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Review Article

The impact of generative artificial intelligence on higher education students in developing cognitive skills: A mini literature review

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Abstract

The frequent usage of generative artificial intelligence (GenAI) in higher education is increasing on a daily basis, and little is known about its effects on the cognitive skills of students. This review study focuses on the impact of GenAI on the development of cognitive skills in higher education students. Implementing the mini literature review methodology, this study analyses existing academic literature that is connected to the research questions of this review study. Thematic analysis was employed to analyse existing academic literature, identifying the key trends, benefits, challenges, and gaps. The review study found that GenAI assists in promoting personalised learning experiences, developing problem-solving skills, and providing real-time feedback, which leads to increased students' cognitive skills development. However, the research also identified that cognitive offloading and over-reliance on GenAI can hamper the student's independent cognition, critical thinking, and deep learning. As a result, higher education institutions (HEIs) must carefully invest resources in developing the students' cognitive skills with GenAI. The review study recommends that training, careful GenAI curricular integration, and continuous investigation into the impact of GenAI on learning outcomes are necessary, as well as a comprehensive process to unpack GenAI's benefits in higher education towards building students' learning, independence, critical thinking, and creativity.

Keywords: artificial intelligence, cognitive skills, critical thinking, generative artificial intelligence, higher education institutions, students.

Introduction and Conceptualisation

The advent of generative artificial intelligence (GenAI) tools in higher education represents a radical disruption and facilitates a systematic change in creating a customisable and effective learning environment for lecturers and students (Moongela et al., 2025). GenAI tools are supposed to reframe how individuals think about knowledge, learning, sharing, and utilising skills for every mode of human professing (Moongela et al., 2025). As Yan et al. (2024) state, GenAI has the potential to alter human learning, nurturing, and analysis. The GenAI tools enhance learning abilities, skills, and talents by promoting personalised learning, thereby making it easier for students to access a broader range of educational materials, receive timely feedback, and produce innovative outcomes (Yan et al., 2024). By removing learning obstacles and improving critical and cognitive skills, the incorporation of GenAI tools will revolutionise students' learning experiences and their cognitive and critical skills (Sadeeq & Robbins, 2024).

Furthermore, Kadaruddin (2023) asserts that through interactive learning environments (experiences), real-world simulations, and instant feedback systems, GenAI in higher education not only improves engagement and customisation but also significantly contributes to the development of critical and cognitive skills through interactive learning environments that promote apt feedback for students. Lecturers (educators) can significantly improve the development of cognitive skills, especially in critical thinking, by utilising AI in guided assessments, which will ultimately improve student engagement and learning outcomes (Afzal & Torralba, 2024). Through more interaction and individualised learning, GenAI may improve cognitive skills, but it also carries the risk of dependency, as well as shallow learning (Qu et al., 2025).

Based on the existing literature above, there is a growing trend in the benefits of GenAI in higher education; however, there are limited academic studies. To explore the impact of GenAI on students' cognitive skills development in higher education, this review study conducted a mini literature review examining the role of GenAI in constraining its effects on students.

An Overview of Generative AI (GenAI)

GenAI is a family of artificial intelligence (AI) systems that can generate new textual, visual, audio, and other kinds of content based on a dataset and/or programmed content. Banh and Strobel (2023) and Dwivedi et al. (2023) have documented GenAI is an innovation in AI technology where a new generation of automated news generation is being developed (for example, content from social media), where GenAI reduces the computer-generated information using advanced machine learning processes (mainly deep generative models) to produce a new computational user generated generation of deep learning generated dataset. It employs the latest standard in machine learning processes, essentially deep learning (Banh & Strobel, 2023), to produce content from large datasets.

GenAI has evolved to become an innovative actor in higher education, and various sources have suggested that GenAI is an innovative way to develop the teaching and learning experience (Sekli et al., 2024). For example, Google Gemini, ChatGPT, and many other similar applications can support lecturers in developing case studies, personalising learning material, and improving extra materials to engage students outside the classroom (Sekli et al., 2024; Yang et al., 2024). In addition, higher

education can improve the quality of its teaching and educational outcomes by employing GenAI to analyse educational data and customise the learning support for differing styles of education (Dasari et al., 2024).

Although GenAI may have potential, a formal review of its associated implications and ethical issues is necessary before deployment within the teaching and learning processes. Even if GenAI tools can support learning, they presently come with questions regarding AI-sourced information quality and trustworthiness, which may also entice lecturers and students to be overly reliant on, misuse, or encourage educational malpractice (Michel-Villarreal et al., 2023). Often linked to the rapid advancements in GenAI technology, issues of plagiarism and authorship also surface (Dai et al., 2023). Educators and scholars must also examine the use and effectiveness of GenAI to ensure positive and responsible integration into educational contexts (Bahroun et al., 2023; Ha et al., 2023; Sekli et al., 2024).

Cognitive Skills

According to Asrif and Fatmi (2024), cognitive skills are mental processes applied in different areas or disciplines. Cognitive skills are regarded as higher-order mental processes that involve problem-solving, critical thinking, and decision-making. It allows students to reason, remember, comprehend, and organise their information in problem-solving and decision-making (Fusar-Poli et al., 2020). At the same time, cognitive thinking is the mental process that functions with cognitive skills to reflect, reason, and inform decision-making (Asrif & Fatmi, 2024). Cognitive skills enable students to comprehend and process given information. It further allows students to synthesise information, gain knowledge (learn), recall, and solve problems. Through cognitive skills, students can pay attention, provide an analysis of a context, discover knowledge, process, and solve problems(Asrif & Fatmi, 2024).

