International Journal of Advanced Research in Islamic Studies and Education (ARISE)
e-ISSN 2785-9088

AI AS A 'CO-THINKER': CHALLENGING OR ENRICHING CRITICAL THINKING IN HIGHER EDUCATION

NUR AISYAH MURSYIDAH ZULKEPLY[1]* & AIDAH ABDUL KARIM[1]

[1*] Fakulti Pendidikan, Fakulti Pendidikan, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.
Corespondent Email: aisyahmzul@gmail.com

Received: 24 March 2025 *Accepted: 26 May 2025* *Published: 05 July 2025*

Abstract: The integration of artificial intelligence (AI) into education has raised important discussions about its dual role as both a collaborator and a potential disruptor of human thinking. This conceptual paper explores the role of AI as a 'co-thinker' in higher education specifically as an epistemic partner that interacts with learners during real-time cognitive tasks. Based on Vygotsky's social constructivism and Facione's critical thinking framework, this paper introduces an Input-Process-Output (IPO) model that outlines how AI may facilitating learners' reasoning processes. Through a critical review of current literature, this paper demonstrates how AI can assist in idea generation, argument development and metacognitive reflection, especially when used ethically and supported by prompt literacy and dialogic pedagogy. At the same time, it highlights major concerns such as algorithmic bias, lack of transparency and the potential loss of intellectual autonomy. The paper also identifies several challenges across institutional, pedagogical and learner-levels that must be addressed to ensure that AI enhances rather than diminishes critical thinking. In response, three pathways are proposed: empirical validation of the model, curricular restructuring to foster AI-literate pedagogy and inclusive access to essential AI tools. Overall, this paper reframes AI as a cognitive collaborator rather than a replacement for human thought, with its impact depends by how learners interact with it. It contributes to ongoing debates about integrating AI meaningfully in higher education with responsible users of AI technologies.

Keywords: Critical thinking, higher education, AI literacy, cognitive collaborator

Cite This Article:
Nur Aisyah Mursyidah Zulkeply & Aidah Abdul Karim. (2025). Ai As A 'Co-Thinker': Challenging or Enriching Critical Thinking in Higher Education. *International Journal of Advanced Research in Islamic Studies and Education (ARISE),* 5(2), 31-52.

INTRODUCTION

The swift progression of Artificial Intelligence (AI) technology, particularly generative AI such as ChatGPT, Gemini and Copilot, has brought about substantial changes in how users interact with information, especially within the field of education. Generative AI (GenAI) is a subset of Artificial Intelligence (AI) that pertains to AI systems capable of producing new content, including text, graphics or code (Ding & Zou, 2024; Qadir, 2023; Dwivedi et al., 2023; Essien et al., 2024). Generative AI offers potential in enhancing the learning process by offering instant feedback, personalizing learning content and facilitating the development of higher-order thinking skills (Adiguzel et al., 2023). This AI model exhibits exceptional proficiency in producing human-like writing, responding to commands and tackling complex problem-solving

tasks (Nikolopoulou, 2024). A study by Essel et al. (2024) and Ehlers (2020) show that generative AI can effectively facilitate students' reflective learning, functioning as both a tool and co-thinker. However, the integration of AI in education also raises numerous ethical and practical concerns that require comprehensive resolution (Rahman & Watanobe, 2023; Tajik & Tajik, 2024). Concerns around algorithmic transparency and the dependability of AI-generated material have emerged as key concerns for educators and learners (Akgun & Greenhow, 2021). To effectively integrate AI into education, it is essential to enhance AI literacy among both educators and students involving understanding the functionality AI systems operate, identifying algorithm biases and developing the ability to critically evaluate AI-generated content (Zhou & Schofield, 2024; Marssof et al., 2022).

Although generative AI offers various advantages in education, concerns have emerged regarding its potential to hinder students' critical thinking development (Essien et al., 2024). Zhai et al. (2024) note that easy access on AI may lead excessive dependence that might reduced cognitive engagement and a decrease in essential analytical skills. Utilizing AI to generate responses without a deep understanding of the material may lead to students developing an over-reliance on technology, thus hindering the development of critical thinking and evaluative skills, impacting students' cognitive abilities (Singh et al., 2021; Bai et al., 2023; Baidoo-Anu & Ansah, 2023). Conversely, some researchers argue that AI can function as a powerful tool for stimulating critical thinking by providing diverse perspectives and constructive feedback when use effectively (Berg & Plessis, 2023). The existing research offers varied viewpoints, with certain scholars warning that AI technologies may hinder the development of critical skills, whereas others contend that AI might enhance learning when utilised appropriately (Vargas-Murillo et al., 2023). Therefore, pedagogical approaches that integrate AI must be carefully designed to ensure that its application enhances the development of critical thinking among students by offering sufficient training and support to educators for the appropriate use of AI in their instruction (Berg & Plessis, 2023; Chica et al., 2023). Futhermore, students should be instructed on the responsible and critical use of AI, allowing them to benefit this technology without undermining their cognitive abilities (Prodhan & Ibrahim, 2022). This divergence in perspectives highlights the necessity for additional investigation from other sources and viewpoints to enhance understanding of the ramifications, consequences and recommendations about AI's position in higher education.

The concept of AI as a co-thinker implies that AI can act as an intellectual collaborator in learning process, rather than simply serving as a tool for delivering answer (Nikolopoulou, 2024). This approach requires students to actively interact with AI, critically evaluate the information provided and make judgement grounded in analytical reasoning (Melisa et al., 2025; Valova et al., 2024; Stolpe & Hallström, 2024). In this context, AI literacy emerges as an essential competence that students must develop to guarantee ethical and successful application of AI in promoting critical thinking (Long & Magerko, 2020). Students should be instructed to interact with AI technology responsibly and critically (Ponomareva, 2023) to maximise AI's potential without compromising their cognitive growth. Vieriu & Petrea (2025) emphasise that integrating AI in education necessitates a comprehensive grasp of AI systems operations and an awareness of possible algorithmic biases. To achieve effective AI integration in education, proper pedagogical strategies must be formulated to ensure that AI serves as a supportive

collaborator that enhances teaching and learning, which includes structured training and continuous support for educators in utilising AI technologies (Amuga, 2023). AI can be a valuable collaborator in the learning journey through a strategic approach, enhancing critical thinking competencies in higher education requires collaboration among educators, students and policymakers to develop effective strategies for AI integration in education (Schiff, 2021). Thus, AI can enhance the educational experience and substantially aid in the development of critical thinking skills among learners.

An increasing amount of study have explored AI's role in education represents a worldwide concern that demands attention has looked into how AI affects learning and how it helps students develop their critical thinking skills (Ogunleye et al., 2024; Amuga, 2023; Prodhan & Ibrahim, 2022). Ogunleye et al. (2024) recommend in their systematic review that using AI in education must be done in a balanced and strategic approach to maximise its benefits while minimising its potential drawbacks. In this context, it is imperative to establish clear guidelines, frameworks and policies for the integration of AI in education (Amuga, 2023). A human-centred approach must integrated throughout the development of AI technologies to ensure that these tools support, rather than replace, the roles of educators and learners in the teaching and learning process (Supianto et al., 2024; Essien et al., 2024; Xu, 2025). Effective AI should function as a supportive tool that strengthens pedagogical and learning methodologies with both educators and students possess AI literacy (Marsoof et al., 2022). Through a holistic and inclusive approach, AI can enhance the students' critical thinking and support the development of their skills by aiding individuals in arranging their thought, enhancing argumentative frameworks and participating in reflective writing (Essel et al., 2024; Tseng & Lin, 2024). A balanced and well-organised strategy can position AI as a valuable co-thinker, an intellectual partner that enhances the learning experience by promoting critical thinking and 21st-century competencies (Prodhan & Ibrahim, 2022). Nonetheless, the realisation of this potential depends on sustained collaboration among teachers, learners and policymakers in designing and executing successful strategies for AI integration among contemporary digital learners (Chica et al., 2023).

