



Transforming Online Learning Through Generative AI: Enhancing Personalized Learning and Student Engagement in Higher Education

Lailatul Qodriyah*, Nadia kholifatul Khoir

Universitas Nurul Jadid, Indonesia

Email: lailatul123@gmail.com

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*Correspondence Address:

lailatul123@gmail.com

Abstract :

This study aims to examine how Generative Artificial Intelligence (GenAI) transforms online learning by enhancing personalized learning and student engagement in education. A qualitative case study design was employed at school. Data were collected through in-depth interviews, observations, and documentation involving school leaders, teachers, and students. Data were analyzed through data condensation, data display, and conclusion drawing and verification, while data credibility was established through source, technique, and time triangulation, supported by member checking. The findings indicate that GenAI enhanced personalized learning by providing individualized explanations, additional examples, repeated clarification, and flexible learning assistance according to students' needs and learning pace. GenAI also strengthened student engagement by encouraging active questioning, cognitive exploration, independent learning, learning persistence, and sustained participation. The study concludes that GenAI functions effectively as a pedagogical mediator when integrated with teacher guidance and purposeful learning activities rather than replacing educators. The findings imply that educational institutions should develop responsible AI integration strategies, strengthen teacher competencies and student AI literacy, and maintain human-centered pedagogical supervision to maximize meaningful learning outcomes.

INTRODUCTION

Generative Artificial Intelligence (GenAI) is reshaping how knowledge is accessed, produced, and shared, making its integration into higher education important for society. Online learning must become more responsive to diverse student needs instead of merely digitizing instruction (He, 2025; Min et al., 2023; Sunarya, 2025; Waziroh et al., 2026). This matters because university students differ in prior knowledge, learning pace, motivation, language proficiency, and access to academic support. Recent evidence indicates that GenAI can facilitate personalized learning, immediate feedback, adaptive explanations, and interactive academic assistance, while systematic reviews report promising effects on engagement and learning processes (Cusi et al., 2023; Liu et al., 2023; Mifsud, 2023). UNESCO therefore emphasizes that GenAI in education should be

implemented through human-centered, ethical, safe, equitable, and pedagogically meaningful approaches. Responsible GenAI integration can strengthen educational inclusion and quality, provided institutions design learning environments that enhance human agency rather than replace lecturers or students, supporting diverse learners and communities worldwide across higher education systems and communities globally.

Despite the potential of online learning, many digital learning environments still provide standardized content, limited individualized feedback, and insufficient interaction with students' learning needs. In conventional online courses, lecturers may struggle to monitor every student's progress, identify misconceptions promptly, and provide differentiated explanations within limited time (Article et al., 2024; Esa et al., 2025; Jedidia & Ghroubi, 2024; Qurrata et al., 2025; Rizal et al., 2023). Students, meanwhile, can experience isolation, delayed feedback, cognitive overload, or declining motivation when learning activities are not sufficiently interactive or personally relevant. The rapid diffusion of GenAI introduces another layer of complexity because students can independently obtain explanations, summaries, examples, and writing assistance, but the quality and pedagogical value of these interactions vary considerably. Reviews highlight opportunities and concerns, including personalization, academic skills, ethical risks, privacy, reliability, and overdependence (Akhter et al., 2023; Fakhruddin et al., 2024; Mukhlishin et al., 2024; Siddiq et al., 2025). Consequently, the problem is not simply whether GenAI should be used, but how it should be pedagogically integrated in practice for students across diverse contexts.