In this era of AI tools like GenAI, which generate human-like text and insightful content that, ordinarily, humans (students) can find difficult or complex to comprehend or bring together, such as an insightful idea (Fusar-Poli et al., 2020). At the heart of the complexity, students are given the opportunity to analyse the content presented to them, make efforts towards making sense of the contexts, and gain additional knowledge through GenAI-generated content (Asrif & Fatmi, 2024).

GenAI and Cognitive Skills

A study conducted by Habib et al. (2024) believed that Generative Artificial Intelligence (GAI) or GenAI has dual implications for students' cognitive skills. Additionally, the study further stated that while GenAI tools can inspire creativity by serving as a starting point for brainstorming and generating new ideas, they also pose risks to critical thinking (Habib et al., 2024). The reliance on GenAI-generated content may lead to a superficial understanding of complex topics, as students might not engage deeply with the material (Habib et al., 2024). Furthermore, the research reported that students who used GenAI in writing and paraphrasing performed worse in critical thinking activities than students who engaged their brains. Considering these findings suggests that GenAI could present negative consequences for students in how they think, analyse, and evaluate. While Asrif and Fatmi (2024) reported that GenAI can support creativity, efficiency, and effectiveness, it can be negatively impacted by improper implementation, which can harm students' critical thinking skills/ability.

Also, researchers like Choi and Chang (2025), as well as Imran and Almusharraf (2024), believe that GenAI, like Google Gemini, Copilot, ChatGPT, and others, have a positive impact on students' cognitive skills and reasoning, as they promote instant feedback, personalised learning, interactive learning, a tailored learning experience, and reflective learning. GenAI content can promote critical thinking by providing real-life situations and exploring different views, ideas, arguments, and questions, which enhance students' analytical thinking and skills (Imran & Almusharraf, 2024). The AI's ability to replicate real-world scenarios allows students to use their knowledge under challenging tasks that require strong problem-solving skills (Habib et al., 2024). This practical method not only assists students in grasping the material more deeply but also increases their self-confidence in handling complex problems on their own (Habib et al., 2024).

Additionally, by encouraging students to review their learning procedures, ChatGPT fosters reflective thinking amongst students by assisting them in pinpointing their areas of strength and weakness, as well as cultivating an attitude of growth in their knowledge production (Abbas & Gasmi, 2024). ChatGPT enables students to see obstacles as opportunities for personal development. This reflective practice is crucial for lifelong learning. All things considered, GenAI enhances the educational process and gives students the cognitive skills they need to successfully negotiate the multifaceted nature of the modern world (Abbas & Gasmi, 2024).

Problem Statement

The use of GenAI in the teaching and learning process is transforming and enhancing the skills and thought processes of students in higher education. GenAI has the potential to enhance cognitive skills such as critical thinking and analysis; however, it also raises concerns about cognitive offloading and the preservation of human agency in educational contexts (Shum, 2024). According to Shum (2024), cognitive offloading refers to the process of relying on external tools or technologies, such as AI, to perform cognitive tasks, thereby reducing the mental effort required to complete those tasks. Tankelevitch et al. (2024) believe that GenAI will reduce cognitive demand in performing tasks like ideation, reasoning, remembrance, and decision-making.

Conversely, researchers like Ahmad et al. (2023) reported that excessive dependence on GenAI leads to students being lazy in conceptualising, analysing, and interpreting an idea. Some argue that GenAI will provide support for better academic writing abilities and skills (Maphoto et al., 2024). Nonetheless, GenAI's effect on students' cognitive skills continues to present evidence of both potential positive impacts and potential negative impacts. More researchers are beginning to examine possible positive and negative aspects of GenAI on the cognitive skills of higher education students, as well as the impacts on their teaching and learning process.

GenAI tools like ChatGPT, Microsoft Copilot, Google Gemini, and others can provide some substantive assistance to the cognitive skills of students in personalised learning scenarios, as well as instant feedback. Huang and Qiao (2024) found that student learners who used AI tools demonstrated significantly greater improvement in their computational thinking skills related to programming compared to those who did not use these AI tools. Also, it suggests that GenAI could enhance student critical thinking and problem-solving, as they are better able to understand and use complex subjects at a deeper level. Additionally, the use of AI tools can also have implications for student confidence and motivation. The possible use and application of AI in the arena of higher education to enhance learners' creativity and self-efficacy have implications for

cognitive skills, two of which are important to students' academic success (Wang et al., 2023). Student learners can also explore various problem-solving paths through AI, which helps develop their analytical thinking while respecting their curiosity as they navigate the curricular experience.

On the other hand, there are significant implications for reliance on GenAI tools. Most importantly, GenAI may not only lead students to rely on its elements in ways that hinder independent learning, critical thinking, or independent thought. For instance, Yilmaz and Yilmaz (2023) argue that while AI could provide immediate responses, it may not actually teach students how to use the messages received in a subject-like programming context. Due to over-dependence, students may only have a superficial comprehension of the content (material) and struggle to apply what they have learned in real-world situations (Yilmaz & Yilmaz, 2023).

