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Adaptive Online Learning and Student Success: Exploring the Role of AI-Powered Personalized Pedagogies in Higher Education

Halimatus Sa'diyah*, Nadia Kholifatul Khoir
Universitas Nurul Jadid, Indonesia
Email: *Sadiyahaja25@gmail.com*

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Correspondence Address:
Sadiyahaja25@gmail.com

Abstract :
This study aims to examine the role of AI-powered personalized pedagogies in adaptive online learning and their contribution to student success in secondary education. A qualitative case study was conducted at school, selected for its digital learning context. Data were collected through interviews, observations, and documentation involving school leaders, teachers, and students. Data were analyzed through data condensation, data display, and conclusion drawing and verification, with credibility strengthened through source, technique, and time triangulation. The findings show that AI-powered personalization supported students through explanations, adaptive resources, timely feedback, and assistance aligned with learning difficulties and learning pace. These practices strengthened engagement, learning autonomy, persistence, and understanding, while teacher guidance remained essential for interpreting AI recommendations and maintaining direction. The study concludes that AI can function as a pedagogical mediator for adaptive learning when technology, teacher facilitation, and student agency operate together. The findings imply that institutions should strengthen AI literacy, teaching competencies, responsible-use guidelines, data protection, and evaluation mechanisms.

INTRODUCTION

Artificial Intelligence (AI) is increasingly reshaping higher education, making adaptive online learning an important societal issue because students need flexible pathways that respond to diverse abilities, circumstances, and learning goals. The central point is that educational quality increasingly depends on institutions' capacity to provide timely, relevant, and individualized support. The reason is that conventional online courses often deliver identical materials despite differences in prior knowledge, learning pace, motivation, and digital competence. Evidence indicates that AI can support adaptive feedback, personalized recommendations, intelligent tutoring, and learning analytics that help educators respond to learner differences. Therefore, AI-powered personalized pedagogies are important not simply for technological modernization, but for improving educational responsiveness and inclusion. Their effective development can contribute to student success by strengthening persistence, engagement, learning progress, and academic achievement across diverse higher education contexts today in

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contemporary higher education systems.

Despite the promise of adaptive learning, many students still encounter standardized online instruction that provides limited differentiation and delayed academic support. This problem is important when students experience different levels of preparedness, motivation, access, and learning difficulty. A uniform online course can make struggling students fall behind while offering insufficient challenge to advanced learners. Lecturers also face difficulties monitoring individual progress, interpreting learning data, and providing timely feedback to large groups. AI introduces possibilities for addressing these limitations, yet its use creates concerns about inaccurate recommendations, privacy, algorithmic bias, excessive automation, and student dependence. The general problem, therefore, is not the absence of digital learning tools, but the difficulty of transforming them into adaptive pedagogical systems that genuinely support student success. Without intentional design, AI may increase efficiency without improving learning quality. This situation requires research examining how personalization, pedagogy, and human facilitation can operate together effectively in practice today overall.

The phenomenon in higher education shows that students increasingly expect online learning environments to respond immediately to their questions, progress, interests, and academic difficulties. AI-powered tools are used to explain concepts, recommend resources, generate practice questions, provide feedback, summarize materials, and support independent study. Lecturers are likewise experimenting with AI for instructional planning, assessment, and learner monitoring. This development reflects a shift from static digital courses toward more interactive and adaptive learning experiences. Nevertheless, actual practices remain uneven. Some students use AI strategically to understand difficult content, whereas others rely on generated answers without evaluation. The phenomenon indicates a gap between technological availability and pedagogical maturity. Understanding how AI-powered personalization operates is essential for determining whether adaptive online learning genuinely supports student success rather than simply increasing access to automated educational assistance across diverse higher education settings and contexts worldwide.

Previous studies have established that artificial intelligence can enhance online learning through adaptive systems, intelligent tutoring, automated feedback, learning analytics, and personalized recommendations. Research on AI in higher education has also demonstrated potential benefits for engagement, self-regulated learning, academic performance, and learner support. However, existing research often concentrates on technological effectiveness, user acceptance, or isolated learning outcomes. Personalization is frequently measured through system functionality rather than pedagogical processes connecting AI recommendations with students' actual learning experiences. Moreover, studies sometimes treat student success as a final performance indicator without examining how adaptive support influences engagement, autonomy, persistence, and academic decision-making. The present research examines AI-powered personalized pedagogy as an integrated process in which technology, teachers, and students interact. This perspective addresses an important gap between adaptive technology and meaningful educational practice within contemporary digital higher education environments and practices today overall.

