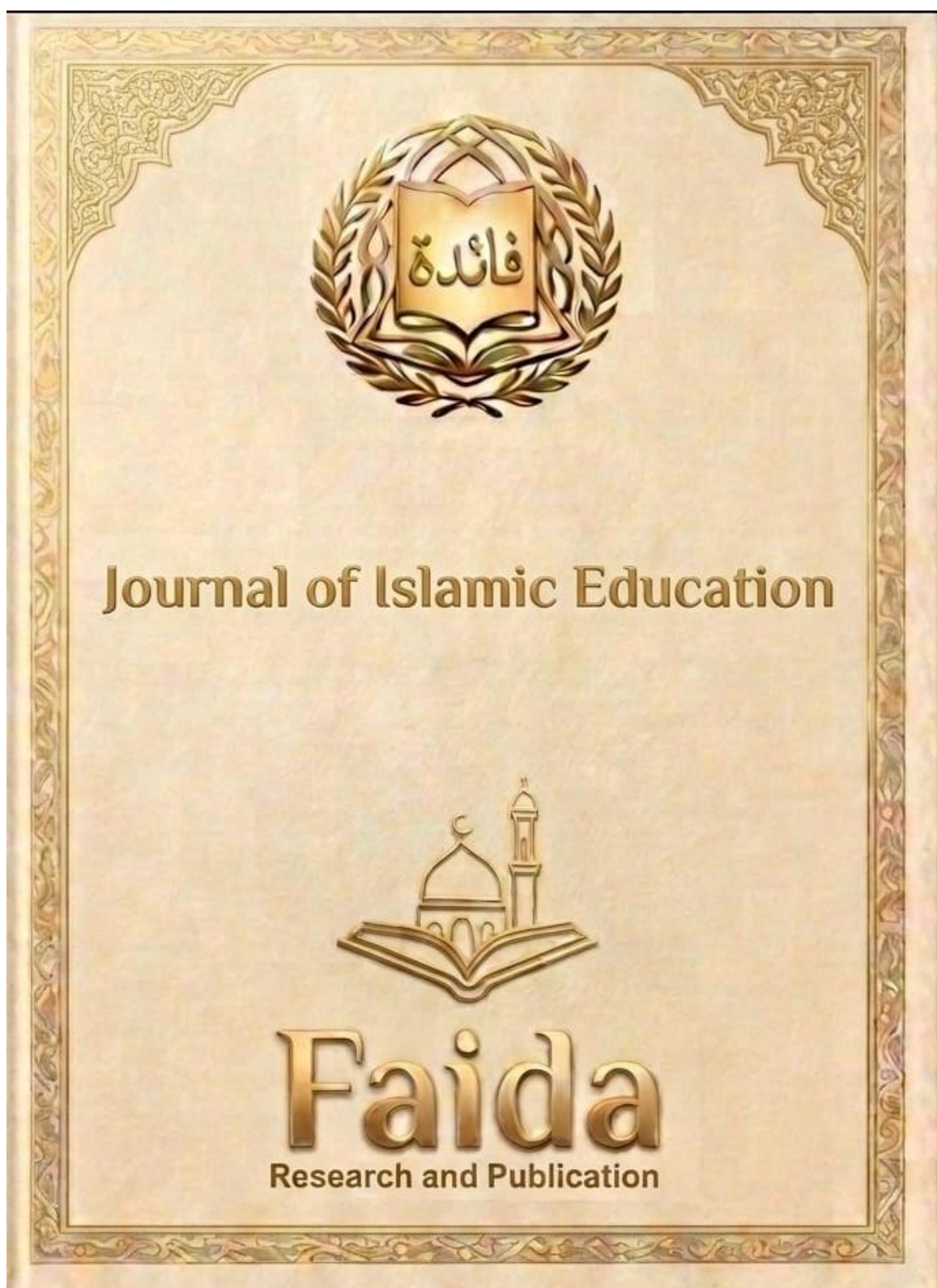




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ARTIFICIAL INTELLIGENCE-SUPPORTED PERSONALIZED LEARNING FOR ENHANCING STUDENT ENGAGEMENT AND 21ST-CENTURY COMPETENCIES: EVIDENCE FROM ISLAMIC SECONDARY SCHOOLS IN INDONESIA