Furthermore, there are significant concerns about the potential longer-term implications for thinking, as well as potential ethical and data privacy risks of its implementation from the standpoint of higher education. If we mismanage the process of integrating GenAI, students may give up their ability to think critically or meaningfully participate in their education. Students who are less skilled or knowledgeable are more likely to cognitively offload through the adverse effect (Tankelevitch et al., 2024). This current review study will explore, using a mini literature review methodology, the implications of generative artificial intelligence for higher education students in developing cognitive skills, given what has been written surrounding the current gap in research. The following research questions guided this review study (mini literature review): *Can GenAI assist higher education students in developing cognitive skills?* And *what are the challenges in using GenAI to develop cognitive skills?*

Methods

Approach

A "mini literature review" is a concise summary of previous research on a particular subject (Chukwuere, 2023). Mini literature reviews evaluate specific literature on a topic to provide insight into significant findings, trends, and gaps in the research, whereas regular reviews can be long-winded and complex (Chukwuere, 2023). A mini literature review is a concise and specific analysis of the literature associated with a topic that identifies major themes, ideas, trends, and research gaps (Chukwuere, 2023). In dynamic topics where scholars need to rapidly frame their understanding of the current knowledge inventory without wading through lengthy and extensive reviews, they are helpful and provide quick insights, such as GenAI in higher education.

Both researchers and practitioners can benefit from mini literature reviews, which can be used to summarise significant findings and generate ideas for future research (Chukwuere, 2023; Collins, 2014; Kraus et al., 2022). A mini literature review of an information systems study is useful because it clearly explains how education and technology come together in this study, which uses GenAI to produce text and images based on the data fed to it. The potential of GenAI for improving cognitive skills, including students' creativity, critical thinking, and problem-solving, has drawn attention from academia.

In examining and synthesising literature studies, the mini literature reviews utilised by the author/researcher Collins (2014) recognise how the existing GenAI tools, such as educational chatbots and adaptive learning platforms, may engage students differently than traditional teaching and learning would accurately achieve. Mini literature reviews are relevant because they are a relatively quick and efficient means of recognising literature on the subject matter, providing summaries of significant trends, and identifying research gaps, so the literature can be used to help further develop knowledge or serve as an impetus for research later down the road (Chukwuere, 2023).

The mini literature review of this review study included several previously published perspectives in the literature, examining the ways GenAI influences the cognitive skills development of higher education students. The research literature suggests GenAI can facilitate deeper thinking through learning experiences that are personalised for each learner's needs, amongst a wide array of other perspectives.

This approach has provided a more nuanced understanding of the potential uses of GenAI technologies to enhance the development of cognitive skills in higher education students. For instance, AI-based solutions could provide learning environments tailored to each learner's unique learning style, which improves their cognitive skills (Collins, 2014; Kabudi et al., 2021; Shodieva, 2024). The application of the research methodology has drawn attention to gaps in the existing research environment. Given the interest in GenAI's potential in higher education, studies assessing the effects of GenAI on cognitive skill development among students in higher education remain limited. Finding these gaps not only informs future research needs but also promotes a more nuanced understanding of the effects of GenAI in educational settings (Collins, 2014).

Literature Retrieval Process

To ensure the quality and reliability of the information related to this review study, the literature included in this mini literature review was deemed to be of high quality because all the research was obtained transparently through a methodical and systematic searching process. This review study ensured the application of a rigorous academic review process, as the literature reviewed consisted of peer-reviewed journal articles published between 2023 and May 2025. The sources for the literature included peer-reviewed journal articles retrieved through academic databases such as ResearchGate, Scopus, ScienceDirect, EBSCOhost, and relevant literature articles and papers found through database searches, including Google Scholar. Also, some of the broader search terms included for sourcing the studies involved "generative AI in education," "AI in higher education," "mini literature review", "GenAI and cognitive skills", "generative artificial intelligence", and "AI in higher education".

In order to obtain reliable research studies from the search terms, the filtering was further limited to articles that were written and published in the English language and strictly peer-reviewed. The articles underwent a second selection process based on their relevance to the study and to cognitive skill development (critical thinking, creativity, and problem-solving), with a particular focus on the use of GenAI in higher education settings. The exclusion criteria included studies that had no relevance to higher education or non-generative artificial intelligence; studies that were not published in English; and non-peer-reviewed articles.

Process of Literature Analysis

After the retrieval of the studies, the selected studies were analysed using the Braun and Clarke's (2006) thematic analysis six-phase process. The thematic analysis process was used to analyse the existing academic literature, identifying trends, benefits, challenges, and gaps. The first stage involved extracting the objectives, methodologies, and results/findings of each article, followed by the identification of themes, patterns, and trends in the collective study and data (Braun & Clarke, 2006; Nowell et al., 2017). This process enabled researchers to compare the results/findings, identify consistencies, and map the gaps and areas established in the study (Braun & Clarke, 2006; Nowell et al., 2017). For example, while different studies did point to a potential ability of GenAI to promote creativity and reflective learning (Collins, 2014; Kabudi et al., 2021), few researchers looked specifically at the measurable impact of GenAI on the cognitive development of higher education students in the long term.

