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Harnessing Generative AI to Overcome Executive Dysfunction in Higher Education: A Case Study

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Abstract

Generative tools such as ChatGPT, Perplexity and Google Gemini have rapidly transformed educational practices across campus environments by providing personalized academic support. This qualitative longitudinal case study examines how such tools can in fact help mitigate challenges linked to a neurodivergent condition called executive dysfunction—a condition that impairs focus, organization, planning, and time management. Using the case study of a student at the University of Toronto (pseudonym "T"), it details the integration of AI for lecture transcription, task management, idea creation, and writing support. The results indicate that when AI is employed as an assistive scaffold rather than a replacement for critical thought, the student demonstrates enhanced metacognitive awareness, more efficient task breakdown, and steadily improved academic performance. These outcomes support the notion that responsible, ethically integrated AI applications can foster inclusive, patient, and personalized learning environments that address individual cognitive profiles and promote independent, self-regulated learning.

Keywords: *Generative AI; Executive Dysfunction; Neurodiversity; Assistive Scaffold; Metacognitive Awareness; Extended Mind.).*

1. Introduction

Today, artificial intelligence is rapidly reshaping academic paradigms. As institutions increasingly deploy generative AI tools as part of personalized, adaptive support, their initiatives hold particular promise for learners with executive dysfunction—characterized by difficulties in task initiation, organization, and planning. Neurodivergent students often struggle with academic workload management due to challenges like impaired working memory and prioritizing information. This paper investigates how AI tools, strategically integrated, supported a neurodivergent student ("T") facing these challenges. Examining AI as a cognitive scaffold enabling T to overcome executive function barriers and develop stronger metacognitive

skills, it addresses the following questions: (1) How can generative AI mitigate executive function challenges? (2) What is the impact of AI-assisted learning on metacognition for neurodivergent students? (3) What are the benefits of AI as an assistive scaffold? Using a qualitative case study approach over five academic semesters (September 2023 to April 2025), including interviews, document analysis, and a personal log, it is argued AI can relieve cognitive load and foster self-regulatory skills without replacing critical thought. This study offers insights on harnessing technology to provide more inclusive learning environments for neurodivergent students.

2. Literature Review

2.1. Generative AI in Education

Recent studies demonstrate generative AI's capacity to enhance student engagement, facilitate self-directed learning, and improve academic performance (Schei et al., 2024; Carik et al., 2024). AI-assisted tools increased assignment completion rates and student confidence (Schei et al., 2024), while students using AI as scaffolds rather than replacements for independent thinking showed meaningful improvements in metacognitive awareness (Carik et al., 2024). "AI literacy" is critical but should be supported by ethical integration through explicit instruction, transparent usage policies, and clear boundaries between AI assistance and independent work (Ramirez & Johnson, 2025).

2.2. Executive Dysfunction and Neurodiversity

Executive dysfunction, common among neurodivergent students, involves impairments in planning, organization, task initiation, and time management (Khan & Lal, 2023). College students with this condition often require substantially more time on assignments despite comparable comprehension, underscoring a disconnect between cognitive capacity and executive control (Westbrook & Chen, 2024). Personalized AI scaffolds have been shown to significantly reduce task abandonment and improve metacognitive awareness in this group (Halkiopoulos & Gkintoni, 2024). Furthermore, combining technological support with explicit strategy instruction is highly effective in promoting independence among students with executive dysfunction (Rodriguez et al., 2024).

2.3. Assistive Technology and Neuroeducation

AI-powered assistive technologies offer personalized educational support, reshaping content to match diverse cognitive profiles. Tanaka and Williams (2024) found adaptive digital tools can leverage neuroplasticity, leading to measurable executive function improvements. Techniques like task chunking—breaking complex assignments into manageable parts—reduce cognitive load and enhance motivation (Pierrès et al., 2024; Sweller & Paas, 2023). The concept of

"precision education" too, advocates for tailoring interventions to individual cognitive profiles (Gonzalez & Park, 2024). While ethical considerations such as data privacy and algorithmic bias necessitate proactive attention and human oversight (Duane, 2024), this brief literature review underscores the potential of generative AI to support executive function and metacognitive development in neurodivergent students, forming a basis for this investigation.

3. Case Study Methodology

3.1. Research Design

This research employs a qualitative single-case study design to examine the impact of generative AI tools on a neurodivergent student with executive dysfunction. The longitudinal approach, spanning five academic semesters from September 2023 to April 2025, allowed for observation of the student's adaptation to AI tools, changes in academic performance, and the development of metacognitive strategies over time.