A further research gap concerns limited contextual understanding of how AI-powered personalization is enacted through everyday pedagogical interactions. Although

adaptive technologies can identify patterns in learner behavior, personalization does not automatically produce meaningful learning. Students must understand, interpret, and act upon recommendations, while lecturers must determine whether AI-generated support aligns with curricular objectives and individual needs. Previous literature provides limited explanation of how adaptive learning influences student success through interconnected processes of feedback, engagement, autonomy, and persistence. The present study addresses this limitation by examining these processes within a real educational context and combining perspectives from educators and students with observations and documentation. Its contribution is therefore not merely to confirm that AI can personalize learning, but to explain how personalization becomes pedagogically meaningful. Resolving this gap is important because institutions need guidance for implementing AI systems that improve student experiences while preserving human judgment, educational responsibility, and equitable access for students and institutions alike.

The state of the art in this study lies in conceptualizing AI-powered personalized pedagogy as a human-mediated adaptive learning process rather than a purely technological function. The study connects AI-supported recommendations, individualized feedback, student agency, and teacher facilitation with broader dimensions of student success, including engagement, persistence, understanding, and independent learning. This approach shifts attention from whether an AI system can adapt toward how adaptive support is interpreted and integrated into actual learning practices. The issue is important because rapid AI adoption may otherwise produce fragmented systems that personalize content without developing learners' capacity to manage their own learning. A human-centered adaptive model can help institutions balance automation with pedagogical judgment, efficiency with meaningful interaction, and personalization with educational equity. By examining these relationships in a real school context, the research provides evidence for designing AI-supported learning environments that are responsive, responsible, and aligned with educational goals for equitable, responsible, inclusive, and effective online higher education transformation across institutions worldwide.

The research problem concerns how AI-powered personalized pedagogies can be implemented in online learning to support student success while maintaining meaningful teacher involvement and student agency. The question is whether those recommendations influence students' learning experiences, participation, persistence, and progress. The study argues that AI is likely to improve student success when adaptive support is connected with purposeful instructional design, timely feedback, differentiated resources, and teacher guidance. This argument assumes that personalization functions through an interaction among technology, learner needs, and pedagogical decisions rather than automation alone. Students may benefit when AI helps them identify difficulties, access suitable resources, and receive immediate assistance, while teachers interpret learning information and provide contextual support. Therefore, the provisional argument is that AI-powered personalized pedagogy can strengthen student success when adaptive technology operates as a pedagogical mediator within a human-centered learning ecosystem rather than as a replacement for educational expertise within diverse educational contexts today overall.

This study further argues that adaptive online learning should be understood as a cycle of identifying learning needs, providing individualized support, monitoring

responses, and refining learning opportunities. AI can accelerate this cycle by processing learning information and generating timely recommendations, while teachers provide the contextual judgment needed to interpret those recommendations. Students remain active participants because they must respond to feedback, regulate learning strategies, and communicate difficulties. The expected contribution is an explanation of how AI-powered personalization can connect adaptive support with student success through engagement, autonomy, persistence, and improved understanding. The practical implication is that institutions should not prioritize AI adoption solely on advanced technical features. Instead, they should establish pedagogical guidelines, teacher competencies, student AI literacy, data protection, and mechanisms for evaluating learning impact. Examining this integrated process can provide evidence for sustainable adaptive online learning and help higher education institutions develop personalized environments that remain equitable, transparent, and educationally purposeful for institutions worldwide.

RESEARCH METHOD

This study employed a qualitative approach using a case study design to examine AI-powered personalized pedagogies in adaptive online learning and their contribution to student success. The case study design was selected because the research focused on a contemporary phenomenon within its natural educational context and sought to understand the experiences, practices, interactions, and perspectives of educational actors in depth. This approach enabled the researcher to investigate how AI was integrated into learning activities, how teachers responded to individual learning needs, and how students experienced personalized support. The qualitative design was also appropriate for identifying processes that could not be adequately captured through numerical measures alone, including students' perceptions, learning strategies, teacher facilitation, and challenges in AI implementation. The case study further allowed the researcher to integrate multiple sources of evidence to develop a comprehensive interpretation. Thus, the design was considered appropriate for explaining how AI-powered personalized pedagogy operated within authentic educational practices.

