Exploring LLM Agents as Interactive Mind Map Creators Tailored for Students with ADHD

Kaiyuan Tang*
University College London
Department of Computer Science
London, United Kingdom
kaiyuan.tang.24@ucl.ac.uk

Kerui Chen*
University College London
Department of Computer Science
London, United Kingdom
kerui.chen.24@ucl.ac.uk

Zhou Jiang
University College London
Department of Computer Science
London, United Kingdom
zhou.jiang.24@ucl.ac.uk

Mark Quinlan
University College London
Department of Computer Science
London, United Kingdom
m.quinlan@ucl.ac.uk

Youngjun Cho
University College London
Department of Computer Science
London, United Kingdom
youngjun.cho@ucl.ac.uk

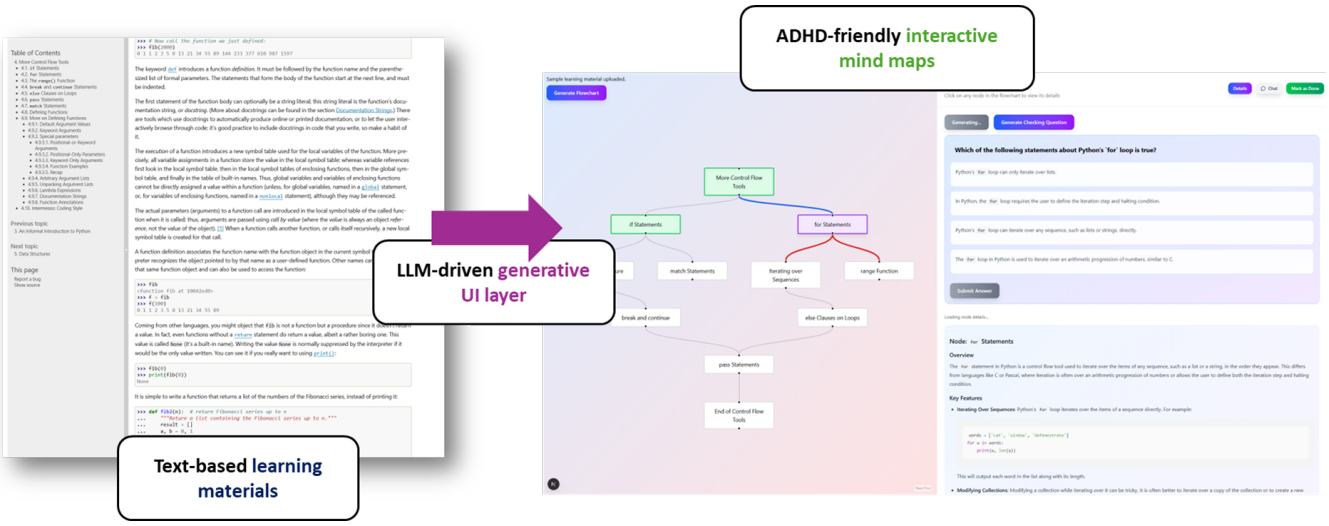

Figure 1: The proposed UI system utilises LLM agents to transform the sample text-based learning material (on the left) into an interactive, ADHD-friendly mind map experience (on the right). Users can interact with nodes, mark progress, expand relevant content, generate dynamic exercises, or chat with the agent to better understand the content.

Abstract

Students with Attention Deficit Hyperactivity Disorder (ADHD) often struggle with traditional text-based learning materials due to executive function deficits that affect their ability to process, organise, and retain information. While the rapid development of Large Language Models (LLMs) has sparked innovation in generative user interfaces, existing products fail to address the specific learning challenges faced by students with ADHD. We introduce a novel approach that leverages LLM agents as interactive mind-map creators specifically designed to support ADHD learners. Our solution automatically transforms dense text-based documents into interactive, ADHD-friendly interactive mind maps. These dynamic visual representations allow students to engage with learning tasks, explore content node by node, asking questions, and monitoring their learning progress. initial evaluation indicates improvements in four key areas: increased motivation to engage with learning materials, enhanced concentration during study sessions, better task planning and organisation skills, and improved ability to extract and understand main ideas from complex texts. By specifically addressing the needs of neurodivergent learners, this research contributes to the emerging field of LLM-powered generative user interfaces by demonstrating their potential as inclusive learning tools, opening up new avenues for exploration.

