PEDAGOGIK JURNAL PENDIDIKAN
P-ISSN : 2528-5793
E-ISSN : 2354-7960

BEYOND PRODUCTIVITY: HOW GENERATIVE AI RESHAPES CREATIVITY, CRITICAL THINKING, AND PERSONALIZED LEARNING IN HIGHER EDUCATION

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Received: March 2025	**Accepted:** December 2025	**Published:** December 2025
DOI: https://doi.org/10.33650.pjp.v12i2.11009		

Abstract : *Higher education has changed dramatically because to GenAI. Academic productivity remains the focus of most studies. The study examines how GenAI transforms creativity, critical thinking, and individualized learning from a Beyond Productivity perspective. This study used qualitative case study design. In-depth interviews, observations, and document analysis of GenAI-using professors and students provided data. The Miles, Huberman, and Saldaña interactive approach was used for data analysis, including condensing, presenting, and extracting conclusions from triangulation of sources and approaches. Two significant findings emerged from the investigation. GenAI helps students develop creativity, critical thinking, introspection, and knowledge construction by shaping human-AI co-creation. GenAI creates an adaptable and personalized learning ecosystem by providing real-time feedback, personalised learning support, and self-regulated learning. This study establishes GenAI as a productivity tool and a catalyst for higher education cognitive and pedagogical change. This finding affects how higher education institutions create AI learning strategies and policies to develop 21st-century competences.*

Keywords : *Artificial Intelligence; Creativity; Critical Thinking; Personalized Learning.*

Abstrak : *Pendidikan tinggi telah berubah secara dramatis karena GenAI. Produktivitas akademik tetap menjadi fokus sebagian besar studi. Studi ini meneliti bagaimana GenAI mentransformasi kreativitas, pemikiran kritis, dan pembelajaran individual dari perspektif Melampaui Produktivitas. Studi ini menggunakan desain studi kasus kualitatif. Wawancara mendalam, observasi, dan analisis dokumen dari profesor dan mahasiswa pengguna GenAI memberikan data. Pendekatan interaktif Miles, Huberman, dan Saldaña digunakan untuk analisis data, termasuk meringkas, menyajikan, dan mengekstrak kesimpulan dari triangulasi sumber dan pendekatan. Dua temuan signifikan muncul dari investigasi ini. GenAI membantu mahasiswa mengembangkan kreativitas, pemikiran kritis, introspeksi, dan konstruksi pengetahuan dengan membentuk kolaborasi manusia-AI. GenAI menciptakan ekosistem pembelajaran yang adaptif dan personal dengan memberikan umpan balik waktu nyata, dukungan pembelajaran yang dipersonalisasi, dan pembelajaran mandiri. Studi ini menetapkan GenAI sebagai alat produktivitas dan katalisator untuk perubahan kognitif dan pedagogis pendidikan tinggi. Temuan ini memengaruhi bagaimana lembaga pendidikan tinggi menciptakan strategi dan kebijakan pembelajaran AI untuk mengembangkan kompetensi abad ke-21.*

Kata Kunci : *Kecerdasan Buatan; Kreativitas; Berpikir Kritis; Pembelajaran yang Dipersonalisasi.*

INTRODUCTION

The advent of Generative Artificial Intelligence (GenAI) has significantly altered the terrain of higher education. Platforms like ChatGPT, Gemini, Claude and Copilot have progressed from being simple information retrieval tools to become cognitive partners that generate writing, graphics, programme code, analyse data and provide quick feedback (Archambault et al., 2024; Zhang et al., 2024). This revolution is a paradigm shift in learning from an approach of task-completion efficiency to one that emphasises collaboration between humans and artificial intelligence (Hadi Mogavi et al., 2024; Khosravi et al., 2023). The change in higher education raises important issues regarding the ability of GenAI to not just improve students' academic efficiency but to encourage creativity, critical thinking skills and a more personalised learning experience.

