



Models and strategies for implementing adaptive learning in madrasah ibtidaiyah/elementary school

Alfan Nur Azizi

Universitas Islam Negeri Maulana Malik Ibrahim Malang

e-mail: alfannurazizi@uin-malang.ac.id

ABSTRACT

This study highlights how artificial intelligence-powered adaptive learning offers a meaningful solution to address diverse learning needs and improve educational outcomes for young students in madrasah ibtidaiyah/elementary school. Despite its potential, implementation faces significant challenges, including limited technological infrastructure, insufficient teacher training, and inflexible curricula. While many studies explore adaptive learning in general, a clear gap remains in understanding its application to primary education in Indonesia. To address this, the present research conducted a scoping review of literature from 2015 to 2025 using a qualitative descriptive approach guided by PRISMA 2020. The review identifies four key models—Personalized Learning, Differentiated Instruction, Adaptive Inquiry Learning, and Hybrid Adaptivity—and proposes three practical approaches: real-time AI personalization, flexible curriculum development, and empowering teachers as caring, data-informed facilitators. Ultimately, the findings emphasize a human-centered approach in which technology serves as a supportive tool that enhances, rather than replaces, teachers' professional judgment, thereby supporting more equitable, engaging, and nurturing learning experiences for young children.

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1. INTRODUCTION

Adaptive Learning is an adaptive form of instruction that modifies materials and methods according to the characteristics of individual students. Recent studies reveal its considerable potential to enhance the quality of education in madrasah ibtidaiyah/elementary school (Rosa et al., 2024). This paradigm shift revolves around the student as it acknowledges that each student has a unique way of learning, thinking, and addressing personal needs (Rizka et al., 2025).

Contrary to this, the traditional “one-size-fits-all” model often does not suffice in heterogeneous classrooms since conventional pedagogy tends to neglect the underlying issues that vary among students (Rizka et al., 2025). In practice, adaptive learning allows educators to plan responsive pathways that are sensitive to students' strengths, weaknesses, and interests, thus preventing any learner from being left behind (Kraf & Simbolon, 2025). This framework is underpinned by the idea of differentiated instruction, which recognizes that students vary widely in their preferred learning styles and provides a range of methods to maximize engagement and success for all learners (Maulidia & Prafitasari, 2023).

This technique becomes even more powerful when combined with artificial intelligence. AI enables personalized learning at scale by analyzing student interactions, identifying patterns in learning behaviors, and automatically recommending appropriate content (Alenezi, 2023). One of the primary advantages of AI in adaptive learning is real-time personalization. AI systems provide

instantaneous insights into a students' current progress, skills, and learning gaps, allowing educators to make timely adjustments to teaching activities (Widodo et al., 2024). This not only creates a more individualized experience for each learner but also streamlines grading and classroom management (Herlambang et al., 2024). Moreover, artificial intelligence delivers personalized feedback that can significantly enhance student motivation and engagement levels (Prayoga et al., 2025). AI-based technologies, such as machine learning, chatbots, and augmented reality, further elevate educational quality by delivering content tailored to each students' needs and interests (Huda & Suwahyu, 2024).

That said, the potential of AI to reduce learning gaps and improve student outcomes is substantial. Adaptive learning approaches, in particular, show strong promise in narrowing achievement gaps and advancing the quality of education in madrasah ibtidaiyah/elementary school (Ansor et al., 2023). Nevertheless, large-scale implementation faces several challenges. These include (1) inadequate technological infrastructure and stable internet access in many regions, which hinders the effective use of devices and online resources (Callaghan et al., 2024); (2) limited teacher training on technological tools and the gradual adaptation to new pedagogical approaches (Triwiyanto et al., 2024); and (3) difficulties faced by educators in planning and allocating resources for differentiated instruction (Rina & Hasanah, 2024). Furthermore, primary education often struggles with personalization because younger children tend to fall behind, while gifted students in subjects such as mathematics or languages require additional challenges to remain engaged (Rambe, 2024).