LITERATURE REVIEW

Artificial intelligence (AI) technologies have revolutionised the higher education landscape by offering personalized learning experiences and automated assessments (Javaid et al., 2023; Sok & Heng, 2023), virtual assistants and exchange idea (Sok & Heng, 2023), content generation and material recommendations (Klimova et al., 2024) and research support, translation assistance and virtual laboratory simulations (Nikolopoulou, 2024). The advent of ChatGPT has improved learner engagement, streamlined administrative processes and promoted interdisciplinary collaboration (Dempere et al., 2023). However, concerns exist arising from the growth of this technology requires a thorough evaluating its consequences (Vargas-Murillo et al., 2023; Nikolopoulou, 2024). AI intended to be considered as an collaborative educational tools that needs human analytical dan critical evaluation review (Graefen & Fazal, 2024).

Critical Thinking in Higher Education

Critical thinking refers to an individual's ability to analyse, evaluate and make rational decisions based on sound evidence. To begin with, Facione (1990) outlines six core cognitive skills involved in critical thinking: interpretation, analysis, evaluation, inference, explanation and self-regulation. These skills are essential for individuals to process information effectively and make informed decisions. In addition, Paul and Elder (2019) propose eight elements of thought: purpose, question, information, inference, concepts, assumptions, implications and point of view as the foundation of the critical thinking process. Similarly, Ennis (2011) defines critical thinking as reasonable and reflective thinking that is focused on deciding what to believe or do. In today's digital age, this capability has become increasingly essential as individuals are required to filter large volumes of information from diverse sources (Facione, 2011). Critical thinking equips individuals with the ability to identify assumptions, assess arguments and make informed decisions (Elder & Paul, 2020). Moreover, Ennis (2011)emphasises that critical thinking involves a disposition to think openly and logically. Elder and Paul (2020) argue that critical thinking is fundamental to lifelong learning and intellectual development. In line with this, Ennis (2011) contends that education should foster critical thinking skills to better prepare students for future challenges. These skills empower individuals to make more effective decisions in both personal and professional contexts (Ehlers, 2020). Additionally, critical thinking serves as a cornerstone for effective problem-solving and decision-making, enabling individuals to navigate complex information landscapes proficiently (Michalon & Camacho-Zuniga, 2023). Incorporating critical thinking into educational curricula can significantly enhance students' abilities to engage with and analyze complex issues, ultimately leading to more informed and responsible decision-making (Kadrija et al., 2022) .

Critical thinking has emerged as an essential competency in higher education for enhancing students' academic success (Andreucci-Annunziata et al., 2023). The rise of technologies such as artificial intelligence (AI) and social media has significantly transformed the way individuals access, interpret and evaluate information (Iacovitti, 2022). In response to these changes, Prodhan and Ibrahim (2022) highlight the growing use of AI in education requires students to be able to analyze, evaluate and synthesize information to make informed decisions and engage in reflective decision-making to evaluate content generated by these technologies. This view is reinforced by Asrifan et al. (2025), who argue that in the digital age, critical thinking helps individuals evaluate information sources, identify biases and make informed decisions. In light of this, cognitive skills are essential for managing complex issues and shifting to the rapidly shifting requirement in this digital technology. Berg (2024) explains that critical thinking enables students to examine opposing perspectives, challenge assumptions, assess information sources and create validated arguments. As students increasingly reliant on digital platforms and AI-generated content for education and study, the ability to critically analyse, reinterpret and recontextualise knowledge becomes essential for intellectual growth and academic research (Chica et al., 2023). In higher education, students are expected to generate original insights, as critical thinking essential for developing effective techniques and the interpreting complex arguments (Lacovitti, 2022). Critical thinking abilities are essential for academic achievement and for making informed decisions and resolving issues

in diverse professional fields (Supianto et al., 2024).

Importantly, critical thinking urges students to question conventional perspectives and consider multiple solutions, nurturing an environment of inquiry and intellectual curiosity (Moustaghfir & Brigui, 2024). This approach improves students' analytical skills and prepares them to capitalise on new opportunities and overcome challenges in their fields of study (Berg, 2024; Schiff, 2021). As higher education evolves in response to societal and technological shifts, emphasizing critical thinking becomes essential for preparing students to contribute meaningfully to their careers and communities (Bennett & Abusalem, 2024). Haleem et al. (2022) assert that fostering critical thinking abilities in higher education is vital for equipping students to face problems in both personal and professional realms. This advancement necessitates that students interact with other viewpoints, evaluate compelling arguments and utilise their knowledge in practical contexts. Consequently, higher education institutions emphasise the cultivation of students' critical thinking abilities, enabling them to navigate intricate surroundings and promoting lifelong learning (Fiialka et al., 2023). Finally, profesional training should be provided to proficiently assist students in developing these competencies balancely (Vieriu & Petrea, 2025). With a complete and comprehensive approach, critical thinking can be fostered effectively in the digital age. It empowers individuals to become discerning and responsible consumers of information in an increasingly intricate world.

AI as a Cognitive Tool and Co-Thinker

The emergence of large language models marks a transformative shift in the role of AI within educational contexts from being mere static information sources to evolving into dynamic cognitive tools capable of meaningfully engaging with users' thought processes (Zhai, 2022). AI today goes beyond mere task automation, it facilitates complex cognitive engagement, enabling users to extend, refine and reorganize their reasoning (Kasneci et al., 2023). As a cognitive tool, AI enhances intellectual capacity by assisting learners in analyzing arguments, rephrasing ideas and synthesizing information (You, 2024). However, when positioned as a co-thinker, AI does more than respond it engages with learners' reasoning processes, creating dialogic exchanges that mirror human mentorship (Ipek et al., 2023). Positioned strategically, AI can function as an intellectual catalyst supporting learners' metacognitive processes while preserving the essential human role in reasoning and judgement (Meletiadou, 2023). Contemporary AI systems can support students' metacognitive growtht by providing real-time assistance in higher-order tasks such as idea generation, logical structuring and argument enhancement (Atchley et al., 2023). When effectively integrated, AI helps clarify unclear statements, offers alternative viewpoints and generates hypotheses that challenge users' cognitive assumptions. For instance, tools like ChatGPT have demonstrated efficacy in aiding argument construction by mapping logical premises and identifying errors, thereby fostering critical self-monitoring and epistemic vigilance (Atchley et al., 2024; Zhai, 2022). Research demonstrate that students utilise AI not just for information retrieval but also engage AI as a cognitive stimulant to test the consistency of their reasoning through dialogic exchanges (Cotton et al., 2023). Cotton et al. (2023) argue that such interactions frequently elicit metacognitive awareness by encouraging students to compare AI-generated suggestions with

their own ideas, thus supporting synthesis and critical evaluation. Besides improving arguing skills, AI significantly encourages inquiry and curiosity, which are vital elements of critical thinking AI also plays a key role in encouraging curiosity and inquiry, which are vital element of critical thinking.

However, for AI to function optimally as a cognitive partner, it must be embedded within pedagogical designs that prioritize critical interaction over passive consumption. Dwivedi et al. (2023) assert that the educational significance of AI is not in its ability to provide immediate answers, but in its capacity to create cognitive dissonance that encourages deeper inquiry. This requires promoting AI literacy among students, including an understanding of how generative models operate as outputs are based on probabilistic pattern-matching rather than epistemic validation (Rudolph et al., 2023). In the absent of such literacy, students may mistakenly accept AI outputs as authoritative knowledge, thereby undermining the critical dialogue essential for deep learning (Rudolph et al., 2023). To protect users' intellectual independence in evaluating information, educators must guide students in recognizing AI as a predictive language model rather than an entity possessing intrinsic understanding or intentionality (Susnjak & McIntosh, 2024). This differentiation is crucial for enabling students to critically assess AI responses rather than accepting them uncritically. Modern pedagogy demands not just merely introduce AI into classrooms, but also the intentional development of its application to foster reflective dialogue, metacognitive control and students' epistemic agency (Kapoor & Kaur, 2023). When utilised as a cognitive tool in ethical and well-structured learning environments, AI can facilitate critical inquiry and promote intellectual engagement, empowering 21st-century learners to engage in critical thinking.

