Exploring the Influence of Student Interaction with ChatGPT on Critical Thinking, Problem Solving, and Creativity

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***Abstract*—In this comprehensive study, 515 participants within educational settings were engaged to investigate the multifaceted impact of ChatGPT interactions. By scrutinizing critical thinking, problem-solving, creativity, and learning domains, the research uncovered nuanced perspectives. The results presented diverse views on how ChatGPT influenced cognitive abilities—some observed substantial improvements, while others perceived limited effects. Notably, intriguing correlations surfaced between enhanced critical thinking and subsequent impacts on problem-solving, creativity, and overall learning approaches. The outlined recommendations underscored the importance of responsible usage, preferring guidance over direct solutions and advocating for instructor involvement. These insights collectively underline ChatGPT's promising potential as an adjunctive educational tool, suggesting its capacity to cultivate dynamic and intellectually engaging learning environments. Despite varied perceptions and user readiness, these findings highlight ChatGPT's intriguing role in shaping educational experiences.**

***Keywords*—education, AI integration, ChatGPT, learning impact, cognitive abilities**

I. Introduction

In modern education, the integration of technology has become pivotal, with AI-powered tools, including ChatGPT, emerging as transformative platforms shaping student engagement and cognitive development [1, 2]. This study explores the impact of ChatGPT interactions on a diverse cohort of 515 participants, encompassing instructors, researchers, parents, and students, with a focus on critical thinking, problem-solving, and creativity. While traditional teaching methods endure, the infusion of AI-driven platforms presents innovative pedagogical pathways, promising to augment students' cognitive capabilities. Leveraging empirical data and statistical analyses, this research aims to unveil the multifaceted influence of varied stakeholders' engagement with ChatGPT [3]. By examining correlations between these interactions and the enhancement of critical thinking, problem-solving, and creativity, this study seeks to elucidate the pedagogical advantages of AI-based educational tools. Through a meticulously designed questionnaire, insights from diverse stakeholders contribute empirical evidence on the transformative impact of AI-driven learning interactions, crucial for shaping contemporary educational practices in an evolving knowledge-centric society [4, 5].

This research expands the existing literature that investigates the influence of AI, particularly ChatGPT, on cognitive capabilities within educational contexts. Its relevance resides in its potential to guide the thoughtful integration of AI technologies in education, a sector experiencing rapid growth. The objective of this research is to delve into the effects of ChatGPT on critical thinking, problem-solving, creativity, and learning. Perspectives from 515 individuals across various educational settings were analyzed, offering a broad perspective to this inquiry. This aligns with the prevailing trend in AI research, where the transformative potential of tools like ChatGPT is increasingly acknowledged. While AI tools hold great promise in education, there is a discrepancy in views regarding their efficacy. Some researchers advocate for the substantial benefits of these tools, whereas others propose more modest results. This research seeks to reconcile this divide by providing a thorough analysis of the impact of ChatGPT on cognitive abilities. The research also underscores the necessity for cautious utilization of AI technologies in education. While some participants reported significant enhancements in their cognitive abilities, others noted more moderate results. This variance highlights the complexity of AI's impact on education and the need for a balanced approach to its implementation [6]. In summary, this research offers valuable insights into the dynamic relationship between cognitive skills and AI interventions. It emphasizes the transformative potential of ChatGPT beyond its function as a simple tool, demonstrating its significant contribution to fostering engaging learning environments. Despite differing opinions and varying levels of user preparedness, these findings underscore the fascinating role that ChatGPT plays in shaping educational experiences.

II. Literature Review

The current body of literature acknowledges ChatGPT's proficiency in generating text and facilitating conversations [7–9]. This has prompted ongoing investigations into its practical applications across various domains, including education and beyond. Notably, ChatGPT demonstrates potential in tailoring educational content to offer students a personalized learning experience [10]. Some researchers advocate its capacity to create interactive learning environments that foster engagement and motivation [11], while others highlight its versatility in elaborating on diverse subjects [12]. Several studies underscore its role in enhancing critical skills like critical thinking, problem-solving, and communication [13–15].

However, certain studies caution against the potential drawbacks of ChatGPT, particularly its seamless access to extensive information, which might impede students' independent critical thinking [16–18]. Concerns arise regarding overreliance on AI, potentially hindering the full development of analytical and evaluative skills. Additionally,

research delves into ChatGPT's efficacy as an independent self-learning tool, particularly in answering multiple-choice questions and providing reasoned explanations [19]. Furthermore, its promising performance in medical education scenarios hints at its potential in assisting clinical decision-making [20]. Beyond this, generative AI shows promise in revolutionizing teaching techniques by aiding educators in creating tailored teaching resources [21, 22].