CCS Concepts

• **Human-centered computing** → **Accessibility systems and tools**; **Interactive systems and tools**.

Keywords

ADHD Learning Support, Generative User Interface, Large Language Models, Generative AI, Inclusive Technologies

1 Introduction

Students with Attention Deficit Hyperactivity Disorder (ADHD) face unique challenges in learning activities. ADHD symptoms can lead to poor performance in task planning, extraction of main ideas, and difficulties in maintaining focus and motivation during extended study sessions [20]. Traditional learning materials, particularly text-based resources, often overlook support for these students, leading to potential inequality and inaccessibility.

Researchers have explored various approaches to support students with ADHD, with interactive learning methods and metacognitive strategies[1] being among the most frequently discussed [23]. Mind mapping, as a metacognitive strategy, has proven valuable in helping students with ADHD improve concentration and executive functions [13, 21]. However, adapting educational materials to support students with ADHD entails additional costs, and there is currently little research exploring efficient tools in this area.

The development of Large Language Models (LLMs), presents new opportunities to create innovative and accessible learning materials at scale. This study explores the use of LLM agents as efficient tools to support students with ADHD in learning activities. Leveraging the reasoning capabilities of LLMs and their ability to process and generate structured output, LLM agents can act as generators of mind maps, diagrams, and dynamic User Interfaces (UI) [8–10].

We present a prototype LLM-powered multi-agent[2] UI system that transforms traditional text-based learning materials into ADHD-friendly, interactive mind mapping experiences[3] (Figure 1). Our system automatically generates visual, node-based representations that allow students to engage with content through interactive exploration, dynamic questioning, and progress tracking.

The rest of the paper is organized as follows. Section 2 reviews the background and related work. Section 3 details the design, prototyping and initial evaluation of the system. Finally, Section 4 concludes the paper and discusses implications and future directions.

2 Background and Related Work

2.1 ADHD Learning Difficulties

Students with ADHD face additional learning challenges due to executive function deficits that result from ADHD symptoms [12]. Research evidence indicates that they often perform poorly in areas such as the extraction of main ideas and task planning[17], the identification of key information, and the formulation of effective learning plans [20]. When dealing with conventional text-based learning materials, these challenges are particularly pronounced[3]. These materials often fail to provide adequate support for students with ADHD, lacking visual guidance, interactivity, and feedback mechanisms. The specific challenges faced by students with ADHD include the following:

- **High Information Density:** Traditional teaching materials often present information with a high density of text but lack clear knowledge frameworks and easy-to-read content structures. This makes it difficult for students with ADHD to grasp the overall context and effectively organise what they have learned.
- **Lack of Visual Aids:** Text-based materials often lack intuitive guiding visual aids, such as graphic chunking and mind mapping, that are helpful to accommodate the cognitive characteristics of students with ADHD [26].
- **Linear Learning Formats:** Traditional teaching materials are often delivered in a linear and singular reading format, which lacks opportunities for interaction and exploration. This limitation makes it challenging to stimulate ADHD students' interest and motivation. [7]
- **Insufficient Executive Function Support:** Text-based materials often lacks tools that support executive functions, such as task breakdown and progress tracking. This deficiency makes it difficult for students with ADHD to effectively plan tasks and engage in self-directed learning. [3]
- **Absence of Immediate Feedback:** The lack of immediate and direct feedback negatively affects ADHD students' motivation to engage with tasks, also leading to increased distraction [22].

These barriers continue to restrict access to educational resources for students with ADHD and hinder their ability to fully benefit from them, thus exacerbating structural inequalities that must be addressed [19].

2.2 ADHD Learning Strategies

In addressing these challenges, metacognitive strategies have been shown to be an effective complement to traditional supportive interventions to alleviate symptoms of ADHD [23]. Metacognitive strategies are defined as the awareness and deliberate consideration of one's cognitive processes, including planning, monitoring, and evaluating learning activities [18, 23]. To facilitate the effective implementation of these metacognitive activities, Graphic Organisers (GOs), which are visual tools that help students structure and organize information through diagrams, charts, and other visual formats to reduce cognitive load and enhance comprehension, are widely utilised as supportive tools [25, 27]. According to the Visual Argument Hypothesis, the spatial characteristics of graphics reduce the need for cognitive transformation, thus alleviating working memory load [6]. Besides, the Dual Coding Theory posits that the simultaneous presentation of verbal and visual information enhances cognitive processing [6].