AI and Critical Thinking: A Symbiotic Relationship or Confrontation

AI offers numerous advantages in enhancing critical thinking, including speeding up the brainstorming process, suggesting alternative arguments and providing immediate feedback on users' writing (Kasneci et al., 2023). These functionalities facilitate the cognitive growth of users, especially in academic and professional contexts (Dwivedi et al., 2023). However, AI also change the way user engage in cognitive processes, potentially prompting a transition from reflective thinking to more reactive forms of cognition (Susnjak & McIntosh, 2024). When prompted intentionally, AI can support critical engagement with information, propose alternative viewpoints and simulate counterarguments effectively mirroring the functions of AI as a dialogic partner (Chaudhry et al., 2023). Research shows that human-AI interaction with active learners can enhance the processes of hypothesis generation and alternative comparison in critical thinking (Atchley et al., 2023). This mirrors reflective practices central to critical thinking, including evaluation, inference, and explanation (Facione, 1990). According to Anderson et al. (2001), critical thinking entails the assimilation of knowledge, analyzing and criticize it prior to reaching a conclusion with a process that can be facilitated by the interactive dialogue offered by AI. Yet, these advantages are only apparent when users have a high level of metacognitive awareness and avoid relying entirely on AI-generated suggestions (Zhai et al., 2022). Therefore, the role of AI as a co-thinker can only be optimally achieved when supported by AI literacy education, ensuring users engage with the technology ethically and critically

(Cotton et al., 2023). In this way, AI can act as a stimulant for intellectual dialogue and the development of deeper reflective thinking.

However, this symbiosis can easily collapse into confrontation when AI is misused or misunderstood. One of the most critical risks is automation bias, where users uncritically accept machine-generated output without reflective reasoning and evaluative judgement (Susnjak & McIntosh, 2024). This raises concerns about academic integrity and the deterioration of deep thinking abilities, particularly when students tend to subtitute their own process of synthesis and intellectual expression with AI generated responses (Rahman & Watanobe, 2023; Tajik & Tajik, 2024). Research by Kasneci et al. (2023) indicates that students often regard AI as a principal source without corroborating the facts or reasoning provided. This undermines the authenticity of thought and threatens students' intellectual autonomy in generating original and independent ideas (Essel et al., 2024). Moreover, ethical challenges surrounding the reliability, transparency and authorship of AI-generated content have become increasingly prominent (Cotton et al., 2023). If users fail to recognize the limitations of AI as a predictive language model, they will mistakenly believe that the information provided is fundamentally correct and authoritative (Valova et al., 2024). Therefore, dialogues on AI as a co-thinker must be inseparable from epistemological and ethical considerations of technology (Essien et al., 2024; Ogunleye et al., 2024). Integrated AI education should prioritise interactive methods that encourage reflection, cross validation and source verification (Dwivedi et al., 2023; Mhlanga, 2023). The relationship between AI and critical thinking can be either symbiotic or adversarial, depending on the user's ability to critically evaluate and interact with the technology itself.

AI APPLICATIONS AS A 'CO-THINKER' IN EDUCATION PRACTICE

The application of AI tools in academic writing expanded from simple automation to performing as a collaborative cognitive partner, assisting with tasks including brainstorming, argument structuring and metacognitive reflection. In the initial writing stages, students who utilising ChatGPT for ideation demonstrated greater diversity in ideas and improved consistency in argument structure compared to peers who did not use the tool (Zhai, 2022). This kind of engagement necessitates writers to refine their own thinking, creating an inverse cognitive loop where machines stimulate human role rather than replace it (Kasneci et al., 2023; Atchley et al., 2024). AI writing assistants such as Quillbot and Grammarly analyze the meaning of sentences and propose stylistic alternatives, prompting writers to evaluate precision, tone and literary clarity (Xu, 2025). Meanwhile, automated writing evaluation (AWE) platforms deployed in higher education institutions often identify logical inconsistencies, weak transitions or unspecific phrasing, prompting revisions that enhance analytical accuracy and argumentative integrity (Abdul Rahman et al., 2025; Ding & Zou, 2024). Dialogic tools such as Scraft further enhance this interplay by posing Socratic questions - this type of question to obtain clarification provides readers with the opportunity to think rationally and logically so that the explanation makes sense that approach intellectual vigilance (Kim & Tan, 2023). The overall effect is that AI transforms from a surface-level editor into a facilitator of higher-order thinking where learners must interpret, critique and justify suggested revisions (Valova et al., 2024).

Educationally-structured AI workshops have effectively integrated these tools within pedagogical designs that prioritize cognitive engagement over convenience. In guided sessions, students generate text using AI outlines via SciSpace or ChatGPT or Canva AI or Consensus, then annotating or justifying each suggested change, bringing metacognitive awareness in the review processes (Valova et al., 2024). When AI-generated outlines prompt students to connect thesis statements with evidence or anticipate counterarguments, they practice inferential reasoning and argumentative coherence (Chaudhry et al., 2023). Simulation tools in professional education, such as medical or legal case scenarios, enhance these principles by requiring learners to evaluate AI-provided scenarios, test diagnostic reasoning and improve argumentation through recursive discussion (Dwivedi et al., 2023). The effectiveness of these applications fundamentally depends on prompt literacy, guiding users to formulate inquiries that stimulate depth information in realism environment rather than generic output (Theophilou et al., 2023). Recognizing AI's limitations as a statistical model, learners are encouraged to validate and possibly correct AI suggestions, transforming potential shortcuts into opportunities for reflective judgment (Atchley et al., 2024; Susnjak & McIntosh, 2024). However, the efficacy of AI as a collaborative thinker is significantly contingent upon users' proficiency in quick formulation and their metacognitive understanding of the technology's limitations and reliability (Mhlanga, 2023). Through this structured and reflective integration, AI becomes a true co-thinker enabling rather than replacing human critical thinking role in higher education.

CHALLENGES IN USING AI TO FOSTER CRITICAL THINKING

The integration of artificial intelligence (AI) in education presents several challenges that can compromise the development of critical thinking. These challenges span cognitive, pedagogical and institutional domains often reinforcing superficial learning, epistemic dependency and ethical ambiguity (Ng et al., 2022; Zawacki-Richter et al., 2019). A significant obstacle in using AI a low level of AI literacy among average students in higher education. Many student interact with AI only at a surface level without understanding the mechanisms behind the generated responses (Valova et al., 2024; Kasneci et al., 2023). Students frequently use AI to paraphrase text, summarize content or complete assignments quickly, often bypassing cognitive difficulty (Cotton et al., 2023). This deficiency of comprehension leads users to utilise AI ineffectively and uncritically; thus, it transform into a mere instrument for obtaining instant answers (Raskin, 2020). As a result, AI is used passively, without involving critical thinking or verification of the received information (Zawacki-Richter et al., 2019). This level of literacy entails not only involves technical proficiency but also a knowledge of the ethics, logic and epistemology of AI (Valova et al., 2024). Therefore, the lack to build strong AI literacy will persist to weaken the potential of AI as a valuable co-thinker (Knoth et al., 2024). AI literacy education should be integrated into the higher education digital curriculum especially in teaching students how to use ChatGPT as a tool for enhancing cognitive abilities and argument structure (Melisa et al., 2025). This literacy must also incorporate an awareness of the limitations and advantages of AI in an intellectual context.

Apart from literacy deficits, another challenge is users' propensity to accept AI-generated answers without verification and assessment. There exists a risk In higher education

that students may accept information from AI without verifying its authenticity, thus impairing their capacity for critical assessment and information processing where generated information is regarded as factual without additional analysis (Michel Villarreal et al., 2023; Fiialka et al., 2023; Susnjak & McIntosh, 2024; Melisa et al., 2025). Studies indicates that numerous students consider AI responses as conclusive answers, neglecting the necessity to cross-check facts, sources and the rational underlying the information which may hinder their critical thinking abilities and reflect a deficiency in critical evaluation (Mhlanga, 2023, Valova et al., 2024). Additionally, Melisa et al. (2025) noted that students may encounter the risk of acquiring wrong or biassed information if they depend on ChatGPT without validating its accuracy. This attitude is highly concerning in the context of higher education, which demands questioning and critical reflection (Logg et al., 2019). It creates lazy thinking and complete dependence on intelligent systems without active cognitive engagement (Valova et al., 2024). Even more worrying, this tendency can change students' thinking patterns to become linear and uncreative due to a lack of motivation to explore alternative possibilities (Atchley et al., 2024). In the long term, it may undermine the culture of knowledge founded on inquiry, debate and philosophy. Therefore, procesures that encourage students to critically evaluate AI responses instead than accepting them unconditionally should be implemented.