While perspectives on ChatGPT's integration in education vary, the overarching concern revolves around maintaining academic integrity while exploring its potential benefits [23]. Some researchers advocate for establishing clear policies and guidelines within educational institutions to mitigate disruptive effects. They propose controlled integration of AI-generated text in assessments as a strategic approach to uphold academic standards [24]. Hence, there is an ongoing need for extensive discussions regarding the ethical and effective applications of AI-generated text, such as ChatGPT [25]. Stressing responsible usage remains crucial, prompting continual dialogues aimed at comprehensively exploring and articulating the technology's limitations.

III. Research Methods

The chosen methodology serves as a robust framework, guiding the exploration into the impact of student interaction with ChatGPT on critical thinking, problem-solving, and creativity. This methodology systematically progresses through distinct stages, encompassing research design, instrumentation and data collection, data analysis, ethical considerations, limitations, and conclusions. Such a structured approach is tailored to effectively capture and address the objectives of assessing the influence of ChatGPT interaction on these cognitive domains. Fig. 1 illustrates the structure of the methodology employed.

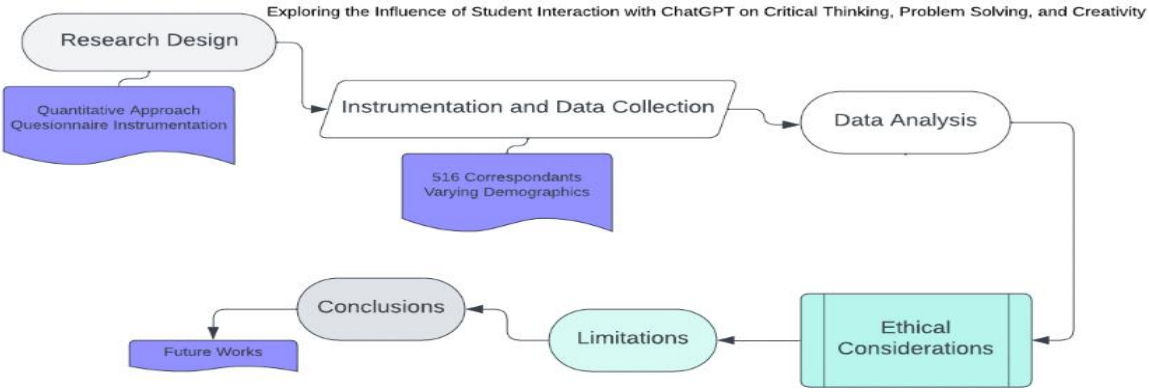

Fig. 1. Research methodology.

The questionnaire's structure received careful attention, encompassing varied question types and themes to capture diverse aspects of participants' engagement with ChatGPT. Open-ended survey responses underwent thematic analysis to enrich quantitative results with detailed perspectives. Using a stratified sampling approach, 515 respondents were selected, ensuring representation across educational levels, demographics, and user categories, including high school students, university entrants, undergraduates, postgraduates, instructors, researchers, and parents.

In analyzing the responses from 515 participants, the data unveiled distinct patterns among various groups based on their interaction with ChatGPT. Among the respondents, 196 indicated no usage of ChatGPT, while a larger cohort of 319 confirmed frequent utilization. Moreover, within this cohort, a breakdown of participant demographics revealed that 83 respondents, primarily comprising high school students and new university entrants, were under 20 years old. This age group constituted individuals who demonstrated a propensity for exploring ChatGPT. Contrarily, 404 respondents, primarily comprised of undergraduate (272) and postgraduate (132) students, showcased an active involvement with ChatGPT. An additional subgroup of 28 participants, comprising solely instructors, actively participated in the study. This disparity among the respondent demographics underlines a notable divide in the adoption of ChatGPT among distinct user categories. The bar chart visually emphasizes this contrast, distinctly portraying the varying degrees of engagement with ChatGPT among these demographics. This delineation between the 'non-users' and the 'frequent users' serves as a pivotal insight, highlighting a substantial portion of participants actively involved with ChatGPT in contrast to those who do not, thus signifying the diverse user engagement levels within the surveyed Population. The findings are depicted in Fig. 2 below.

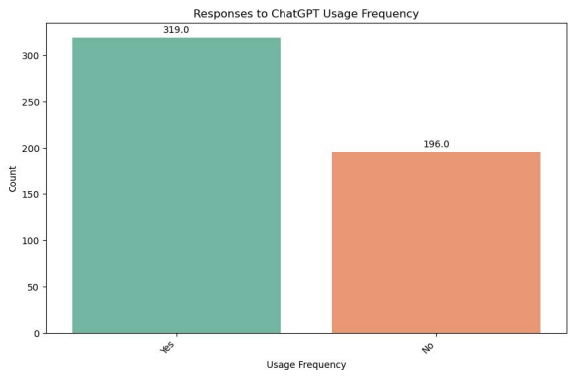

Fig. 2. Bar chart of ChatGPT usage frequency.

