

NAVIGATING GENERATIVE AI IN EDUCATION: EFFECTS ON STUDENTS' SELF-DIRECTED LEARNING AND CRITICAL THINKING

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Abstract

The rapid adoption of generative artificial intelligence (GenAI) has transformed how students access information, complete academic tasks, and manage their learning processes. This study examines the effects of GenAI use on students' self-directed learning and critical thinking skills. It employs a qualitative approach based on library research. Data were collected from reputable journal articles, academic books, and institutional reports identified through Scopus, ScienceDirect, SpringerLink, Taylor & Francis, and Google Scholar. The literature was analyzed using thematic content analysis involving identification, selection, classification, synthesis, and interpretation. The findings demonstrate that GenAI can function as a personalized learning assistant by helping students identify learning needs, formulate learning goals, understand complex concepts, explore alternative perspectives, and obtain immediate feedback. Reflective and purposeful use of GenAI can strengthen students' autonomy and promote interpretation, analysis, evaluation, inference, and problem-solving skills. However, passive and excessive use may lead to technological dependence, cognitive offloading, superficial understanding, violations of academic integrity, and uncritical acceptance of inaccurate or biased information. Therefore, the educational effects of GenAI are determined not only by the frequency of its use but also by students' purposes, AI literacy, self-regulation, verification practices, and instructional design. This study highlights the conceptual relationship between GenAI use, self-directed learning, and critical thinking within an integrated analytical framework. Higher education institutions should position GenAI as a cognitive scaffold rather than a substitute for students' intellectual effort. Universities should consequently develop responsible AI policies, authentic assessments, and AI literacy programs that emphasize fact-checking, ethical disclosure, reflective learning, and independent reasoning. Further empirical and longitudinal research is recommended to validate these relationships across disciplines and educational contexts.

Keywords: generative artificial intelligence, self-directed learning, critical thinking, higher education, AI literacy.

Introduction

The development of *generative artificial intelligence* (GenAI), especially since the advent of ChatGPT, has changed the way students search for information, understand material, complete assignments, and generate knowledge. GenAI can provide explanations tailored to user needs, summarize sources, compile ideas, generate

feedback, and support learning at any time. These characteristics make GenAI a potentially valuable personal learning partner that helps students set goals, choose strategies, and independently evaluate their understanding. In higher education, this technology is seen as able to increase access to knowledge and create a more adaptive, personalized, and interactive learning experience (Kasneci et al., 2023; Tlili et al., 2023).

However, students' use of GenAI presents a paradox. On the one hand, students can use GenAI to obtain alternative explanations, explore ideas, formulate questions, and get feedback quickly. These facilities have the potential to increase learning efficiency and independence. On the other hand, the ease of obtaining instant answers can encourage dependence, reduce cognitive effort, and weaken students' ability to evaluate information in depth. GenAI can also produce information that is inaccurate, biased, or not accompanied by verifiable sources so that users still need digital literacy and critical thinking skills (Farrokhnia et al., 2024; Kasneci et al., 2023). Thus, the use of GenAI does not automatically improve the quality of learning.

The research problem lies in the unclear direction and strength of the influence of GenAI's use on *self-directed learning* and students' critical thinking skills. Constructive use can help students identify learning needs, access resources, develop problem-solving strategies, and reflect. On the other hand, use that is only oriented towards task completion can replace students' thinking processes and cause *cognitive offloading*. This condition raises a fundamental question: does GenAI really empower students to become independent and critical learners or does it make them more dependent on technology? This issue becomes increasingly important because GenAI's response looks convincing even though it is not necessarily factual and academic (Lo, 2023; Tlili et al., 2023).

Previous studies have discussed many opportunities and risks of ChatGPT in education, academic integrity, changes in assessment systems, and student and lecturers' perceptions of the use of AI. Lo (2023), for example, found that ChatGPT has the potential as a learning tool, but it also raises issues regarding information accuracy, plagiarism, and user dependency. Meanwhile, Cotton et al. (2024) emphasized the challenges of using ChatGPT to academic integrity, while Chan (2023) proposed an AI policy framework to support the responsible integration of technology in universities. Although it provides an important foundation, most of the research is still conceptual, exploratory, or focused on the acceptance and ethics of GenAI's use.