3.2. Participant Selection and Profile

The participant, "T," was selected based on self-identified executive dysfunction challenges affecting academic performance, enrollment in a STEM program at a research university, and willingness to explore AI tools as academic supports. T provided informed consent, with assurances that all identifying information would be anonymized.

3.3. Data Collection

Multiple data sources were used to ensure methodological triangulation and enhance findings' validity. Semi-structured interviews, conducted weekly (60-90 minutes each), explored T's experiences with AI tools, perceived changes in academic functioning, and evolving integration strategies. These conversations were not audio-recorded. Document analysis involved examining T's academic work, focusing on assignments completed before and during AI implementation to track changes in organization, complexity, and quality. T also maintained a participant journal or reflective log documenting specific AI tool use instances, challenges, and perceived benefits, providing real-time data and reducing retrospective bias. To allow T to develop her AI-assisted workflows naturally, direct observation was not employed.

4. Case Study: One Neurodivergent Student's Experience

4.1. Student Profile and Challenges

T is a 42-year-old mature student in her second year of Physical and Environmental Science. Her academic journey is significantly affected by executive dysfunction. Her primary

challenges manifest as working memory limitations, making it difficult to process lectures effectively; task initiation difficulties, often leading to "analysis paralysis" when facing assignments; and issues with time perception and management. Despite these hurdles, T possesses notable cognitive strengths, including exceptional pattern recognition and the ability to quickly grasp complex concepts when they accommodate her learning style, which is visual-spatial with secondary strengths in verbal-linguistic processing.

4.2. AI Tool Implementation

T's relationship with AI tools evolved through discovery, adaptation, and increasing sophistication over five academic semesters. She began by using TurboLearn (an earlier version of TurboScribe) for real-time lecture transcription, but quickly moved to utilizing its "key concept highlighting" feature as well to create lists of course-specific terminology and reduce the cognitive load of identifying important information during lectures. She then realized she could offload taxing cognitive processes by employing ChatGPT as an external working memory for summarizing complex texts. That freed her mental resources to focus on making connections between ideas—a cognitive strength. Her second semester saw further integration of ChatGPT into her study routine for preliminary research, idea generation, and assignment structuring. She developed a methodical, structured prompting strategy that helped overcome task initiation difficulties by breaking down assignments into smaller, manageable steps, facilitating comprehension and minimizing working memory limitations. Her approach to prompting moved from general requests to specific queries that yielded more nuanced results and demonstrated greater executive control. By her third semester, T incorporated Paperpal to enhance her writing process, submitting drafts for feedback on language and clarity. Her initial uncritical acceptance of suggestions was gradually replaced by a systematic process for evaluating them.

4.3. Evolution of AI Usage: Developing a Comprehensive System through AI Literacy

By the end of her third semester, T frequently challenged AI recommendations and synthesized multiple suggestions into original approaches. In this decisive phase, she integrated her tools into cohesive systems for both study and assignment workflows. Her AI literacy advanced significantly, enabling her not only to formulate and adapt prompts but also to critically evaluate AI-generated content and decide how to incorporate it effectively. Since then, she has strategically deployed various AI tools to address specific executive function limitations. Her current procedure for written assignments showcases how she retains critical thinking and uses these tools as targeted scaffolds. For task breakdown and initial planning, she uses Genspark.ai to create outlines and combat "analysis paralysis," followed by Goblin Tools for detailed idea sequencing. In the research phase, T combines Perplexity, Elicit, and Google Gemini to gather diverse sources, overcoming working memory limitations by storing and organizing her

information in NotebookLM and requesting connections. During drafting and refinement, she uses Genspark.ai for a first draft, then seeks suggestions from Paperpal and constructive criticism from ChatGPT, critically assessing feedback against course objectives and her own voice. Zotero helps manage citations, and she sometimes utilizes university Writing Support for final proofreading. T has developed a similar multi-tool workflow for studying, using TurboScribe for transcription, Genspark for initial review, Quizlet for recall, NotebookLM for synthesis, Reclaim.ai for scheduling and Forest for focus. In both workflows, she actively directs each step, evaluating suggestions and integrating information. Her AI tools function as cognitive extensions that deepen her understanding and management of course content. It is her higher-order cognitive activities that guide, shape, evaluate and integrate the AI capabilities.