The matter of authenticity in AI usage poses challenges inside academics. A significant of users rely on AI as a mechanism to generating essays, reports and papers without genuinely participating in the intellectual process (Choi et al., 2023; Komolafe & Qian, 2020). This not only undermines academic integrity but also diminishes the originality of the author's uniqueness and identity. In higher education, authenticity is not not only avoiding plagiarism but entails the development of original ideas, arguments and syntheses that reflect the student's intellectual growth. When AI is utilised without regulation, the author's voice becomes indistinct as the content is ceases to originate from reflective thinking (Rahman & Watanobe, 2023). This raises significant quiries regarding the actual author behind the written work. Additionally, universities and higher education institutions continue to seek the best approaches for addressing the excessive and immoral utilisation of AI (Susnjak & McIntosh, 2024). Therefore, authenticity in the AI era needs to be redefined and placed within a framework of intellectual agency that balanced between machine assistance with human cognition (Nikolic et al., 2023; Rahman & Watanobe, 2023). Chan and Lee (2023) rising concern about the diminishing of intellectual autonomy among users, especially students who excessively rely on AI in academic tasks. Uncritical use of AI can cause users to lose control over their cognitive and decision-making process (Mhlanga, 2023). The concept of agency in education refers to students' ability to direct their own learning, make choices and take responsibility for learning outcomes (Barana et al., 2023). When AI takes over this role, students become passive and forfeit their ability for independent thought (Essien et al., 2024). This tendency may weaken intrinsic motivation to learn because the final outcome is no longer perceived a personal accomplishment. Therefore, it is important to ensure AI functions as a tool that strengthens students' agency rather than replacing it (Valova et al., 2024).

The development of academic integrity and identity among students is also threatened when AI serves as the primary middleman in academic writing (Valova et al., 2024; Cong-Lem et al., 2024). The forming intellectual identity should occur through experiences of writing,

failing, reevaluating and improving one's own ideas (Atchley et al., 2024). Choi et al. (2023) found that students who over-relied on AI for idea generation reported reduced confidence in their own thinking and writing. In the long run, this can produce a generation of scholars who lose intellectual identity and do not have their own voice in academic discourse (Ogunleye et al., 2024; Valova et al., 2024). This issue is highly concerning as it relates not only to ethics but also to the core of scholarly identity that underpins the building of intellectual civilization. Resulting in erodes learners' feeling of authorship and their ability to formulate independent arguments a skill foundational to advanced critical thinking and academic development. Moreover, automatic AI use without pedagogical training can hinder the meaningful AI skills among students (Melisa et al., 2025; Berg & Plessis, 2023). AI is engineered to provide answers rather than to interrogate people regarding their thinking and considerations behind an input. If individuals are not educated to reflect on their own cognition, the advent of AI will simply reinforce the inclination to seek easy solutions (Rudolph et al., 2023; Qadir, 2023). This contradicts modern educational goals that prioritise complex thinking and critical knowledge creation. Ultimately, institutional limitations within the education system impede the integration of AI as a collaborative thinker. Numerous educational institutions remain unprepared for policies, educator training and technological infrastructure for the ethical and effective integration of AI, as well as lacking clear guideline (Zawacki-Richter et al., 2019). Access to high-quality AI tools often requires reliable internet, advanced devices and language proficiency. In the absence of institutional support, educational disparities may be exacerbated and students may utilise AI indiscriminately and uncontrollably, preventing the complete realization of beneficial potential (Dwivedi et al., 2023). Without coherent policies and collaboration among policymakers, educators and technology developers, institutions risk normalizing misuse, undermining trust in educational process.

STRATEGIES FOR UTILIZING AI TO ENHANCE CRITICAL THINKING

To effectively leverage the potential of artificial intelligence (AI) in fostering critical thinking in education, the challenges identified underscore the urgent need to deliberate with a multi layered strategies. Without pedagogical scaffolding, the advantages of AI may be lost and its use may even undermine the cognitive processes it is meant to enhance (Ng et al., 2022; Dwivedi et al., 2023). At the learner level, cultivating AI literacy as a cognitive discipline is essential. This involves not only understanding how AI works but also evaluating the credibility and logic of outputs and ethical responsibility (Luckin & Holmes, 2016). Within the realm of critical thinking, AI literacy serves a essential role by enabling users to identify possible logical error or biases embedded within AI-generated recommendations (Akgun & Greenhow, 2021; Mhlanga, 2023). Stolpe and Hallström (2024) and Ng et al. (2022) propose a three of AI literacy framework for technological knowledge: technical literacy (how to use AI), critical literacy (evaluating the credibility and logic of outputs) and ethical literacy (interacting with AI responsibly). Embedding these literacies into coursework ensures that students do not passively consume AI content but interrogate and reflect on it. Knoth et al. (2024) and Long and Magerko (2020) state that AI literacy should include understanding AI decision-making processes and the ability to critically assess the usefulness and accuracy of AI outputs in educational contexts.

An effective pedagogical method is the implementation of prompt engineering through a professional development program, including workshops centred on AI-enhanced pedagogies. Theophilou et al. (2023) show that students who are explicitly trained in crafting sophisticated, open-ended prompts demonstrate greater cognitive flexibility and promoted deeper metacognitive questioning, shifting their engagement from passive input to purposeful inquiry. Students are thus encouraged to compare AI-generated answers with academic sources and to formulate conclusions based on stringent scholarly standards (Vargas-Murillo et al., 2023). They are guided to view AI not as a source of answer but as a stimulus for critical thinking thus inviting more complex reasoning processes. In a meanwhile, a crucial method entails utilising dialogic interaction models in interactions with AI. Dialogic interaction involves mutual questioning, commentary, and intellectual challenge between students and AI systems during the meaning-making process (Atchley et al., 2024). This mode of engagement improves learners' ability to formulate arguments, identifying underlying assumptions and critically evaluate the logic and evidence provided by AI. Based on Bakhtinian discourse theory, AI can be utilised to create a dynamic discursive environment that nurtures the growth of students' intellectual voices (Matusov et al., 2022). Assignments designed to foster ongoing, reflective dialogue with AI enhance metacognitive engagement. Additionally, when AI is utilized to represent diverse perspectives on a particular issue, students are encouraged to evaluate and embrace positions based on principled intellectual reasoning rather than simple preference (Supianto et al., 2024). The dialogic approach reduce overreliance on individual responses, promoting cognitive flexibility and receptiveness (Essien et al., 2024). This process, as outlined by Bloom, students should includes the ability of cognitive key component by engaging in evaluation information and make reasonable judgement, than passively admitting information (Anderson et al., 2001). Responsive, multi-voiced AI interactions enrich the cognitive environment, thus positioning AI as an active participant in intellectual discourse rather than a passive repository source.

At the educator level, instructor play a pivotal role as AI mediators, guiding students in epistemically meaningful ways. This involves designing learning tasks where AI serves not as an answer generator, but as a provocateur of inquiry. For instance, students could be required to compare AI-generated arguments with peer-reviewed literature, critique logical consistency or trace fallacious reasoning patterns in AI outputs (Valova et al., 2024). Such activities promote the cognitive skills of evaluation, inference and self-regulation (Facione, 1990). In addition, reflective activities such as AI journaling, learning logs and think-aloud protocols has been shown to elevate students' self-awareness of their thinking processes (Zawacki-Richter et al., 2019). Cong-Lem et al. (2024) found that when students reflected on their interaction with AI, they demonstrated greater control over their reasoning processes and developed more nuanced perspectives. Empirical research from Kasneci et al. (2023) indicates that when students are tasked with evaluating, comparing and rectifying AI responses, their analytical and reflective thinking capacities are significantly improved. Engaging in a critical annotation of AI outputs effectively enhance evaluative skills related to evidence evaluation and argumentation logic (Susnjak & McIntosh, 2024). This educational method requires educators to offer challenges that compel students to not only extract knowledge from AI systems but also to critically evaluate and question the veracity and reasoning behind the AI's assertions (Cotton

et al., 2023). Futhermore, educators must also model epistemic humility when engaging with AI by questioning AI in real time and demonstrating how to apply disciplinary reasoning to assess validity (Rudolph et al., 2023). Kapoor and Kaur (2023) suggest that when instructors openly challenge AI-generated information, students are more likely to adopt critical inquiry as a norm. Such modelling reinforces the idea that AI is a collaborator, not an oracle and that human judgment remains central (Kapoor & Kaur, 2023).