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ABSTRACT

The integration of Artificial Intelligence (AI) in education has created new opportunities for personalized and adaptive learning experiences. While AI-supported personalized learning has gained increasing attention in educational research, its implementation within Islamic secondary schools remains underexplored. This study aims to investigate how AI-supported personalized learning contributes to student engagement and the development of twenty-first-century competencies in Islamic secondary education in Indonesia. This research employed a qualitative multiple-case study involving three Islamic secondary schools that have integrated digital learning technologies into their educational practices. Data were collected through semi-structured interviews with school leaders, teachers, and students, complemented by classroom observations and document analysis. The data were analyzed using thematic analysis through data condensation, data display, and conclusion drawing. The findings reveal that AI-supported personalized learning facilitates adaptive learning through individualized content, personalized feedback, and flexible learning pathways. Furthermore, AI-enhanced learning environments promote behavioral, emotional, and cognitive engagement by increasing students' motivation, participation, and learning autonomy. The study also found that AI integration supports the development of twenty-first-century competencies, particularly critical thinking, creativity, collaboration, and communication skills. However, challenges related to digital literacy, teacher readiness, and technological infrastructure continue to influence the effectiveness of implementation. This study contributes to the literature on AI in education by providing contextual insights into Islamic secondary schools and highlighting the potential of AI-supported personalized learning to foster meaningful engagement and future-oriented competencies.

Keywords: Artificial Intelligence; Personalized Learning; Student Engagement; Twenty-First-Century Competencies; Islamic Secondary Education.

1. INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) is reshaping educational systems across the globe and redefining the ways in which teaching and learning are designed, delivered, and evaluated (Kamalov et al., 2023; Suryanarayana et al., 2024). As educational institutions face increasing pressure to prepare learners for the demands of the Fourth Industrial Revolution and Society 5.0, AI has emerged as one of the most transformative technologies in contemporary education. AI-powered applications, including intelligent tutoring systems, adaptive learning platforms, automated assessment tools, and learning analytics, have enabled educational environments to become more responsive to learners' individual needs and learning trajectories (Rizvi et al., 2025; Strielkowski et al., 2025). Unlike traditional instructional models that often rely on standardized content delivery, AI technologies facilitate data-driven decision-making that allows educators to personalize learning experiences according to students' abilities, preferences, and learning progress.

The growing adoption of AI in education is closely associated with the shift from teacher-centered instruction toward learner-centered pedagogies. Contemporary educational theories increasingly emphasize the importance of recognizing learner diversity and providing opportunities for

individualized learning experiences (Goyibova et al., 2025; Walkington & Bernacki, 2020). In this regard, AI-supported personalized learning has gained substantial attention because it offers the potential to tailor instructional content, pacing, feedback, and assessment to individual learners. Through continuous analysis of learner behavior and performance data, AI systems can identify learning gaps, recommend appropriate resources, and provide immediate feedback that supports student learning. As a result, personalized learning has become one of the most widely discussed innovations in educational technology research and practice.

The significance of personalized learning extends beyond academic achievement. Scholars argue that personalized learning environments promote greater learner autonomy, self-regulation, motivation, and ownership of learning (Alamri et al., 2020; Tur et al., 2024). By allowing students to progress according to their individual needs and interests, personalized learning can foster deeper engagement and encourage active participation in educational activities. These characteristics are particularly relevant in contemporary educational contexts where students are expected not only to acquire knowledge but also to develop critical thinking, problem-solving abilities, collaboration skills, and lifelong learning dispositions (Hamad et al., 2026; Terblanche et al., 2025). Consequently, personalized learning has increasingly been viewed as a strategic approach for cultivating competencies required in rapidly changing social and professional environments.

