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OPTIMIZING RESOURCES THROUGH NOTEBOOKLM TRAINING: 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 21st century has brought about significant changes in how the learning process is designed, implemented, and evaluated. The rapid development of information and communication technology has prompted educational

institutions to make various adjustments to meet the needs of students living in the digital age. The digital revolution has not only changed how people communicate and access information but has also shifted the educational paradigm from teacher-centered learning toward student-centered learning. In this context, digital technology has become a vital tool enabling more interactive, flexible, collaborative, and innovative learning. Therefore, the use of technology in the learning process is no longer an option but a necessity that every educational institution must fulfill to produce graduates with competencies aligned with the demands of the times (Mishra & Koehler, 2006).

dvances in digital technology have introduced various platforms, applications, and devices that can be utilized to support the learning process. The use of digital technology in education offers immense opportunities to enhance the quality of learning by providing a broader range of learning resources, faster access to information, and more engaging learning experiences for students. According to Sari (2024), the use of digital technology has proven effective in increasing student engagement in the learning process, boosting learning motivation, and creating more meaningful learning experiences. When technology is used appropriately, students are not merely passive recipients of information but become active participants capable of independently exploring knowledge. Thus, the integration of technology into learning can support the creation of a more effective and efficient learning process.

In the context of Islamic education, the utilization of digital technology is becoming increasingly urgent. Islamic Religious Education (IRE), as a subject aimed at shaping students' character, morality, and spirituality, must adapt to the times without abandoning the Islamic values that form its foundation. IRE instruction is no longer sufficient when conducted through conventional approaches that rely solely on lectures; it requires innovations capable of accommodating the characteristics of today's digital generation. Students growing up in the technological era tend to be more interested in learning that utilizes visual, audio, and interactive media compared to one-way instruction. Therefore, PAI teachers are required to be able to integrate technology into the learning process so that religious material can be presented in a more engaging, relevant, and easily understandable manner for students (Rahman & Nuryana, 2023).

Although various government policies have promoted the digitization of education, its implementation in the field still faces numerous challenges. One of the key factors determining the success of technology integration in learning is teacher competence. Aliyah et al. (2024) explain that digital learning transformation requires not only the availability of technology but also teachers' ability to integrate technology with appropriate pedagogical strategies. Teachers play a central role in determining how technology is used to support the achievement of learning objectives. Without adequate competencies, available technology will merely become a resource that is not utilized optimally.

Teachers' digital competencies are a key indicator of the success of educational transformation. Teachers are not only expected to be able to operate technological devices but must also understand how such technology can be used to enhance the quality of learning. The Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006) emphasizes that teachers need to master three main types of knowledge: content knowledge, pedagogical knowledge, and technological knowledge. These three aspects must be integrated so that teachers can design effective learning in the digital age. Thus, mastery of technology alone is not enough if it is not balanced with adequate pedagogical skills.

The situation at MTsN 1 Palembang indicates that the use of technology in Islamic Education (PAI) instruction is still not optimal. Based on initial observations, some teachers still predominantly rely on lecture-based methods to deliver instructional content. However, the school has provided various supporting facilities, such as projectors, digital televisions, internet access, and other technological devices that can be utilized to enhance the learning process. This situation highlights a gap between the availability of technological resources and their actual utilization in teaching practice. This phenomenon suggests that the presence of technological facilities does not automatically drive educational transformation unless accompanied by improvements in teachers' competencies.

These findings align with Afnani's (2025) research, which states that one of the primary barriers to implementing digital learning is the low level of technological skills among teachers. Many teachers still lack confidence in using technology due to limited knowledge and experience. Consequently, they tend to opt for conventional teaching methods, which are perceived as easier and more familiar. This situation poses a serious challenge to efforts to achieve digital educational transformation, particularly in madrasah settings, which have traditionally been associated with conventional teaching approaches.