In a mean time, strategic policies and infrastructure must be introduced to normalize ethical with critical AI use. Dwivedi et al. (2023) argue that banning AI outright is counterproductive, as it pushes use underground and removes the opportunity for guided, transparent learning. These should be supported by tutorials, exemplars, and access to regulated AI platforms within higher education use systems. Providing digital equitable access to AI technologies is also essential. Zawacki-Richter et al. (2019) note that disparities in internet access, lack of access to devices, bandwidth or AI interfaces exacerbates existing educational inequality. Institutions should consider subsidizing access to vetted AI platforms, especially in multilingual tolkits or underserved contexts, while ensuring that these tools are embedded within learning management systems to support usage oversight and analytic. Finally, rather than focusing solely on outcomes, educators should assess reasoning processes through annotated essays, verbal defense of positions or critical commentaries on AI responses. Swargiary (2025) advocates for performance-based evaluations that measure intellectual engagement and depth of analysis rather than AI-assisted productivity. This reframing encourages learners to prioritize thoughtful reasoning over efficiency. A collaborative curriculum design involving educators, students and AI developers can ensure that AI integration aligns with cognitive development goals (Long & Magerko, 2020). Participatory workshops and feedback loops allow for context-sensitive improvements, ensuring that AI-enhanced learning environments remain responsive, ethical and intellectually rigorous. In conclusion, promoting critical thinking through AI is not about teaching students to trust or reject AI, but to dialogue with it intelligently. Through strategic design, pedagogical intentionality and institutional vision, AI can shift from being a passive source of information to an active co-participant in human thought.

CONCEPTUAL FRAMEWORK

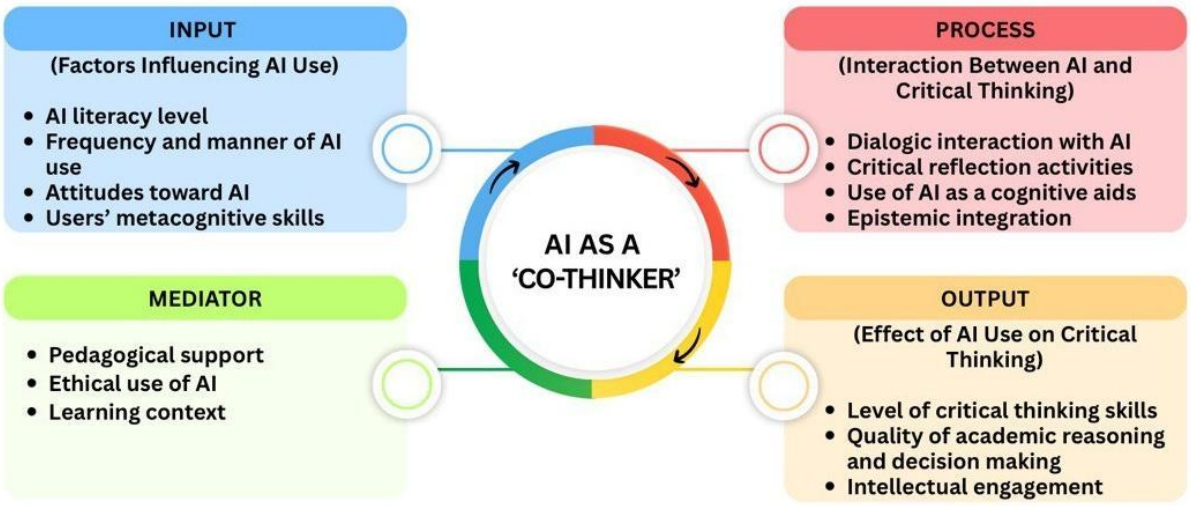

Fig 1: Human-AI Symbiotic Interaction for Critical Thinking Development

Figure 1 illustrates the cognitive flow and interrelationship between the key concepts that form the foundation of this discussion. This framework adopts the Input-Process-Output (IPO) Model to explain how artificial intelligence (AI) positioned as a 'co-thinker', plays a role in either supporting or challenging the development of critical thinking among 21st century users. This integration of AI into the educational domain is theoretically grounded in Vygotsky's Constructivism, which posits that meaningful knowledge construction occurs through active engagement and socially mediated experiences (Setiawan, 2024). Traditionally, learning environments have prioritised passive reception of information often through rote memorisation limiting students' opportunities to apply knowledge critically. The integration of AI as a co-thinker challenges this paradigm by immersing users in dialogic and contextually rich interactions (Komolafe & Qian, 2020). In this model, AI acts not merely as a tool, but as a cognitive and dialogical scaffold that supports learners in constructing meaning and engaging in reflective inquiry. Through sustained AI-student interactions, learners are positioned to strengthen their analytical reasoning, evaluative judgment and evidence-based decision-making. As such, deploying AI as a 'thinking partner' signals a pedagogical shift that foregrounds higher-order thinking and metacognitive control, offering new trajectories for critical engagement in 21st-century digital learning ecosystems.

The first component, input, comprises the foundational factors that influence the utilisation of AI as a co-thinker. These include students' level of AI literacy, frequency and mode of AI use, user attitudes towards AI and metacognitive skills. AI literacy determines a learner's ability to understand both the capabilities and limitations of AI. Furthermore, the mode of interaction whether passive or strategic affects the quality of AI engagement. Strategic and frequent users are more likely to optimise AI in completing tasks that involve critical thinking. Thus, AI should not be used passively; rather, users must act as intellectual filters who evaluate the validity, logical coherence and contextual appropriateness of AI-generated content.

Additionally, a positive disposition towards AI enhances learners' engagement and

openness to diverse perspectives, facilitating its function as an intellectual dialogue partner. Students who perceive AI positively are more receptive to feedback and more inclined to engage in cognitive co-construction with the system. Metacognitive skills also play a crucial role, as they enable learners to plan, monitor and evaluate their thought processes during AI interaction—thereby ensuring more deliberate and reflective use of the tool. Collectively, these input factors are critical in shaping the quality and effectiveness of the learner–AI interaction in the co-construction of knowledge and critical reflection.

The second component, process, refers to the mechanisms of student–AI interaction within learning environments that foster critical thinking development. These mechanisms include reflective dialogue, critical thinking activities, the use of AI as a cognitive tool and epistemic integration. These interactions typically unfold within the learner's Zone of Proximal Development (ZPD), where AI acts as a form of digital scaffolding. Dialogues between students and AI offer opportunities to test ideas, receive immediate feedback and explore diverse perspectives. Such dialogic engagement can stimulate higher-order thinking and deepen conceptual understanding. In this capacity, AI serves as a co-thinker by prompting questions, suggesting alternative arguments and challenging assumptions. It also functions as a cognitive tool that facilitates analysis, synthesis and evaluative reasoning. This includes supporting reasoning tasks, modelling argumentative structures and simulating complex academic scenarios thereby expanding students' information processing capacities.

Critical reflection activities enable students to assess AI outputs, compare them with prior knowledge and refine their arguments. These reflective practices are supported by intellectual feedback loops, whereby students continuously interrogate and recalibrate their thinking. Through epistemic integration within these digital discussions, students begin to merge AI-generated content with their existing knowledge structures, allowing for the emergence of more robust and critical understandings. At the process level, these components interact dynamically to form an intellectual dialogue space in which AI functions not merely as a tool, but as an active cognitive interlocutor.

Next, the mediator component consists of pedagogical support, ethical use of AI and the learning context. These intermediary factors play a crucial role in ensuring that interactions between students and AI occur effectively and ethically. All three factors function as either catalysts or barriers to the effectiveness of AI–student interactions within the context of critical thinking. Pedagogical support is essential in guiding students to use AI wisely and critically. According to Rasul et al. (2023), the effectiveness of AI in learning largely depends on the role of lecturers as facilitators who guide student–AI interactions. Ethical use of AI must also be ensured to avoid overdependence and violations of academic integrity principles (Schiff, 2021). Hwang et al. (2021) further emphasize that teacher guidance and ethical usage protocols are critical for ensuring meaningful interactions, preventing misuse of information and assisting students in evaluating the quality of AI-generated content.