Mind mapping, as a practical metacognitive tool, presents knowledge connections and content in a visually structured form with minimal text annotation, helping to reduce cognitive load [2, 26]. They encourage students to actively organise and review information, supporting planning, progress monitoring, and self-assessment throughout the learning process. Studies have demonstrated that regular use of mind maps can help students with ADHD develop stronger self-regulation and inhibitory control, serving as a valuable supplement to existing support methods [11]. Related research

[1] A metacognitive strategy is a deliberate technique to plan, monitor, or evaluate one's own learning process.

[2] In our context, an agent is an LLM instance designed to perform a specific function, such as analyzing text content, generating mind map structures, or facilitating interactive Q&A with students. Multi-agents work together to accomplish these tasks.

[3] The complete code for the prototype described in this paper can be found at: https://github.com/9vek/llm-driven-interactive-mind-map.

indicates that mind mapping software effectively stimulates motivation, aids information organisation, and enhances overall learning and cognitive abilities in students with ADHD and other learning disabilities during writing tasks [21]. Currently, mind maps have been successfully implemented in school settings, becoming an important strategy for supporting ADHD students' learning activities [13]. However, there is a lack of efficient mind mapping tools specifically designed for students with ADHD, as customising tools or materials to meet their cognitive needs often demands extra time, expertise, and costs.

2.3 LLM Development and Generative UI

We propose that LLMs would be potentially valuable tools to facilitate ADHD-friendly mind map generations. With the rapid development of GenAI and LLMs in recent years, an increasing number of software systems are attempting to integrate LLM-powered services. The revolutionary capabilities of LLMs in reasoning, processing and generating information and content offer great potential for various generative applications [4]. In many early examples, LLMs often serve users in the form of Conversational Agents (CA, such as ChatGPT), and the dialogue and Q&A-based interaction forms remains mainstream to this day [14, 16].

However, as the LLM development kit and structured output patterns evolve and mature [1], more research is beginning to move beyond the classic text dialogue format, focusing on applying LLMs as generative UI technologies [5, 9]. Generative UI refers to user interfaces that are dynamically created and modified by LLMs in real-time, where the interface elements, content, and interactions are generated based on user input rather than being pre-designed static components. The output of the LLMs are not only presented in text form but is also used to update and change interface elements. For example, the study of [15] demonstrated using LLM to generate just-in-time UI mockups based on user intent; the study of [9] demonstrated an LLM assistant capable of generating dynamic UI components during conversations, allowing users to interact with the generated panel as a supplement to text input; the study of [5] showcased the ability of LLMs to generate visuals driven by data, highlighting the intriguing potential of presenting LLM outputs within visual interface elements. However, LLM-powered generated UIs are still in the very early stages of research. The proposed approach in this paper of using LLM agents as creators of interactive mind maps to support students with ADHD will contribute an interesting exploration to this field.

2.4 Path to LLM-generated Interactive Mind Maps and Gaps in existing products

Both industry and academia are exploring the use of LLMs to generate diagrams and mind maps. For instance, LLM products like ***Mapify*** and ***ResearchFlow*** allow users to upload text or files to generate corresponding mind maps, while studies [8] and [10] have investigated the use of LLMs to create visual and interactive diagrams. However, we argue that there are two gaps in current products that need to be addressed. The first issue is **interactivity**: some LLM-powered products on the market merely visualise text into the form of mind maps, essentially remaining as dense text information without exploring other beneficial interactive design possibilities (Figure 2). Secondly, there is currently no research on **how to design LLM-powered mind map creators tailored specifically for learners with ADHD**. As a user group that most needs such learning tools, it is crucial to explore the design issues of LLMs as interactive mind map generation tools based on the visual and interaction preferences associated with ADHD to smoothen their entire learning process. The two gaps formed the motivation for us to design this demo.