In recent years, various studies have examined the importance of utilizing digital technology in education. Research conducted by Sari (2024) indicates that the use of digital technology can enhance students' active participation in the learning process. Technology enables students to engage more intensively with learning materials, thereby improving conceptual understanding and learning outcomes. Additionally, technology provides teachers with opportunities to develop more varied and engaging teaching methods.

Another study by Aliyah et al. (2024) emphasizes that digital learning transformation requires a systematic and integrated approach. Integrating technology into education is not sufficient merely through the provision of hardware and software; it also requires changes in organizational culture, human resource capacity building, and sustained policy support. These findings indicate that digital transformation is a complex process involving various aspects of the education system.

Zahra et al. (2025) revealed that the main challenge teachers face in implementing digital learning is a lack of proficiency in operating educational technology. Many teachers have not received adequate training, leading to difficulties in effectively utilizing technology. This finding is reinforced by research by Imanda et al. (2025), which shows that technology training can improve teachers' digital competencies and foster innovation in learning. Teachers who receive ongoing training tend to be more confident in using technology and more creative in designing learning activities.

Furthermore, Novela's (2024) study shows that the use of digital media can create more dynamic and participatory learning interactions. Digital media enables learners to actively engage in the learning process through various interactive activities such as virtual discussions, digital quizzes, simulations, and project-based learning. This indicates that technology has great potential to improve the quality of learning when utilized optimally.

Nevertheless, these studies still leave several research gaps. First, most research remains focused on the general use of digital technology and has not extensively examined the application of artificial intelligence (AI)-based technology in learning. In fact, advancements in AI have introduced various applications capable of supporting the learning process in a more personalized, adaptive, and efficient manner. One AI technology that is increasingly being used in education is NotebookLM, developed by Google. NotebookLM enables users to process various information sources into learning materials that are more structured, interactive, and easy to understand.

Second, research on teacher technology training generally focuses only on improving individual competencies without linking it to the overall optimization of educational resources. In reality, the success of technology implementation in education is not determined solely by teachers' capabilities but is also influenced by the availability of human resources, technology, infrastructure, and organizational support. An educational resource management perspective is crucial for understanding how these various components can be effectively integrated to support learning transformation.

Third, research specifically examining the use of AI-based technology in Islamic Religious Education at madrasahs remains very limited. Most research on the digitization of learning has been conducted in public schools or universities. However, madrasahs have distinct characteristics because they integrate general education with religious education. Therefore, research is needed to explain how AI-based technology can be utilized in Islamic Religious Education (IRE) without compromising the Islamic values that are the hallmark of madrasahs.

Based on these issues, this study offers a novel approach by integrating three main aspects: the use of AI-based technology through NotebookLM, teacher training to enhance digital competencies, and educational resource management as a framework to optimize technology utilization in learning. This study was conducted within the context of Islamic Religious Education (IRE) at MTsN 1 Palembang, and is thus expected to

provide a new perspective on the implementation of AI technology within the madrasah environment.

The urgency of this research is further underscored by the fact that digital transformation in education is a national strategic agenda requiring support from all stakeholders. Teachers, as the frontline of education, must be equipped with adequate competencies to effectively utilize technology. On the other hand, educational institutions must ensure that all available resources are used effectively to support learning innovation. Thus, this study is expected to provide theoretical contributions to the development of AI-based digital learning research as well as practical contributions to madrasahs in designing more innovative, effective, and sustainable learning transformation strategies.

METHOD

This study employs a qualitative approach with an intrinsic case study design to gain an in-depth understanding of the phenomenon of NotebookLM training in supporting the optimization of educational resources in Islamic Religious Education (IRE) instruction at MTsN 1 Palembang. The qualitative approach was chosen because it allows researchers to explore teachers' experiences, perceptions, and practices in a natural context holistically (Creswell & Poth, 2018). Meanwhile, the case study design was used because the research focuses on a single location with specific characteristics, namely a madrasah currently implementing a digital technology-based learning transformation (Yin, 2018).

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, considering their ability to provide relevant and in-depth information related to the research focus (Sugiyono, 2023). The informants consisted of PAI teachers participating in the training, training facilitators, and the madrasah's vice principal for curriculum, with a total of between eight and twelve individuals.