Additionally, a conducive learning context such as institutional policies, infrastructure availability, open environments and academic culture affects both the acceptance and effectiveness of AI as a co-thinker (Zhang et al., 2025). You (2024) and Barana et al. (2023) found that low-pressure learning environments increase students' willingness to explore new ideas, in line with the concept of the Zone of Proximal Development (ZPD), where learners can

achieve higher cognitive levels with external support. At the mediator stage, these elements ensure that the input is translated into meaningful processes and quality learning outcomes, while also serving as safeguards against potential risks associated with AI use.

Finally, the outcome of interactions between AI and students facilitated by the process and influenced by mediators yields learning outputs measured by three main indicators: the level of critical thinking skills, the quality of academic reasoning and decision-making and students' intellectual engagement. Research by Atchley et al. (2023) and Valova et al. (2024) found that students who actively engage with AI demonstrate significant improvements in critical thinking competence, particularly in rational argumentation and the ability to structure ideas logically. This finding is supported by Favero et al. (2024), who showed notable improvements in students' critical thinking abilities through structured interaction with a Socratic chatbot AI.

Furthermore, AI enhances the quality of academic reasoning by providing diverse perspectives and challenging student assumptions. According to Asrifan et al. (2025), AI encourages students to make evidence-based and logical decisions, thereby sharpening their reasoning capabilities. Zhang et al. (2025) further demonstrated that AI improves the quality of academic reasoning and decision-making through classroom debates. Additionally, AI can increase students' intellectual engagement, as it provides a safe space for exploring ideas without fear of social criticism (Rasul et al., 2023). Students who are actively involved in cognitive dialogue with AI in a pressure-free environment benefit from what Krashen's affective filter hypothesis describes: that positive learning environments increase motivation and academic achievement (Tseng & Lin, 2024; Fiialka et al., 2023; Melisa et al., 2025). The output component reflects the direct impact of student–AI interactions guided by mediators and influenced by input, ultimately fulfilling the goals of higher education in producing students who think critically, analytically and reflectively.

Overall, this model explains the relationship between input factors influencing student–AI interaction processes, the mediators determining the effectiveness and risk regulation of AI use and the interaction process itself, which then produces learning outcomes that shape students' critical thinking. These components interact dynamically to contribute toward achieving learning outcomes that reflect the development of students' critical thinking skills.

This conceptual framework portrays a symbiotic relationship between humans and AI, in which users drive AI through critical prompts, while AI responds by challenging the users' cognition. The model demonstrates that AI is not merely a supportive tool but can act as an active co-thinker in developing students' critical thinking provided that its use is informed by positive input factors, responsible mediators and a supportive learning context. This cyclical process fosters a deep, two-way learning environment. Ethical and epistemically aware use of AI will enhance users' cognitive strength, whereas uncritical dependence on AI risks weakening intellectual identity. Ultimately, AI can significantly enhance academic reasoning, reflective thinking skills and students' intellectual engagement.

CONCLUSION

The implementation of Artificial Intelligence (AI) into education marks a defining moment in

the evolution of human cognition. AI is not simply a tool operates as an automated instrument, it has the ability to function as a co-thinker, an engaged intellectual collaborator that fosters and stimulates users' critical thinking abilities in reflective, evaluative and analytical reasoning. This assurance can only be actualised when users exhibit metacognitive awareness, strong AI literacy and an epistemic comprehension of the limitations and uses of this technology. When used critically, AI can enhance cognitive capacity, facilitate idea generation and provoke dialectical thinking. This concept paper has clarified that the relationship between humans and AI is symbiotic rather than linear, with the effectiveness of the interaction reliant on the user's active engagement in questioning, assessing and synthesising AI-generated information. With ethically integrated within educational contexts, AI can facilitate higher-order thinking, enhance inquiry and strengthen users' intellectual engagement. Critical thinking, long regarded as a cornerstone of higher education, must now be reinterpreted in light of AI's generative capacities. As students engage with language models capable of simulating arguments, suggesting counterpoints and responding to inquiry, the boundaries between internal reasoning and external dialogue begin to blur. This demands a pedagogical shift from teaching students what to think, to teaching them how to think in the presence of AI.

The conceptual framework presented in this paper reframes human–AI interaction as a cognitive system structured through an Input–Process–Output (IPO) model. Within this framework, learners' epistemic dispositions, metacognitive strategies and prompt literacy influence the depth and quality of their cognitive engagement. The process phase characterized by analysis, evaluation and iterative refinement determines whether AI is integrated as a thinking partner or merely consumed as a source of answers. The output, then, is not merely task completion but the development of robust reasoning skills and heightened epistemic vigilance. Yet, challenges remain been highlighted. Without adequate training, AI literacy, and institutional support, students may default to passive or ethically ambiguous uses of AI. Overreliance can erode cognitive agency, diminish intellectual originality and compromise the authenticity of learning. Consequently, educational strategies should prioritise on reinforcing AI literacy, designing learning experiences that emphasize critical reflection and implement pedagogies that facilitate dialogic and responsible human–AI interaction. Educational systems must adopt a dual commitment: to prepare learners for an AI rich world while safeguarding the human faculties of judgment, reasoning and self-correction. In a nutshell, AI is not an adversary to critical thinking, nor does it replace human intellect. The key to success lies in users ability to utilise this technology to enhance their cognitive process using AI, rather than surrending critical thinking entirely. The symbiosis between AI and humans will be productive only when humans control the direction of thought and AI acts as a trigger for reflection and critical evaluation. Thus, the future of learning and knowledge production will continue to be anchored in advanced human thinking, supported by ethically guided technology.

REFERENCES

Abdul Rahman, N. A., Zulkornain, L. H., & Hamzah, N. H. 2022. Exploring Artificial Intelligence using Automated Writing Evaluation for Writing Skills. *Environment-Behaviour Proceedings Journal, 7*(SI9): 547–553.

https://doi.org/10.21834/ebpj.v7isi9.4304

Adiguzel, T., Kaya, M. H., & Cansu, F. K. 2023. Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology*, 15(3). https://doi.org/10.30935/cedtech/13152

Akgun, S., & Greenhow, C. 2021. Artificial intelligence in education: Addressing ethical challenges in K-12 settings. https://doi.org/10.1007/S43681-021-00096-7

Amuga, E. O. 2023. Artificial Intelligence in Education. https://doi.org/10.4018/978-1-6684-3595-3.ch012

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., & Wittrock, M. C. 2001. *A Taxonomy for Learning Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Longman.

Andreucci-Annunziata, P., Riedemann, A., Cortés, S., Mellado, A., del Río, M. T., & Vega-Muñoz, A. 2023. Conceptualizations and instructional strategies on critical thinking in higher education: A systematic review of systematic reviews. *Frontiers in Education*, 8: 1–18. https://doi.org/10.3389/feduc.2023.1141686

Asrifan, A., Widyaningrum, A., Ramli, R. B., Riyanti, R., & Sultan, S. 2025. Navigating the AI Era: Enhancing Critical Thinking Skills for Global Challenges. In *Enhancing Classroom Instruction and Student Skills With AI* (pp. 449-480). IGI Global Scientific Publishing.

Atchley, P., Pannell, H., Wofford, K., Hopkins, M., & Atchley, R. A. 2024. Human and AI collaboration in the higher education environment: opportunities and concerns. Cognitive research: principles and implications, 9(1): 20.

Bai, L., Liu, X., & Su, J. 2023. ChatGPT: The cognitive effects on learning and memory. *Brain-X*, 1(3), 1–9. https://doi.org/10.1002/brx2.30

Baidoo-Anu, D., & Ansah, L. O. 2023. Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of chatgpt in promoting teaching and learning. *Journal of AI,* 7(1): 52–62. https://doi.org/10.61969/jai.1337500

Barana, A., Marchisio, M., & Roman, F. 2023. Fostering problem solving and critical thinking in mathematics through generative artificial intelligence. *20th International Conference on Cognition and Exploratory Learning in Digital Age* (CELDA 2023), pp: 377–385.