The discrepancy between theoretical knowledge and practical implementation underscores an urgent need for actionable recommendations and verifiable solutions. Previous studies have consistently demonstrated a strong positive relationship between the use of AI-based adaptive tools and improved academic outcomes (Sappaile et al., 2024). However, there remains a lack of systematic reviews that synthesize available methods and assess the acceptability of user-friendly interfaces for these tools. Such a review should be data-driven and context-specific to Madrasah Ibtidaiyah (MI) and elementary school (SD) settings.

It is within this context that the issues of reusing and reproducing research findings become particularly significant, necessitating a multidisciplinary approach. This forms the primary rationale for the present study: to review (a) adaptive learning models best suited for madrasah ibtidaiyah/elementary school environments and (b) optimal implementation strategies that leverage artificial intelligence. The study aims to generate both theoretical insights and practical guidance for teachers and policymakers. Ultimately, this research seeks to harness AI to support personalized e-learning, thereby enhancing the quality of elementary education (Gligorea et al., 2023).

Accordingly, the study proposes the strategic integration of AI in developing data-driven adaptive learning tools (Luon et al., 2025). This involves strengthening the technological infrastructure, providing comprehensive teacher training, and formulating education policies that actively support AI adoption (Lubis et al., 2024).

Adaptive learning is an approach that modifies what and how something is taught based on each students' individual needs. It holds significant promise for enhancing teaching quality in madrasah ibtidaiyah/elementary school (Rosa et al., 2024). This approach is needed because it supports the learning environment in identifying and responding to the fact that every person is different from another, so that no learner is left behind (Kraf & Simbolon, 2025). Adaptive learning is a personalized approach that employs technology and intelligent algorithms to adjust

content, achievement strategies, and pace based on students' engagement (Gligorea et al., 2023). In addition, it could also encourage various learning strategies based on students' diverse capabilities (Maulidia & Prafitasari, 2023). This is a more effective and meaningful way of learning (Sukiastini et al., 2024), especially for explaining complex concepts, and it also provides individual access for students who have difficulties with traditional materials at their own pace.

While teachers often struggle with planning and resource deployment (Rina & Hasanah, 2024), this model might improve students' learning experience by transforming how teaching is delivered. While these problems remain, AI offers a way to personalize each students' learning, which could make the training experience more efficient and relatable for all (Widodo et al., 2024).

The higher the frequency of using AI-based adaptive learning tools, the greater the improvement in students' academic performance (Sappaile et al., 2024). Data collected by government and statutory bodies from various sources highlight that the adoption of novel technologies is essential for creating situational, adaptive, and motivational learning environments while strengthening the necessary infrastructure readiness (Widianto et al., 2025). This capability enables AI-powered adaptive learning to effectively bridge educational gaps (Ansor et al., 2023) and enhance students' overall learning performance (Rambe, 2024). The importance of this approach is particularly evident in primary schools, which often adopt overly competitive teaching methods that overlook students who fall behind while failing to sufficiently challenge those who are gifted (Rambe, 2024).

An AI-based adaptive learning system allows schools to monitor students' current progress in real time and make immediate instructional adjustments. By offering a personalized perspective on each learner's journey, this approach provides targeted educational support (Li, 2020). These systems empower students to learn at their own pace and tailor instructional methods to individual needs (Maola et al., 2024). Furthermore, artificial intelligence can deliver timely personalized feedback, adapt learning plans according to students' unique styles, quickly identify areas of difficulty, and sustain motivation by maintaining high levels of engagement (Ronsumbre et al., 2023).

Research on interactive adaptive learning with artificial intelligence has largely focused on personalized lessons, analysis of student data, and content recommendations. While many studies address broader educational technology issues (Kochmar et al., 2022), more specific research is still needed to clarify suitable models, requirements, and challenges for implementing adaptive learning at the primary school level. When deploying AI in education, inclusion principles are critically important to prevent a widening digital divide (UNESCO, 2021). Equal access, teacher readiness, and data ethics must also be prioritized (Annawa UBM et al., 2026). UNESCO (2021) further emphasizes that AI should facilitate teaching, learning, and assessment in a human-centered manner that promotes equity and inclusivity for all learners.