Students' use of GenAI has grown dramatically during the last two years. Students use this technology to write essays, make presentations, analyse data, translate literature, and even receive adaptive explanations of topics. Meanwhile, lecturers are starting to use GenAI as a learning support tool through the development of materials, provision of automated feedback and development of more adaptive examinations (Alkaeed et al., 2023). But these advances pose a new issue. On the other hand, GenAI can improve the efficiency of learning and offer a personalised learning experience (Doğan et al., 2025). On the other side, there are concerns that the use of the technology without the proper pedagogical practices can lead to a lack of creativity, dependency on AI by students and a decrease in critical thinking skills. Universities have indeed started reforming their evaluation processes (Mundiri et al., 2025). For example, they have introduced oral exams so that students can continue to improve their independent reasoning skills.

There is empirical evidence from several past research that GenAI has a good effect on student learning results. Research has demonstrated that the quality of student interaction with GenAI increases learning motivation, academic engagement and better learning results (Lee & Kwon, 2024; Veronika et al., 2024). Other research has also shown that the integration of GenAI in other fields can improve the effectiveness of collaborative learning and enhance multidisciplinary learning techniques (Hafferty et al., 2024; Mundiri et al., 2021). In addition, a meta-analysis of dozens of research finds that the use of GenAI generally has a favourable impact on academic accomplishment, language skills, learning motivation and higher-order thinking skills.

However, the past study has concentrated mostly on the improvement of learning efficiency, academic achievement, technological adoption or student productivity. There is yet relatively little research on the simultaneous relationship between the use of GenAI and the development of creativity, critical thinking and personalised learning. Some research even demonstrate that AI use without reflective activities can potentially decrease students'

ability to assess information, formulate arguments and generate novel ideas. The usage of GenAI should be seen not just as a tool for automating academic labour, but as a technology that can shape students' thinking process, creativity, and learning experiences when integrated through proper learning design.

This study provides a novel perspective, beyond productivity, in which Generative AI is considered as a learning transformation agent, influencing student creativity, fostering critical thinking skills, and enabling personalised learning experiences in higher education, beyond its role as an efficiency tool to improve academia. This approach offers a more holistic perspective than previous research by integrating three related elements of 21st-century capabilities as the primary impact of GenAI implementation in higher education.

The research seeks to explore the impact of using Generative AI on the development of student creativity, critical thinking abilities and support of personalised learning in higher education settings. This research also aims to unpack the mechanisms of change that occur when GenAI is positioned as a learning partner, rather than just a tool for completing academic assignments. The main argument of this research is that the success of the implementation of Generative AI in Higher Education cannot be measured only by increasing productivity or speed of work completion, but should be seen in its ability to promote thinking processes, generate authentic creativity, and provide adaptive learning experiences according to the characteristics of each student. It is intended that the outcomes of this research can be a conceptual contribution to the development of AI-based pedagogy and also constitute the basis for the formulation of Generative AI implementation strategies that are directed towards increasing the quality of learning in higher education.

METHOD

The qualitative approach with a case study design was adopted to acquire a better understanding of how Generative Artificial Intelligence (GenAI) is impacting creativity, critical thinking abilities, and tailored instruction in higher education institutions. This was chosen because it allows us to explore the experiences, perspectives and practices of students and teachers who utilize GenAI in their educational experience. This study investigates the usage of GenAI as a tool to improve academic performance and the way it influences students' thinking and learning as a learning partner.

This study was conducted at a university that has incorporated Generative AI into its academic activities. The informants selected for this study were chosen based on their experience and intensity of GenAI use in the learning process (Creswell, 2014). The informants consisted of lecturers who use GenAI in their teaching activities and students

from various study programs that use GenAI platforms such as ChatGPT, Gemini, Claude, and Co. One of the goals of selecting these diverse informants was to obtain comprehensive perspectives.

Table 1: Research Informant

Code	Number	Role	Inclusion Criteria
L1–L2	2	Lecturers	Experienced in integrating Generative AI into teaching practices
S1–S8	6	Undergraduate Students	Active users of Generative AI for academic learning
A1	2	Academic Program Coordinator	Responsible for or knowledgeable about institutional policies regarding AI integration in higher education
Total		10	

Research data were collected through semi-structured interviews, non-participant observations, and document analysis. Semi-structured interviews explored participants' experiences of integrating Generative Artificial Intelligence (GenAI) into teaching and learning, with particular attention to its contribution to creativity, critical thinking, and personalized learning. Observations focused on classroom practices involving GenAI to examine how teachers incorporated AI-supported instructional strategies into authentic learning activities. Document analysis was conducted to complement and verify the empirical findings through the examination of lesson plans, instructional materials, institutional policies, and other relevant educational documents.