Based on these conditions, there is a *research gap* in the form of limited empirical research that simultaneously examines the influence of GenAI use on two interrelated learning outcomes, namely *self-directed learning* and critical thinking skills. Previous research also tends to see GenAI as a technology tool in general, without paying attention to the quality of its use, such as its use for information exploration, providing feedback, problem solving, verifying answers, and learning reflection. In fact, the impact of GenAI is estimated not only by the frequency of use, but also by the goals, strategies, and ability of students to assess the outputs produced by the technology (Farrokhnia et al., 2024; Kasneci et al., 2023). Therefore, empirical evidence regarding the relationship between

these constructs still needs to be strengthened, especially in the context of students and specific characteristics of higher education.

The novelty or *incremental newness* of this research lies in the integration of the use of GenAI, *self-directed learning*, and critical thinking skills in one analytical framework. This study not only assesses whether students use GenAI, but also examines how the use helps them plan, implement, monitor, and evaluate the learning process and analyze the credibility of information. The framework allows the research to explain the benefits and consequences of using GenAI on students' cognitive independence. In addition, *self-directed learning* can be studied as a direct result of the use of GenAI as well as as a mechanism that explains the development of critical thinking skills.

This research is urgent because the integration of GenAI in education takes place faster than the provision of empirical evidence and adequate pedagogical guidelines. Without proper understanding, educational institutions risk implementing policies that are too restrictive or otherwise allowing the use of GenAI without direction. The results of the research are expected to be the basis for universities and lecturers to design learning strategies, authentic assessments, AI literacy, and guidelines for the responsible use of GenAI. Thus, GenAI can be directed as a *cognitive scaffold* that strengthens learning independence and critical thinking skills, not as a substitute for students' intellectual processes.

Research Methods

This study uses a qualitative approach with the *library research method* to analyze the influence of the use of *generative artificial intelligence* (GenAI) on students' *self-directed learning* and critical thinking skills. The research data is sourced from articles of reputable scientific journals indexed by Scopus, academic books, and relevant official institution reports. The literature was searched through the Scopus, ScienceDirect, SpringerLink, Taylor & Francis, and Google Scholar databases using a combination of keywords, such as "generative artificial intelligence", "ChatGPT in education", "self-directed learning", "learning autonomy", "critical thinking", and "higher education". Literature was selected based on relevance to the topic, quality of sources, availability of complete texts, and publication priorities of the last five years. Articles that were not directly related to the educational context and research variables were excluded from the analysis process.

Data were analyzed using thematic content analysis techniques through the stages of identification, selection, grouping, synthesis, and interpretation of the literature. Each source was classified based on the focus of the research, the theoretical foundation, the method, the main findings, and its limitations. Furthermore, the findings were grouped into main themes, namely the pattern of use of GenAI in learning, GenAI's contribution to the planning and management of independent learning, its influence on information analysis and evaluation, and the risk of dependency and cognitive effort decline. The results of the synthesis were used to identify similarities, differences, and gaps in previous research and build a conceptual explanation of the conditions when GenAI strengthens or

weakens students' learning independence and critical thinking skills. The validity of the analysis is maintained through comparison between sources, the use of reputable articles, and systematic recording of search procedures.

Results and Discussion

Research Results

The results of the literature synthesis show that the use of *generative artificial intelligence* (GenAI) makes it easier for students to access information, obtain material explanations, summarize readings, and develop ideas quickly. GenAI also allows for flexible learning interactions because students can ask repeated questions and get responses tailored to their learning needs. This feature can help students overcome the limitations of learning resources and support the learning process outside the classroom. Thus, GenAI has the potential to function as a personal learning assistant that increases the efficiency and affordability of learning (Kasneci et al., 2023; Tlili et al., 2023).

In relation to *self-directed learning*, GenAI helps students identify learning needs, set goals, develop plans, find alternative sources, and evaluate understanding independently. Students can use GenAI to create study schedules, obtain material recommendations, simplify complex concepts, and receive initial feedback on their work. This support increases student control over the learning process and reduces dependence on lecturer attendance. However, increased independence only occurs if students remain active in selecting, verifying, and reflecting on the information obtained (Farrokhnia et al., 2024; Lo, 2023).

The results of the study also show that GenAI can support critical thinking skills when used to compare perspectives, develop questions, test arguments, and evaluate alternative solutions. Students can ask GenAI to present different points of view, identify weaknesses in an argument, or present cases that need to be analyzed. These activities have the potential to encourage interpretation, analysis, evaluation, inference, and problem-solving skills. However, GenAI's output that looks convincing is not necessarily accurate, so users must cross-check with credible scientific sources (Kasneci et al., 2023; Chan, 2023).