This study seeks to bridge a critical gap by establishing a direct linkage between adaptive learning models and the specific instructional needs of madrasah ibtidaiyah/elementary school. While earlier research has often treated AI applications, digital media, and differentiated instruction as separate domains, the present article offers a comprehensive overview of four key adaptive learning models—Personalized Learning, Differentiated Instruction, Adaptive Inquiry Learning, and Hybrid Adaptivity—and connects them to three practical implementation strategies in primary education: leveraging AI to facilitate personalized learning, developing a more flexible curriculum, and supporting teachers as data-informed facilitators (Bach et al., 2025).

The article also presents a practical madrasah ibtidaiyah/elementary school model along with actionable steps for educators to individualize content, processes, pacing, and feedback according to each students' needs (Sunaryati et al., 2025). Building upon this foundation, the study aims to integrate suitable adaptive learning models for madrasah ibtidaiyah/elementary school contexts and to explore AI-driven strategies that are not only pedagogically effective but also contextually meaningful, while actively advancing fairness, equity, and educational opportunities for all learners (Zakariyah et al., 2026).

2. METHOD

This study employed a systematic literature review with a qualitative descriptive approach to synthesize available evidence. This method was selected because the research objectives focused on identifying, appraising, and synthesizing existing literature on adaptive learning models and their implementation strategies in madrasah ibtidaiyah and elementary school settings. By adopting explicit, transparent, and replicable procedures, a systematic literature review enables researchers to gather and interpret relevant evidence while minimizing selection bias and enhancing the credibility of the synthesis (Azarian et al., 2023; Bolaños et al., 2024; Kitchenham, 2004). The reporting of this study adhered to the PRISMA 2020 guidelines, which provide a structured process for identifying, screening, and including relevant studies in the review (Page et al., 2021).

A purposive search was conducted across five major academic databases: Google Scholar, ERIC, Scopus, Web of Science, and DOAJ. The keywords were carefully designed to capture both Indonesian and international publications in both languages. Search terms included “pembelajaran adaptif MI”, “pembelajaran adaptif SD”, “model pembelajaran adaptif”, “adaptive learning primary school”, “AI in primary education”, “personalized learning primary education”, and “differentiated instruction elementary school”. To ensure alignment with recent developments in adaptive learning, artificial intelligence, and elementary education, the search was limited to studies published from 2015 onwards, in accordance with the predefined inclusion and exclusion criteria.

The PRISMA 2020 guidelines were followed to establish the inclusion criteria, which were as follows: (1) studies addressing adaptive learning models, adaptive learning strategies, personalized learning, differentiated instruction, and/or AI-supported learning; (2) research conducted in madrasah ibtidaiyah/elementary school or equivalent primary education contexts; (3) publications in Indonesian or English; (4) studies drawing on empirical data or providing extended conceptual frameworks; and (5) articles containing sufficient methodological and thematic information for data extraction. The exclusion criteria were: (1) studies focused on educational levels other than primary education; (2) research on educational technology in general without specific relevance to adaptive learning; (3) non-academic sources such as popular articles or opinion papers; (4) references without full-text availability; and (5) duplicate studies in terms of funding source or research domain.

The article selection process comprised four main stages. An initial search across five databases yielded 182 records: Google Scholar ($n = 78$), ERIC ($n = 24$), Scopus ($n = 31$), Web of Science ($n = 22$), and DOAJ ($n = 27$). After removing 36 duplicates, 146 articles underwent title and abstract screening. In the next stage, 91 articles were excluded because they did not align with the research focus—either by failing to address madrasah ibtidaiyah/elementary school

contexts, lacking coverage of adaptive learning methods, or discussing digital learning in overly general terms. This left 55 articles for full-text evaluation. After careful assessment, 20 additional articles were excluded for the following reasons: six did not focus on madrasah ibtidaiyah/elementary school or elementary education; four addressed AI broadly without linking it to adaptive learning strategies; three lacked sufficient empirical data or conceptual depth; three provided inadequate methodological information; and two focused solely on differentiated instruction without addressing adaptivity or shared redundant findings with more comprehensive studies. Ultimately, 30 articles were included in the thematic and narrative synthesis.