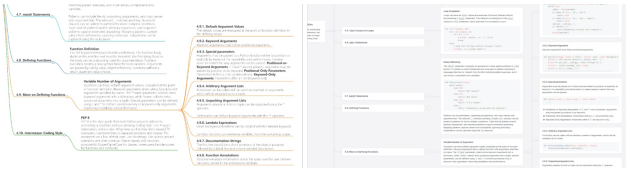

Figure 2: Screenshots from market-available LLM-generated mind mapping products. Most of existing products still generate mind maps based on dense textual information and lack ADHD-friendly interaction design.

3 Prototyping

3.1 System Design

We prototyped a web-based UI to demonstrate the proposed concept. We tested integrating OpenAI APIs in the LLM layer and used the React framework for the UI development. Figure 3 shows the complete UI workflow in supporting ADHD learning process.

Two of our lead authors, who have lived experience of diagnosed adult ADHD, facilitated our system design and prototyping process. Based on the previous literature reviews and the researchers' recommendations, we established the following three design goals:

- **DG1: Enhance Visual Aids:** The generated interactive mind maps should incorporate intuitive visual aids to accommodate the cognitive characteristics of students with ADHD. Improve concentration and reduce cognitive load.
- **DG2: Promote Non-Linear Exploration:** The system should allow non-linear learning formats, allowing users to interact with and explore content dynamically. This approach seeks to stimulate interest and motivation beyond traditional linear reading experience.
- **DG3: Support Executive Functioning:** The LLM-powered mind map creators should assist with executive functions, such as task breakdown, progress tracking, and key information extraction.

To address **DG1**, we adopted colour scheme and information density based on literature recommendations (e.g. use red colour for better focus maintenance [26]). In the display of the interactive mind maps, we incorporated simplified visual elements to make the content more accessible and less overwhelming for students with ADHD. The design includes clear, distinct pathways and nodes that help them visually organise information. Additionally, we only extract and expand detailed information when the user needs it, making it easier to follow without feeling overloaded (Figure 1 and 3).