Altogether, to maintain rigour in this review study, transparency was maintained by including academic databases, search terms, and inclusion and exclusion criteria throughout the literature search phase. By utilising only credible and peer-reviewed articles, the researchers departed from the working papers and grey literature often included in literature reviews, in order to abide by the principles of relevance and maintain academic integrity. Critical scrutiny was utilised to verify the engagement of the review with the literature and the study overall, as warranted by the research question. This mini review of the literature provided a clear, concise, and expansive focal synthesis of past studies concerning the impact of generative artificial intelligence on higher education students as they develop cognitive skills. Further, it assisted the researcher in identifying existing research gaps.

Findings and Discussion

Three main themes were identified in this review study (mini literature review): 1) How using GenAI in higher education can help students improve cognitive skills, 2) The challenges in implementing GenAI to improve students' cognitive skills, and 3) Specific cognitive skills contributions by GenAI.

How Using GenAI in Higher Education can Help Students Improve Cognitive Skills.

GenAI can improve cognitive skills in higher education. According to the study conducted by Abbas and Gasmi (2024), a key component of using GenAI to build cognitive skills is enhancing students' critical thinking, problem-solving, and analytical reasoning abilities through interactive learning environments, personalised feedback, and real-world simulations. The following are some ways that GenAI in higher education could enhance cognitive skills:

Interactive problem-solving: Utilising GenAI platforms, including Google Gemini, ChatGPT, and many others, students take part in real-time scenario-based problem-solving. Students are given the opportunity to assess circumstances, weigh options, and make decisions through this participatory approach, which is a crucial element of critical thinking and problem-solving abilities (Irfan & Robbins, 2024). AI enables students to interact with content, promoting deeper comprehension and

cognitive development, in contrast to traditional passive learning approaches, where students absorb information without application (Dita & Wishart, 2024; Irfan & Robbins, 2024).

Promoting problem-solving: By providing students with multiple, varied approaches to challenges, GenAI can help them develop their problem-solving skills. Thiga (2024) suggests that GenAI assists students in making informed decisions by considering the viability of multiple options through the generation of numerous answers or perspectives, thereby challenging them to build upon those and add their own perspective. It also improves creative thinking and analytical capacity (Thiga, 2024).

Enhancing independent research: GenAI tools have the potential to stimulate the students' independent research efforts. The writer found that students will use AI-generated content as a base for in-depth research and move away from dependence on conventional sources (Lin et al., 2024), and it bolsters support for cognitive skills and inspires students toward further information seeking, veracity, and coalescing from multiple resources (Thiga, 2024).

Metacognitive engagement: Students can evaluate their problem-solving practices, reflect on alternative ways of doing things, and contemplate their ways of thinking while using GenAI (Irfan & Robbins, 2024). This metacognitive work is essential in developing self-awareness and improving cognition (Irfan & Robbins, 2024).

Personalised learning experiences: Sreen and Majid (2024) state that GenAI generates responses based on each student's individual needs, learning styles, and skill levels. By allowing students to receive feedback that aligns with their needs and desires, this personalisation enhances the way that students learn (Sreen & Majid, 2024). For example, if students are struggling with a concept, tools like Google Gemini, Copilot, ChatGPT, and others can provide personalised views or alternative options to help students understand a challenging concept. By remedying particular issues and assisting them in mastering complex topics, this support contributes to the growth of cognitive skills (Dita & Wishart, 2024; Irfan & Robbins, 2024).

Realistic scenario simulation: Students can apply their learning to realistic contexts by engaging in discussions or conversations with GenAI tools. Typically, when students have disconnected perspectives on reality, they can actively assess multiple perspectives, justify their own, and draw reasonable conclusions (Lee et al., 2023). This level of engagement prepares students to apply their cognitive skills to real-life scenarios, while enhancing their analytical thinking using GenAI (Dita & Wishart, 2024; Irfan & Robbins, 2024).

Iterative learning and rapid feedback: GenAI provides students with rapid feedback on their inquiries and also encourages ongoing skill development. Students are invited to engage in self-directed learning and are helped to locate the areas of their inclinations to learn through the ongoing learning process (Lee et al., 2023). Rapid feedback advances a growth mindset and is a necessary condition for the development of cognitive skills (Dita & Wishart, 2024).

Structured discussion and debate: GenAI can stimulate discussions on an array of topics and encourage students to evaluate counter-arguments and form a well-considered viewpoint (Irfan & Robbins, 2024). Once students develop the capacity to assess the evidence and communicate their ideas, this task strengthens their critical analysis and reasoning skills (Irfan & Robbins, 2024).

Encouraged analytical reasoning: GenAI shall invite students to investigate and review evidence with original ideas through engaging tasks or scenario-based thinking and learning (Sreen & Majid, 2024). This activity fosters the development of analytical thinking skills, which are essential for both academic achievement and successful problem-solving in various settings (Dita & Wishart, 2024).

Support for various learning types: By offering individualised learning opportunities, GenAI is capable of accommodating a variety of learning types and styles (Olabiyi & Henry, 2024). AI-generated infographics or diagrams, for example, can be helpful for visual students, whereas text-to-speech functionalities may be more engaging for auditory students (Olabiyi & Henry, 2024). This flexibility enables every student to improve their cognitive skills in ways that suit their unique learning styles and types (Thiga, 2024).

Growth of reflective thinking: GenAI has the potential to encourage students to think critically about the consequences of the knowledge they are given by fostering reflective thinking (Thiga, 2024). For instance, students can critically assess the information's overall correctness, importance, and consistency whenever they employ GenAI to create content. Reflective thinking involves the development of higher-order cognitive skills such as appraisal and synthesis abilities (Thiga, 2024).