Table 1. PRISMA-Based Article Selection Process

PRISMA Stage	Description	Number of Articles
Identification	Records identified from Google Scholar, ERIC, Scopus, Web of Science, and DOAJ	n = 182
Duplicate removal	Duplicate records removed	n = 36
Screening	Records screened by title and abstract	n = 146
Initial exclusion	Records excluded after title and abstract screening	n = 91
Full-text retrieval	Articles sought for full-text assessment	n = 55
Full text unavailable	Articles excluded because the full text was not available	n = 5
Eligibility	Full-text articles assessed for eligibility	n = 50
Full-text exclusion	Articles excluded after full-text assessment	n = 20
Inclusion	Articles included in the final synthesis	n = 30

The quality assessment was conducted using the critical appraisal principles of the Joanna Briggs Institute (JBI) and the Critical Appraisal Skills Program (CASP). These tools evaluated each study for its relevance, methodological clarity, and trustworthiness in relation to the focus of this research. A coding template was developed comprising five key indicators: relevance to madrasah ibtidaiyah/elementary school contexts, clarity of research objectives, methodological rigor, relevance of findings to adaptive learning, and contribution to adaptation or implementation strategies. Studies that met the established quality criteria were included in the synthesis, while those with insufficient methodological or thematic relevance were excluded.

Thematic analysis, combined with narrative synthesis, was used to interpret the data. The analytical process comprised three main steps. First, all selected articles were read thoroughly to gain a comprehensive understanding of their research questions, adaptive learning models, implementation strategies, and associated challenges. Second, relevant findings were coded and grouped into broader themes, including Personalized Learning, Differentiated Instruction, Adaptive Inquiry Learning, Hybrid Adaptivity, AI-supported personalization, curriculum flexibility, and the role of teachers as facilitators of learning. Third, these themes were narratively synthesized to construct a conceptual framework for implementing AI-enabled adaptive learning models in madrasah ibtidaiyah/elementary school contexts.

3. RESULT AND DISCUSSION

Critical Synthesis of Adaptive Learning Models in Madrasah Ibtidaiyah/Elementary School

The findings of this review highlight that implementing adaptive learning in madrasah ibtidaiyah/elementary school contexts requires far more than simply providing tablets or adopting the latest artificial intelligence tools. At its core, adaptive learning is a deeply human-centered pedagogical framework that thoughtfully integrates student data, teachers' professional judgment, flexible lesson plans, and the specific needs of local communities. Among the reviewed studies, four core models emerged as particularly relevant: Personalized Learning, Differentiated Instruction, Adaptive Inquiry Learning, and Hybrid Adaptivity. Although all four models aim to address the unique needs of individual students, they differ significantly in their reliance on technology, the demands they place on teachers, and their practical feasibility in real classroom settings.

Personalized Learning is often regarded as an umbrella term encompassing various educational approaches that seek to honor the unique talents, backgrounds, and learning trajectories of every student (Shemshack & Spector, 2020). This model emphasizes the creation of individualized learning pathways. It aligns particularly well with artificial intelligence systems that can deliver immediate feedback and personalized recommendations, functioning essentially as digital one-to-one tutors (Gligorea et al., 2023; Shemshack & Spector, 2020; Widodo et al., 2024). However, successful implementation depends heavily on adequate technological infrastructure, reliable internet access, sufficient devices, and teachers who are confident in interpreting digital data (Callaghan et al., 2024; Triwiyanto et al., 2024). Without these supporting conditions, technology-driven personalization risks exacerbating educational inequalities rather than reducing them (Moltudal et al., 2022).