Within this context, student engagement has emerged as a critical construct for understanding educational effectiveness. Student engagement refers to the degree of students' behavioral, emotional, and cognitive involvement in learning activities (Abbasi et al., 2026; PINAR & OCAK, 2026). Behavioral engagement encompasses participation, attendance, and effort invested in learning tasks; emotional engagement reflects students' sense of belonging, interest, and enjoyment in learning; while cognitive engagement involves strategic thinking, self-regulation, and intellectual investment in academic activities (Rahayu et al., 2026; Viviers et al., 2026). Extensive research has demonstrated that engagement serves as a strong predictor of academic achievement, persistence, motivation, and educational success. Students who are actively engaged tend to demonstrate greater commitment to learning, higher levels of achievement, and stronger academic resilience than those who are disengaged.

The integration of AI into personalized learning environments has created new opportunities for enhancing student engagement (Vendrell & Johnston, 2026). AI technologies enable learning experiences that are more interactive, adaptive, and responsive to individual learners. For example, adaptive learning systems can adjust content difficulty according to student performance, while intelligent feedback systems provide immediate guidance that helps students overcome learning challenges (Bahari, 2026; Kim et al., 2025). Such features have the potential to increase students' interest, motivation, and participation in learning activities. Nevertheless, the relationship between AI-supported personalized learning and student engagement remains complex and context-dependent. While some studies report positive outcomes, others highlight concerns regarding technological dependence, reduced social interaction, and unequal access to digital resources. These contrasting findings indicate the need for further investigation into how AI-supported personalized learning is experienced by learners in different educational contexts.

In addition to fostering engagement, contemporary education is increasingly expected to prepare students with competencies necessary for success in the twenty-first century (Mncube et al., 2026; Yaseen et al., 2025). International educational frameworks consistently emphasize the importance of developing critical thinking, creativity, collaboration, and communication skills. These competencies are considered essential for addressing complex global challenges, participating effectively in digital societies, and adapting to rapidly evolving labor markets. Consequently, educational institutions are challenged to create learning environments that not only transmit knowledge but also cultivate higher-

order thinking and social competencies (Chiu & Rospigliosi, 2025; Rapaka et al., 2025). Emerging evidence suggests that AI-supported learning environments may contribute to competency development by encouraging active learning, inquiry, collaboration, and problem-solving. However, empirical understanding of how such competencies are developed through AI-enhanced personalized learning remains limited.

Despite the growing body of literature on AI in education, several important gaps remain. First, existing studies have predominantly focused on higher education institutions and technologically advanced learning environments, while relatively little attention has been given to secondary education settings (Wang & Huang, 2025). Second, most research has concentrated on measuring academic performance and learning outcomes, with less emphasis on understanding how AI-supported personalized learning influences student engagement and competency development. Third, previous studies have largely been conducted within Western educational contexts, limiting understanding of how AI technologies are implemented and experienced in diverse cultural and religious educational settings. These limitations suggest the need for context-sensitive research that explores the educational implications of AI beyond mainstream educational institutions.

The context of Islamic secondary schools provides a particularly important setting for investigating AI-supported personalized learning. Islamic educational institutions play a significant role in shaping educational experiences for millions of students worldwide, particularly in countries with large Muslim populations such as Indonesia (Gericke et al., 2023; Mitsopoulou & Pavlatou, 2024). In recent years, Islamic schools have increasingly embraced digital transformation initiatives aimed at improving educational quality and competitiveness. Nevertheless, the integration of AI technologies within Islamic educational contexts presents unique opportunities and challenges. On one hand, AI may support more personalized and effective learning experiences (Grab, 2025). On the other hand, its implementation must remain aligned with institutional values, religious principles, and character education objectives that constitute the foundation of Islamic schooling.

