motivation, expand access to authentic Islamic learning resources, and strengthen interaction between teachers and students. However, technology must not replace the teacher's role as an educator, mentor, and moral exemplar. Teachers continue to play a central role in guiding students to use technology wisely in accordance with Islamic values.

This view is reinforced by Azra (2021), who states that the integration of technology into Islamic education must always take into account the dimensions of ethics, spirituality, and character development. Technology is merely a tool that aids the educational process, while the success of education remains determined by the quality of pedagogical interaction between teachers and students. Therefore, the use of artificial intelligence-based applications such as NotebookLM should be directed as a learning support tool capable of enhancing the effectiveness of the learning process without compromising the humanistic values of Islamic education.

Enhancing teachers' ability to integrate technology requires ongoing professional development programs. From the perspective of teacher professional development, training is not merely a knowledge-transfer activity but rather an adult learning process aimed at transforming competencies, mindsets, and teaching practices. Darling-Hammond et al. (2021) emphasize that effective training must be ongoing, grounded in teachers' real needs, and involve hands-on practice, reflection, and collaboration among participants to yield tangible changes in the learning process.

One highly recommended form of professional development is **in-house training** because it allows training to be tailored to the characteristics and needs of the educational institution. Avalos (2021) explains that school-based training provides opportunities for teachers to learn collaboratively, discuss real-world challenges they face, and immediately implement training outcomes in their daily teaching practices. This approach is more effective than general training because the content is tailored to the institution's specific conditions and available resources.

Nevertheless, the success of training is not determined solely by the quality of the material or the presenters, but also by the sustainability of the program. Fullan (2020) emphasizes that changes in teaching practices require organizational support, school leadership, a collaborative culture, and a mentoring system after the training concludes. Without follow-up, most teachers tend to revert to their previous teaching habits, so the impact of the training is only temporary. Thus, technology-based learning transformation requires a comprehensive approach through the optimization of educational resources, the improvement of teachers' digital literacy, the strengthening of TPACK competencies, the application of technology based on the SAMR framework, the development of technology-based Islamic Education (PAI) learning that upholds Islamic values, and the implementation of continuous professional development programs for teachers. The integration of these various perspectives forms a strong conceptual foundation for analyzing the implementation of NotebookLM training as a strategy for optimizing educational resources in madrasahs. In line with Selwyn's (2022) view, sustainable digital transformation can only be achieved if technology is positioned as part of an educational ecosystem supported by teacher competencies, organizational leadership, a culture of innovation, and the commitment of the entire school community to improving the quality of learning.

METHOD

This study employs a qualitative approach with an intrinsic case study design to gain an in-depth understanding of the implementation of NotebookLM training in optimizing educational resources at MTsN 1 Palembang. The case study design was chosen because the research focuses on a single educational institution with specific characteristics—namely, a madrasah currently undergoing a transformation toward digital technology-based learning. This approach allows the researcher to comprehensively examine the relationship between technology training, teacher competencies, and the utilization of educational resources in a real-world context. The research was conducted at MTsN 1 Palembang in April 2026, coinciding with the NotebookLM training program held from April 6–10, 2026. Research informants were selected using *purposive sampling*, which included Islamic Religious Education (PAI) teachers participating in the training, *trainers*, and the madrasah’s vice principal for curriculum. The number of informants ranged from eight to twelve individuals deemed capable of providing in-depth information relevant to the research focus.

Data collection was conducted through moderate participatory observation, semi-structured in-depth interviews, and document analysis. Observations focused on the training sessions, interactions among teachers, and the implementation of NotebookLM in the learning process. Interviews were conducted to explore the teachers’ experiences, perceptions, challenges, and changes in teaching practices following the training, while documentation included training modules, instructional materials, activity reports, photos of the training sessions, and learning products such as presentation materials and videos created by the participants. Data were analyzed using the interactive model proposed by Miles, Huberman, and Saldaña (2019) through the stages of data condensation, data presentation, and the drawing and verification of conclusions. Data analysis was reinforced through the processes of *open coding*, *axial coding*, and *selective coding* to identify key themes regarding digital literacy, the enhancement of teacher competencies, and technology-based learning transformation. Data validity was ensured through the application of *trustworthiness* criteria—including *credibility*, *transferability*, *dependability*, and *confirmability*—by utilizing source triangulation, methodological triangulation, research process audits, and direct quotations from informants. However, this study was limited to a single research site; therefore, the findings cannot yet be broadly generalized and do not quantitatively measure the training’s impact on student learning outcomes.