The phenomenon observed reflects a transition from experimental AI adoption toward routine student use of generative tools in academic activities. Students use conversational systems to clarify concepts, generate examples, brainstorm ideas, summarize materials, obtain feedback, and support independent study. At the same time, lecturers and institutions are exploring AI-supported tutoring, assessment, curriculum design, and learning analytics (Alzahrani & Alasmari, 2024; Bahroun et al., 2023; Biagini, 2025; Mortlock & Lucas, 2024; Southworth et al., 2023). Systematic reviews show that GenAI applications are expanding across higher education, with attention to creativity, critical thinking, learning autonomy, prompt literacy, and personalized learning. Evidence suggests that GenAI can positively influence cognitive and emotional engagement, although outcomes depend on learning strategies, subject contexts, and how the technology is implemented. This creates a practical contradiction: students expect flexible, immediate, personalized support, while institutions must prevent superficial learning, misinformation, academic misconduct, and excessive cognitive offloading. The field needs approaches connecting technology with sound pedagogy effectively today.

Previous research has established several key foundations for understanding AI-supported learning. Systematic reviews indicate that artificial intelligence can personalize instructional content, learning pace, feedback, and educational pathways, while large language models can support real-time interaction and individualized assistance. Research examining GenAI in higher education identifies benefits for academic skills, creativity, autonomy, critical thinking, and learning support (Deric et al., 2025; Khan et al., 2025; Ming et al., 2025; Munifah et al., 2026; Yusuf et al., 2024). These findings demonstrate that GenAI can function as an interactive learning partner when designed appropriately. However, much of the existing literature remains fragmented across specific applications, disciplines, or outcomes. Some studies emphasize technical capabilities, whereas others focus on student attitudes, academic integrity, or general learning outcomes. Evidence remains less integrated regarding how GenAI can

simultaneously personalize online learning and sustain meaningful student engagement through coherent pedagogical processes (Adams et al., 2023; Ng, Su, et al., 2023; Shloul et al., 2024; Zhang & Tur, 2023). This fragmentation creates a research gap that deserves investigation in higher education, particularly for sustainable digital education.

Another limitation is the tendency to evaluate GenAI through isolated outcomes rather than examining the relationship between personalization and engagement as mutually reinforcing dimensions of online learning. Reviews also identify concerns about privacy, ethical use, reliability, human oversight, and students' dependence on AI-generated responses (Ada, 2024; Cotton et al., 2023; Ng, Wu, et al., 2023; Ortiz-Bonnin & Blahopoulou, 2025). Moreover, personalized learning does not automatically guarantee deeper engagement; an individualized system may improve convenience while weakening collaboration, critical reflection, or learner agency if students simply accept generated answers. Recent scholarship argues that effective AI personalization should account for dynamic learning processes and broader educational competencies, not only individual preferences. This research addresses the gap by examining GenAI as a pedagogically mediated mechanism for tailoring learning experiences while encouraging active participation, interaction, and autonomy (Chan & Hu, 2023; Malik et al., 2024; Ravšelj et al., 2025; Yilmaz & Yilmaz, 2023). This position extends existing scholarship from technology adoption toward an integrated understanding of how GenAI can transform online learning experiences responsibly and meaningfully today.

This study's state of the art lies in conceptualizing GenAI not merely as an automated assistant, but as an adaptive pedagogical layer within online higher education. It connects three processes often examined separately: personalized content and support, continuous learner interaction, and student engagement. Rather than treating personalization as the delivery of customized materials alone, the study considers how GenAI can respond to students' questions, learning progress, difficulties, and interests while prompting reflection and active participation. This approach aligns with evidence that multimodal and conversational GenAI can create more responsive learning environments, while systematic reviews emphasize the importance of context, learning strategy, and pedagogical design. The issue is important to resolve because technology adoption is outpacing institutional capacity to establish effective instructional frameworks. A grounded model can help universities maximize GenAI's value while protecting integrity, agency, equity, privacy, and meaningful learning.