The research process adhered to strict ethical guidelines to safeguard participant rights and ensure the integrity of the study. Prior to participation, informed consent was obtained from each of the 515 respondents, ensuring their understanding of the study's purpose, procedures, and data

usage. However, when incorporating ChatGPT into educational settings, it's essential to comprehensively tackle ethical and privacy considerations [6, 24]. Confidentiality measures were in place to anonymize participant information, preserving their privacy. Robust data security protocols were implemented to protect collected data in compliance with relevant data protection regulations. Additionally, the survey questions were designed to avoid causing discomfort or stress to participants. The study respected diversity by considering varied perspectives and demographics. These ethical measures aimed to uphold participant well-being, confidentiality, and the integrity of the study's findings.

However, while the implemented ethical measures were meticulous, the integration of AI, particularly ChatGPT, in educational settings warrants an in-depth exploration of ethical dimensions. In specific relation to student learning, privacy concerns, and the evolving landscape of AI utilization in education, a more detailed examination of ethical implications and potential impacts is essential.

IV. Result and Discussion

The analysis of responses to the question regarding the frequency of ChatGPT usage for assignments or exams offers deeper insights into participants' engagement levels. Out of the 515 respondents, a majority of 121 individuals stated that they had never utilized ChatGPT for academic tasks, while 109 indicated rare usage. Interestingly, a larger cohort, comprising 165 respondents, reported occasional utilization. Moreover, 72 participants acknowledged frequent usage, while 48 respondents affirmed regular reliance on ChatGPT.

This breakdown delineates a spectrum of engagement, showcasing varying levels of integration of ChatGPT into academic workflows among the surveyed population. When compared to the earlier distinction between "non-users" and "frequent users," these nuanced categories provide a more detailed understanding of participants' frequency of engagement with ChatGPT for academic purposes. This information augments the previous findings, offering a multifaceted view of how students interact with ChatGPT, ranging from complete non-utilization to regular incorporation into academic activities. The specific results are depicted in the following Fig. 3.

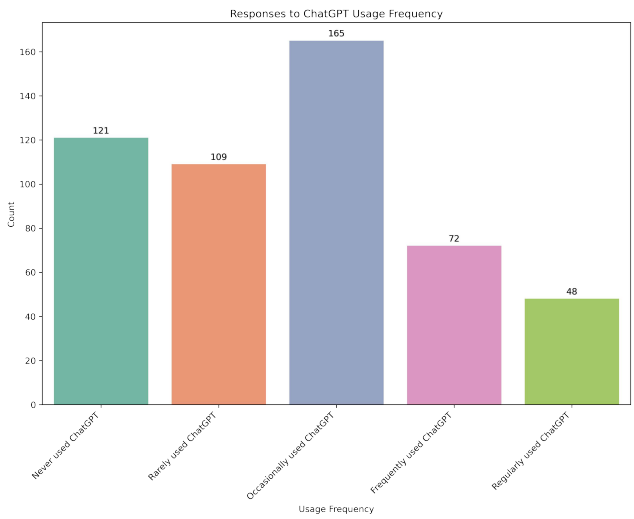

Fig. 3. Frequency of ChatGPT usage for academic tasks.

The survey responses regarding the impact of ChatGPT on critical thinking skills revealed varied perceptions among participants. Notably, 125 respondents reported no improvement, while 92 indicated slight enhancement, suggesting a limited impact. Conversely, a larger group of 184 participants perceived a moderate improvement, and 114 respondents acknowledged a significant impact on their critical thinking skills. These findings underscore diverse perceptions, ranging from negligible to noticeable improvements. Overall, the responses highlight the subjective nature of individuals' perceptions regarding ChatGPT's impact on enhancing critical thinking abilities.

Participants' views on ChatGPT's influence on problem-solving abilities presented a diverse spectrum of perceptions. A considerable segment, comprising 134 respondents, indicated non-utilization of ChatGPT for problem-solving tasks. Concurrently, 120 participants expressed a perception that ChatGPT had no significant impact on their problem-solving abilities, aligning closely with previous sentiments regarding limited improvement in critical thinking skills. However, a distinct subset of respondents diverged from this trend. Notably, 117 individuals highlighted an improved approach to problem-solving resulting from ChatGPT usage, and 108 respondents noted the platform's facilitation in exploring alternative solutions. Intriguingly, 32 participants attributed a direct enhancement in their problem-solving abilities to ChatGPT.

