Education Reform and Development, 2026, Volume 8, Issue 5
https://ojs.bbwpublisher.com/index.php/ERD
Online ISSN: 2652-5372
Print ISSN: 2652-5364

The Impact of AI-Generated Language on Critical Thinking Skills

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Abstract: The proliferation of artificial intelligence (AI) in everyday communication, from automated content creation to AI-assisted writing tools, has fundamentally altered how individuals use and produce language. While these technologies offer unprecedented efficiency and accessibility, concerns are mounting regarding their potential impact on human cognitive faculties, particularly critical thinking. This study investigates the relationship between AI-generated language and critical thinking skills, positing that overreliance on AI for cognitive tasks may lead to a decline in analytical reasoning, argument evaluation, and independent problem-solving. Employing a mixed-methods research design, the study integrates quantitative data, derived from standardized critical thinking assessments administered to control and experimental groups exposed to varying degrees of AI-generated content, with qualitative data gathered from in-depth interviews and think-aloud protocols. The quantitative phase measures the correlation between the frequency of AI tool usage and performance on critical thinking metrics, while the qualitative phase explores the cognitive processes, perceptions, and behavioral adaptations of users as they interact with AI-generated text. The research has two primary objectives: first, to quantify the correlation between AI-language dependency and specific dimensions of critical thinking, such as logical fallacy recognition and source credibility assessment; and second, to qualitatively explore the cognitive offloading behaviors that occur when individuals use AI tools for complex writing and analysis tasks. The findings will benefit a broad spectrum of stakeholders. Educators and curriculum developers will gain insights for integrating AI literacy into pedagogical frameworks, while policymakers can utilize this evidence to formulate guidelines for responsible AI deployment in academic and professional settings.

Keywords: Artificial Intelligence (AI); AI-generated language; Critical thinking skills; Cognitive offloading

Online publication: June 30, 2026

1. Introduction

The integration of Artificial Intelligence (AI) into the fabric of daily life represents one of the most significant technological shifts of the 21st century. Among its most pervasive applications is the generation of human-like language, with tools capable of composing essays, summarizing complex documents, drafting emails, and generating creative content at a scale previously unimaginable. For students, professionals, and the public,

AI language models have become ubiquitous assistants, offering solutions to cognitive tasks with remarkable speed and fluency.

However, this unprecedented convenience introduces a critical paradox: while AI exponentially enhances productivity, it may simultaneously erode the very cognitive faculties required to use it judiciously. Critical thinking, the disciplined ability to conceptualize, analyze, synthesize, and independently evaluate information, is the cornerstone of informed decision-making and intellectual autonomy. As AI systems increasingly mediate our interaction with information, a pressing concern emerges regarding the phenomenon of "cognitive offloading." Seduced by the authoritative tone and structural polish of AI-generated text, users are increasingly susceptible to an "illusion of accuracy," prompting a dangerous transition from active, critical engagement with content to the passive acceptance of algorithmic outputs.

While existing literature has extensively debated the ethical, pedagogical, and academic integrity implications of generative AI, there remains a notable scarcity of empirical research measuring its direct impact on human cognitive architecture. Specifically, it remains unclear how habitual reliance on AI language tools affects fundamental sub-skills of critical thinking, such as logical deduction, argument evaluation, and the identification of unstated assumptions. This study addresses this critical gap by systematically examining how the use of AI-generated language influences these core critical thinking capacities. By employing a comprehensive mixed-methods research design, this paper moves beyond speculative, theoretical debate to provide concrete empirical evidence. Ultimately, this research seeks to determine whether these advanced generative tools function primarily as "cognitive prosthetics" that elevate human learning and analytical reach, or as "cognitive crutches" that precipitate intellectual deskilling and diminished metacognitive awareness.