The Challenges in Implementing GenAI to Improve Students' Cognitive Skills

There is no question about GenAI's ability to improve cognitive skills. Nevertheless, the tool has problems such as "a risk of fluency bias," which causes students to over- or underestimate what they learned, which affects their cognitive abilities and ability to process information (Yan et al., 2024). To optimise its potential advantages, several issues must be addressed when implementing GenAI in higher education to foster cognitive skills.

Since the efficacy of GenAI tools largely depends on the calibre of the material and their contextual suitability, one major challenge is making sure that AI-driven content adheres to high standards of accuracy and relevance while also aligning with academic goals and objectives (Irfan & Robbins, 2024). The possibility of bias in AI algorithms, which may reinforce preexisting preconceptions and inequities and eventually lower the standard of learning for student experiences, is a challenge to adoption (Abbas & Gasmi, 2024).

The accuracy and standard of the results produced by GenAI pose another difficulty in reliability and validity (Chan & Hu, 2023). Students who lack background expertise to evaluate the content carefully could be misinformed by the technology's propensity to produce content that's skewed (biased), false, or completely inaccurate (Chan & Hu, 2023). In the higher education environment, where reliability and accuracy are keys to the literature, the issue becomes even more problematic when generative AI is included. Students may struggle to effectively integrate GenAI into their lesson process, as many institutions have yet to establish clear policies and procedures for leveraging these technologies to enhance cognitive skills (An et al., 2025). Although there are no due diligence processes (frameworks) to ascertain the manner in which GenAI facilitates cognitive development, this will complicate the attempt to implement generative AI into a higher education environment (Thiga, 2024).

In addition, students may become overly dependent on AI to answer problems, which could hinder their ability to think critically and independently (Irfan & Robbins, 2024). Students' critical thinking and problem-solving skills may suffer as a

result of an excessive reliance on AI tools. When students rely merely on GenAI to provide materials or answers, they risk missing critical final steps of self-directed inquiry, analysis, and review. The lack of effort may cause reduced engagement in the depth of learning the material would otherwise require, hindering the students' higher-order cognitive skills from developing. With GenAI being so user-friendly, students may easily accept 'answers' and/or 'outputs' generated by an AI, and thereby, it is easy to see how students find themselves left with a shallow or thin understanding of complex content (Thiga, 2024).

Since a lack of familiarity with these technologies may result in inadequate deployment, lecturers (educators) must have the training and tools they need to successfully incorporate GenAI into the way they teach in order to conquer these challenges (Irfan & Robbins, 2024). To guarantee a secure and fair learning setting, ethical issues, including the privacy of information and the possibility of bias in AI replies, present serious obstacles that need to be resolved (Irfan & Robbins, 2024). Furthermore, as biases or mistakes in answers can deceive students and impede their cognitive development, it is imperative to ensure the appropriateness and accuracy of AI-generated content (Abbas & Gasmi, 2024). Given the sensitive nature of educational data, the security and privacy of data are particularly crucial; strong ethical standards and legal structures (framework) are required to safeguard student data (Abbas & Gasmi, 2024).

Further, the issue of the "digital divide" is that unequal access to technology may worsen educational inequalities and keep some students from using GenAI and its enhanced learning resources (Abbas & Gasmi, 2024). These issues must be addressed to ensure the proper and effective integration of GenAI in higher education, enabling all students to develop the cognitive skills necessary for functioning in increasingly complex environments. These difficulties underscore the need for careful planning and consideration when GenAI is integrated into higher education environments to impact students' cognitive skills effectively.

Specific Cognitive Skills Contributions by GenAI

This mini literature review contributed to and increased academic knowledge by presenting ways GenAI can develop students' cognitive skills and abilities. These cognitive skills are valuable for both academic and non-academic behaviours for higher education lecturers and students. The cognitive skills are:

The ability to expedite solutions: GenAI generates alternative solutions to complex problems, which encourages learners to consider all of their alternatives and come to a sensible decision (Moongela et al., 2025).

Analytical reasoning: Students are encouraged by GenAi to interrogate texts and develop creative solutions through progressive tasks and learning scenarios (Zhao et al., 2025). Importantly for these skills, informed decision-making, problem-solving, and academic performance are core (Zhao et al., 2025).

Critical thinking: Learning in GenAI; students are developing critical thinking skills and capabilities through evaluation and analysis of information, they can consider alternative approaches to action and reflect on their own thinking (Moongela et al., 2025).

Creative thinking: GenAI can encourage students to think outside the box (Moongela et al., 2025) by providing multiple solutions or perspectives on a problem, thereby promoting creative thinking.

Metacognitive skills: GenAI supports students in developing their cognitive skills and metacognition, because GenAI allows students to reflect on their learning and behavioural patterns (Zhao et al., 2025).

Reflective thinking: Reflective thinking underpins higher-order cognitive skills, namely synthesising and evaluating. GenAI encourages reflective assessment of the content generated (Moongela et al., 2025; Zhao et al., 2025).

Knowledge synthesis: Students' cognitive skills can be developed by applying GenAI in combination with learning content across multiple sources and promoting independent research (Zhao et al., 2025).