Data were collected through moderate participant observation, semi-structured in-depth interviews, and document analysis. Observations were conducted to monitor training activities, interactions among participants, and the implementation of technology in learning. Interviews were developed based on the Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006), while documentation included training modules, learning materials, activity reports, activity photos, and training outcomes such as instructional videos and presentation media.

Data analysis utilized the interactive model by Miles, Huberman, and Saldaña (2019), which includes data condensation, data presentation, and drawing conclusions. The analysis process was reinforced through open coding, axial coding, and selective coding techniques to identify the main themes emerging from the field data (Strauss & Corbin, 1998). Data validity was ensured through the application of trustworthiness criteria,

which include credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). However, this study was limited to a single research site; therefore, the results are not intended to be broadly generalized, and the quantitative impact of the training on student learning outcomes has not yet been measured.

RESULTS AND DISCUSSION

This study aims to describe how training in the use of NotebookLM contributes to the optimization of educational resources in Islamic Religious Education (IRE) at MTsN 1 Palembang. Research data were obtained through participatory observation, in-depth interviews with IRE teachers, training instructors, and the madrasah's vice principal for curriculum, as well as a document analysis of training modules, learning materials, and training outcomes. Data analysis was conducted using the interactive model by Miles, Huberman, and Saldaña (2019) through the stages of data condensation, data presentation, and drawing conclusions.

The research findings indicate that prior to the implementation of the NotebookLM training, the PAI learning process at MTsN 1 Palembang was still dominated by a conventional, teacher-centered approach. Most teachers relied on the lecture method as the primary strategy for delivering content. Although the school had provided various technological facilities such as projectors, digital televisions, and internet access, their utilization in the learning process remained very limited. One PAI teacher stated that they still frequently used the lecture method because they were not yet accustomed to utilizing digital technology in teaching. The use of digital media was generally limited to supervision activities and had not yet become part of daily teaching practices.

These findings indicate a gap between the availability of technological resources and teachers' ability to utilize them optimally. This situation suggests that digital transformation requires not only the provision of technological devices but also the enhancement of the capacity of the human resources managing them. This phenomenon aligns with the research by Zahra et al. (2025), which explains that low digital literacy among teachers is one of the main barriers to the implementation of technology-based learning. Teachers who lack adequate digital competencies tend to stick to traditional teaching methods because they are considered easier and more in line with habits that have been in place for years.

Training on the use of NotebookLM was subsequently conducted as an effort to enhance teachers' digital competencies and promote the optimal utilization of educational resources available at the madrasah. The training took place over five days using an in-house training approach involving internal trainers. This training model provided teachers with the opportunity to learn collaboratively within their own work environment. Based on interview results, the majority of participants stated that this approach was highly beneficial because the material provided was relevant to their daily teaching needs.

A trainer explained that the training was designed to provide hands-on experience so that participants not only understand the concepts of using artificial intelligence-based technology but are also able to implement them in the development of learning materials. Participating teachers noted that NotebookLM made it easier for them to summarize lesson content, create presentation materials, and develop educational videos—tasks that previously required a relatively long time. These findings indicate that the training successfully enhanced teachers' ability to utilize digital technology to support the learning process.

The research findings show that the impact of the training extended beyond the technical aspects of technology use to include an increase in teachers' self-confidence. Before participating in the training, some teachers felt less confident in using digital devices due to limited experience and knowledge. After the training, they demonstrated a more positive attitude toward the use of technology in learning. One teacher stated that they now feel more confident in integrating digital media into the learning process. This change indicates that the training serves as a means of strengthening competencies while empowering teachers to address the demands of digital education transformation.

Based on the analysis, the optimization of educational resources occurred across four main aspects: human resources, technological resources, physical resources, and organizational resources. Regarding human resources, the training made a significant contribution to enhancing teachers' digital competencies. Teachers not only acquired new skills in using NotebookLM but also experienced a shift in mindset regarding the importance of innovation in learning. This finding supports Becker's (2020) assertion that investing in human resource development through training can enhance individual productivity and performance quality.