The research problem concerns how Generative Artificial Intelligence can be integrated into online higher education to enhance personalized learning without reducing students' active intellectual engagement. The question is not whether GenAI can generate educational content, but how its capabilities can be organized into learning experiences that remain adaptive, interactive, and learner-centered. It requires examining how AI-supported personalization influences engagement through timely feedback, individualized explanations, flexible learning resources, dialogic interaction, and opportunities for self-directed learning. It also requires consideration of institutional and pedagogical safeguards because effective implementation depends on human oversight, clear learning objectives, and responsible AI literacy. The study argues that GenAI will produce stronger educational value when embedded within intentional pedagogy rather than introduced as an independent technological tool. This argument provides the conceptual foundation for investigating its transformative role in higher education and contemporary universities with clear pedagogical direction within universities.

This study proposes that Generative AI can transform online learning when its technology aligns with personalized, interactive, and pedagogically intentional learning processes. The argument is that adaptive explanations, immediate feedback, conversational assistance, and differentiated learning resources can increase students' perceived relevance, autonomy, confidence, and participation, strengthening cognitive, behavioral, and emotional engagement. However, these effects do not emerge automatically. They depend on how lecturers structure tasks, guide AI interaction, evaluate generated information, and preserve opportunities for critical thinking and collaboration. The study positions GenAI as a complementary learning mediator rather than a substitute for lecturers or student agency. By examining this relationship, the research seeks to contribute empirical and conceptual evidence for universities developing responsible online learning strategies. Ultimately, the study argues that meaningful transformation requires technology, pedagogy, and human oversight within a coherent learning ecosystem for contemporary universities and society.

RESEARCH METHOD

This study employed a qualitative approach using a case study design to gain an in-depth understanding of the transformation of online learning through the use of Generative Artificial Intelligence (GenAI) in enhancing personalized learning and student engagement. The case study design was selected because the research focused on exploring a contemporary phenomenon within its real-life educational context, particularly how GenAI is utilized in learning activities, how technology supports more personalized learning experiences, and how its implementation influences student engagement. The qualitative approach enabled the researchers to explore participants' experiences, perceptions, strategies, interactions, and responses comprehensively. A case study also allowed the integration of multiple sources of evidence to develop a contextual and holistic interpretation of the phenomenon. Therefore, this design was considered appropriate for identifying the mechanisms, benefits, challenges, supporting factors, and pedagogical practices associated with the implementation of GenAI in technology-supported learning at the school level.

The research was conducted at SMP Nurul Jadid, which was purposively selected because of its relevant educational context and potential for examining technology-supported learning practices. The school provides an appropriate setting for investigating the integration of digital technology into educational activities and the development of innovative pedagogical practices. Its educational environment, which is closely connected with the pesantren context, also provides a distinctive setting for examining how contemporary technologies can be integrated with established educational values and practices. Participants were selected purposively based on their direct involvement and experience with technology-supported learning. The informants included the principal, vice principal for curriculum affairs, teachers, and students involved in the learning process. Their selection was based on their capacity to provide substantive information regarding the implementation of GenAI, personalized learning experiences, student participation, learning interactions, and the opportunities and challenges encountered during the implementation of technology-supported learning.

Data were collected through in-depth interviews, observations, and documentation. In-depth interviews were conducted to explore participants' experiences, perceptions, strategies, benefits, challenges, and changes in the learning

process following the use of GenAI. Observations were conducted to identify patterns of interaction, student participation, technology use, responses to learning materials, and teacher facilitation during learning activities. Documentation was used to complement the interview and observation data through relevant learning documents, teaching materials, student assignments, activity records, and documentation of digital learning practices. The collected data were analyzed interactively through data condensation, data display, and conclusion drawing and verification. During data condensation, relevant information was selected, simplified, categorized, and organized according to emerging themes, including GenAI utilization, personalized learning, student engagement, pedagogical practices, supporting factors, and implementation challenges. The condensed data were subsequently displayed in thematic matrices and narrative descriptions to facilitate pattern identification and interpretation. Conclusions were continuously verified by comparing evidence across data sources.