Data were analyzed using the interactive analysis model proposed by Miles, Huberman, and Saldaña (2014), comprising data condensation, data display, and conclusion drawing and verification. Interview transcripts, observation field notes, and documentary evidence were analyzed iteratively through systematic coding to generate categories and themes relevant to the research objectives. The emerging themes were continuously refined by comparing evidence across different data sources to identify recurring patterns and relationships among the findings. This iterative analytical process facilitated a comprehensive interpretation of participants' experiences regarding the educational use of GenAI. To enhance the trustworthiness of the findings, the study employed source triangulation, methodological triangulation, member checking, and peer debriefing. These strategies strengthened the credibility, dependability, confirmability, and consistency of the analysis by ensuring that the interpretations accurately reflected participants' perspectives while minimizing researcher bias.

RESULT AND DISCUSSION

1. Results

a) Generative AI Reshapes Higher-Order Cognitive Processes Through Human–AI Co-Creation

This study found that the World Muslim Scout Jamboree (WMSJ) 2025 is not just an international scouting activity but also a social education space that systematically develops collaborative Islamic leadership by integrating values, social structures, and collective experiences across cultures. Based on the results of interviews, participatory observations, and document analysis, it can be seen that the process of leadership formation in WMSJ 2025 takes place through interrelated relationships between the basis of the implementation of activities, the social design of the camp, cross-cultural interaction, and the internalization of values that occur simultaneously.

The research findings show that the role of Generative Artificial Intelligence (GenAI) in higher education has considerably evolved from a productivity-enhancing tool to a cognitive companion that facilitates higher-order thinking processes through ongoing human-AI collaboration. GenAI helps students not only do their projects faster, but also come up with ideas, think critically, create information and expand their cognitive abilities. Both students and AI are actively involved in this conversation, which allows them to shape the content through academic reasoning, explore other viewpoints, assess AI answers, and amend questions in real time. Consequently, the best course of action is to work with AI to improve cognitive processes like imagination and analysis.

Table 2. Human-AI Co-Creation in Enhancing Higher-Order Cognitive Processes

Interview / Observation Data	Description	Code
S1: *"I no longer use ChatGPT simply to obtain answers. Instead, I ask it to generate different perspectives before deciding which argument is the strongest."*	AI functions as a partner for generating multiple ideas before decision-making.	Idea Generation
S4: *"Sometimes the AI's answer is inaccurate, so I compare it with journal articles and revise my own conclusion."*	Students critically evaluate AI-generated information before accepting it.	Critical Evaluation
L1: *"Students who use AI effectively tend to ask deeper questions rather than seeking instant answers."*	AI stimulates inquiry-based learning and reflective thinking.	Reflective Inquiry
Classroom observation shows students repeatedly modifying prompts until they	Knowledge is developed through iterative dialogue between students and AI.	Human-AI Co-Creation

obtain more relevant explanations and examples.		
L2: *"Students increasingly combine their own ideas with AI suggestions to produce more original academic work."*	AI supports collaborative knowledge construction instead of replacing human thinking.	Knowledge Construction
S5: *"AI often provides unexpected viewpoints that inspire me to develop new research ideas."*	AI broadens cognitive flexibility and academic creativity.	Cognitive Expansion

Table 2 demonstrates that Generative AI reshapes higher-order cognitive processes through continuous human-AI co-creation. Rather than functioning merely as an automated information provider, Generative AI emerges as a collaborative cognitive partner that encourages students to actively engage in higher-level thinking throughout the learning process. The interview and classroom observation data consistently indicate that students do not simply accept AI-generated responses but interact with them through iterative dialogue, verification, reflection, and reinterpretation before constructing their own understanding. This pattern suggests that the educational value of Generative AI lies not in replacing human cognition but in extending students' cognitive capabilities through collaborative knowledge creation. The research data table shows the following findings:

First, AI as an idea-generation partner. The data shows that students mostly use GenAI to explore alternative ideas, develop research subjects, build conceptual frameworks, and generate varied academic perspectives. Students are not passive recipients of the first machine output but take part in iterative exchanges that develop divergent thinking. With this method, they think of a more creative solution by looking at the issues in several perspectives before choosing the most relevant academic argument. The findings further indicate that students no longer perceive Generative AI merely as a technological tool for retrieving information but increasingly position it as a cognitive partner that supports higher-order thinking. Rather than accepting AI-generated outputs uncritically, students engage in iterative interactions that involve questioning, comparing, refining, and synthesizing information before constructing their own understanding. This pattern suggests a transition from technology-assisted learning toward human–AI cognitive partnership, in which intellectual responsibility remains with learners while AI functions as a catalyst for cognitive exploration.