Differentiated Instruction appears to be the most suitable model for many primary school teachers, as it requires no expensive technological devices. This model is grounded in differentiated strategies encompassing content, process, product, and learning environment, all of which are adjusted according to students' readiness, interests, and abilities (Nugroho et al., 2025). It is built on the premise that every student possesses unique strengths, often described through the lens of multiple intelligences, and that teaching approaches should accommodate these differences (Anshori, 2025). The reviewed studies affirm that this model effectively moves away from the traditional "one-size-fits-all" approach (Maulidia & Prafitasari, 2023; Rina & Hasanah, 2024). Nevertheless, its main challenge lies in the additional workload it places on teachers, who must prepare multiple lesson variations while managing administrative duties and working with limited resources.

Adaptive Inquiry Learning centers on problem-solving and exploration, driven by student curiosity. In this model, adaptation occurs primarily through scaffolding — the temporary, tailored support provided by teachers to help students master new concepts and develop independent critical thinking. For young learners in madrasah ibtidaiyah/elementary school settings who are still developing these skills, such scaffolding is essential. Here, AI and digital tools should function merely as supportive mechanisms that signal when a student needs additional guidance or a greater challenge. Technology cannot replace the warm relationships and professional judgment that teachers bring to the classroom, a point consistently emphasized by educators (Moltudal et al., 2022).

Hybrid Adaptivity represents a balanced and realistic middle ground for many schools. It combines the strengths of teacher guidance with digital assistance (Rosyidah et al., 2025). Rather than full automation, this model promotes the use of simple technology and formative assessments that enable teachers to make informed instructional decisions. Successful implementation requires more than tools; schools must foster a supportive culture that provides teachers with adequate time and training to innovate (Rahmawanti & Dinata, 2025). By integrating high-tech personalization with traditional teaching practices, hybrid adaptivity offers a scalable pathway for improving adaptive learning in madrasah ibtidaiyah/elementary school education.

Table 2. Critical Comparison of Adaptive Learning Models in Madrasah Ibtidaiyah/Elementary School

Adaptive Learning Model	Main Focus	Strength in madrasah ibtidaiyah/elementary school context	Main Limitation	Implementation Implication
Personalized Learning	Individual learning path, pace, and content	Supports real-time personalisation and student-specific feedback	Requires data, devices, internet access, and teacher data literacy	Best used when schools have adequate digital infrastructure
Differentiated Instruction	Adjustment of content, process, product, and learning environment	Pedagogically flexible and can be applied without advanced technology	Increases teacher workload and requires careful lesson planning	Suitable for schools with limited technology but strong teacher capacity
Adaptive Inquiry Learning	Guided exploration, questioning, and problem-solving	Develops curiosity, critical thinking, and independent learning	Requires strong scaffolding for young learners	AI should support, not replace, teacher guidance
Hybrid Adaptivity	Combination of teacher-led instruction, digital tools, and adaptive feedback	Most realistic for diverse madrasah ibtidaiyah/elementary school conditions	Requires institutional support and a clear implementation design	Recommended as the most feasible model for gradual implementation

In summary, no single adaptive learning model is universally perfect for every school context. Personalized Learning offers powerful potential through advanced technology, but it depends heavily on robust digital infrastructure. Differentiated Instruction is a pedagogically sound and elegant approach that effectively addresses student diversity; however, it demands significant effort and creativity from teachers in real-world implementation. Adaptive Inquiry Learning can nurture deep thinking and independent exploration when properly guided. Ultimately, Hybrid Adaptivity emerges as the most practical and balanced pathway forward for madrasah ibtidaiyah/elementary school settings. It enables educators to implement adaptive strategies gradually while preserving essential human connections, professional judgment, and warm teacher-student relationships in the classroom.

Implementation Challenges and Strategic Synthesis

The on-field implementation of adaptive learning in madrasah ibtidaiyah/elementary school is not merely a technical upgrade; rather, it represents a profoundly human journey that demands careful preparation, compassion, and sustained support. The reviewed studies consistently highlight three major challenges confronting schools: achieving technological readiness, developing teacher confidence and professional capacity, and creating a truly flexible curriculum that addresses the diverse needs of every student.