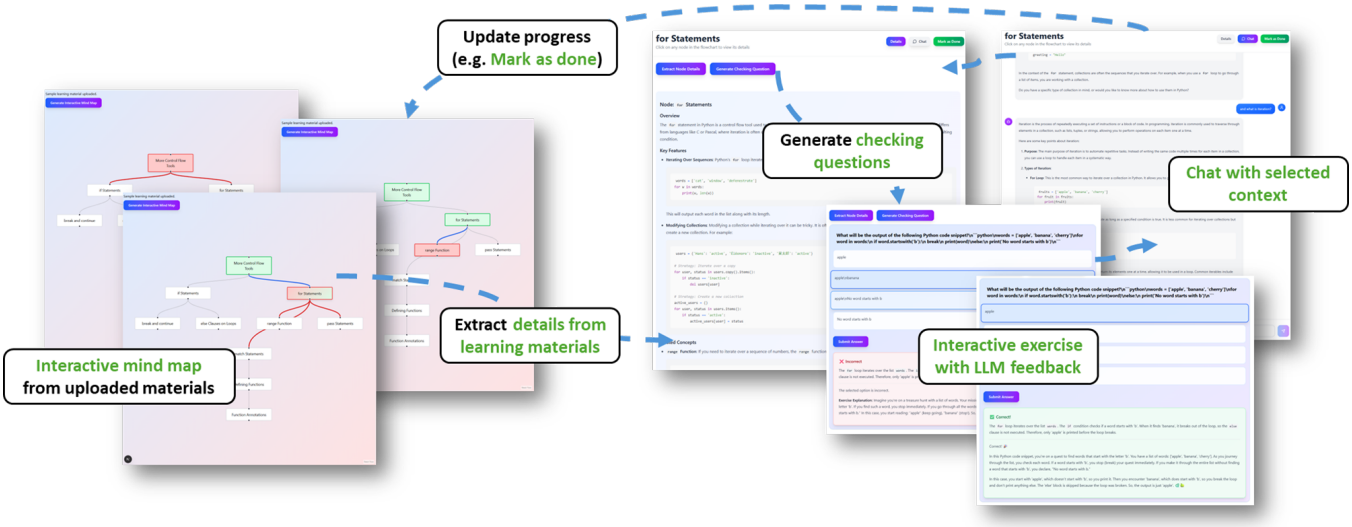

Figure 3: UI workflow: the user first uploads the learning materials, and the LLM-powered mind map creator analyses the content within the materials to generate a intuitive, interactive mind map. The user uses this mind map as a visual learning path and can click on specific nodes to extract detailed information from the materials. Another set of LLM agents is responsible for presenting the extracted information in a ADHD-friendly manner, providing conversational Q&A, or generating dynamic checking questions to help the user assess their learning outcomes. After finishing a node, the user can change the status of the node, such as marking them as done, to track progress, plan tasks, and stay focused.

For achieving **DG2** and **DG3**, we implemented a multiagent architecture (Figure 4) and optimised the LLM agents through advanced prompt engineering and fine-tuning to deliver an efficient interactive experience. This architecture adopted specialised agents to support dynamic mind map generation and content expansion at each node, allowing users to explore topics non-linearly, which is essential for maintaining interest and motivation in students with ADHD.

Our prompt engineering strategies focus on reducing cognitive load and progressively extracting knowledge. By integrating research recommended strategies into LLM prompts to guide agents through converting complex information in manageable steps, the system extract node details, generates interactive checking questions, and context-based dialogues tailored to the learning needs of ADHD students. These features support executive functioning by helping them break down tasks and track progress effectively. The agents are designed to facilitate self-directed learning, improve focus, and enhance task completion efficiency by providing smooth guidance and feedback throughout the learning process (Figure 3).

3.2 Initial Evaluations

We recruited two researchers with lived ADHD experience to test the prototype, during which they interacted with the UI system and compared it with the traditional learning approaches (reading the text-based learning materials). Based on their feedback, we posit that the prototype shows significant promise in the following two aspects:

Using LLM as a helpful tool to generate ADHD-friendly information visualisations and reduce text density: The initial

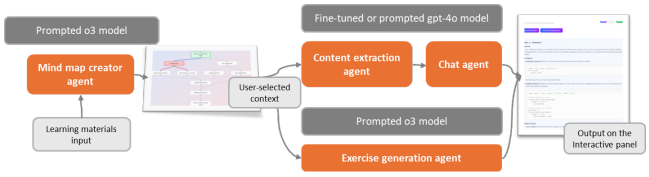

Figure 4: The multiagent architecture adopted in the demo consists of four agents who collaborate as follows: The mind map creator agent (AG1) is prompted to extract and generate a suitable learning framework from the uploaded materials. It focuses on generating an easy-to-understand, clear-path mind map (using structured output). Once completed, the content extractor agent (AG2) then extracts relevant information from the uploaded materials. This agent works based on the results from AG1, and which node the user selected, in a progressive, low-density manner. The chat agent (AG3) has been specifically fine-tuned using a dataset of appropriate responses, provides examples and explanations based on the context from AG 1 and 2, and user questions. Finally, the exercise generation agent (AG4) has also been fine-tuned, and generates dynamic checking questions (using structured output it has been fine-tuned on) based on the context to check user's learning progress.

evaluation revealed that LLM agents can generate satisfactory and intuitive mind maps. The approach effectively reduces text density, making verbose information more accessible to students with ADHD. The colours and visual elements used on the generative UI

help in minimising cognitive overload and improving focus, further facilitating a more accessible learning experience.

Crafting an LLM-powered interactive and enjoyable learning experience that is accessible to students with ADHD: The prototype's interactive features driven by LLMs were found to create an engaging and enjoyable learning environment for students with ADHD. The ability to explore content non-linearly and interact with dynamic nodes fosters a sense of curiosity and motivation. The system's personalised guidance and feedback mechanisms, tailored to the unique learning needs of ADHD students, support self-directed learning and enhance task completion efficiency, making the educational process both effective and enjoyable.