Evidence from interviews demonstrates that students continuously negotiate meaning through repeated prompting, evaluation of alternative explanations, and integration of AI-generated suggestions with disciplinary knowledge and academic

evidence. Consequently, knowledge construction becomes a dialogic process characterized by reciprocal interaction between human judgment and computational intelligence. This finding extends existing perspectives on AI-assisted learning by demonstrating that educational value emerges not from automated answer generation but from students' active regulation of the cognitive process.

Second, AI promotes critical evaluation rather than passive acceptance. AI can give quick answers but students must constantly think critically by checking facts in academic papers, textbooks and other relevant academic sources. The interview results indicate that students consider AI-generated content as a starting point rather than an absolute understanding. Critical thinking is developed through techniques such as verification, comparison, synthesis, and evidence-based reasoning before coming to a decision. Students initially use GenAI to generate multiple ideas, which stimulates divergent thinking and expands the range of possible interpretations. These ideas are subsequently subjected to critical evaluation through verification and comparison with authoritative academic sources. The evaluation process encourages reflective inquiry, as students repeatedly reformulate prompts, question AI-generated explanations, and refine their own understanding. Finally, this recursive interaction culminates in human–AI co-creation, where learners synthesize AI-generated insights with prior knowledge and disciplinary evidence to construct original academic products. The progression illustrates that higher-order cognitive development is not produced directly by AI itself but emerges through continuous interaction between learners' metacognitive regulation and AI-supported cognitive stimulation. Accordingly, Generative AI functions as an enabling environment that amplifies students' reasoning processes rather than replacing human intellectual activity.

Third, AI facilitates reflective inquiry through dialogic interaction. The findings suggest that students interact with the GenAI in a more recursive manner, revising their prompts, demanding clarification, critiquing the AI's responses, and seeking deeper explanations. This ongoing dialogue makes learning a two-way information retrieval process instead of a one-way distribution of information. Students also generate more analytical and higher level queries after interaction with AI, suggesting an increase in metacognitive awareness.

Fourth, higher-order knowledge construction emerges through human-AI co-creation. GenAI is not a substitute for the intellectual efforts of students but a collaborative collaborator in the creation of new knowledge. Students develop fresh interpretations and answers based on the AI's recommendations, their own expertise, classroom discussions, and academic resources. Knowledge generation is therefore a

collaborative process, in which AI provides cognitive stimulation and students are responsible for interpretation, evaluation and final decision-making.

Fifth, AI expands cognitive flexibility and academic creativity. The results suggest GenAI can provide students different perspectives, interdisciplinary links and alternate approaches to problems they may not have previously thought about. This exposure allows the students to re-assess their preconceptions, re-think their initial thoughts, and develop more creative academic works, thus enhancing cognitive flexibility. Therefore, creativity is shown not using AI-generated content but through the students' capacity to convert AI concepts into original and relevant information in the situation. Overall, our findings indicate that higher-order cognitive processes in higher education are influenced by human-AI co-creation with Generative AI. The transformation is not only about improving the kids' grades, but also about creating a school where students may continually participate in activities that build their imagination, analysis, reflection, and the extension of their knowledge base. The GenAI cognitive accelerator can assist the intellectual growth of youngsters, but still leave human agency intact in areas like appraisal, creative decision making and thought. The study concludes that Generative AI is more effective in educating students to think critically, collaborate to develop information and be creative than to replace human thought processes.