Technological readiness remains the first and most fundamental obstacle. Effective adaptive learning requires reliable, high-speed internet, sufficient devices for all students, and robust data management systems that support AI-powered personalization. In many regions, the absence of basic infrastructure makes adaptive learning more of an aspirational ideal than a practical reality (Mirata et al., 2020). This issue is especially pronounced in madrasah ibtidaiyah/elementary school settings, where disparities in funding and digital access are frequently tied to geographical location (Rahmatika & Sulasmi, 2025).

Teacher competence lies at the heart of the successful implementation of adaptive learning. A key insight from the reviewed studies is that teachers are not mere users of technology but the central designers and facilitators of the entire learning experience (Rincón-Flores et al., 2024). While AI can generate valuable data and provide immediate feedback, it cannot replace a teacher's deep understanding of a student's emotional, social, and developmental needs. Therefore, continuous professional development is essential—not focused solely on operating digital tools, but on developing skills in data interpretation, personalized scaffolding, and supporting holistic student growth (Rahmatika & Sulasmi, 2025; Simon & Zeng, 2024).

Curriculum flexibility constitutes the third critical pillar that enables genuine adaptive learning in madrasah ibtidaiyah/elementary school settings. A rigid curriculum often hinders teachers' ability to adjust pacing, content, or materials for students who are struggling or those who need greater challenges. In contrast, a flexible curriculum celebrates the individual backgrounds, interests, and abilities of each student while maintaining clear learning objectives and multiple pathways to success (Almeida-Albuja & Bustos, 2025; Fernandes, 2024).

In light of these challenges, this study proposes a simple three-layer conceptual framework to guide schools in implementing adaptive learning. At its core, the framework emphasizes that technology in the classroom should serve people, not the other way around—positioning teachers and students as the central focus of the educational process (Khan et al., 2025; Peng et al., 2019).

Table 3. Conceptual Framework for AI-Supported Adaptive Learning in Madrasah Ibtidaiyah/Elementary School

Layer	Main Component	Function	Practical Example
Pedagogical Layer	Differentiation, inquiry, scaffolding, formative assessment	Ensures that teaching stays focused on the student's needs and growth.	A teacher gives different tasks to students based on what they already know.
Technological Layer	AI analytics, adaptive content, automatic feedback	Provides the tools to see student progress in real-time and offer help quickly.	A computer program suggests extra practice for a child who is stuck on a math problem.

Institutional Layer	Infrastructure, policy, teacher training, data ethics	Provides the foundation and rules needed to make the system last and stay fair.	The school holds a workshop for teachers to learn how to protect student privacy.
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At its core, this three-layer conceptual framework reaffirms that pedagogy must always take precedence. While discussing technological tools, it is essential to remember that these tools are ultimately used by and for people — both students and teachers. By placing human connection at the center of the learning process, artificial intelligence becomes a powerful supportive tool that helps every child in madrasah ibtidaiyah/elementary school settings reach their highest potential.

Conceptual Contribution of the Study

This study contributes to the literature on adaptive learning by providing a context-specific synthesis focused on madrasah ibtidaiyah/elementary school education. While previous research has often treated adaptive learning and artificial intelligence as separate technological tools, significant opportunities exist to enhance adaptation through emerging AI capabilities. However, these advancements remain largely unintegrated with practical frameworks that address real-world pedagogical and institutional needs in primary schools. The primary contribution of this research is the development of a comprehensive framework that integrates adaptive learning models with AI-enabled personalization, curriculum flexibility, and teacher facilitation.

Theoretically, this study shifts the discourse from a technology-centric to a pedagogy-centered approach. It connects four key models—Personalized Learning, Differentiated Instruction, Adaptive Inquiry Learning, and Hybrid Adaptivity—not as isolated strategies, but as interconnected components that teachers can flexibly employ according to their students’ needs (Moltudal et al., 2022). Within this framework, AI does not replace teachers; instead, it serves as a supportive tool for analyzing student progress and challenges, thereby enabling more responsive and personalized instructional activities (Gligorea et al., 2023; Widodo et al., 2024).