Data validity was ensured through source triangulation, technique triangulation, and time triangulation. Source triangulation was conducted by comparing information obtained from the principal, teachers, and students to determine the consistency of perspectives concerning GenAI implementation, personalized learning, and student engagement. Technique triangulation involved comparing findings from interviews, observations, and documentation to ensure that the interpretation was not dependent on a single data collection technique. Time triangulation was applied by collecting and comparing data at different points during the research process to examine the consistency of emerging findings and minimize situational bias. In addition, member checking was conducted by confirming significant interpretations and preliminary findings with selected informants. Peer discussion was also used to examine the consistency and plausibility of the researchers' interpretations. These procedures strengthened the credibility, dependability, confirmability, and transferability of the findings and supported the production of trustworthy evidence concerning the role of GenAI in transforming technology-supported learning.

RESULT AND DISCUSSION

Result

Personalized Learning through Generative AI

Personalized learning through Generative Artificial Intelligence (GenAI) refers operationally to the use of AI-based learning support that adapts explanations, learning materials, examples, feedback, and learning assistance to students' individual needs, abilities, interests, and learning pace. At SMP Nurul Jadid, this sub-finding was identified through the use of GenAI as an additional learning resource that enabled students to obtain explanations according to their difficulties and formulate questions beyond the limitations of conventional classroom interaction. Personalization was reflected in students' ability to request simplified explanations, additional examples, alternative formulations, and immediate responses when they encountered difficulties. Thus, GenAI functioned not merely as a digital information source but as a responsive learning mediator that supported differences in students' learning needs.

An interview with a teacher indicated that GenAI helped students obtain explanations that were more appropriate to their individual understanding. The teacher explained, "Students have different levels of understanding. Some students immediately understand the material, while others need repeated explanations. Through GenAI,

students can ask questions again and request simpler examples until they understand the concept.” This statement indicates that GenAI expanded opportunities for differentiated learning by allowing students to regulate the depth and form of explanations they received. The researcher interprets this finding as evidence that GenAI contributed to reducing the uniformity of conventional learning experiences. Instead of waiting for the teacher to provide repeated explanations individually, students could independently obtain supplementary assistance based on their specific learning difficulties.

A student similarly stated, “When I do not understand the teacher’s explanation, I use AI to ask about the material again. I can ask it to explain in simpler language or give an example, so it is easier for me to understand.” This statement demonstrates that personalization was experienced directly by students through conversational interaction with GenAI. The ability to formulate repeated questions and request different forms of explanation provided students with greater control over their learning process. The researcher interprets this finding as an indication that GenAI supported learner autonomy by allowing students to determine what information they needed and how that information should be presented. Personalization therefore emerged not only from technological adaptation but also from students’ active capacity to use AI according to their individual learning conditions.

Observation of learning activities showed that students used GenAI differently according to their respective learning difficulties. Some students utilized AI to clarify unfamiliar concepts, while others requested examples, summaries, alternative explanations, or assistance in completing learning tasks. The observation also indicated that students did not interact with GenAI in an identical manner; the duration, frequency, and type of questions varied according to their level of understanding and learning objectives. The researcher interprets this pattern as evidence of differentiated AI-supported learning behavior. GenAI created an opportunity for students to receive learning assistance at their own pace without requiring all students to follow an identical sequence of explanations. However, teacher supervision remained important to ensure that AI-generated information was relevant, accurate, and aligned with learning objectives.

The overall findings restate that GenAI provided students with flexible learning assistance that could be adjusted according to individual needs. The data from interviews and observations consistently demonstrate three major forms of personalization: individualized explanations, flexible learning resources, and immediate learning assistance. Students who experienced difficulties could repeatedly ask questions, simplify explanations, or request additional examples, while students who had already understood the material could explore related information independently. This finding indicates that GenAI transformed personalization from a teacher-dependent process into a shared process involving teachers, students, and AI-supported resources. Nevertheless, personalization did not mean that AI replaced the teacher; rather, it extended the availability of learning support beyond conventional classroom interaction.