These findings further suggest that the educational significance of Generative AI extends beyond improving academic productivity. Instead, its primary contribution lies in reshaping the nature of learning itself, where students actively negotiate meaning through continuous interaction with intelligent systems. In this context, Generative AI functions as a cognitive partner that amplifies human intellectual capacity rather than replacing it, reinforcing the central role of human agency in higher education while simultaneously creating new opportunities for creativity, critical thinking, and collaborative knowledge construction.

b) Generative AI Drives the Transformation Toward Adaptive and Personalized Learning Ecosystems

The findings indicate that Generative Artificial Intelligence (GenAI) is transforming learning practices in higher education toward a more adaptive and personalized learning ecosystem. Evidence from interviews, classroom observations, and document analysis shows that learning is no longer delivered through a uniform instructional approach but increasingly adapts to students' individual learning needs, prior knowledge, learning pace, and academic goals. Rather than relying solely on lecturers as the primary source of knowledge, students actively engage with GenAI to obtain personalized explanations, immediate feedback, contextual examples, and

continuous academic support. This transformation positions students as active participants who regulate their own learning processes while enabling more flexible, learner-centered educational experiences.

Classroom observations further revealed that students used Generative AI in different ways according to their individual learning objectives. Some students sought simplified explanations before attending lectures, whereas others requested more advanced conceptual discussions, real-world examples, programming assistance, or recommendations for additional academic resources. Students also repeatedly refined their prompts until the AI-generated explanations matched their level of understanding. These observations indicate that learning was not experienced uniformly across students but evolved dynamically according to each learner's cognitive needs and academic readiness.

Table 3: Phenomenological Analysis of Generative AI in Developing Adaptive and Personalized Learning Ecosystems

Interview / Observation / Documentation Data	Description	Code
S3: *"If I don't understand what the instructor is saying, I ask ChatGPT to explain it in simpler words. If I still don't understand, I keep asking until it matches the way I think."*	Students continuously adapt AI explanations until they align with their cognitive needs and preferred understanding.	Personalized Learning Support
S6: *"AI gives me different examples depending on what I ask. Sometimes I ask for business cases, sometimes educational ones."*	Students personalize learning by requesting contextualized examples relevant to their interests and academic tasks.	Contextual Personalization
Classroom Observation: Students requested different types of AI support, ranging from basic explanations, advanced conceptual discussions, programming assistance, to additional references.	Learning pathways differ according to students' prior knowledge, learning objectives, and academic readiness.	Adaptive Learning Pathways
Classroom Observation: Students repeatedly modified prompts until AI responses matched their level of understanding.	Students actively regulate and refine learning through iterative interaction with AI.	Adaptive Learning Regulation
L2: *"Students who prepare with AI tend to ask more critical questions because they already understand the basic concepts before entering the classroom."*	AI-supported preparation changes classroom dynamics from knowledge transmission toward deeper discussion and inquiry.	Enhanced Classroom Engagement

Table 3 shows that the transformation toward adaptive and personalized learning is reflected in several interconnected patterns emerging from the interview, observation, and documentation data. These patterns indicate that Generative AI has shifted learning from a uniform instructional model toward a more individualized learning experience, where students actively determine how they access, understand, and apply knowledge according to their own academic needs. Rather than functioning merely as a digital information source, Generative AI supports a learning process that continuously adapts to students' cognitive readiness, learning preferences, and disciplinary contexts.

The interview findings reveal that students no longer expect identical explanations for every learning task. Instead, they intentionally adjust AI-generated responses by requesting simpler language, additional examples, different disciplinary contexts, or more detailed explanations until the information corresponds to their own level of understanding. This iterative interaction demonstrates that personalization is actively constructed by students rather than passively provided by technology. Students exercise control over the depth, format, and contextual relevance of learning materials, enabling them to develop learning experiences that are aligned with their individual academic goals.

Classroom observations further reinforce these findings by showing considerable variation in how students utilized Generative AI during their learning activities. Some students employed AI to strengthen their conceptual understanding before attending lectures, while others used it to explore more complex theories, obtain programming assistance, identify recent scholarly references, or examine authentic case studies relevant to classroom discussions. The observation data also indicate that students frequently revised and refined their prompts when the initial AI responses were considered insufficient or overly general. This repeated prompt refinement reflects an adaptive learning process in which students continuously modify their learning strategies to obtain explanations that better correspond to their cognitive needs. Consequently, learning progresses through ongoing adjustment rather than through a predetermined instructional sequence.