In practical terms, the study clarifies the evolving role of teachers in adaptive learning environments. Teachers transition from traditional content deliverers to “learning orchestrators” (Çelik et al., 2022) or “augmented teachers” (Seo et al., 2024). In this new role, AI handles administrative tasks such as grading and basic assessments, allowing teachers to devote more time to one-on-one attention, emotional support, and moral guidance—elements that are especially vital for young learners in madrasah ibtidaiyah/elementary school settings (Fitas, 2025). This teacher-facilitated integration ensures that technology enhances rather than diminishes meaningful human experiences in the classroom (Moltudal et al., 2022).

Finally, this research demonstrates that Hybrid Adaptivity offers the most inclusive and feasible model for madrasah ibtidaiyah/elementary school education. By combining teacher-led instruction with flexible digital tools, adaptive learning can be implemented progressively, significantly lowering barriers related to infrastructure and training (Khan et al., 2025). This “pedagogy-first” approach ensures that technological innovation remains equitable and sustainable. Overall, the framework provides a practical roadmap for educators and policymakers to create learning environments that are not only more effective but also fundamentally human-centered and fair for every child.

4. CONCLUSION

This study concludes that adaptive learning has great opportunities to improve the quality of madrasah ibtidaiyah/elementary school learning, which can respond to students' different abilities and overlapping interests, needs, and development. Four models emerged as adaptive learning interventions in the madrasah ibtidaiyah/elementary school context from the systematic literature review: Personalized Learning, Differentiated Instruction, Adaptive Inquiry Learning, and Hybrid Adaptivity. These models have different advantages. Personalized Learning has individual learning paths and provides immediate feedback. Differentiated Instruction allows the teacher to modify content and how it is being learned. Adaptive Inquiry Learning teaches how to explore and solve problems, whereas the Hybrid Adaptivity Model provides the most accurate representation of madrasah ibtidaiyah/elementary school by combining teacher-directed instruction, individualized strategies, formative assessment, and AI-powered aids.

The results suggest that technology adoption should not be the only consideration for adaptive learning implementation in madrasah ibtidaiyah/elementary school. Using artificial intelligence can help with large-scale personalization as it has the ability to track their progress of learning, identify their strengths and weaknesses, provide recommendations for improving areas or topics in which they are struggling, and provide adaptive feedback that changes according to how well a student does. However, AI should be more like a support system and not a complete counter for teachers. Teachers continue to be at the center of learning design, facilitation, data interpretation, and ethical decision-making. It is more vital in madrasah ibtidaiyah/elementary school because primary school students still need the accessibility of direct, hands-on support from an adult for emotional availability, social skills awareness, and developmental scaffolding.

The review underscores three essential conditions for successful implementation: technological readiness, curriculum flexibility, and teacher competency. Achieving technological readiness involves access to digital platforms, devices, connectivity, and learning data systems. Curriculum flexibility can be fostered by teachers who are supervised and held accountable, enabling them to adapt learning objectives, materials, tasks, and assessment strategies to meet the needs of specific students. Teacher competence is crucial, as adaptive learning extends beyond mere technology; while these tools are vital, the true challenge lies in teachers' ability to analyze and interpret data effectively, with the aim of making pedagogically sound decisions.

This study's key contribution is the development of an integrated conceptual framework for AI-enhanced adaptive learning systems in madrasah ibtidaiyah/elementary school. Grounded in educational theory, the framework emphasizes pedagogy-first approaches, utilizing AI to support instructional decisions rather than replacing the learning process itself. Given this, the most feasible way to serve madrasah ibtidaiyah/elementary school effectively is through Hybrid Adaptivity. This approach facilitates the implementation of adaptive learning, especially for schools that are gradual in adopting new technologies, helping organizations align their infrastructure, teacher readiness, and institutional support.

Future research should test this idea in real classrooms to see if it works. Future studies can also look into how AI helps students learn better, stay interested, and become more independent, while being fair to everyone. Other important questions include how to protect students' data, how prepared teachers are, and how to keep adaptive learning running smoothly in schools with different levels of technology.

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