The pattern emerging from the data shows that GenAI personalization operated through a sequence of individual learning difficulty → AI interaction → adaptive explanation or resource → improved understanding → greater learning autonomy. The consistency between teacher perspectives, student experiences, and classroom observations strengthens the interpretation that personalization was not an isolated technological practice but an emerging feature of the learning process. The data also

reveal that the strongest personalization occurred when students actively formulated specific questions and critically evaluated AI responses. Consequently, the effectiveness of GenAI depended not only on technological availability but also on students' digital and learning literacy and teachers' pedagogical guidance. The pattern suggests that GenAI can function as a personalized learning mediator when its use is integrated with intentional instructional objectives and continuous human supervision.

Student Engagement through Generative AI

Student engagement through Generative Artificial Intelligence (GenAI) refers operationally to the active involvement of students in learning activities through behavioral, cognitive, and emotional dimensions facilitated by AI-supported interaction. At SMP Nurul Jadid, student engagement was identified through students' willingness to ask questions, participate in learning discussions, explore additional information, complete learning tasks, and interact repeatedly with digital learning resources. GenAI provided an interactive environment in which students could obtain immediate responses and explore topics according to their interests and learning difficulties. Consequently, engagement was not limited to physical participation during classroom activities but also extended to students' independent learning outside direct teacher interaction. The findings indicate that GenAI created additional opportunities for students to become active participants in learning by encouraging questioning, exploration, and independent problem solving. Thus, GenAI functioned as a complementary learning medium that strengthened students' behavioral participation, cognitive involvement, and emotional interest in learning.

An interview with a teacher revealed that the use of GenAI changed students' participation patterns during learning activities. The teacher stated, "Students who were usually quiet became more willing to ask questions after using AI because they could first explore the material independently and then discuss what they found with the teacher." This statement demonstrates that GenAI provided an intermediate space for students who were previously reluctant to communicate directly in class. The researcher interprets this finding as evidence that AI-supported learning can reduce psychological barriers to participation by providing students with an accessible environment for preliminary exploration. Students could formulate questions privately, obtain initial explanations, and subsequently participate more confidently in classroom discussions. Therefore, GenAI contributed to behavioral engagement by encouraging students to move from passive reception toward more active questioning and interaction.

A student provided a complementary perspective, stating, "I become more interested in learning when I can ask AI questions directly. If the first answer is not clear, I can ask again, and sometimes I look for another example or related information." This statement indicates that GenAI encouraged continuous cognitive engagement through iterative questioning and information exploration. The researcher interprets the finding as evidence that engagement was strengthened through the interactive characteristics of GenAI rather than through content delivery alone. Students were able to determine the direction of their learning by asking follow-up questions, requesting clarification, and exploring related topics. This process transformed learning from a one-directional activity into an interactive dialogue. The repeated interaction also suggests that GenAI supported students' curiosity and persistence, particularly when they encountered difficult concepts or wished to understand learning materials more deeply.

Classroom observations showed that students demonstrated different forms of engagement while interacting with GenAI. Some students actively formulated questions related to the learning material, others compared AI-generated explanations with teacher explanations, and several students used AI to explore additional examples before completing assignments. Students also demonstrated greater persistence when encountering difficult learning tasks because they could obtain immediate assistance rather than discontinue the activity. The researcher interprets these observations as evidence of multidimensional engagement. Behavioral engagement was reflected in active participation and task completion, cognitive engagement appeared through questioning, comparison, and exploration, while emotional engagement was indicated by students' curiosity and sustained interest. Nevertheless, teacher monitoring remained necessary because active interaction with AI did not automatically guarantee meaningful learning. Engagement became educationally valuable when students critically processed AI-generated information and connected it with learning objectives.