The lecturers' interviews reveal that these individualized learning practices have also influenced classroom instruction. Lecturers observed that students who had prepared using Generative AI generally entered the classroom with stronger preliminary conceptual understanding, allowing classroom interactions to move beyond introductory explanations toward analytical discussion, argument evaluation, and collaborative problem-solving. Rather than reducing lecturers' instructional roles, this shift enables lecturers to devote more time to facilitating deeper conceptual

exploration and higher-level academic dialogue. The findings therefore suggest that adaptive learning extends beyond students' independent study and contributes to changes in the overall dynamics of classroom learning.

Evidence from document analysis further supports the emergence of personalized learning practices beyond formal classroom activities. Students' reflective journals and AI-assisted assignments demonstrate that learning continues through cycles of interaction, reflection, revision, and improvement. The documents show that students regularly compared multiple AI-generated responses, evaluated their accuracy against lecturers' feedback and academic references, revised their understanding, and documented the progress of their learning. These records indicate that Generative AI facilitates continuous learning rather than one-time task completion, encouraging students to monitor and regulate their own academic development over time.

Taken together, the evidence presented in Table 3 demonstrates that the transformation toward adaptive and personalized learning is characterized by three interrelated changes. First, students increasingly regulate their own learning by tailoring AI-generated explanations to their individual needs and learning preferences. Second, classroom learning becomes more adaptive as lecturers build upon students' prior preparation rather than focusing primarily on content transmission. Third, learning extends beyond scheduled classroom sessions through continuous interaction with AI, reflective practice, and ongoing revision of understanding. Collectively, these findings indicate that Generative AI supports the development of a learning environment in which personalization, adaptability, and learner autonomy become integral characteristics of higher education learning processes.

2. Discussion

The study found that Generative Artificial Intelligence (GenAI) offers many benefits in the classroom, beyond bettering exam scores. GenAI acts as an educational and cognitive support, providing personalized and adaptive learning settings and enabling students to develop their higher-order thinking skills. The results support the core premise of the study that the influence of GenAI on higher education should not be measured by its task performance but by its contribution to cognitive growth and support of learner-centered pedagogical reforms. This finding indicates that the educational value of GenAI lies in its ability to facilitate meaningful learning experiences rather than simply accelerating academic tasks. By supporting individualized learning pathways and encouraging active engagement with knowledge, GenAI contributes to a learning

environment where students become more reflective, autonomous, and intellectually involved. Consequently, the integration of GenAI should be viewed as part of a broader pedagogical transformation that prioritizes deep learning, cognitive development, and long-term educational outcomes over short-term academic performance.

The first finding shows that Generative AI changes higher-order cognitive processes through the human-AI cooperation, where students interact with AI to generate ideas, assess facts, build arguments, and expand knowledge (Desmaniar et al., 2022). AI is not a substitute for human cognition, but an intellectual partner that promotes analytical reasoning and drives creative problem-solving (Yong et al., 2024). This finding is in line with the constructivist view that knowledge is actively constructed through interaction and reflection rather than passively received from external sources. In the GenAI space, it's not only learners and instructors that are interacting, but also intelligent technology providing continuous cognitive engagement. This collaborative interaction enables students to participate in a more dynamic learning process in which questioning, revising, and refining ideas become continuous activities. Instead of merely receiving answers, learners actively negotiate meaning through dialogue with AI, strengthening conceptual understanding and intellectual independence. Such a process reflects the evolution of learning environments where technology functions as an interactive cognitive partner capable of stimulating deeper reasoning and sustained knowledge construction.

This result seen in this study aligns with the concept of enhanced intelligence where AI is perceived as a technology that enhances and does not replace human intelligence. Students iteratively modified questions, assessed AI responses, considered multiple opinions, and incorporated information from academic sources to reach conclusions (Hafferty et al., 2024; Eager & Brunton, 2023). These methods show that cognitive engagement is preserved under the human supervision, and AI provides a trigger for greater intellectual investigation. Hence, creativity is derived from the combination of the students' own ideas with the AI-generated possibilities and critical thinking is promoted through verification, evaluation and reflective thinking.