On the other hand, a number of risks were found, namely technology dependence, passive acceptance of answers, decreased cognitive effort, plagiarism, and violations of academic integrity. When GenAI is used only to obtain final answers or complete assignments, students have the potential to skip the process of reading, analyzing, and composing arguments independently. The impact of GenAI on learning is thus not singular, but is determined by the purpose of use, AI literacy, learning design, type of assignment, and academic supervision. Reflective use can improve the quality of learning, while substitute use can weaken independence and critical thinking skills (Cotton et al., 2024; Farrokhnia et al., 2024).

Discussion

The research findings confirm that GenAI is a technology with dual characteristics in education. GenAI can be a *cognitive scaffold* that helps students understand the material and manage learning, but it can also be a shortcut that replaces intellectual engagement. The difference in impact does not only depend on the sophistication of the technology, but especially on the way students use it. If GenAI is used to obtain clues, explore alternatives, and test understanding, students remain the main controllers of the learning process. On the other hand, if the entire thought process is left to GenAI, the quality of learning can decline even if the results of the assignment look good (Kasneci et al., 2023).

From the perspective of *self-directed learning*, the benefits of GenAI can be seen in its ability to provide personal and timely learning support. Students do not have to wait for lecturers' explanations when facing difficulties because they can ask for examples, additional explanations, or feedback from GenAI. These conditions can increase initiative, motivation, and learning responsibility. However, learning independence does not only mean being able to learn without lecturers, but also includes the ability to set goals, choose credible sources, monitor progress, and evaluate learning outcomes. Therefore, the high intensity of GenAI use does not necessarily reflect the high level of learning independence if students simply follow the answers generated by technology (Lo, 2023; Tlili et al., 2023).

The relationship between GenAI and critical thinking skills is also conditional. GenAI can enrich the thinking process if students use it to conduct critical dialogues, compare arguments, ask for evidence, or identify weaknesses in an explanation. However, GenAI can produce *hallucinations*, biases, invalid sources, and arguments that appear logical but contain errors. Therefore, the use of GenAI needs to be accompanied by verification, reflection, and evaluation of evidence. Students' ability to formulate questions and evaluate answers is more important than the ability to obtain information alone (Farrokhnia et al., 2024; Kasneci et al., 2023).

The findings show a conceptual relationship between the use of GenAI, *self-directed learning*, and critical thinking. The targeted use of GenAI can increase learning independence, while the independence encourages students to control and evaluate the process of seeking knowledge. Students who have good self-regulation are less likely to accept GenAI's outputs directly, but rather compare them with academic sources and develop their own conclusions. Thus, *self-directed learning* can serve as a mechanism that bridges the use of GenAI with critical thinking skills. However, this relationship requires further empirical testing as it can be influenced by AI literacy, learning motivation, discipline, and student experience.

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Conclusion

Based on the results of the literature review, the use of *generative artificial intelligence* (GenAI) has a dual effect on *self-directed learning* and students' critical thinking skills. GenAI can act as a personal learning assistant that helps students determine learning needs, obtain explanations, develop ideas, develop learning strategies, and get feedback quickly. Directed, active, and reflective use can strengthen learning independence while encouraging students to compare perspectives, evaluate arguments, verify information, and solve problems critically.

On the other hand, the passive and excessive use of GenAI has the potential to cause technological dependence, reduce cognitive effort, and weaken academic originality and integrity. Therefore, the impact of GenAI is not only determined by the intensity of its use, but also by the purpose of its use, AI literacy, self-regulation ability, learning design, and academic supervision. This study concludes that GenAI should be placed as a *cognitive scaffold* that supports students' intellectual processes, not as a substitute for reading, analyzing, evaluating, and building arguments independently.

Suggestions

Universities are advised to develop a clear, ethical, and adaptive policy for the use of GenAI and integrate AI literacy into the learning process. Lecturers need to design authentic learning and assessments that require students to explain the thinking process, verify GenAI's output with scientific sources, transparently list the use of AI, and reflect on the learning outcomes. Students also need to use GenAI responsibly as a tool for exploration, discussion, and feedback, not to produce final answers without an evaluation process.

Further research is suggested using quantitative, qualitative, or *mixed methods approaches* to empirically test the relationship between the use of GenAI, *self-directed learning*, and critical thinking skills. Future research can also include AI literacy, self-regulation, learning motivation, and technology use ethics as mediation or moderation

variables. In addition, longitudinal and experimental research is needed in various study programs, education levels, and regions to determine the long-term impact and differences in the influence of GenAI based on student characteristics and learning context.

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