2. Review of literature

2.1. Theoretical foundations: Cognitive offloading and the extended mind hypothesis

The theoretical underpinnings of AI's impact on cognition are deeply rooted in the concept of cognitive offloading, the tendency to reduce cognitive demand by relying on external tools. Clark and Chalmers (1998) introduced the Extended Mind Hypothesis [1], arguing that external artifacts (e.g., notebooks, calculators, and increasingly AI systems) function as extensions of the human cognitive system when reliably coupled with the user. While such offloading can enhance efficiency by freeing working memory, it may also lead to the atrophy of internal cognitive capacities when overutilized. Risko and Gilbert (2016) expanded on this by demonstrating that individuals strategically offload cognitive tasks to external resources based on perceived effort and reliability [2], yet often overestimate the durability of their internal skills. Furthermore, Carr (2020) warned that technologies designed to optimize for convenience risk diminishing deep, contemplative thought processes [3]. Therefore, understanding AI's impact on critical thinking requires examining how cognitive offloading transforms the user from an active processor into a passive curator of AI-generated content [4,5].

2.2. Empirical studies on AI tools and cognitive skill development

Empirical research examining the direct impact of AI-assisted writing and analytical tools on cognitive skills has produced mixed but increasingly concerning findings. A study by Doshi, Hauser, and Sood (2023) investigated the effects of large language model usage on undergraduate writing tasks [6], revealing that while AI significantly improved surface-level writing quality and efficiency, students demonstrated reduced ability to critically evaluate sources and construct original arguments without AI assistance. Similarly,

Mollick and Mollick (2022) found that when students used AI for problem-solving [7], they exhibited higher rates of "automation bias" the tendency to accept AI-generated outputs uncritically, even when outputs contained factual errors or logical inconsistencies. Conversely, some research suggests that when AI tools are intentionally designed to promote reflection, they can serve as effective scaffolds for learning. For instance, Kasneci et al. (2023) argued that AI language models have the potential to enhance education if integrated with pedagogical strategies that emphasize critical engagement rather than passive consumption[15]. However, the prevailing evidence indicates that without structured guidance, users tend to default to cognitive laziness, accepting AI outputs with minimal scrutiny [8].

2.3. Metacognition, self-regulation, and the risks of intellectual deskilling

A critical dimension of the AI-critical thinking nexus involves metacognition the awareness and regulation of one's own cognitive processes. Researchers have increasingly focused on how AI tools influence users' ability to monitor their comprehension, evaluate the quality of information, and self-correct during analytical tasks. Salomon and Globerson (1987) initially articulated the "substitution myth," cautioning that external cognitive tools [9], if not used mindfully, can lead to the deterioration of the very skills they are meant to support. In the contemporary AI context, Wardat, Tashtoush, and Al-Qaisi (2024) found that students using AI for complex reasoning tasks demonstrated inflated confidence in their own understanding while simultaneously exhibiting lower performance on subsequent unaided assessments, a phenomenon they termed "AI-induced overconfidence." This aligns with research by Sperling, Howard, and Staley (2024), who reported that frequent AI users showed diminished self-regulatory behaviors such as planning, monitoring, and evaluating their own work [10].

3. Methodology

This study employs a mixed-methods sequential explanatory design, integrating both quantitative and qualitative approaches to provide a comprehensive understanding of the phenomenon.

(1) Qualitative Objective 1: To explore and describe the cognitive processes, decision-making strategies, and metacognitive awareness (or lack thereof) exhibited by individuals when interacting with AI-generated language, with a focus on understanding the phenomenon of cognitive offloading. A purposive sample of 20 participants from the experimental group would be selected for in-depth qualitative exploration.

(2) Quantitative Objective 2: To determine the statistical correlation between the frequency and nature of AI language tool usage and the variance in standardized critical thinking assessment scores. The quantitative phase utilized a quasi-experimental design involving a sample of university students (n=200). Participants were divided into two groups: an experimental group that would use AI language tools (e.g., advanced large language models) to complete a series of analytical writing and problem-solving tasks over a period of eight weeks, and a control group that completed the same tasks without AI assistance. Statistical analysis (e.g., ANCOVA) was used to compare the change in critical thinking scores between the two groups, controlling for pre-test scores and demographic variables.

4. Findings and recommendation

(1) Objective 1

Thematic analysis of semi-structured interviews with 20 participants revealed three dominant themes

related to cognitive processes and metacognitive awareness when interacting with AI-generated language. Findings are summarized in **Table 1**.