The research was conducted at SMA Nurul Jadid, which was purposively selected because it provides a relevant educational setting for examining AI-supported adaptive learning. The school was selected based on its engagement with digital learning practices and its potential to demonstrate how AI can be incorporated into learning while maintaining teacher facilitation and student participation. The educational context of SMA Nurul Jadid also provides an appropriate setting for investigating the interaction between technological innovation, pedagogical practice, and student learning needs. Research participants were selected purposively based on their direct involvement in technology-supported learning activities and their ability to provide substantive information about the phenomenon. The informants included school leaders, teachers, and students. Their perspectives were considered important for understanding how AI-powered personalization was implemented, how students responded to adaptive support, how teachers guided its use, and what factors supported or constrained its contribution to student success in the learning process.

Data were collected through in-depth interviews, observations, and documentation. Interviews were conducted with selected informants to explore their experiences, perceptions, strategies, and challenges related to AI-powered personalized

learning. Questions focused on how teachers identified students' learning needs, how AI was used to provide individualized assistance, how students responded to recommendations, and how personalized support influenced engagement, autonomy, persistence, and understanding. Observations were conducted to examine learning practices directly, including students' interactions with AI, responses to feedback, participation in learning activities, and teacher facilitation. Documentation was used to complement interview and observation findings through learning materials, lesson plans, student assignments, digital learning records, and relevant institutional documents. Data were analyzed interactively through data condensation or reduction, data display, and conclusion drawing and verification. During condensation, relevant information was selected, coded, categorized, and organized around themes concerning AI personalization, adaptive support, student success, teacher facilitation, and implementation challenges.

Data credibility was established through source, technique, and time triangulation. Source triangulation involved comparing information obtained from school leaders, teachers, and students to identify consistencies and differences regarding AI-powered personalized learning. Technique triangulation was conducted by comparing interview findings with observation and documentation data to ensure that interpretations were supported by multiple forms of evidence. Time triangulation involved collecting and comparing information at different stages of the research process to examine the consistency of participants' responses and observed learning practices. Member checking was also conducted by presenting selected interpretations and preliminary findings to relevant informants for confirmation. Peer discussion was used to examine the logic, coherence, and plausibility of the researcher's interpretations. These procedures strengthened the credibility, dependability, confirmability, and transferability of the findings. The combination of triangulation, member checking, and peer discussion ensured that the conclusions represented the experiences and practices surrounding AI-powered personalized pedagogy at SMA Nurul Jadid rather than isolated observations.

RESULT AND DISCUSSION

Result

AI-Powered Personalized Pedagogy and Student Success

AI-powered personalized pedagogy was operationally defined in the field as the use of Artificial Intelligence to provide learning assistance that responds to students' individual needs, learning difficulties, interests, abilities, and learning pace. At SMA Nurul Jadid, personalization appeared through AI-supported explanations, additional examples, recommended resources, immediate feedback, and assistance with difficult learning tasks. The practice did not position AI as a replacement for teachers; instead, AI functioned as an additional learning mediator that expanded opportunities for students to obtain support beyond conventional classroom interaction. Student success was reflected through improved understanding, greater engagement, increased learning autonomy, persistence in completing tasks, and willingness to seek clarification. The operational definition therefore connected technological adaptation with pedagogical processes. Personalization became meaningful when students actively communicated their needs, interpreted AI-generated responses, and applied the assistance to learning tasks under teacher guidance.

An interview with a teacher indicated that AI helped accommodate differences in

students' learning abilities. The teacher explained, "Students do not understand the material at the same level. Some need repeated explanations, so I allow them to use AI to ask for simpler explanations or additional examples." This statement indicates that AI expanded the teacher's capacity to provide differentiated learning support. The researcher interprets the finding as evidence that personalization was not limited to automated recommendations but also involved teacher-directed use of AI to address individual learning difficulties. Students could obtain additional explanations without requiring the teacher to repeat identical material individually for every learner. This practice potentially created greater flexibility in the learning process because students could access assistance according to their immediate needs. The finding also demonstrates that teacher facilitation remained important because AI was introduced within an intentional instructional framework rather than being used independently without pedagogical direction.