The research findings can be restated as showing that GenAI strengthened student engagement by creating opportunities for continuous interaction, independent exploration, and immediate learning assistance. Across interviews and observations, three recurring forms of engagement emerged: active participation, cognitive exploration, and sustained learning interest. Students became more willing to formulate questions, investigate additional information, and continue working when they encountered difficulties. The availability of immediate responses reduced waiting time and enabled students to maintain their learning momentum. At the same time, students' engagement increasingly extended beyond classroom boundaries because GenAI could be accessed during independent study. These findings demonstrate that GenAI expanded the temporal and interactive dimensions of student engagement. However, meaningful engagement remained dependent on students' ability to evaluate information critically and on teachers' capacity to provide appropriate pedagogical direction.

The pattern emerging from the findings demonstrates a relationship between AI accessibility → interactive questioning → exploration → sustained participation → deeper learning engagement. The data indicate that immediate access to AI-supported assistance encouraged students to initiate questions, while conversational interaction encouraged them to continue exploring information. This repeated interaction subsequently supported persistence in completing learning activities and strengthened students' cognitive involvement. The pattern also demonstrates that GenAI influenced different dimensions of engagement simultaneously rather than affecting participation alone. Nevertheless, the findings suggest that technology functions as an enabling factor rather than an independent determinant of engagement. Students became more engaged when GenAI was integrated into meaningful learning tasks, supported by teacher guidance, and accompanied by opportunities for discussion and critical reflection. Therefore, GenAI can strengthen student engagement when positioned as an interactive pedagogical mediator rather than merely an automated answer-generating tool.

Discussion

The findings demonstrate that Generative Artificial Intelligence (GenAI) strengthens personalized learning by enabling students to obtain explanations, examples, feedback, and learning assistance according to their individual needs and pace. This

finding is consistent with previous literature emphasizing AI's capacity to personalize educational experiences through adaptive support and individualized interaction (Kakomole et al., 2025; Saputra & Hartati, 2024; Simatupang et al., 2024; Zahiri & Sahal, 2025). Recent studies have similarly reported that generative AI can provide flexible explanations and immediate assistance, potentially supporting learner autonomy and self-directed learning. However, the present findings extend this literature by showing that personalization at SMP Nurul Jadid was not primarily achieved through sophisticated adaptive systems, but through conversational interaction initiated by students themselves. Students actively requested simpler explanations, additional examples, and repeated clarification. Theoretically, this finding strengthens the view of personalized learning as an interactive process involving learner agency rather than merely technological customization (Hamid et al., 2025; Handayani et al., 2025; Syamsir et al., 2025; Wen et al., 2025). Practically, schools can use GenAI to complement teacher-led differentiation while maintaining teacher supervision and curriculum alignment.

The findings concerning student engagement also correspond with previous research indicating that GenAI can promote behavioral, cognitive, and emotional engagement through immediate interaction, exploratory learning, and personalized support. Students in this study demonstrated increased willingness to ask questions, explore additional information, and persist when encountering learning difficulties. These results support scholarship suggesting that conversational AI can reduce barriers to participation by providing students with accessible opportunities to formulate questions and receive immediate responses (Gaffar et al., 2025; Kholik et al., 2026; Nurhikmah, 2024; Ramdhani et al., 2025; Siswadi et al., 2025). Nevertheless, the findings differ from perspectives that associate AI use primarily with passive dependence or cognitive offloading. At SMP Nurul Jadid, engagement increased when students used GenAI iteratively and critically rather than simply accepting generated answers. Theoretically, this suggests that the relationship between GenAI and engagement is mediated by learner agency and pedagogical guidance. Practically, teachers should design activities requiring questioning, comparison, verification, discussion, and reflection rather than allowing AI to become a substitute for student thinking.