RESULTS AND DISCUSSION

The findings of this study demonstrate that the implementation of NotebookLM training served as a strategic intervention in strengthening teachers’ digital competencies and optimizing educational resources at MTsN 1 Palembang. The analysis was developed from participant observations, in-depth interviews, and document analysis conducted during the five-day in-house training program. The findings reveal that the digital transformation process did not merely involve the adoption of artificial intelligence (AI)-

based technology but also influenced teachers' professional confidence, instructional practices, organizational support, and the utilization of existing educational facilities. Four major themes emerged from the qualitative analysis: the initial condition of teaching practices, the implementation of NotebookLM training, the optimization of educational resources, and changes in classroom learning after the intervention.

Prior to the implementation of the training program, Islamic Religious Education (PAI) teachers predominantly employed conventional teaching approaches. Classroom observations indicated that teacher-centered instruction remained the dominant instructional strategy, with lectures functioning as the primary method of content delivery. Although the school had provided various digital facilities, including projectors, digital televisions, internet access, and multimedia equipment, these resources were rarely integrated into everyday classroom instruction. Most teachers admitted that digital media were only utilized during classroom supervision or formal evaluation sessions rather than becoming a regular component of teaching practice. This situation illustrates a significant discrepancy between technology availability and technology utilization, suggesting that the existence of infrastructure alone is insufficient to promote instructional innovation.

One participant explained:

"I still frequently use the lecture method because I am not yet accustomed to using digital technology. Digital media are generally used only when classroom supervision is conducted." (PAI Teacher, 2026)

This statement reflects that the primary obstacle was not the absence of technological facilities but rather teachers' limited digital literacy and lack of confidence in integrating technology into classroom instruction. The finding confirms that technological readiness should be understood as a combination of physical infrastructure and human competence rather than merely technological availability. The evidence also indicates that the digital transformation agenda requires systematic professional development to bridge the gap between existing facilities and teachers' instructional capabilities.

The five-day NotebookLM training program was designed as an in-house collaborative professional development initiative. Rather than inviting external consultants, the school appointed experienced internal trainers who were already familiar with the institutional culture and teachers' instructional needs. This strategy created a collaborative learning atmosphere in which participants felt more comfortable asking questions, discussing classroom challenges, and experimenting with AI-assisted instructional activities. Teachers emphasized that learning from colleagues reduced anxiety toward technology while simultaneously encouraging professional collaboration.

One trainer stated:

"This training was extremely helpful because teachers learned directly from their own colleagues."

The collaborative structure of the training also encouraged continuous interaction among participants. Teachers practiced using NotebookLM to summarize instructional materials, organize lesson content, generate PowerPoint presentations, prepare teaching videos, and improve lesson planning. Unlike conventional technology workshops that often focus exclusively on technical procedures, this training emphasized authentic classroom applications, enabling participants to immediately visualize how AI tools could support their daily instructional responsibilities. Consequently, teachers perceived NotebookLM not merely as a technological innovation but as a practical instructional assistant capable of reducing administrative workload while improving lesson quality.

The findings further demonstrate substantial improvements in the optimization of educational resources after the intervention. The first dimension concerns human resources. Before the training, many teachers expressed uncertainty regarding digital learning technologies and preferred conventional instructional approaches. Following the completion of the training, however, participants consistently reported increased confidence in designing and delivering technology-enhanced lessons. They described themselves as more willing to experiment with digital media and AI-assisted instructional resources.

One teacher commented:

"Now I feel much more confident using digital media during classroom instruction."

This increased confidence represents an important indicator of professional growth because teacher self-efficacy strongly influences instructional innovation. Rather than viewing technology as an intimidating challenge, participants began to perceive it as an instructional resource that could enhance student engagement and improve classroom interaction. This behavioral change suggests that professional development contributed not only to technical competence but also to teachers' beliefs regarding their own instructional capabilities.

The second dimension concerns technological resources. Prior to the intervention, available technological facilities remained significantly underutilized. Teachers primarily relied on printed instructional materials despite the availability of digital devices. After participating in the NotebookLM training, however, teachers reported that AI significantly simplified lesson preparation. Participants utilized NotebookLM to summarize textbooks, generate presentation materials, organize lesson outlines, and produce instructional videos within considerably shorter periods than before.

One participant explained:

"NotebookLM makes it easier for me to summarize teaching materials, prepare PowerPoint presentations, and create instructional videos."

These findings indicate that NotebookLM functioned as a productivity-enhancing tool rather than replacing teachers' pedagogical responsibilities. Instead of generating fully automated instruction, teachers selectively adapted AI-generated materials according to

curriculum objectives and student characteristics. Such practices demonstrate that technology served as a complementary instructional resource supporting teachers' professional decision-making rather than substituting their pedagogical expertise.

The optimization of physical resources also became increasingly visible following the training. Before the intervention, projectors and digital televisions were used infrequently despite their availability in classrooms. Participants acknowledged that these facilities were generally activated only for administrative supervision or special instructional occasions. Following the training, however, teachers increasingly incorporated multimedia presentations, digital videos, and AI-generated instructional resources into routine classroom practice. Consequently, educational facilities that had previously remained underutilized became integral components of everyday teaching activities.