Bennett, L., & Abusalem, A. 2024. Artificial intelligence (AI) and its potential impact on the future of higher education. Athens Journal of Education, 11(3): 195–212. https://doi.org/10.30958/aje.11-3-2

Berg, G. van den, & Plessis, E. du. 2023. ChatGPT and generative AI: possibilities for its contribution to lesson planning, critical thinking and openness in teacher education. *Education Sciences,* 13: 1–12. https://doi.org/10.3390/educsci13100998

Berg, G. van den. 2024. Generative AI and educators: partnering in using open digital content for transforming education. *Open Praxis,* 16(2): 130–141. https://doi.org/10.55982/openpraxis.16.2.640

Chan, C. K. Y., & Lee, K. K. W. 2023. The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers? *Smart Learning Environments*, 1–23. https://doi.org/10.1186/s40561-023-00269-3

Chica, M., Guerra, M. C., & Guerra, G. C. 2023. The Role of Artificial Intelligence in the Development of Teaching Effectiveness: A Tool for Personalization of Learning in Higher Education. In IAFOR Conference on Educational Research & Innovation Official Conference Proceedings. https://doi. org/10.22492/issn (pp. 2435-1202).

Cong-Lem, N., Tran, T. N., & Nguyen, T. T. 2024. Academic integrity in the age of generative AI: Perceptions and responses of Vietnamese EFL teachers. *Teaching English with Technology,* 24(1): 28–48. https://doi.org/10.56297/FSYB3031/MXNB7567

Cotton, D. R. E., Cotton, P. A., & Kneale, P. E. 2023. Chatting and Cheating: Ensuring Academic Integrity in the Era of ChatGPT. Innovations in Education and Teaching International, 60(2): 148–159. https://doi.org/10.1080/14703297.2023.2190148

Dempere, J., Modugu, K., Hesham, A., & Ramasamy, L. K. 2023. The impact of ChatGPT on higher education. Frontiers in Education, 8(September). https://doi.org/10.3389/feduc.2023.1206936

Ding, L., & Zou, D. 2024. Automated writing evaluation systems: A systematic review of Grammarly, Pigai, and Criterion with a perspective on future directions in the age of generative artificial intelligence. *Education and Information Technologies*, 29(11): 14151-14203.

Dwivedi, Y. K., Hughes, D. L., Baabdullah, A. M., et al. 2023. 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

Ehlers, U.-D. 2020. Future Skills-Future Learning and Future Higher Education (U.-D. Ehlers (ed.)). Springer. https://doi.org/10.1007/978-3-658-29297-3

Elder, L., & Paul, R. 2020. Critical thinking: Learn the tools the best thinkers use. Rowman & Littlefield.

Ennis, R. 2011. Critical thinking: Reflection and perspective Part II. Inquiry: Critical thinking across the Disciplines, 26(2): 5-19.

Essel, H. B., Vlachopoulos, D., Essuman, A. B., & Amankwa, J. O. 2024. ChatGPT effects on cognitive skills of undergraduate students: Receiving instant responses from AI-based conversational large language models (LLMs). Computers and Education: Artificial Intelligence, 6: 1–13. https://doi.org/10.1016/j.caeai.2023.100198

Essien, A., Bukoye, O. T., O'Dea, X., & Kremantzis, M. 2024. The influence of AI text generators on critical thinking skills in UK business schools. *Studies in Higher Education*, 49(5): 865–882. https://doi.org/10.1080/03075079.2024.2316881.

Facione, P. 1990. Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction (The Delphi Report).

Facione, P. A. 2011. Critical thinking: What it is and why it counts. *Insight assessment*, 1(1): 1-23.

Favero, L. et al. 2024. Enhancing Critical Thinking in Education by means of a Socratic Chatbot. *arXiv preprint arXiv:2409.05511*.

Fiialka, S., Kornieva, Z., & Honcharuk, T. 2023. ChatGPT in Ukrainian education: Problems and prospects. *International Journal of Emerging Technologies in Learning*, 18(17):

236–250. https://doi.org/10.3991/ijet.v18i17.42215

Graefen, B., & Fazal, N. 2024. From Chat bots to virtual tutors: An overview of Chat GPT's role in the future of education. *Archives of Pharmacy Practice,* 15(2): 43–52. https://doi.org/10.51847/touppjedsx

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. 2022. Understanding the role of digital technologies in education: A review. Sustainable operations and computers, 3: 275-285.

Iacovitti, G. 2022. How technology influences information gathering and information spreading. Church, Communication and Culture. https://doi.org/10.1080/23753234.2022.2032781

İpek, Z. H., Gözüm, A. İ. C., Papadakis, S., & Kallogiannakis, M. 2023. Educational applications of the ChatGPT AI system: A systematic review research. *Educational Process: International Journal,* 12(3): 26–55. https://doi.org/10.22521/edupij.2023.123.2

Kadrija, R., Gashi Shatri, Z., & Vala Këndusi, V. 2022. Effects of Critical Thinking Implementation on Enhancing of Teaching Quality. Journal of Educational and Social Research. https://doi.org/10.36941/jesr-2022-0159

Kapoor, J., & Kaur, I. 2023. Artificial Intelligence Technology-Embedded Learning: Rethinking Pedagogy for Digital Age. https://doi.org/10.1109/ICAAIC56838.2023.10140614

Kasneci, E., Sessler, K., & Bittner, E. 2023. ChatGPT for Good? On Opportunities and Challenges of Large Language Models for Education. Learning and Individual Differences, 103, 102221. https://doi.org/10.1016/j.lindif.2023.102221

Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... & Kasneci, G. 2023. ChatGPT for good? On opportunities and challenges of large language models for education. Learning and individual differences, 103: 102274.

Kim, T. W., & Tan, Q. 2023. Repurposing Text-Generating AI into a Thought-Provoking Writing Tutor. *arXiv preprint arXiv*:2304.10543.

Klimova, B., Pikhart, M., & Al-Obaydi, L. H. 2024. Exploring the potential of ChatGPT for foreign language education at the university level. *Frontiers in Psychology,* 15: 1–10. https://doi.org/10.3389/fpsyg.2024.1269319

Knoth, N., Tolzin, A., Janson, A., & Leimeister, J. M. 2024. AI literacy and its implications for prompt engineering strategies. Computers and Education: Artificial Intelligence, 6, 100225.

Komolafe, B. F., & Qian, X. 2020. Critical Thinking an Antidote to Artificial Intelligence Threat: An Innovation in Teacher Education Practices. https://doi.org/10.17501/24246700.2020.6205

Logg, J. M., Minson, J. A., & Moore, D. A. 2019. Algorithm appreciation: People prefer algorithmic to human judgment. *Organizational Behavior and Human Decision Processes*, 151: 90–103. https://doi.org/10.1016/j.obhdp.2018.12.005

Long, D., & Magerko, B. 2020. What is AI Literacy? Competencies and Design Considerations. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems,* 1–16. https://doi.org/10.1145/3313831.3376727

Luckin, R., & Holmes, W. 2016. Intelligence unleashed: An argument for AI in education.

Marsoof, A., Luco, A. C., Leng, H. H., & Tan, S. 2022. Content-filtering AI systems–limitations, challenges and regulatory approaches. Information & Communications Technology Law. https://doi.org/10.1080/13600834.2022.2078395

Matusov, E., GPT, C., Smith, M. P., & Shugurova, O. 2024. Does ChatGPT4 have a dialogical self?: A Bakhtinian perspective. *Culture & Psychology*, 30(4): 841-870.

Meletiadou, E. 2023. Experimenting With AI-Powered Learning Tools and Mobile-Assisted Learning to Improve Student Learning Performance, Autonomy and Metacognitive Skills. Advances in Educational Technologies and Instructional Design Book Series. https://doi.org/10.4018/978-1-6684-8292-6.ch002

Melisa, R., Ashadi, A., Triastuti, A., Hidayati, S., Salido, A., Ero, P. E. L., Marlini, C., Zefrin., & Fuad, Z. A. 2025. Critical Thinking in the Age of AI: A Systematic Review of AI's Effects on Higher Education. *Educational Process: International Journal, 14*, e2025031. https://doi.org/10.22521/edupij.2025.14.31

Mhlanga, D. 2023. Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. In *FinTech and artificial intelligence for sustainable development: The role of smart technologies in achieving development goals* (pp. 387-409). Cham: Springer Nature Switzerland.