4 Discussion and Conclusion

This study explored LLM agents as interactive mind maps creators tailored to support the learning activities of students with ADHD. Taking into account their typical difficulties in executive functioning. We prototyped a web-based UI system that transforms traditionally verbose text-based materials into ADHD-friendly, interactive, and visually accessible learning interface. By integrating the ADHD-resulted cognitive characteristics and relevant design recommendations, our initial testing indicated that the mind mapping-based interface potentially improved the learning experience of students with ADHD, particularly their ability in organising information, planning tasks, and keeping focus.

However, the current prototype exhibits several limitations. First, it has not been subjected to extensive user testing, which is crucial to assessing its effectiveness and usability. Secondly, the generated mind map content may lack precision due to the incomplete optimisation of the underlying LLM layer. This can result in errors or misalignment with specific learning contexts. To address these issues, incorporating domain-specific fine-tuned models or optimisation algorithms [24] could enhance the accuracy and outputs quality. Our future work will focus on resolving these challenges and exploring more targeted design and interaction strategies, such as gamification, to expand the system's applicability and engagement potential.

This study addresses the unique learning needs of students with ADHD, and based on a cognition-driven design approach, expands the application potential of LLMs in educational contexts. It aims to provide more inclusive assistive technologies for the ADHD community and to promote the evolution of traditional educational environments toward greater equity and diversity.

References

[1] Josh Achiam, Steven Adler, Sandhini Agarwal, Lama Ahmad, Ilge Akkaya, Florencia Leoni Aleman, Diogo Almeida, Janko Altenschmidt, Sam Altman, Shyamal Anadkat, et al. 2023. Gpt-4 technical report. *arXiv preprint arXiv:2303.08774* (2023).

[2] Yenelys Acosta Baxter. 2025. Designing for Neurodiversity: Creating ADHD-Friendly Digital Publications. (2025).

[3] Adi Brann and Yael Sidi. 2025. Metacognitive scaffolding for digital reading and mind-wandering in adults with and without ADHD. *Learning and Instruction* 95 (2025), 102051.

[4] Tom Brown, Benjamin Mann, Nick Ryder, Melanie Subbiah, Jared D Kaplan, Prafulla Dhariwal, Arvind Neelakantan, Pranav Shyam, Girish Sastry, Amanda Askell, et al. 2020. Language models are few-shot learners. *Advances in neural information processing systems* 33 (2020), 1877–1901.

[5] Yining Cao, Peiling Jiang, and Haijun Xia. 2025. Generative and Malleable User Interfaces with Generative and Evolving Task-Driven Data Model. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems*. 1–20.

[6] Douglas D Dexter. 2010. Graphic organizers and their effectiveness for students with learning disabilities. *Thalamus* 26, 1 (2010), 51–67.

[7] Rosa Angela Fabio and Alessandro Antonietti. 2014. Hypermedia tools enhance learning in ADHD students. *The ADHD Report* 22, 4 (2014), 8.

[8] Tianhao He, Karthi Saravanan, Evangelos Niforatos, and Gerd Kortuem. 2025. " A Great Start, But...": Evaluating LLM-Generated Mind Maps for Information Mapping in Video-Based Design. In *Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems*. 1–7.

[9] Nobukatsu Hojo, Kazutoshi Shinoda, Yoshihiro Yamazaki, Keita Suzuki, Hiroaki Sugiyama, Kyosuke Nishida, and Kuniko Saito. 2025. GenerativeGUI: Dynamic GUI Generation Leveraging LLMs for Enhanced User Interaction on Chat Interfaces. In *Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems*. 1–9.

[10] Peiling Jiang, Jude Rayan, Steven P Dow, and Haijun Xia. 2023. Graphologue: Exploring large language model responses with interactive diagrams. In *Proceedings of the 36th annual ACM symposium on user interface software and technology*. 1–20.

[11] Natalia Kajka and Agnieszka Kulik. 2021. The influence of metacognitive strategies on the improvement of reaction inhibition processes in children with ADHD. *International Journal of Environmental Research and Public Health* 18, 3 (2021), 878.

[12] Steven T Kane, John H Walker, and George R Schmidt. 2011. Assessing college-level learning difficulties and "at riskness" for learning disabilities and ADHD: Development and validation of the learning difficulties assessment. *Journal of Learning Disabilities* 44, 6 (2011), 533–542.

[13] Agnieszka Kulik and Natalia Kajka. 2021. Application of metacognitive strategies in the development of emotional and motivational self-regulation of students with special educational needs. Research on children with ADHD. (2021).