This transition illustrates that educational technology investments become meaningful only when accompanied by adequate teacher competence. Physical resources themselves possess limited instructional value unless teachers understand how to integrate them effectively into pedagogical practice. Therefore, the improvement observed in this study resulted from the interaction between enhanced teacher competence and increased utilization of technological infrastructure rather than from technological availability alone.

Table 1. Summary of Research Findings

EDUCATIONAL RESOURCE	INITIAL CONDITION	NOTEBOOKLM TRAINING INTERVENTION	OBSERVED IMPACT
HUMAN RESOURCES	Teachers relied mainly on lecture-based instruction with limited digital literacy.	Five-day collaborative NotebookLM training.	Improved digital competence and teacher confidence.
TECHNOLOGY RESOURCES	Digital technology was rarely integrated into instruction.	AI-assisted lesson preparation and instructional media development.	Technology became a strategic instructional resource.
PHYSICAL RESOURCES	Projectors and digital televisions were rarely utilized except during supervision.	Integration of multimedia into classroom teaching.	Increased utilization of existing educational facilities.
ORGANIZATIONAL RESOURCES	Digital professional development programs were	School-based in-house collaborative training.	Stronger collaborative culture and

ISLAMIC EDUCATION LEARNING	not systematically implemented.		instructional innovation.
	Passive and teacher-centered instruction.	Technology- supported learning activities.	More interactive and engaging classroom learning.

The findings presented above collectively indicate that NotebookLM training influenced multiple dimensions of educational resource management rather than affecting technological competence alone. Improvements in teacher confidence, instructional preparation, facility utilization, and collaborative learning culture illustrate that successful digital transformation depends upon the simultaneous optimization of human, technological, physical, and organizational resources. These findings also suggest that AI-supported professional development may serve as an effective institutional strategy for accelerating digital transformation within Islamic secondary schools while preserving teachers' central pedagogical roles.

Beyond the improvement of teachers' individual competencies, the findings indicate that NotebookLM training also strengthened organizational resources within MTsN 1 Palembang. Organizational support emerged as one of the most influential factors determining the sustainability of technology integration after the completion of the training program. Unlike many professional development initiatives that end immediately after workshop activities, the NotebookLM training was designed as part of the school's broader digital transformation agenda. The vice principal for curriculum emphasized that the program was intended not only to introduce a new technological application but also to establish a culture of continuous digital innovation among teachers.

School leaders actively encouraged teachers to implement the skills acquired during the training in their daily instructional practices. Administrative policies also supported experimentation with digital learning media by allowing teachers to redesign lesson plans and integrate AI-assisted instructional materials into classroom activities. Such organizational encouragement reduced teachers' reluctance to adopt unfamiliar technologies and fostered a positive institutional climate toward innovation.

One administrator explained:

"Our goal is not merely to train teachers to operate NotebookLM but to encourage them to transform their instructional practices. We continuously support teachers after the training through discussion, monitoring, and collaborative reflection." (Vice Principal for Curriculum, 2026)

This finding demonstrates that organizational commitment plays a critical role in sustaining educational innovation. Professional development becomes substantially more effective when accompanied by leadership support, collaborative culture, and

institutional policies that encourage experimentation. Consequently, digital transformation should be understood as an organizational process rather than an isolated technological intervention.

Another important finding concerns the emergence of collaborative professional learning among teachers. During observations, participants frequently exchanged ideas regarding prompt construction, instructional design, lesson organization, and classroom implementation strategies. Rather than competing with one another, teachers voluntarily shared successful experiences and collectively solved technical problems encountered while using NotebookLM.

One teacher stated:

"When someone discovers a better way to organize learning materials with NotebookLM, everyone immediately wants to learn it. We help each other because we all want our teaching to improve."

This collaborative atmosphere contributed significantly to teachers' confidence in adopting AI technology. Instead of learning individually through trial and error, teachers benefited from peer support that accelerated the acquisition of new digital competencies. Such collaboration also reduced technology-related anxiety, particularly among senior teachers who initially perceived artificial intelligence as difficult to understand.

The findings further reveal substantial changes in classroom instructional practices following the implementation of NotebookLM. Before participating in the training, classroom activities were largely characterized by one-way communication in which teachers explained concepts verbally while students functioned primarily as passive listeners. Learning materials were generally presented through textbooks and handwritten notes, resulting in relatively limited student engagement.

Following the training, classroom observations documented notable instructional changes. Teachers increasingly incorporated multimedia presentations, visual summaries, interactive learning materials, short instructional videos, and AI-assisted explanations into classroom activities. These digital resources enabled teachers to present Islamic Religious Education content more systematically while simultaneously increasing students' interest in classroom discussions.

One participant explained:

"Students become much more enthusiastic when I use digital presentations and videos. They ask more questions and participate more actively during discussions."