5. Analysis of AI Impact on Learning Outcomes

5.1. Cognitive and Metacognitive Development

The use of AI tools caused a remarkable shift in T's overall approach to learning. Greater AI literacy, comfort with technology and a significantly reduced cognitive load increased her confidence. Specifically addressing T's executive dysfunction challenges, AI-generated structured schedules and task lists helped her overcome difficulties with task initiation, substantially reducing deadline stress. T developed sophisticated "AI literacy"—the ability to critically evaluate AI-generated content and determine its appropriate integration into her work. Her iterative drafting process refined her critical reflection. As she grew more independent, she challenged AI recommendations and routinely synthesized diverse suggestions into original approaches. Perhaps the most significant outcome, however, was enhanced metacognitive awareness—the ability to reflect on, monitor, and adjust her own learning processes. Evaluating outcomes helped her continually refine learning strategies, thereby building a stronger foundation for self-regulated learning. Indeed, analysis of T's reflective journals revealed a progressive increase in metacognitive language. While early entries focused primarily on fears and content-related challenges, later entries showed sophisticated process awareness. This suggests T was able to internalize the external scaffolding provided by AI in the form of metacognitive strategies, and that AI tools did not replace her thinking but instead enabled a fuller expression of her capabilities by removing executive function barriers.

5.2. Academic Performance and Quality of Work

Academic abilities impacted by executive dysfunction showed enhanced cognitive outcomes as offloading routine tasks freed mental resources, allowing deeper engagement with course content. Improvements were observed in T's working memory, cognitive flexibility, initiation, planning, and time management skills. Quantitative academic outcomes provide further evidence: T's grade point average increased steadily over four semesters, rising from 1.85 to

3.35, or in European terms from an E to a C/B. While multiple factors likely contributed to this improvement, the correlation with AI implementation and T's own attributions suggest a significant relationship. Content analysis of written assignments revealed improvements not only in organization but also in analytical depth and integration of course concepts, suggesting that freed cognitive resources were redirected toward deeper conceptual engagement.

6. Discussion: Broader Implications

6.1. Philosophical Insights: AI as Cognitive Augmentation

T's case study is illustrative of broader insights into human-AI collaboration that deserve our attention. It shows us that AI tools can function as active collaborators in cognition, in alignment with Distributed Cognition theories where cognitive processes extend beyond the individual mind into other individuals, artifacts and environments. In T's experience, her cognitive system effectively distributes across her AI tools, compensating for executive function limitations while enhancing her strengths. Her sophisticated prompt engineering and critical evaluation ensure she directs the process and remains responsible for the output. This approach exemplifies Clark and Chalmers' Extended Mind thesis, where external tools seamlessly integrate into thinking processes, becoming functional extensions of cognition (Clark & Chalmers, 1998). When T uses NotebookLM as external memory or TurboScribe for transcription, these tools augment, rather than replace, her thinking. Free of specific burdens, T can apply her cognitive resources to a deeper engagement with course material and participate more fully in her education. Her human-AI partnership enhances her intellectual contribution: explanations and syntheses are no longer the products of an isolated biological brain but the achievements of a human-led, cognitively augmented system. This idea, it seems to me, begs a redefinition of understanding as it has been traditionally accepted.

6.2. The Universal Horizon: Redefining Intellectual Contribution

T's evolution prompts reconsideration of what constitutes "authentic" intellectual contribution. Throughout history, humans have used tools to extend cognitive capabilities, whether printing press, calculator or search engine. I would suggest that equating academic integrity solely with unassisted work may oversimplify intellectual contribution in the AI age. As exemplified by T's actions, meaningful contribution can be demonstrated through activities like strategic prompt engineering, critical evaluation of AI outputs, refinement and integration of information with personal insights, and contextual application of knowledge. This perspective suggests we need to evolve not only our understanding of understanding but, but our understanding of academic integrity as well. Rather than focusing on whether work is produced without technological assistance, we might instead emphasize transparency, critical engagement, human value-add,

and accountability, shifting focus from mere production to the higher-level skill of strategic orchestration.

6.3. Implication for Educational Practice and Future Directions

For educators, T's journey highlights the implications of using AI as an assistive scaffold for self-regulated learning. For example, curriculum design could incorporate AI-assisted task management and writing support as integrated components rather than ad hoc interventions.