Limitations and Recommendations

Limitations of the Review Study

This review study faced several limitations, including a lack of empirical data, a limited scope and depth, and the inclusion of fewer sources, which resulted in a lack of comprehensive coverage of the literature. As a result, some conflicting results/findings or important aspects of the study may have been missed, thereby reducing the overall depth of the analysis. Additionally, no structured methodology was applied for retrieving the literature, as would have been done in a systematic review, which may impact the validity. Due to the limited number of sources used in this review study, the findings and insights in this mini literature review may not apply to a broader population or context, and no collection of primary data was carried out in this review study.

Recommendations and Future Studies

This part of the review study outline suggestions for future studies and also provided findings that promote the adoption of GenAI to enhance the cognitive skills of higher education students. These recommendations offer valuable insights for scholars, practitioners, and students on the effectiveness of GenAI in higher education, particularly in developing students' cognitive skills.

Recommendations of the Review Study

Curriculum combination: This review study recommends that higher education providers carefully integrate GenAI tools into their curricula to develop cognitive skills. To ensure the use of AI promotes students' critical thinking and problem-solving capacity, the GenAI integration should be aligned with educational learning outcomes, as well as with appropriate integration.

Educator training: Educators should receive training to integrate GenAI tools in teaching and learning appropriately. Such approaches should highlight their use of AI and the capacity to tap into students' independent thinking and creativity; however, they also highlight the dangers of using these technologies too explicitly.

Monitoring and evaluation: The research suggests developing mechanisms for tracking and evaluating how GenAI tools can improve cognitive skills. It includes assessing the quality of information produced by AI as well as how it impacts the educational results of students.

Future Studies

Longitudinal studies: To be able to assess the long-term effects of GenAI upon the enhancement of cognitive skills (abilities), this investigation suggests conducting longitudinal research. The research may shed light on the long-term positive and negative impacts of regular use of AI tools on students' learning outcomes.

Diverse learning contexts: The efficacy of GenAI in an array of educational scenarios and populations ought to be explored extensively. Understanding how different groups of students interact with GenAI may help educators adapt how they teach in order to meet the needs of a range of students.

Research into new technologies: In use alongside GenAI, studies on modern technologies such as virtual reality (VR) and augmented reality (AR) may be done to create fully immersive learning environments that enhance cognitive skills.

Addressing ethical issues: Further studies might investigate the ethical implications of using GenAI in higher education, particularly issues with biases in machine learning algorithms and the accuracy of the information these tools generate. Future studies should focus on developing requirements for the ethical application of AI in higher education.

Conclusion

The introduction of GenAI into higher education presents a unique opportunity for cognitive skill development for students. Through engaging pedagogical practices and personalised feedback, this research demonstrated that GenAI can positively impact problem-solving skills, logical reasoning, and analytical thinking. GenAI promotes higher levels of cognitive engagement and further supports an interactive educational environment by providing students with timed problem-solving situations coupled with individualised learning opportunities. The findings also highlight concerns about the integration of GenAI, including limits to cognitive offloading, dependency on technology, and potential biases in AI systems. Lecturers need to mitigate these concerns to ensure that the integration of GenAI enhances students' cognitive skills rather than detracts from them.

The recommendations for this review study highlight the necessity of thoughtful curriculum integration of GenAI, comprehensive training for lecturers (educators), and continuous evaluation of the effectiveness of GenAI. Future research should address the impact of GenAI on the development of cognitive skills in various educational contexts, the long-term impact of GenAI on cognitive skills, and the ethical implications of GenAI in higher education. Although GenAI has the potential to significantly enhance education and cognitive skills development, its use must be strategic in informing rather than providing an artificial crutch that may limit independent and creative thinking. These findings suggest that GenAI better supports students and scholars in enhancing cognitive skills, regardless of the context, to support their academic and extracurricular pursuits while developing their cognitive abilities.

Conflict of Interest

The author has no conflict of interest to declare.

Author Contributions

Joshua E. Chukwuere - Conceptualised the topic, provided the structure and wrote the first draft of the literature.

Goodness C.J. Chukwuere - Wrote the methodology, findings, discussions, limitations, recommendations, and conclusions. Also, conducted the overall review and proofreading.

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References

Abbas, J., & Gasmi, S. (2024). *Generative AI and education: Enhancing cognitive skills through ChatGPT integration.* Unpublished. https://doi.org/10.13140/RG.2.2.28520.07688

Afzal, I., & Torralba, A. (2024*). Cognitive skills development through AI tools: Critical thinking and pedagogics design in modern education.* Unpublished. https://doi.org/10.13140/RG.2.2.34811.53281

Ahmad, S. F., Han, H., Alam, M. M., Rehmat, M. K., Irshad, M., Arraño-Muñoz, M., & Ariza-Montes, A. (2023). Impact of artificial intelligence on human loss in decision making, laziness and safety in education. *Humanities and Social Sciences Communications*, *10*(1), 311. https://doi.org/10.1057/s41599-023-01787-8

An, Y., Yu, J. H., & James, S. (2025). Investigating the higher education institutions' guidelines and policies regarding the use of generative AI in teaching, learning, research, and administration. *International Journal of Educational Technology in Higher Education*, *22*(1), 10. https://doi.org/10.1186/s41239-025-00507-3