An important contribution of this study is its identification of a connected mechanism between personalized learning and student engagement. Existing literature frequently discusses personalization and engagement as separate outcomes of educational technology, whereas the present findings indicate that they can operate as mutually reinforcing processes (Ehimuan et al., 2024; Finch & Butt, 2025; Ostian, 2024; Williamson & Prybutok, 2024). Students who received explanations suited to their learning difficulties became more confident in asking questions, while increased interaction subsequently encouraged further exploration and independent learning. This pattern can be conceptualized as individual learning difficulty → GenAI interaction → personalized assistance → improved understanding → increased confidence → sustained engagement. Theoretically, this extends technology-mediated learning perspectives by positioning GenAI as a pedagogical mediator connecting individualized support with active participation (Fatmawati et al., 2025; Kulothungan, 2025; Purnomo, 2026; Putri, 2025). The contribution is also contextual because the findings emerge from an educational environment combining contemporary digital technology with the established pedagogical culture of SMP Nurul Jadid. Thus, GenAI transformation should be understood through pedagogical processes rather than technological adoption alone.

The study also reveals an important qualification regarding the educational value of GenAI. Although previous literature frequently highlights efficiency, personalization, and accessibility, the findings indicate that these benefits do not automatically produce meaningful learning (Goldsmith & Yang, 2025; Greenstein & Zamboni, 2025; Zaidan & Ibrahim, 2024). Students' interaction with GenAI became educationally valuable when teachers provided direction, students critically evaluated generated information, and AI use was connected to clearly defined learning objectives. This finding is consistent with human-centered approaches to AI in education, which emphasize teacher oversight, learner agency, ethical responsibility, and critical engagement. Theoretically, the finding supports a mediated model in which technology provides responsiveness, students exercise agency, and teachers maintain pedagogical authority (MohammadAmini et al., 2023; Yoon et al., 2025; Zisu, 2025). Practically, schools should develop clear guidelines for responsible AI use, strengthen students' AI literacy, and train teachers to design AI-supported learning tasks. Such measures can reduce misinformation, dependency, and superficial learning while maximizing the benefits of personalized support and interactive engagement.

Overall, the findings contribute to the emerging understanding of Generative AI as a transformative pedagogical mediator in contemporary learning environments. Rather than replacing teachers, GenAI expanded opportunities for individualized explanation, continuous interaction, independent exploration, and sustained participation. The findings therefore support previous scholarship on AI-supported personalization and engagement while extending it by demonstrating how these dimensions interact within an actual educational context (Al-Shawabkeh & Aljasmī, 2025; Cojocar, 2025; Hadi et al., 2025; Langer, 2024; Li, 2025; Mark & Morison, 2025; Pasupuleti, 2026; Roehl & Hansen, 2024; Wirtz et al., 2020). Theoretically, the study proposes that meaningful GenAI integration should be understood through the interaction of technological responsiveness, learner agency, and teacher facilitation. Practically, the findings provide a framework for schools seeking to integrate GenAI responsibly: provide personalized assistance, encourage iterative questioning, require critical verification, maintain teacher supervision, and connect AI use with purposeful learning activities. The study's principal contribution lies in demonstrating that educational transformation depends less on the mere presence of GenAI than on how effectively technology is embedded within intentional pedagogy. This perspective offers a foundation for future research examining sustainable, ethical, and learner-centered AI integration.

CONCLUSION

The study concludes that Generative Artificial Intelligence (GenAI) can transform learning by strengthening personalized learning and student engagement through individualized explanations, immediate interaction, independent exploration, and sustained participation. The most important lesson is that the educational value of GenAI does not arise from technology alone, but from its integration with learner agency and purposeful teacher facilitation. The study's scientific contribution lies in demonstrating the interconnected relationship between personalized learning and student engagement, positioning GenAI as a pedagogical mediator rather than a replacement for teachers. However, the study is limited by its qualitative case study design and focus on a single educational institution, which restricts the generalizability of the findings to broader

educational contexts. Future research should therefore involve multiple schools, larger and more diverse participant groups, longitudinal designs, and mixed-method or experimental approaches to examine the sustained effects of GenAI on learning outcomes, engagement, critical thinking, digital literacy, and responsible AI use across different educational settings.

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