[14] Lizi Liao, Grace Hui Yang, and Chirag Shah. 2023. Proactive conversational agents in the post-chatgpt world. In *Proceedings of the 46th International ACM SIGIR Conference on Research and Development in Information Retrieval*. 3452–3455.

[15] Palash Nandy, Sigurdur Orn Adalgeirsson, Anoop K Sinha, Tanya Kraljic, Mike Cleron, Lei Shi, Angad Singh, Ashish Chaudhary, Ashwin Ganti, Christopher A Melancon, et al. 2024. Bespoke: using LLM agents to generate just-in-time interfaces by reasoning about user intent. In *Companion Proceedings of the 26th International Conference on Multimodal Interaction*. 78–81.

[16] Hyanghee Park and Daehwan Ahn. 2024. The promise and peril of ChatGPT in higher education: opportunities, challenges, and design implications. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*. 1–21.

[17] Kaitlyn MA Parks, Christine N Moreau, Kara E Hannah, Leah Brainin, and Marc F Joanisse. 2022. The task matters: A scoping review on reading comprehension abilities in ADHD. *Journal of attention disorders* 26, 10 (2022), 1304–1324.

[18] Nelba Maria Teixeira Pisacco, Yasmini Lais Spindler Sperafico, Jacqueline Raquel Bianchi Enricone, Luciano Santos Pinto Guimarães, Luis Augusto Rohde, and Beatriz Vargas Dorneles. 2018. Metacognitive interventions in text production and working memory in students with ADHD. *Psicologia: Reflexão e Crítica* 31 (2018), 5.

[19] Nuril Kusumawardhani Soeprapto Putri, Marisa Karsen, Hanny Juwitasary, Pingkan CB Rumondor, and Desi Maya Kristin. 2023. The use of interactive digital content as assistive technology for student with ADHD. In *2023 International Conference on Information Management and Technology (ICIMTech)*. IEEE, 211–216.

[20] Abigail Reaser, Frances Prevatt, Yaacov Petscher, and Briley Proctor. 2007. The learning and study strategies of college students with ADHD. *Psychology in the Schools* 44, 6 (2007), 627–638.

[21] Betty Shrieber. 2016. Using Mind Mapping Software to Initiate Writing and Organizing Ideas for Students with SLD and ADHD. In *Computers Helping People with Special Needs: 15th International Conference, ICCHP 2016, Linz, Austria, July 13-15, 2016, Proceedings, Part II 15*. Springer, 351–357.

[22] Stephanie L Simon-Dack, P Dennis Rodriguez, and Geoff D Marcum. 2016. Study habits, motives, and strategies of college students with symptoms of ADHD. *Journal of Attention Disorders* 20, 9 (2016), 775–781.

[23] Mary V Solanto, David J Marks, Jeanette Wasserstein, Katherine Mitchell, Howard Abikoff, Jose Ma J Alvir, and Michele D Kofman. 2010. Efficacy of meta-cognitive therapy for adult ADHD. *American Journal of Psychiatry* 167, 8 (2010), 958–968.

[24] Jiabin Tang, Yuhao Yang, Wei Wei, Lei Shi, Lixin Su, Suqi Cheng, Dawei Yin, and Chao Huang. 2024. Graphgpt: Graph instruction tuning for large language models. In *Proceedings of the 47th International ACM SIGIR Conference on Research and Development in Information Retrieval*. 491–500.

[25] Keith W Thiede and Mary CM Anderson. 2003. Summarizing can improve metacomprehension accuracy. *Contemporary Educational Psychology* 28, 2 (2003), 129–160.

[26] Tien Tran, Hae-Na Lee, and Ji Hwan Park. 2024. Discovering Accessible Data Visualizations for People with ADHD. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*. 1–19.

[27] Karolina Urton, Mariola Moeyaert, Kerstin Nobel, Anne Barwasser, Richard T Boon, and Matthias Grünke. 2025. Effects of Graphic Organizers on Outcomes

for Students with Disabilities: Three-Level Meta-Analysis of Single-Case Studies. *Exceptionality* 33, 1 (2025), 17–39.