Asrif, Y., & Fatmi, H. (2024). A cognitive revolution: Generative artificial intelligence in higher education. academia.edu. https://d1wqtxts1xzle7.cloudfront.net/118615058/A_Cognitive_Revolution_Generative_AI_in_Higher_Education_Yasser_Asrif-libre.pdf?1727941663=&response-content-disposition=inline%3B+filename%3DA_Cognitive_Revolution_Generative_Artifi.pdf&Expires=1749635211&S

Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023). Transforming education: A comprehensive review of generative artificial intelligence in educational settings through bibliometric and content analysis. *Sustainability*, *15*(17), 12983. https://www.mdpi.com/2071-1050/15/17/12983

Banh, L., & Strobel, G. (2023). Generative artificial intelligence. *Electronic Markets*, *33*(1), 63. https://doi.org/10.1007/s12525-023-00680-1

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Chan, C. K. Y., & Hu, W. (2023). Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *International Journal of Educational Technology in Higher Education*, *20*(1), 43. https://doi.org/10.1186/s41239-023-00411-8

Choi, W. C., & Chang, C. I. (2025). Enhancing education with ChatGPT 4o and Microsoft Copilot: A review of opportunities, challenges, and student perspectives on LLM-based text-to-image generation models. *Preprints.* https://doi.org/10.20944/preprints202503.1081.v2

Chukwuere, J. E. (2023). Exploring literature review methodologies in information systems research: A comparative study. *Education & Learning in Developing Nations (ELDN)*, *1*(2), 38–46. http://doi.org/10.26480/eldn.02.2023.74.82

Collins, L. (2014). Mini literature review: A new type of literature review article. *Journal of Family Business Management*, 1–7. https://www.emeraldgrouppublishing.com/archived/products/journals/call_for_papers.htm%3Fid%3D5730

Dai, Y., Lai, S., Lim, C. P., & Liu, A. (2023). ChatGPT and its impact on research supervision: Insights from Australian postgraduate research students. *Australasian Journal of Educational Technology*, *39*(4), 74–88. https://doi.org/10.14742/ajet.8843

Dasari, D., Hendriyanto, A., Sahara, S., Suryadi, D., Muhaimin, L. H., Chao, T., & Fitriana, L. (2024). ChatGPT in didactical tetrahedron, does it make an exception? A case study in mathematics teaching and learning. *Frontiers in Education*, *8,* 1295413. https://doi.org/10.3389/feduc.2023.1295413

Dita, M., & Wishart, D. (2024). ChatGPT in education: Future learning and cognitive skills development through generative AI. https://doi.org/10.13140/RG.2.2.17824.60161

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D.,…Wright, R. (2023). Opinion Paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, *71*, 102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Fusar-Poli, P., Salazar de Pablo, G., De Micheli, A., Nieman, D. H., Correll, C. U., Kessing, L. V., Pfennig, A., Bechdolf, A., Borgwardt, S., Arango, C., & van Amelsvoort, T. (2020). What is good mental health? A scoping review. *European Neuropsychopharmacology*, *31*, 33-46. https://doi.org/10.1016/j.euroneuro.2019.12.105

Ha, Y. J., Hendrickson, S., Nagy, A., Sylvan, E., & Zick, T. (2023). Exploring the impacts of generative AI on the future of teaching and learning. *Harvard University, Berkman Klein Center.* https://cyber.harvard.edu/story/2023-06/impacts-generative-ai-teaching-learning

Habib, S., Vogel, T., Anli, X., & Thorne, E. (2024). How does generative artificial intelligence impact student creativity*? Journal of Creativity*, *34*(1), 100072. https:/doi.org/10.1016/j.yjoc.2023.100072

Huang, X., & Qiao, C. (2024). Enhancing computational thinking skills through artificial intelligence education at a STEAM high school. *Science & Education*, *33*(2), 383–403. https://doi.org/10.1007/s11191-022-00392-6

Imran, M., & Almusharraf, N. (2024). Google Gemini as a next generation AI educational tool: A review of emerging educational technology. *Smart Learning Environments*, *11*(1), 22. https://doi.org/10.1186/s40561-024-00310-z

Irfan, N., & Robbins, S. (2024). Generative AI in education: Teaching strategies for cognitive skills and critical thinking with ChatGPT. https://doi.org/10.13140/RG.2.2.14469.15844

Kabudi, T., Pappas, I., & Olsen, D. H. (2021). AI-enabled adaptive learning systems: A systematic mapping of the literature. *Computers and Education: Artificial Intelligence*, *2*, 100017. https://doi.org/10.1016/j.caeai.2021.100017

Kadaruddin, K. (2023). Empowering education through generative AI: Innovative instructional strategies for tomorrow's learners. *International Journal of Business, Law, and Education*, *4*(2), 618 - 625. https://doi.org/10.56442/ijble.v4i2.215

Kraus, S., Breier, M., Lim, W. M., Dabić, M., Kumar, S., Kanbach, D., Mukherjee, D., Corvello, V., Piñeiro-Chousa, J., Liguori, E., Palacios-Marqués, D., Schiavone, F., Ferraris, A., Fernandes, C., & Ferreira, J. J. (2022). Literature reviews as independent studies: guidelines for academic practice. *Review of Managerial Science*, *16*(8), 2577–2595. https://doi.org/10.1007/s11846-022-00588-8

Lee, G. G., Mun, S., Shin, M. K., & Zhai, X. (2023). Collaborative learning with artificial intelligence speakers (CLAIS): Pre-service elementary science teachers' responses to the prototype. *arXiv preprint*. https://doi.org/10.48550/arXiv.2401.05400

