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UNDERSTANDING COGNITIVE OFFLOADING IN AI-ASSISTED RESEARCH

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Abstract

The increasing use of Artificial Intelligence in academic settings has changed how academician manage cognitive demands when completing academic tasks. This article aims to explore the role of cognitive offloading in AI-assisted research, particularly its benefits and potential risks for cognitive engagement and critical thinking, from the existing literature. This article discusses the relationship between cognitive load and cognitive offloading, the use of GenAI assistants in academic activities, and their implications for learning and research performance. Previous studies suggest that GenAI tools can reduce cognitive demands, improve efficiency, and support academic writing and analytical tasks. However, excessive reliance on these tools may reduce independent thinking, limit critical evaluation, and weaken the development of cognitive skills. Conversely, other findings indicate that AI-assisted cognitive offloading can support critical thinking when users remain actively engaged in evaluating and developing their work. These contrasting findings suggest that the impact of cognitive offloading depends not only on the use of AI tools but also on how individuals engage with them. Therefore, balancing AI assistance with active cognitive engagement is essential to support learning and research productivity.

Keywords: Artificial Intelligence, cognitive loading, cognitive offloading, research

1. Cognitive Load and Cognitive Offloading

Cognitive load is the mental effort required to analyse and comprehend information, whether relevant or irrelevant. Intrinsic load stems from the complexity of the material's complexity, whereas external load stems from how information is presented (Khan & Suhluli, 2025). Cognitive load is understood through the Cognitive Load Theory (CLT), which examines how mental effort influences learning and performance (Khan & Suhluli, 2025). Research productivity, which encompasses efficiency, quality, creativity, completion rates and the speed at which an individual makes decisions, is significantly influenced by cognitive load, the total mental effort expended in working memory. High cognitive load can lead to errors and disruptions, thereby reducing the quality of work output, prolonging the time taken to complete tasks, and reducing processing efficiency [19,20]. Although an ideal level of cognitive load can enhance engagement (Eesee et al., 2024; de Bruin et al., 2025), it also limits cognitive flexibility, hence restricting creativity and innovation. Furthermore, a heavy load hinders task completion, particularly under time limits, and strains cognitive resources (Dong et al., 2020), thereby affecting decision-making speed and accuracy (Ball et al., 2023).

On the other hand, cognitive load serves a different function to cognitive offloading. Risko and Gilbert define cognitive offloading as the use of physical actions to alter the way information is processed in a task, thereby reducing cognitive demands. The theory of cognitive offloading suggests that individuals tend to delegate information storage and decision-making to external systems, thereby reducing their cognitive load but also risking a decline in mental capacity in the long term (Risko & Gilbert, 2016; Kulal, 2025). Cognitive offloading occurs when individuals delegate cognitive tasks to external aids, thereby reducing their engagement in deep and reflective thinking (Sparrow, 2011; Gerlich, 2025). This phenomenon is of particular concern in the context of critical thinking, which requires active cognitive engagement to analyse and evaluate information effectively (Gerlich, 2025).

According to Dawson, the term 'cognitive offload' refers to the use of externally sourced tools or strategies to reduce the mental effort required to complete complex tasks (Dawson, 2020; Hong et al., 2025). Cognitive offload

is a phenomenon whereby users tend to rely increasingly on external systems to perform tasks that typically involve active cognitive functions (Risko & Gilbert, 2016; Kulal, 2025)). On the one hand, cognitive offloading can significantly enhance productivity and the quality of writing by utilising various tools and techniques to manage cognitive load more effectively (Khan & Suhluli, 2025). On the other hand, however, this reliance may erode users' ability to engage in higher-order reasoning and reflection, particularly in academic and professional contexts over time (Sparrow, 2011; Gerlich, 2025). This can hinder the development and maintenance of critical cognitive skills, particularly if individuals become overly reliant on external aids (Gerlich, 2025).

Understanding both cognitive load and cognitive offloading is essential in educational settings, as they help explain how students. Those constructs help explain how students manage their effort in academic settings, particularly in completing academic tasks and how students' reliance on AI tools. Moreover, it reflects how their learning and cognitive skills are developed in academic settings.

2. Cognitive Offloading and Generative AI Assistants

Digital tools play a vital role in alleviating cognitive load, particularly when using generative artificial intelligence (GenAI) such as ChatGPT, Claude, Grammarly and other tools. GenAI systems such as ChatGPT, Jasper AI and Grammarly are rapidly transforming the way academic research is conducted. These technologies can simplify academics' work and boost their productivity by automating tasks such as writing, summarising and evaluating (Fernández Cerero et al., 2025; Khan & Suhluli, 2025). Grammar and spelling checker software helps researchers focus on content creation rather than mechanical errors. The reduction in cognitive load also includes the use of reference management tools such as Mendeley, Zotero or EndNote. Using these tools helps to organise and cite sources, thereby reducing the mental effort involved in managing bibliographic information. By automating the citation process, researchers can concentrate on constructing arguments and integrating evidence effectively (Khan & Suhluli, 2025).

However, alongside these benefits, there are growing concerns regarding the potential cognitive and social impacts of AI use in academia and research on human users, particularly in relation to critical thinking skills (Gerlich, 2025; Peng & Yeh, 2025). Given the benefits outlined, a key question arises: how does the increasing use of GenAI alter the cognitive and emotional demands of research work? Cognitive load, such as the mental effort required to absorb and integrate information and task fatigue and stress arising from performing the same tasks for prolonged periods or repeatedly are two key factors researchers must bear in mind when navigating complexity and maintaining their performance (Khan & Suhluli, 2025). This also raises the questio about when routine thinking tasks are delegated to external systems, can the results still be considered the work of the authors and the researchers involved? Given that they are no longer actively contributing their own thoughts, but merely critiquing. This marks a categorical shift from delegation via self-documentation, writing notes that still need to be coded, retrieved and then reintegrated by the individual towards delegation via machines, where the generative act itself is carried out by the system (Su et al., 2026).