Indonesia offers a particularly relevant context for exploring these issues because it possesses one of the largest Islamic education systems in the world. Islamic secondary schools have experienced substantial growth in technological adoption, particularly following the expansion of digital learning practices during and after the COVID-19 pandemic (Carroll et al., 2022; Yan & Peng, 2026). Despite these developments, empirical research examining the role of AI-supported personalized learning in Indonesian Islamic secondary schools remains scarce. Existing studies primarily focus on digital learning adoption, educational technology acceptance, or online learning effectiveness, while limited attention has been devoted to understanding how AI technologies influence student engagement and twenty-first-century competency development.

Furthermore, little is known about how school leaders, teachers, and students perceive and experience AI-supported personalized learning in everyday educational practices (De Vroey et al., 2016; ElSayary, 2024). Understanding these experiences is essential because successful technology integration depends not only on technological capabilities but also on institutional culture, teacher readiness, learner acceptance, and contextual factors. A qualitative exploration of these experiences can provide deeper insights into the mechanisms through which AI-supported personalized learning shapes engagement and competency development within Islamic educational environments.

Therefore, this study seeks to explore the implementation of AI-supported personalized learning and its contribution to student engagement and twenty-first-century competencies in Islamic secondary schools in Indonesia. Using a qualitative multiple-case study approach, the research investigates how AI technologies are integrated into learning practices, how students experience AI-enhanced personalized learning environments, and how such experiences contribute to the development

of critical thinking, creativity, collaboration, and communication skills. By focusing on Islamic secondary schools, this study contributes to the growing literature on artificial intelligence in education by extending existing knowledge to a context that remains underrepresented in current scholarship. The findings are expected to provide theoretical insights into the relationship between AI-supported personalized learning, engagement, and competency development, while also offering practical implications for educators, school leaders, and policymakers seeking to leverage AI technologies to improve educational quality in the digital age.

2. METHODOLOGY

This study employed a qualitative multiple-case study design to explore the implementation of AI-supported personalized learning and its contribution to student engagement and the development of twenty-first-century competencies in Islamic secondary schools in Indonesia (Robert K. Yin, 2008). A multiple-case study approach was selected because it enables an in-depth understanding of complex educational phenomena within their real-life contexts while allowing cross-case comparisons across different institutional settings. The study was conducted in three Islamic secondary schools that had demonstrated active adoption of digital learning technologies and AI-assisted educational practices. These schools were purposively selected based on their experience in integrating AI-supported tools into teaching and learning activities and their commitment to educational innovation.

Data were collected through semi-structured interviews, classroom observations, and document analysis. The interviews involved school principals, vice principals for curriculum affairs, teachers, information technology coordinators, and students, providing diverse perspectives on the implementation and impact of AI-supported personalized learning. Classroom observations were conducted to examine how AI technologies were utilized during instructional activities and how students interacted with personalized learning systems. In addition, institutional documents, curriculum materials, learning reports, digital platform records, and school policy documents were analyzed to strengthen data triangulation and provide contextual understanding of technology integration practices.

Data analysis followed the interactive model developed by Miles, Huberman, and Saldaña, consisting of data condensation, data display, and conclusion drawing. Interview transcripts, observation notes, and documentary evidence were coded and analyzed using thematic analysis to identify recurring patterns, similarities, and differences across cases. The analysis focused on three key themes: the implementation of AI-supported personalized learning, the influence of AI on student engagement, and the contribution of AI-assisted learning to the development of twenty-first-century competencies. Cross-case analysis was subsequently conducted to identify common themes and contextual variations among the participating schools.

To ensure the trustworthiness of the findings, the study employed several validation strategies, including source triangulation, method triangulation, member checking, and peer debriefing. Data were collected from multiple participants and sources to enhance credibility and reduce potential bias. Participants were given opportunities to review and confirm interview transcripts and preliminary interpretations. Furthermore, prolonged engagement in the research sites enabled a deeper understanding of the educational contexts and strengthened the dependability of the findings. Through these procedures, the study sought to provide a rigorous and comprehensive account of how AI-supported personalized learning is experienced and enacted within Islamic secondary education.