Educators need to embrace deliberate strategies that guide effective AI tool use and promote independent cognitive development to counter overdependency. Educational institutions too must invest in professional development and policy frameworks that contemporize academic integrity concepts while addressing potential issues like algorithmic bias and data privacy. Future research should explore the long-term academic impacts of cognitive augmentation across diverse learning profiles. Longitudinal studies are needed to track how AI-supported learning translates to sustained capabilities beyond the university setting. Moreover, as AI technologies continue to evolve, regular assessment of their practical and ethical implications will be crucial to ensuring equitable access and fairness (Duane, 2024; Khan & Lal, 2023).

7. Conclusion

In answer to the research questions posited, this study explicitly demonstrated how generative AI tools can effectively mitigate executive dysfunction challenges, enhance metacognitive awareness, and serve as assistive scaffolds that augment rather than replace critical thought. It contributes to understanding AI in education by offering concrete implementation strategies for specific executive dysfunction aspects. It highlights viewing AI as process support rather than content generator, emphasizing how AI tools enhance metacognitive development when integrated properly. Furthermore, it suggests educators reflect on what constitutes authentic intellectual contribution and consider how understanding and academic integrity might be productively redefined when AI assistance is combined with active human oversight.

For T, this redefinition represents an evolution, not an erosion, of intellectual endeavor. Her experience demonstrates that using AI as an assistive scaffold enables significant academic growth for students with executive dysfunction. Strategically offloading executive burdens led to improvements in T's metacognitive awareness, organization, and confidence, reflected in deeper engagement and increased personal wellbeing. Her case study suggests AI integration holds particular promise for neurodivergent students, a potential that in future could be extended to student communities more generally. Rather than viewing AI as a threat, we might see it as a tool for creating more inclusive, adaptive, and personalized educational environments that accommodate cognitive diversity while facilitating excellence. Approached as a tool for empowerment, as in T's case, AI can help individuals overcome limitations and realize their full

potential, becoming not a replacement for human cognition but an enabling scaffold for all of us.

References

Carik, B., Ping, K., Ding, X., & Rho, E. H. (2024). Exploring Large Language Models Through a Neurodivergent Lens: Use, Challenges, Community-Driven Workarounds, and Concerns. *Proceedings of the ACM on Human-Computer Interaction, 9*(1), 1–28 2.

Clark, A., & Chalmers, D. J. (1998). The extended mind. *Analysis*, *58*(1), 10-23. https://consc.net/papers/extended.html

Duane, A. (2024). Can Artificial Intelligence Complete My Assessment? A Student Led Initiative to Stress Test the Academic Integrity of University Assessment Using Generative AI 3.

Gonzalez, M., & Park, S. (2024). Precision Education: Tailoring Technology to Individual Neurocognitive Profiles. *Educational Technology Research and Development, 72*(3), 415-438 4.

Halkiopoulos, C., & Gkintoni, E. (2024). Leveraging AI in e-learning: Personalized learning and adaptive assessment through cognitive neurotechnology – A systematic analysis. *Electronics, 13*(18), 3762 5.

Khan, K., & Lal, P. (2023). Executive Dysfunctions in Different Learning Disabilities: A Review. Journal of Indian Association for Child and Adolescent Mental Health, 19(2), 126–142 6.

Pierrès, O., Darvishy, A., & Christen, M. (2024). Exploring the Role of Generative AI in Higher Education: Semi-Structured Interviews with Students with Disabilities. *Education and Information Technologies*.

Ramirez, J., & Johnson, T. (2025). AI Literacy in Higher Education: A Framework for Ethical Integration. *Journal of Computing in Higher Education, 37*(1), 78-96 9.

Rodriguez, K., Smith, L., & Thompson, J. (2024). Interventions for Executive Dysfunction in Higher Education: A Meta-Analysis. *Journal of Learning Disabilities, 57*(2), 183-201 10.

Schei, O. M., Møgelvang, A., & Ludvigsen, K. (2024). Perceptions and Use of AI Chatbots among Students in Higher Education: A Scoping Review of Empirical Studies. *Education Sciences, 14*(8), 922 11.

Sweller, J., & Paas, F. (2023). Cognitive Load Theory: Recent Advances and Applications. *Educational Psychology Review, 35*(2), 121-146 12.

Tanaka, H., & Williams, R. (2024). Digital Tools and Neuroplasticity: Longitudinal Effects of Adaptive Technology Use on Executive Function. *Neuropsychology, 38*(3), 275-291 13.

Westbrook, J., & Chen, L. (2024). Time Management Disparities: Comparing Task Completion Patterns Between Neurodivergent and Neurotypical College Students. *Journal of College Student Development, 65*(2), 189-205 14.