3. Benefits and Potential Risks of Cognitive Offloading

AI assistants improve immediate collaborative performance, but it often comes at the cost of critical thinking and skill development (Crowston & Bolici, 2025; Macnamara et al., 2024; Natali et al., 2025; Ding et al., 2027; Peng & Yeh, 2025). The pervasive availability of AI assistants, which offer quick solutions and ready-made information, can discourage users from engaging in the cognitive processes essential for critical thinking (Gerlich, 2025). Research indicates that when AI systems carry the bulk of the cognitive load to maximize efficiency, they reduce the user's need for active cognitive engagement and reflection (Buçinca et al., 2021). This leads users to rely on heuristic shortcuts that impair their ability to critically evaluate AI-generated outputs, making them less likely to detect errors or hallucinations (De Jong et al., 2025; Zhai et al., 2024). A particularly consequential source of uncertainty is the tendency of generative AI to produce outputs that are fluent and confident in presentation yet factually incorrect, logically inconsistent, or contextually inappropriate, a phenomenon widely described as hallucinations (Gu et al., 2024; Lane, 2025; Misiejuk et al., 2026) . This phenomenon may be more severe for novices, who lack the robust mental schemas that experts use to monitor AI performance. While AI can compensate for a novice's lack of task-specific resources, it may simultaneously suppress the independent competence necessary for growth (Chen et al., 2024 11). (Misiejuk et al., 2026)

Lee et al. (2025) found that higher confidence in generative AI predicted less enacted critical thinking, whereas higher self-confidence in one's own ability predicted more. AI tools such as data analytics software and machine learning algorithms can enhance analytical capabilities by processing vast amounts of data and identifying patterns that might be difficult for humans to detect. For instance, AI-powered data visualisation tools can help users see trends and correlations in large datasets, thereby aiding analytical thinking. However, there is a risk that over-reliance on AI for analysis may undermine the development of human analytical skills. Individuals who depend

too heavily on AI to perform analytical tasks may become less proficient at engaging in deep, independent analysis. This reliance can lead to a superficial understanding of information and reduce the capacity for critical analysis(Gerlich, 2025)

Studies have shown that task difficulty (Walsh & Anderson, 2009), tool characteristics (Weis & Wiese, 2019), memory capabilities (Gilbert, 2015), individuals' perceptions of their ability (Gilbert et al., 2020), and cognitive offloading costs (Grinschgl, Papenmeier, et al., 2021) all influence whether people perform cognitive offloading. Individuals decide whether to offload cognition based on the difficulty of the task at hand (Peng & Yeh, 2025). Gilbert found that participants with poorer memory capabilities, less confidence in their overall performance, and less confidence in completing specific tasks were more likely to adopt cognitive offloading. These indicate that individuals would consider the difficulty of the tasks, evaluate their abilities and external resources, and then decide on their problem-solving strategies (Gilbert et al., 2020; Peng & Yeh, 2025)

Previous research demonstrates a significant negative correlation between the frequent use of AI tools and critical thinking abilities, mediated by the phenomenon of cognitive offloading. This suggests that while AI tools offer undeniable benefits in terms of efficiency and accessibility, they may inadvertently diminish users' engagement in deep, reflective thinking processes (Gerlich, 2025). The other results showed that although cognitive load and fatigue were expected to affect performance negatively, the manifestations were less pronounced than predicted, implying that scholars rely on resilience, engagement, and online solutions to mitigate mental pressure. Conversely, the effect of GenAI immersion was significantly negative, and excess dependence on tools, such as ChatGPT, was associated with less originality and critical thinking (Khan & Suhluli, 2025).

These results differ from those found in Hong et al (2025), when the tasks set were related to language and writing assessment. The results were highly positive, with pupils reporting an improvement in their critical thinking skills, particularly in writing English essays. This improvement was attributed to the capabilities of the AI platform, which not only helped pupils develop stronger arguments and support them with evidence in their essays, but also assisted them in finding relevant research papers. Consequently, the essays produced were more robust, ensuring that their arguments were well-supported by credible evidence. The platform also corrected grammatical errors and suggested modifications to sentence structure, thereby improving the overall quality and readability of their essays. Overall, this finding suggest that AI-assisted cognitive offloading does not necessarily undermine critical thinking, but may instead support cognitive engagement and learning when AI tools are used to reduce cognitive efforts while allowing students to remain involved in the academic activities.

Artificial Intelligence's Usage Declaration

The authors used artificial intelligence (ChatGPT and DeepL) to assist with language refinement and proof-reading, during the drafting of this manuscript. All initial drafts were written by the authors, while artificial intelligence was used solely as a language aid. All content produced has been carefully reviewed, revised, and verified by the authors. The authors take full responsibility for the accuracy, completeness, and authenticity of the final manuscript.

Authors' Contributions

The first author (SY) was responsible for the study conceptualization, methodology development, data collection, data analysis and writing the original manuscript draft. The second author (GIRM) contributed to methodology development. The third author (RG) provided critical review and editing the article. All authors have read and approved the final version of the manuscript and take responsibility for its academic integrity.

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Conflict of Interest Declaration

All authors declared no conflicts of interest related to the study and publication for this article.

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