These findings are in line with recent studies showing that GenAI improves creative ideation and aids complex problem-solving by offering learners a variety of perspectives. Studies have shown that AI-assisted discourse boosts diverse thinking, encourages exploratory learning, and increases students' willingness to investigate unknown topics (Mamad & Vígh, 2024). Likewise, research on higher-order thinking has shown that AI can boost analytical reasoning, when learners critically evaluate AI-produced material rather than take it at face value. The current findings extend this knowledge base by showing that creativity and critical thinking are not discrete outputs,

but interrelated cognitive processes that emerge from the continuing human-AI collaboration. This perspective broadens previous discussions by emphasizing that the educational impact of GenAI is not limited to isolated cognitive gains but involves an integrated process of intellectual development. As students continuously interact with AI, they simultaneously generate original ideas, evaluate evidence, and synthesize multiple viewpoints into coherent arguments. These interconnected cognitive activities reinforce one another, illustrating that creativity and critical thinking develop through sustained collaborative engagement rather than through separate instructional interventions.

This study adds an important conceptual framework for understanding higher-order cognition development in AI-supported learning environments in providing human–AI co-creation (Afifah et al., 2025; Zamroni et al., 2020). Much of the earlier work has been on AI as a teaching tool or productivity enhancer. This paper argues that GenAI actively contributes to the knowledge-construction process by prompting reflection, boosting cognitive flexibility, and facilitating iterative thinking (Habash, 2024; Lisbet et al., 2025). This shifts the conversation from one of technology support to that of collaborative cognition, where meaningful learning arises from interactions between human and artificial intelligence.

Findings indicate that it is not the sophistication of AI but the students' ability to critically engage with AI-generated knowledge that determines the quality of learning. Students who consistently questioned AI output, checked facts and reworked arguments showed more cognitive growth than students who passively accepted generated content (Pham et al., 2024; Zynuddin et al., 2023). The finding is consistent with the theory of metacognitive learning which places emphasis on the monitoring, appraisal and regulation of one's own cognition as an important aspect of advanced learning. The effectiveness of GenAI as a teacher is closely related to the critical literacy and reflective engagement of learners.

The second finding shows that Generative AI revolutionizes higher education from one-size-fits-all teaching to adaptable and individualized learning environments. The results show that students are increasingly embracing AI as a personalized educational assistant that provides customized explanations, contextual examples, immediate feedback, and continuous academic assistance. Learning is more individualized, flexible and sensitive to the cognitive qualities of each student, and educational experiences can extend beyond the four walls of the classroom (Cheung et al., 2021; Qushwa et al., 2024; Sain et al., 2024).

This finding supports the learner-centered learning notion that effective education must take into account individual differences in learning speed, interests, prior knowledge, and cognitive preferences. Students can customize the complexity and structure of learning materials to their unique needs using AI-generated adaptive answers. In this way, students are active participants in the construction of their own learning, rather than passive recipients of standardized instruction. With the injection of AI, personalized learning ceases to be an educational ideal and becomes a pedagogical possibility.

The results further support the ideas of self-regulated learning (SRL). Students were seen to formulate learning objectives, recognize conceptual difficulties, get clarifications from AI, evaluate their understanding, correct mistakes, and independently evaluate learning outcomes (Saihi et al., 2024; Seo et al., 2024). These steps fit within the cyclical stages of self-regulated learning, including planning, monitoring, and reflection (da Costa et al., 2024; Mores et al., 2019). Unlike traditional educational settings where feedback is usually delayed, AI allows for quick formative feedback, letting students continuously improve their performance throughout their learning process. Such immediacy fosters autonomy in learning and the ability to manage their academic progress.

These results are in line with past studies showing that AI-driven tutoring systems can boost student engagement, motivation, and academic achievement through adaptive instructional support. In this work we extend the state of the art by defining personalized learning as an AI-powered learning environment , rather than simply personalized instruction (Dahri et al., 2024). The ecosystem viewpoint recognizes that the transformation of learning is influenced by the interactions among students, instructors, AI technologies, educational resources and institutional behaviors. Thus, personalized learning is viewed as a systemic educational transformation rather than simply a technology attribute.

One major issue is about the changing nature of the role of lecturers in AI-enhanced higher education. Lecturers are increasingly becoming facilitators, mentors, ethics guides and examiners of students' thinking processes, rather than mere information suppliers. Since students can access explanations independently from the AI, classroom interactions become more focused on debate, reflection, argumentation, and collaborative problem solving. This educational change is a shift from knowledge transfer to knowledge facilitation, which is typical of Education 5.0.