The incorporation of multimedia resources also contributed to greater instructional flexibility. Teachers reported that NotebookLM helped them organize extensive learning materials into concise and understandable summaries. Consequently, classroom time could be allocated more efficiently to discussions, collaborative learning activities, and reflective exercises rather than lengthy teacher explanations.

The findings additionally suggest that NotebookLM improved teachers' instructional planning efficiency. Prior to the intervention, teachers often required considerable time to prepare lesson plans, summarize reference materials, and design instructional media. Following the training, these preparation activities became substantially more efficient because AI-assisted tools facilitated information organization while allowing teachers to focus on pedagogical decision-making.

Several teachers reported that lesson preparation time decreased considerably without compromising instructional quality. Instead of manually reviewing numerous reference books, participants could upload teaching materials into NotebookLM, generate structured summaries, identify key concepts, and develop presentation outlines within a much shorter period.

One participant commented:

"Previously, preparing one lesson could take several hours. Now I can organize materials much faster and spend more time thinking about how students will learn instead of simply preparing documents."

This finding indicates that artificial intelligence should not be viewed as replacing teachers but rather as augmenting their professional productivity. AI functioned primarily as an instructional assistant that reduced repetitive administrative tasks while preserving teachers' responsibility for curriculum interpretation, instructional design, classroom interaction, and assessment.

Qualitative coding of interview transcripts further identified three interconnected categories that explain the overall transformation experienced by participants. During the open coding stage, recurring concepts included limited digital literacy, low technological confidence, underutilization of educational facilities, enthusiasm toward AI technology, collaborative learning, and instructional innovation. These initial codes illustrate teachers' transition from technological hesitation to active experimentation.

During axial coding, these initial concepts were organized into broader analytical categories representing relationships among teacher competence, technological utilization, organizational support, and instructional transformation. The analysis demonstrated that increased digital competence influenced teachers' willingness to utilize available technological resources, while organizational encouragement strengthened the sustainability of these instructional changes.

Finally, selective coding identified one overarching core category that integrated all findings: AI-assisted professional development as a catalyst for educational resource optimization and instructional transformation. This central theme explains that the effectiveness of NotebookLM training extended beyond technical skill acquisition by influencing organizational culture, teacher collaboration, instructional innovation, and resource utilization simultaneously.

Table 2. Qualitative Coding Results

OPEN CODING	AXIAL CODING	SELECTIVE CODING
LIMITED DIGITAL LITERACY	Improvement of teachers' digital competence	AI-assisted professional development promotes educational transformation
DEPENDENCE ON LECTURE-BASED INSTRUCTION	Instructional innovation through AI integration	AI-assisted professional development promotes educational transformation
UNDERUTILIZED TECHNOLOGICAL FACILITIES	Optimization of educational resources	AI-assisted professional development promotes educational transformation
INCREASED CONFIDENCE USING NOTEBOOKLM	Professional growth and teacher self-efficacy	AI-assisted professional development promotes educational transformation
COLLABORATIVE LEARNING AMONG TEACHERS	Organizational support for digital innovation	AI-assisted professional development promotes educational transformation
AI-ASSISTED LESSON PREPARATION	Technology-enhanced instructional effectiveness	AI-assisted professional development promotes educational transformation

Overall, the qualitative findings consistently demonstrate that NotebookLM training generated multidimensional improvements across human, technological, organizational, and instructional domains. Teachers not only acquired technical skills related to artificial intelligence but also developed stronger professional confidence, collaborative learning habits, and greater willingness to redesign classroom instruction using digital resources. Existing educational facilities became more effectively utilized because teachers possessed the competencies necessary to integrate them into authentic learning activities. The evidence therefore suggests that successful digital transformation in Islamic secondary education depends on the interaction among teacher competence, institutional leadership, organizational culture, and appropriate technological support rather than on technological infrastructure alone. These findings provide a strong empirical foundation for the subsequent discussion concerning the implications of AI-supported professional development within the frameworks of educational resource management, TPACK, and the SAMR model.

CONCLUSION

Training on the use of NotebookLM at MTsN 1 Palembang has proven effective in enhancing teachers' digital competencies and optimizing the utilization of educational resources, including human resources, technology, facilities, and organizational structures. The impact is evident in the transformation of Islamic Education (PAI) instruction, which has become more interactive and innovative; however, this transformation is still in the early stages of practice improvement and has not yet fully achieved a profound shift in teaching and learning. Therefore, there is a need to develop ongoing training programs, strengthen the integration of pedagogy and technology in learning, and conduct evaluations based on student learning outcomes. In addition, schools need to foster a culture of collaborative learning, teachers need to continue

improving their digital competencies through reflective practice, and policymakers are expected to provide systematic support so that the digital transformation of education can proceed optimally and sustainably.

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