Lin, X., Luterbach, K., Gregory, K. H., & Sconyers, S. E. (2024). A case study investigating the utilization of ChatGPT in online discussions. *Online Learning, 28*(2), 1–23. https://doi.org/10.24059/olj.v28i2.4407

Maphoto, K. B., Sevnarayan, K., Mohale, N. E., Suliman, Z., Ntsopi, T. J., & Mokoena, D. (2024). Advancing students' academic excellence in distance education: Exploring the potential of generative AI integration to improve academic writing skills. *Open Praxis*, *16*(2), 142–159. https://doi.org/10.55982/openpraxis.16.2.649

Michel-Villarreal, R., Vilalta-Perdomo, E., Salinas-Navarro, D. E., Thierry-Aguilera, R., & Gerardou, F. S. (2023). Challenges and opportunities of generative AI for higher education as explained by ChatGPT. *Education Sciences*, *13*(9), 856. https://www.mdpi.com/2227-7102/13/9/856

Moongela, H., Matthee, M., Turpin, M., & van der Merwe, A. (2025). The effect of generative Artificial Intelligence on cognitive thinking skills in higher education institutions: A systematic literature review. In A. Gerber, J. Maritz, & A.W. Pillay (Eds.), *Artificial Intelligence Research. SACAIR 2024. Communications in Computer and Information Science. 2326.* Springer. https://doi.org/10.1007/978-3-031-78255-8_21

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, 16(1). https://doi.org/10.1177/1609406917733847

Olabiyi, W., & Henry, E. (2024). *How conversational AI can tailor educational content to individual student needs, learning styles, and paces.* Unpublished. https://www.researchgate.net/publication/384070113_How_conversational_AI_can_tailor_educational_content_to_individual_student_needs_learning_styles_and_paces

Qu, X., Sherwood, J., Liu, P., & Aleisa, N. (2025). Generative AI tools in higher education: A meta-analysis of cognitive impact. *Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA'25). Association for Computing Machinery, USA*, 1–9. https://doi.org/10.1145/3706599.3719841

Sadeeq, N., & Robbins, S. (2024). Future learning innovations: Overcoming teaching challenges with generative AI and pedagogics design. https://doi.org/10.13140/RG.2.2.27890.93125

Sekli, G. M., Godo, A., & Véliz, J. C. (2024). Generative AI solutions for faculty and students: A review of literature and roadmap for future research. *Journal of Information Technology Education: Research*, *23*(014). https://doi.org/https://doi.org/10.28945/5304

Shodieva, M. (2024). The influence of artificial intelligence on education. *Modern Science and Research*, *3*(2), 394–401. https://doi.org/10.5281/zenodo.10647594

Shum, S. B. (2024). Generative AI for critical analysis: Practical tools, cognitive offloading and human agency. *First International Workshop on Generative AI for Learning Analytics (GenAI-LA): 14th International Learning Analytics*

and Knowledge Conference (LAK'24), Japan. https://simon.buckinghamshum.net/wp-content/uploads/2024/02/LAK24_GenAI_Wkshp_BuckinghamShum.pdf

Sreen, A. H. S., & Majid, M. H. M. (2024). Leveraging ChatGPT for personalized learning: A systematic review in educational settings. *Amandemen: Journal of Learning, Teaching and Educational Studies*, *2*(1), 63–78. https://doi.org/10.61166/amd.v2i1.72

Tankelevitch, L., Kewenig, V., Simkute, A., Scott, A. E., Sarkar, A., Sellen, A., & Rintel, S. (2024). The metacognitive demands and opportunities of generative AI. *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI '24). Association for Computing Machinery, USA,* 1–24. https://doi.org/10.1145/3613904.3642902

Thiga, M. M. (2024). Generative AI and the development of critical thinking skills. *IRE Journals*, *7*(9), 83–90. https://www.irejournals.com/formatedpaper/1705580.pdf

Wang, S., Sun, Z., & Chen, Y. (2023). Effects of higher education institutes' artificial intelligence capability on students' self-efficacy, creativity and learning performance. *Education and Information Technologies*, *28*(5), 4919–4939. https://doi.org/10.1007/s10639-022-11338-4

Yan, L., Greiff, S., Teuber, Z., & Gašević, D. (2024). Promises and challenges of generative artificial intelligence for human learning. *Nature Human Behaviour*, *8*(10), 1839-1850. https://doi.org/10.1038/s41562-024-02004-5

Yang, X., Wang , Q., & Lyu , J. (2024). Assessing ChatGPT's educational capabilities and application potential. *ECNU Review of Education*, *7*(3), 699-713. https://doi.org/10.1177/20965311231210006

Yilmaz, R., & Yilmaz, F. G. K. (2023). The effect of generative artificial intelligence (AI)-based tool use on students' computational thinking skills, programming self-efficacy and motivation. *Computers and Education: Artificial Intelligence*, *4*, 100147. https://doi.org/10.1016/j.caeai.2023.100147

Zhao, G., Sheng, H., Wang, Y., Cai, X., & Long, T. (2025). Generative artificial intelligence amplifies the role of critical thinking skills and reduces reliance on prior knowledge while promoting in-depth learning. *Education Sciences*, *15*(5), 554. https://www.mdpi.com/2227-7102/15/5/554