Table 1. Thematic Analysis of Cognitive Processes in AI Interaction

Theme	Description	Representative Participant Statement
Unconscious Cognitive Offloading	Participants routinely delegated analytical tasks to AI without deliberate awareness, viewing AI as an invisible extension of thought.	"I don't really think about it anymore—I just ask the AI to do the thinking for me."
Diminished Metacognitive Monitoring	Users demonstrated limited ability to evaluate AI output accuracy or reflect on their own comprehension gaps.	"I assumed it was correct because it sounded confident. I didn't question it."
Strategic Reliance vs. Passive Acceptance	A minority exhibited deliberate strategies, verifying AI outputs; most displayed passive acceptance without verification behaviors.	"I always fact-check the AI because I've caught errors before."

Thematic analysis of semi-structured interviews with 20 participants revealed three dominant themes related to cognitive processes and metacognitive awareness when interacting with AI-generated language. Findings are summarized in **Table 1**. Central to these findings was the phenomenon of "Unconscious Cognitive Offloading," where users routinely delegated analytical tasks to the AI, viewing the technology as an "invisible extension" of their own thought processes rather than an external tool. Participants exhibited minimal metacognitive awareness, with 15 of 20 failing to articulate strategies for evaluating AI-generated content. This deficit was further characterized by "Diminished Metacognitive Monitoring," a state in which the confident tone of AI-generated text discouraged users from questioning accuracy or recognizing their own comprehension gaps; as Participant 14 noted, the superficial fluency of the output often precluded the need for scrutiny. While the majority of the cohort displayed a pattern of "Passive Acceptance," a distinct contrast was observed in the theme of "Strategic Reliance." Those demonstrating strategic reliance reported prior experiences with AI errors, suggesting that negative feedback may prompt critical engagement. For these individuals, the transition from passive trust to active verification, such as the fact-checking behaviors reported by Participant 03, was a learned response to previous instances where the AI's performance failed to meet their expectations.

(2) Objective 2

A quasi-experimental study was conducted with 200 university students to examine the correlation between AI language tool usage and critical thinking performance. Participants were assigned to an experimental group (n = 100) using AI tools for analytical tasks over eight weeks, and a control group (n = 100) completing identical tasks without AI assistance. Critical thinking was assessed pre- and post-intervention using the Watson-Glaser Critical Thinking Appraisal, measuring logical deduction, argument evaluation, and assumption identification.

Table 2. ANCOVA Results for Critical Thinking Outcomes

Critical Thinking Subscale	Experimental Group (n=100) Mean Change (SD)	Control Group (n=100) Mean Change (SD)	F-value	p-value	η^2
Logical Deduction	-4.32 (3.21)	+1.45 (2.89)	18.74	< 0.001	0.09
Argument Evaluation	-3.87 (3.05)	+1.92 (2.76)	22.13	< 0.001	0.10
Assumption Identification	-5.01 (3.44)	+2.18 (3.01)	27.56	< 0.001	0.12
Total Critical Thinking Score	-13.20 (8.92)	+5.55 (7.34)	31.42	< 0.001	0.14

A quasi-experimental study was conducted with 200 university students to examine the correlation between AI language tool usage and critical thinking performance. Participants were assigned to an experimental group (n = 100) using AI tools for analytical tasks over eight weeks, and a control group (n = 100) completing identical tasks without AI assistance. Critical thinking was assessed pre- and post-intervention using the Watson-Glaser Critical Thinking Appraisal, measuring logical deduction, argument evaluation, and assumption identification. After controlling for pre-test scores and demographic variables, ANCOVA revealed statistically significant differences between groups across all subscales and the total score. Overall, the experimental group experienced a substantial decline in their Total Critical Thinking Score (M = -13.20, SD = 8.92), whereas the control group demonstrated notable improvement, yielding a significant and large main effect.