In the technological resources aspect, NotebookLM serves as a tool that helps teachers manage learning materials more efficiently. Teachers can use artificial intelligence-based technology to summarize instructional materials, generate learning ideas, create presentations, and produce educational videos. The utilization of this technology indicates a shift from previously passive technology use toward a more active and strategic approach. This finding reinforces the results of Imanda et al. (2025), which show that technology training can enhance learning innovation and encourage teachers to utilize technology more effectively.

Regarding physical resources, the study found an increase in the utilization of existing learning facilities at the school. Before the training, projectors and digital televisions were rarely used in the learning process. After the training, these facilities began to be utilized more intensively as media for displaying presentations, educational videos, and various other digital materials. This indicates that physical resources will provide maximum benefits only when supported by adequate user competencies.

Furthermore, regarding organizational resources, the research results indicate strong support from the madrasah administration for the implementation of technology-based

learning innovations. This support is manifested through the conduct of internal training, the provision of digital learning facilities, and the provision of opportunities for teachers to develop their professional competencies. The vice principal in charge of the curriculum stated that the school is committed to continuing to support the development of digital learning as part of efforts to improve the quality of education. These findings indicate that the success of digital transformation is determined not only by individuals but also by an organizational culture that supports innovation and continuous learning.

Changes in these four resource aspects have a direct impact on the PAI learning process. Before the training, learning tended to be one-way and lacked active student participation. After the training, teachers began integrating various digital media into the learning process, making the classroom atmosphere more interactive and engaging. Students showed greater enthusiasm when material was presented through visual presentations, educational videos, or other digital media. One teacher noted that students became more active in asking questions and participating in discussions when learning utilized digital media compared to conventional lecture methods.

Data coding analysis yielded several main themes that describe the learning transformation process at MTsN 1 Palembang. The first theme is the low level of teachers' digital literacy as an initial barrier to the implementation of learning technology. The second theme is the effectiveness of training as a means of enhancing teachers' competencies and self-confidence. The third theme is changes in learning practices marked by increased use of digital media in the teaching and learning process. The fourth theme is increased student motivation and engagement as a result of the learning innovations implemented by teachers. The fifth theme is the importance of organizational support in fostering the sustainability of digital transformation.

Overall, the research findings indicate that the NotebookLM training serves as a strategic intervention linking initial learning conditions to expected changes. In the early stages, learning was still dominated by lecture-based methods, teachers' digital literacy was relatively low, and the utilization of technological facilities was not yet optimal. Through collaborative-based training, teachers acquired new skills enabling them to utilize technology more effectively. This process subsequently led to the optimization of various educational resources, resulting in improved learning quality.

The research results also indicate that digital transformation does not occur automatically merely due to the presence of technology. The success of technology implementation heavily depends on the integration of teacher competencies, facility availability, organizational support, and an adaptive learning culture. These findings align with the perspective of Mishra and Koehler (2006), who emphasize that effective technology integration requires a combination of technological knowledge, pedagogy, and learning content. Thus, training in the use of NotebookLM not only enhances teachers' technical skills but also drives a paradigm shift in learning toward a more innovative, interactive model aligned with the demands of the digital age.

Based on the overall findings, this study indicates that optimizing the use of educational resources through AI-based technology training can serve as an effective strategy to support digital transformation in madrasahs. The success of the training is evident in the increased digital competence of teachers, the optimal utilization of technology and learning resources, the formation of a collaborative culture within the school organization, and the improved quality of PAI instruction, which is now more engaging and participatory. Ultimately, these changes serve as a crucial foundation for enhancing educational quality and fostering the development of madrasahs that are adaptable to technological advancements in the digital age.

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 profound changes in teaching and learning. Therefore, there is a need for the development of sustainable training programs, the strengthening of the integration of pedagogy and technology in learning, and evaluations based on student learning outcomes. Additionally, schools need to foster a culture of collaborative learning, teachers need to continuously enhance 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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