Michalon, B., & Camacho-Zuñiga, C. 2023. ChatGPT, a brand-new tool to strengthen timeless competencies. *Frontiers in Education*, 8: 1–13. https://doi.org/10.3389/feduc.2023.1251163

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: 1–18. https://doi.org/10.3390/educsci13090856

Moustaghfir, S., & Brigui, H. 2024. Navigating critical thinking in the digital era: An informative exploration. *International Journal of Linguistics, Literature and Translation,* 7(1): 137-143.

Nikolic, S., Daniel, S., Haque, R., Belkina, M., Hassan, G. M., Grundy, S., Lyden, S., Neal, P., & Sandison, C. 2023. ChatGPT versus engineering education assessment: A multidisciplinary and multiinstitutional benchmarking and analysis of this generative artificial intelligence tool to investigate assessment integrity. *European Journal of Engineering Education, 48*(4): 559 – 614. https://doi.org/10.1080/03043797.2023.2213169

Nikolopoulou, K. 2024. Generative artificial intelligence in higher education: Exploring ways of harnessing pedagogical practices with the assistance of ChatGPT. *International Journal of Changes in Education,* 1(2): 103–111. https://doi.org/10.47852/bonviewijce42022489

Ogunleye, B., Ibilola, K., Zakariyyah, Ajao, O., Olayinka, O., & Sharma, H. 2024. Higher education assessment practice in the era of generative AI tools. *Journal of Applied Learning & Teaching,* 7(1): 25–34. https://doi.org/10.37074/jalt.2024.7.1.28

Paul, R., & Elder, L. 2019. The miniature guide to critical thinking concepts and tools. Rowman & Littlefield.

Ponomareva, E. A. 2023. Responsible AI: From Principles to Action. Frontiers in Artificial

Intelligence and Applications. https://doi.org/10.3233/faia220595

Prodhan, M. I. S., & Ibrahim, N. O. 2022. Playing with AI to Investigate Human-Computer Interaction Technology and Improving Critical Thinking Skills to Pursue 21st Century Age. Education Research International. https://doi.org/10.1155/2022/6468995

Qadir, J. 2023. Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for education. In *2023 IEEE global engineering education conference (EDUCON)* (pp. 1-9). IEEE.

Rahman, M. M., & Watanobe, Y. 2023. ChatGPT for education and research: Opportunities, threats, and strategies. *Applied Sciences (Switzerland*), 13(9). https://doi.org/10.3390/app13095783

Raskin, R. 2020. Literacy strategies and instructional modalities in introductory accounting. *In Teaching College-Level Disciplinary Literacy* (pp. 79–105). https://doi.org/https://doi.org/10.1007/978-3-030-39804-0

Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., ... & Heathcote, L. 2023. The role of ChatGPT in higher education: Benefits, challenges, and future research directions. Journal of Applied Learning and Teaching, 6(1): 41-56.

Rudolph, J., Tan, S., & Tan, C. 2023. Prompt engineering in AI-supported education: Skills for deeper learning. British Journal of Educational Technology, 54(3): 456–469. https://doi.org/10.1111/bjet.13372

Schiff, D. 2021. Education for AI, not AI for Education: The Role of Education and Ethics in National AI Policy Strategies. International Journal of Artificial Intelligence in Education. https://doi.org/10.1007/S40593-021-00270-2

Setiawan, R. 2024. Revolutionizing Education: Exploring the Impact of Innovative Teaching Methods. *Innovative Journal of Educational Research and Insights, 1*(2 December), 109-119.

Singh, S., Manchekar, O., Patwardhan, A., Rote, U., Jagtap, S., & Chavan, D. H. (2021, May). Computer application for assessing subjective answers using AI. *In Proceedings of the 4th International Conference on Advances in Science & Technology (ICAST2021).* http://dx.doi.org/10.2139/ssrn.3867385

Sok, S., & Heng, K. 2023. ChatGPT for education and research: A review of benefits and risks. *Cambodian Journal of Educational Research*, 3(1): 110–121. https://doi.org/10.62037/cjer.2023.03.01.06

Stampfl, R., Geyer, B., Deissl-O'meara, M., & Ivkic, I. 2024. Revolutionising role-playing games with ChatGPT. Advances in Artificial Intelligence and Machine Learning, 4(2): 2244 – 2257. https://doi.org/10.54364/aaiml.2024.42129

Stolpe, K., & Hallström, J. 2024. Artificial intelligence literacy for technology education. Computers and Education Open, 6, 100159.

Supianto, Widyaningrum, R., Wulandari, F., Zainudin, M., Athiyallah, A., & Rizqa, M. 2024. Exploring the factors affecting ChatGPT acceptance among university students. *Multidisciplinary Science Journal*, 6(12). https://doi.org/10.31893/multiscience.2024273

Susnjak, T., & McIntosh, T. R. 2024. Chatgpt: The end of online exam integrity?. *Education Sciences*, 14(6): 656.

Swargiary, K. 2025. *Reimagining Education: A Personal Journey Toward a Future-Ready Curriculum*. Scholar's Press. ISBN: 978-3-639-86271-3.

Tajik, E., & Tajik, F. 2024. A comprehensive examination of the potential application of Chat GPT in higher education institutions. *SSRN Electronic Journal*, April. https://doi.org/10.2139/ssrn.4699304

Theophilou, E., Bursic, S., Donabauer, G., Testa, A., Boiano, R., Hernández-Leo, D., Ruskov, M., Taibi, D., Gabbiadini, A., & Ognibene, D. 2023. Learning to Prompt in the Classroom to Understand AI Limits: A pilot study. arXiv.Org. https://doi.org/10.48550/arXiv.2307.01540

Tseng, Y.-C., & Lin, Y.-H. 2024. Enhancing english as a foreign language (EFL) learners' writing with ChatGPT: A university-level course design. *The Electronic Journal of E-Learning,* 78–97. https://doi.org/10.34190/ejel.21.5.3329

Valova, I., Mladenova, T., & Kanev, G. (2024). Students' perception of ChatGPT usage in education. *International Journal of Advanced Computer Science and Applications*, 15(1): 466 – 473. https://doi.org/10.14569/IJACSA.2024.0150143

Vargas-Murillo, A. R., Pari-Bedoya, I. N. M. de la A., & Guevara-Soto, F. de J. 2023. Challenges and opportunities of AI-assisted learning: A systematic literature review on the impact of ChatGPT usage in higher education. *International Journal of Learning, Teaching and Educational Research, 22*(7): 122 – 135. https://doi.org/10.26803/ijlter.22.7.7

Vieriu, A. M., & Petrea, G. 2025. The impact of artificial intelligence (AI) on students' academic development. *Education Sciences,* 15(3): 343.

Vygotsky, L. S. 1978. Mind in Society: The Development of Higher Psychological Processes. Harvard University Press.

Xu, Z. 2025. Patterns and Purposes: A Cross-Journal Analysis of AI Tool Usage in Academic Writing. *arXiv preprint arXiv*:2502.00632.

You, S. 2024. A systematic review of the impact of ChatGPT on higher education. *International Journal of Technology-Enhanced Education, 3*(1): 1–14. https://doi.org/10.4018/ijtee.343528

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. 2019. Systematic review of research on artificial intelligence applications in higher education–where are the educators? *International journal of educational technology in higher education,* 16(1): 1-27.

Zhai, C., Wibowo, S. & Li, L.D. 2024. The effects of over-reliance on AI dialogue systems on stuents cognitive abilities: a systemic review. Smart Learn. Environ. 11, 28. https://doi.org/10.1186/s40561-024-00316-7

Zhang, Z., Sun, B., & An, P. 2025. Breaking Barriers or Building Dependency? Exploring Team-LLM Collaboration in AI-infused Classroom Debate. In Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (pp. 1-19).

Zhou, X., & Schofield, L. 2024. Developing a conceptual framework for Artificial Intelligence (AI) literacy in higher education. Journal of Learning Development in Higher Education, 31. https://doi.org/https://doi.org/10.47408/jldhe.vi31.1354.