After controlling for pre-test scores and demographic variables, ANCOVA revealed statistically significant differences between groups across all subscales. The experimental group demonstrated mean score declines ranging from 3.87 to 5.01 points across subscales, while the control group showed improvements. Effect sizes (η^2) ranged from 0.09 to 0.14, indicating moderate to large practical significance. Findings suggest a negative correlation between AI language tool usage and critical thinking skill development, particularly in assumption identification, where the largest decline was observed.

5. Recommendations

To mitigate the cognitive risks associated with AI dependency, a multi-stakeholder approach is essential. First, Educators and Academic Institutions should redesign curricula to integrate comprehensive AI literacy, emphasizing the critical evaluation of AI-generated outputs rather than mere tool proficiency. This pedagogical shift requires moving away from purely product-oriented assessments toward process-oriented evaluations, such as oral defenses or iterative drafting, which make students' underlying reasoning visible. Simultaneously, students must adopt balanced, mindful approaches, using AI as a supplemental learning aid while intentionally preserving their analytical engagement [11,12]. Instead of utilizing AI as an automated oracle that bypasses rigorous thought, learners should be trained to use it as a collaborative sounding board, actively applying metacognitive monitoring to fact-check and challenge the AI's assertions. On a systemic level, Policymakers should establish ethical guidelines ensuring that academic and professional assessments measure genuine critical thinking rather than AI-assisted output [13,14]. Furthermore, regulatory bodies must collaborate with educational leaders to draft transparent acceptable-use policies that clearly delineate the boundary between ethical technological scaffolding and intellectual outsourcing. Finally, AI Developers are urged to design human-centered tools that incorporate "cognitive friction" mechanisms. These features would prompt users to question, verify, and reflect on AI-generated content, thereby supporting active intellectual engagement over

passive consumption. By intentionally designing interfaces that highlight algorithmic uncertainty, require users to validate source citations, or prompt them to confirm logical steps, developers can dismantle the "illusion of accuracy" and foster a more symbiotic, intellectually sustainable human-AI relationship.

6. Conclusion

This study addressed a critical juncture in modern education and digital literacy by examining the impact of AI-generated language on critical thinking skills through a comprehensive mixed-methods approach. Quantitative findings revealed a statistically significant negative correlation between AI language tool usage and critical thinking performance. Over eight weeks, the experimental group demonstrated substantial declines across all measured subscales, logical deduction, argument evaluation, and assumption identification, while the control group exhibited measurable improvements. The magnitude of these declines, characterized by moderate to large effect sizes, highlights the rapid pace at which cognitive atrophy can occur when analytical processes are outsourced. The most pronounced deterioration was observed in assumption identification, a particularly concerning trend that suggests a fundamental loss of the user's ability to detect underlying biases, unstated premises, and logical gaps in presented information.

Qualitative findings strongly corroborated these statistical results, illuminating the psychological mechanisms driving this cognitive decline. The data revealed that participants frequently engaged in unconscious cognitive offloading, treating the AI not merely as a collaborative tool, but as an infallible proxy for their own reasoning. Lulled by the syntactic fluency and authoritative tone of AI outputs, users exhibited diminished metacognitive awareness. Consequently, the vast majority accepted AI-generated content passively, with only a small, strategic minority employing rigorous verification strategies.

Collectively, these findings provide compelling evidence that habitual, uncritical reliance on AI language tools fundamentally erodes core critical thinking capacities. The research indicates that the mental "friction" inherent in traditional writing and problem-solving is not merely an inefficiency to be optimized away, but a necessary catalyst for intellectual development. Therefore, this study underscores the urgent need for systemic educational interventions that promote active metacognitive monitoring and strategic AI engagement. Furthermore, it serves as a call to action for developers and policymakers to design and regulate AI tools that foster intellectual scaffolding rather than intellectual outsourcing. Future research should prioritize longitudinal studies to assess the long-term cognitive impacts of AI dependency across diverse demographics and investigate whether targeted AI literacy programs can successfully mitigate these deficits. Ultimately, as AI continues to seamlessly integrate into daily communication, preserving human intellectual autonomy will require a deliberate, mindful, and highly strategic approach to human-computer interaction.

Disclosure statement

The author declares no conflict of interest.

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