A student provided a complementary perspective, stating, "When I do not understand a topic, I ask AI to explain it in simpler words or give another example. After that, I can continue the assignment." This statement demonstrates that students experienced personalization directly through flexible and immediate learning assistance. The researcher interprets the finding as evidence that AI supported learning continuity by reducing interruptions caused by conceptual difficulties. Instead of stopping an activity or waiting for the next teacher explanation, students could seek supplementary assistance and continue working. The finding also suggests that personalized AI support contributed to learner autonomy because students were able to identify their own difficulties and determine the type of assistance required. However, autonomy did not imply independence from teachers. Students still needed teacher guidance to determine whether AI-generated information was accurate and relevant. Thus, personalization emerged through the interaction between student initiative, AI responsiveness, and teacher supervision.

Classroom observations showed that students used AI according to different learning needs and stages of task completion. Some students requested simplified explanations, while others searched for examples, alternative perspectives, or additional resources. Students also demonstrated different patterns of interaction, including repeated questioning when the initial response was unclear. Several students compared AI-generated explanations with teacher-provided materials before incorporating information into assignments. The researcher interprets this observation as evidence of differentiated learning behavior supported by AI. The variation in students' questions indicated that personalization was occurring at the level of learning process rather than merely through predetermined content. Students could regulate the depth and type of assistance according to their immediate difficulties. At the same time, observation showed that teacher monitoring remained necessary to prevent inaccurate information from being accepted uncritically. AI therefore functioned most effectively as a flexible supplementary resource embedded within guided learning activities.

The research findings can be restated as showing that AI-powered personalized pedagogy provided students with flexible assistance that corresponded to individual learning needs. Across interviews and observations, four recurring forms of personalization emerged: individualized explanation, additional learning resources, immediate assistance, and flexible learning pace. Students who experienced difficulties could ask questions repeatedly, request simpler explanations, and obtain examples that

helped them continue learning activities. Students with greater understanding could explore additional information independently. These findings demonstrate that AI expanded the availability of differentiated support beyond the limits of direct teacher interaction. Nevertheless, personalization did not mean that technology replaced teachers. Teachers remained responsible for determining learning objectives, guiding students, evaluating AI-generated information, and maintaining pedagogical quality. Therefore, the central finding is that AI supported student success when its adaptive capabilities were integrated into intentional learning processes involving technology, teacher facilitation, and student agency.

The pattern emerging from the data can be described as individual learning need → AI-supported assistance → improved understanding → increased autonomy → sustained engagement → student success. The first stage occurred when students identified difficulties or specific learning requirements. AI then provided explanations, examples, resources, or feedback that addressed those needs. When the support was perceived as useful, students were able to continue tasks with greater confidence and independence. Repeated interaction subsequently strengthened engagement and persistence. The pattern demonstrates that personalization and student success were interconnected rather than separate outcomes. The data also indicate that the effectiveness of AI depended on students' ability to formulate questions and teachers' capacity to provide appropriate guidance. Therefore, the observed pattern represents a human-mediated adaptive process rather than technological automation alone. AI provided responsiveness, students exercised agency, and teachers maintained pedagogical direction, collectively creating a learning environment more capable of accommodating individual differences.

Discussion

The findings indicate that AI-powered personalized pedagogy supported student success through individualized explanations, adaptive resources, timely feedback, and assistance aligned with students' learning difficulties. This finding is consistent with literature describing AI as capable of adapting educational support to learner characteristics and providing immediate responses. However, the present study extends previous work by showing that personalization at SMA Nurul Jadid was not experienced as automated content recommendation. Instead, teachers interpreted student needs and guided AI use, while students actively requested clarification and selected resources. This suggests that personalization is pedagogically meaningful when technological adaptation is combined with human judgment. Theoretically, the finding strengthens adaptive learning perspectives by emphasizing the interaction between algorithmic responsiveness and learner agency. Practically, schools can use AI to supplement differentiated instruction, particularly when teachers need scalable mechanisms for supporting students with different learning paces and difficulties.