The two main findings together imply that Generative AI changes both the cognitive processes of pupils and the way they learn at the same time. The first transformation occurs at the cognitive level through human-AI co-creation, where

creativity and critical thinking are created from collaborative knowledge development. The second change happens at the pedagogical level through adaptive individualized learning ecosystems that foster student autonomy, continuous feedback, and flexible learning experiences. These two transformations are closely interconnected, as stronger cognitive engagement enables students to make better use of personalized learning opportunities. Likewise, adaptive learning environments encourage learners to participate more actively in knowledge construction, reinforcing creativity, critical thinking, and independent learning as complementary outcomes of AI-supported education.

The results naturally expand the ongoing discussion of AI in education away from technological adoption and productivity enhancements. The study advocates for the perception of GenAI as a cognitive and pedagogical ecosystem in which higher-order thinking, collaborative knowledge creation, self-regulated learning and personalized education are integrated into a unified conceptual structure (Mawangir, 2022; Munir & Mudarris, 2024). This perspective provides a richer description of the role of AI in education than models of technology acceptance or instructional support. Accordingly, the effectiveness of AI integration should be assessed through its contribution to meaningful learning experiences, cognitive development, and learner autonomy rather than solely through technological performance or operational efficiency. This broader perspective better reflects the complexity of contemporary higher education.

Institutions of higher education should advocate for pedagogical approaches that develop AI literacy, critical evaluation skills, ethical use of AI, and reflective learning practices. Providing access to AI technologies alone will not suffice to improve the quality of education. Universities need to change their curricula, evaluation methods and teaching styles to promote critical engagement with AI rather than reliance on it. This approach ensures the Generative AI functions as a catalyst for intellectual development rather than only a tool for academic efficiency. Equally important, lecturers should receive continuous professional development to effectively integrate AI into teaching while maintaining academic integrity. Institutional policies should also encourage responsible AI use, ensuring that technological innovation supports educational quality and sustainable student learning.

This study reaffirms that the future of higher education is not in the replacement of human intellect by artificial intelligence but in the building of collaborative educational environments where both intelligences complement each other. From this perspective, the true educational value of Generative AI is in its potential to revolutionize creativity, promote critical thinking, and develop tailored learning environments that

prepare students for the complex challenges of the twenty-first century, not only in terms of productivity. Therefore, successful AI implementation should prioritize human intellectual growth over technological dependence. Higher education should cultivate graduates who are creative, reflective, ethically responsible, and capable of collaborating effectively with AI to address increasingly complex academic and professional challenges.

CONCLUSION

A study has shown that Generative Artificial Intelligence (GenAI) is not merely a tool to boost academic productivity but a cognitive partner that molds how students think and learn in higher education. GenAI stimulates creativity, critical thinking skills and knowledge generation through reflective dialogues and constant review of information in the human-AI co-creation process. GenAI also creates an adaptive and personalized learning ecosystem, where the learning experience is adapted to the needs, abilities and characteristics of each learner. "The results suggest that the value of GenAI is not in the speed of performing a task but rather how it can impact cognitive processes and allow for more learner-centric learning.

Nevertheless, this study has several drawbacks. However, the study used a qualitative case study approach with a small number of informants, hence the outcomes of the study have not been generalizable to all higher education environments. In addition, this study is primarily focused on the experience and perspective of GenAI users, rather than statistically analysing its impact on the improvement of creativity, critical thinking skills, and student learning outcomes. Therefore, future research is expected to use mixed methods or longitudinal approaches with a broader scope of universities and disciplines to gain a more comprehensive understanding of the long-term effects of the implementation of Generative AI in higher education.

ACKNOWLEDGMENT

The authors sincerely express their gratitude to all individuals and institutions who contributed to the completion of this study. Special appreciation is extended to the academic experts, educators, and participants whose valuable insights and experiences enriched the research process. The authors also acknowledge the support provided by their affiliated institution in facilitating this research. Finally, the authors are grateful to the reviewers and editors for their constructive comments and suggestions, which have significantly improved the quality of this research.

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