3. FINDINGS AND DISCUSSION

AI-Supported Personalized Learning as an Adaptive Learning Ecosystem

The findings indicate that AI-supported personalized learning has transformed the learning environment from a uniform instructional model into a more adaptive and learner-centered ecosystem. Across the three participating schools, AI technologies were utilized to provide individualized learning materials, adaptive assessments, automated feedback, and personalized recommendations. Teachers reported that AI-assisted platforms enabled them to identify students' learning needs more efficiently and adjust instructional strategies accordingly. Rather than delivering identical content to all learners, teachers were able to differentiate learning experiences based on students' abilities, interests, and progress.

Students also perceived AI-supported learning as beneficial because it allowed them to access learning resources according to their individual needs and learning pace (Gadzhimusieva et al., 2026; Luketi'c & Dikovi'cdikovi'c, 2026). Several students explained that AI-generated feedback helped them identify weaknesses and improve their understanding of difficult concepts. Classroom observations further revealed that students demonstrated greater independence in navigating learning activities and managing their own learning progress (Arefian, 2026; Gallo et al., 2026). These findings suggest that AI-supported personalized learning contributes to the creation of adaptive learning environments that support learner autonomy and individualized instruction.

The cross-case analysis revealed that although the three schools adopted different AI-based applications and digital platforms, they shared similar goals of enhancing learning flexibility and personalization. However, variations were observed in the level of technological infrastructure and teacher readiness, which influenced the effectiveness of implementation.

Table 1. Cross-Case Findings on AI-Supported Personalized Learning

Theme	School A	School B	School C
Adaptive Content	High	Moderate	High
Personalized Feedback	High	High	Moderate
Learning Flexibility	High	Moderate	High
Student Autonomy	High	High	Moderate
AI Integration Level	Advanced	Intermediate	Advanced

The findings support contemporary perspectives on personalized learning, suggesting that AI technologies facilitate adaptive instructional practices that respond to learner diversity. Consistent with learner-centered educational theories, personalized learning environments encourage students to become active participants in their educational experiences rather than passive recipients of information.

Enhancing Student Engagement through AI-Enhanced Learning Experiences

A second major finding concerns the influence of AI-supported personalized learning on student engagement. Data from interviews and observations revealed that AI-enhanced learning environments positively affected students' behavioral, emotional, and cognitive engagement (Ikram et al., 2026; Kassenkhan et al., 2026). Teachers consistently reported increased participation in classroom activities, particularly when AI-supported platforms provided interactive learning tasks and immediate feedback (Okada et al., 2025a; Sinclair, 2026a). Students indicated that personalized recommendations and adaptive learning pathways made learning more enjoyable and relevant to their interests.

Behavioral engagement was reflected in increased participation, assignment completion, and active involvement in learning activities. Emotional engagement emerged through students' enthusiasm, curiosity, and positive attitudes toward learning. Cognitive engagement was evident in students' willingness to explore additional learning resources, solve problems independently, and reflect on their learning progress. These findings demonstrate that AI technologies not only support instructional efficiency but also contribute to more meaningful and engaging learning experiences.

Observational data further revealed that students were more likely to remain focused during learning activities when digital platforms offered personalized challenges and instant feedback (Khalifeh et al., 2026; Meng et al., 2026). Teachers noted that students who previously demonstrated low motivation became more engaged when learning activities aligned with their interests and ability levels.

Table 2. Dimensions of Student Engagement Identified Across Cases

Engagement Dimension	Key Indicators	Evidence from Participants
Behavioral Engagement	Participation, attendance, task completion	Increased classroom participation
Emotional Engagement	Interest, enjoyment, motivation	Positive attitudes toward learning
Cognitive Engagement	Critical reflection, problem-solving, self-regulation	Deeper learning involvement
Social Engagement	Collaboration and interaction	Improved peer collaboration

These findings reinforce existing literature suggesting that engagement is strengthened when learning experiences are personalized and responsive to students' needs. AI-supported learning appears to create conditions that encourage active participation and sustained involvement in educational activities.