The study also found that personalized AI support contributed to student engagement, autonomy, persistence, and understanding. Students were more willing to continue learning when they could obtain immediate explanations and alternative examples suited to their difficulties. This result agrees with research linking personalized digital learning with learner participation and self-regulation. Nevertheless, the finding differs from technology-deterministic interpretations that assume personalization automatically improves outcomes. In the present context, benefits depended on

students' willingness to interact with AI and teachers' ability to guide its use. Theoretically, this indicates that student success should be understood as an emergent outcome of technology, pedagogy, and learner agency rather than a direct consequence of AI exposure. Practically, teachers should design activities that require students to respond to feedback, reflect on recommendations, and communicate learning difficulties. Such practices can turn AI-generated assistance into sustained learning behavior rather than technological convenience.

A contribution of the research is the identification of a process connecting AI personalization with student success: learning difficulty, AI-supported assistance, improved understanding, increased confidence, sustained engagement, and greater learning persistence. Existing studies evaluate adaptive technologies through system accuracy, satisfaction, or achievement scores, while giving less attention to the pedagogical pathway connecting personalization with student experiences. The findings extend the literature by emphasizing personalization as an interactive process rather than a feature. Theoretically, this contributes to human-centered adaptive learning by positioning teachers as interpreters of AI recommendations and students as active participants in regulating learning. Practically, the model can guide institutions in designing AI-supported learning environments that combine individualized assistance with teacher monitoring. It also suggests that successful implementation requires mechanisms for identifying learning needs, providing appropriate resources, reviewing student responses, and adjusting learning support in real time for education and institutions today.

The findings further demonstrate that teacher involvement remains essential in AI-powered personalized learning. Teachers at SMA Nurul Jadid did not allow students to follow AI recommendations independently; they monitored learning activities, clarified inappropriate responses, connected AI-generated information with curriculum objectives, and encouraged students to use AI responsibly. This finding is consistent with human-centered AI literature emphasizing educator oversight, transparency, and learner agency. It also differs from approaches that prioritize automation as the primary route to educational efficiency. Theoretically, teacher facilitation can be understood as the mediating layer that converts algorithmic personalization into pedagogical personalization. Practically, institutions should strengthen teacher competencies in AI literacy, instructional design, data interpretation, and responsible technology use. Guidelines are necessary to address privacy, accuracy, academic integrity, and dependence. Thus, AI implementation should be evaluated by system performance and by the quality of human pedagogical decisions surrounding its use.

Overall, the findings support the view that adaptive online learning can contribute to student success when AI-powered personalization operates within a human-centered pedagogical ecosystem. The study is consistent with literature emphasizing personalized support, engagement, and adaptive feedback, but extends previous scholarship by connecting these elements through teacher facilitation and student agency in an educational setting. The theoretical implication is that adaptive learning should be conceptualized as a relational process involving technology, teachers, and learners rather than as an automated function. The practical contribution is a framework emphasizing diagnosis of learning needs, individualized support, feedback, learner response, and pedagogical adjustment. This framework can help institutions move beyond AI adoption toward educational transformation. It also highlights the need to monitor whether

personalization improves understanding and persistence. AI-powered pedagogy should therefore be implemented as an evaluated process that balances technological responsiveness, educational equity, human judgment, and student success today.

CONCLUSION

This study concludes that the most important lesson from AI-powered personalized pedagogy at SMA Nurul Jadid is that Artificial Intelligence becomes educationally valuable when its adaptive capabilities are integrated with teacher facilitation and student agency. The findings demonstrate that personalized explanations, adaptive resources, immediate assistance, and flexible learning support can strengthen student understanding, engagement, autonomy, and persistence. The principal scholarly contribution lies in identifying personalization as a human-mediated process connecting AI responsiveness with student success rather than as a purely technological function. The study also demonstrates that teachers remain essential for interpreting AI recommendations, maintaining curricular alignment, and ensuring responsible use. However, the research is limited by its qualitative case study design and focus on a single institution, which restricts the transferability of findings to other contexts. Future research should involve multiple institutions, larger and more diverse participants, longitudinal designs, and mixed-method or experimental approaches to examine the sustained effects of AI personalization on achievement, engagement, autonomy, persistence, digital literacy, and equitable student success.

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