Developing Twenty-First-Century Competencies through AI-Supported Learning

The third major theme concerns the contribution of AI-supported personalized learning to the development of twenty-first-century competencies (Bircan et al., 2025; Okada et al., 2025b). Participants consistently reported that AI-enhanced learning environments encouraged students to develop skills associated with critical thinking, creativity, collaboration, and communication. Teachers emphasized that AI-supported learning activities often required students to analyze information, evaluate sources, solve complex problems, and generate innovative solutions.

Critical thinking emerged as one of the most prominent competencies developed through AI-assisted learning. Students frequently engaged in inquiry-based activities, information evaluation, and reflective learning tasks (Asad & Anwar, 2025; Gökçe & Nacaroglu, 2025a). Creativity was fostered through project-based learning activities supported by AI-generated resources and content recommendations. Collaboration skills developed through group assignments and digital learning platforms that facilitated communication and teamwork (Gan Erkan et al., 2026; Zorlu, 2025). Communication competencies were strengthened through presentations, discussions, and digital interactions within personalized learning environments.

Despite these positive outcomes, participants also identified several challenges. These included varying levels of digital literacy, unequal access to technological resources, and concerns regarding

excessive dependence on AI-generated information. Teachers emphasized the importance of maintaining human guidance and ethical considerations in AI-supported learning environments.

Table 3. Twenty-First-Century Competencies Developed through AI-Supported Learning

Competency	Learning Activities	Observed Outcomes
Critical Thinking	Problem-solving, inquiry tasks	Improved analytical skills
Creativity	Project-based learning, content creation	Increased innovation
Collaboration	Team assignments, digital interaction	Enhanced teamwork
Communication	Presentations, online discussions	Improved communication skills

Overall, the findings suggest that AI-supported personalized learning contributes significantly to the development of competencies required for success in the digital age (Annisa et al., 2026). The results indicate that AI functions not merely as a technological tool but as an educational catalyst that supports competency development through adaptive, engaging, and learner-centered experiences. In the context of Islamic secondary education, the integration of AI demonstrates considerable potential for enhancing educational quality while preparing students to navigate the challenges of an increasingly complex and technology-driven society (Gökçe & Nacaroglu, 2025b; Sinclair, 2026b).

4. CONCLUSION

This study explored the implementation of AI-supported personalized learning and its contribution to student engagement and the development of twenty-first-century competencies in Islamic secondary schools in Indonesia. The findings indicate that AI-supported personalized learning functions as an adaptive learning ecosystem that transforms traditional instructional practices into more learner-centered and responsive educational experiences. Through personalized content, adaptive feedback, and flexible learning pathways, AI technologies enable students to learn according to their individual needs and learning progress. As a result, students demonstrate greater autonomy, motivation, and participation in learning activities, suggesting that AI can play a significant role in enhancing the quality of educational experiences within Islamic secondary education.

The study further reveals that AI-enhanced learning environments contribute positively to behavioral, emotional, and cognitive engagement. Personalized learning experiences encourage students to become more actively involved in classroom activities, develop stronger interest in learning, and engage more deeply with educational content. In addition, the findings show that AI-supported personalized learning facilitates the development of twenty-first-century competencies, particularly critical thinking, creativity, collaboration, and communication skills. By supporting inquiry-based learning, problem-solving activities, and collaborative interactions, AI technologies create opportunities for students to acquire competencies that are increasingly essential in contemporary society and future workplaces.

This study contributes to the growing literature on artificial intelligence in education by providing empirical evidence from the relatively underexplored context of Islamic secondary schools. The findings suggest that the successful integration of AI in education requires not only technological infrastructure but also teacher readiness, digital literacy, and institutional support. Therefore, educational policymakers, school leaders, and teachers should view AI-supported personalized learning as a strategic approach to strengthening student engagement and fostering future-oriented competencies. Future research may expand this inquiry by examining diverse educational contexts and exploring the long-term impact of AI-assisted learning on educational outcomes and institutional transformation.

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