This diverse range of responses echoes the previous findings on critical thinking skills, where a similar trend of limited impact was observed alongside a parallel group perceiving improvements. Interestingly, there appears to be a correlation between those reporting enhancements in critical thinking and subsequent perceived improvements in problem-solving strategies. This correlation suggests a potential relationship between ChatGPT's influence on critical thinking and its subsequent impact on problem-solving abilities, pointing to a nuanced interplay between these cognitive domains. The findings are depicted in the following Fig. 4.

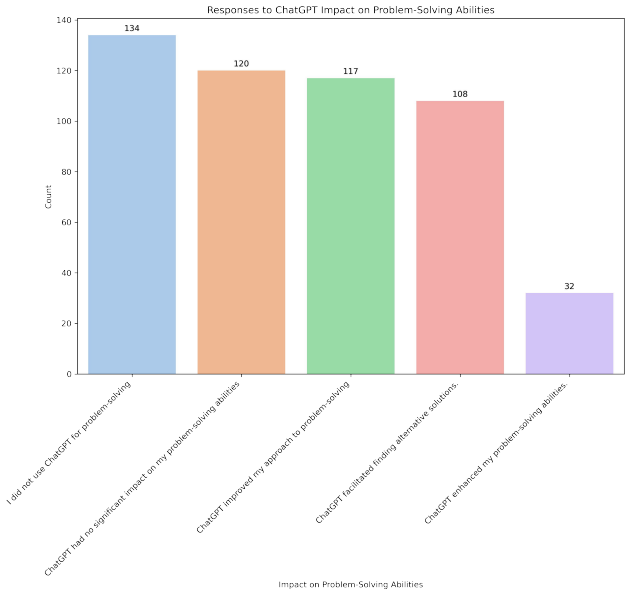

Fig. 4. Impact of ChatGPT on problem-solving abilities.

Furthermore, the responses obtained regarding ChatGPT's influence on creativity during academic tasks reveal a diverse spectrum of perceptions among the 515 respondents. Out of this pool, 181 individuals indicated that ChatGPT didn't notably enhance their creative output, suggesting a significant segment found no substantial impact. Conversely, 141 respondents expressed an improved ability to generate creative content due to ChatGPT, highlighting a positive influence on their creative processes. Additionally, 92 participants credited ChatGPT for inspiring innovative approaches to assignments or exams, emphasizing its role in stimulating unconventional ideas and methods. Moreover, 52 respondents noted ChatGPT's assistance in thinking outside the box, while 49 individuals mentioned its role in sparking new ideas and perspectives, showcasing its impact in broadening academic viewpoints.

These findings align with previous analyses on critical thinking and problem-solving. Similar to those cognitive domains, perceptions regarding ChatGPT's impact on creativity varied widely among participants, underscoring the subjective nature of experiences. Just as observed with critical thinking and problem-solving, some users reported concrete benefits in their creative processes, while others did not perceive substantial enhancement. Of particular interest is the potential correlation that emerges between perceived improvements in creativity and previously identified enhancements in critical thinking and problem-solving abilities. This potential link suggests a complex interplay between these cognitive aspects influenced by ChatGPT. Despite varied opinions, these findings hint at a potential relationship wherein advancements in one cognitive domain might influence developments in another, indicating the multi-dimensional impact of ChatGPT on various facets of academic tasks, ranging from creativity to critical thinking and problem-solving. The results depicting "How ChatGPT enhanced creativity in completing assignments or exams" are illustrated in Fig. 5 below. Moreover, the responses reflecting the impact of ChatGPT on the learning process revealed a spectrum of viewpoints among the 515 participants. Within this group, 137 respondents expressed that ChatGPT didn't notably influence their learning experiences. Conversely, 129 participants perceived ChatGPT as a catalyst for more interactive and dynamic learning, highlighting its active role in their educational journey. Furthermore, 88 individuals noted increased engagement with the subject matter, while 61 participants recognized ChatGPT's support for self-paced learning. Additionally, 100 respondents acknowledged ChatGPT's efficacy in swiftly accessing information, indicating its proficiency in retrieving knowledge. The alignment of responses regarding ChatGPT's influence on learning methods mirrors the varied perceptions observed in its impact on critical thinking, problem-solving, and creativity. As before, opinions among participants diverged widely regarding ChatGPT's effect on their learning process. Moreover, the reported positive influence of ChatGPT in fostering interactive and dynamic learning experiences parallels its observed impact on creativity, hinting at potential connections between these aspects. Additionally, the emphasized enhancements in engagement, self-paced learning, and swift information access echo the themes seen in improved critical thinking and problem-solving abilities, suggesting a comprehensive impact on cognitive processes across various academic tasks.

Overall, the findings suggest that ChatGPT's influence on the learning process encompasses aspects of interactivity, engagement, and access to information, similar to its impact on cognitive domains. These parallels indicate a comprehensive impact of ChatGPT on various facets of the learning experience, potentially intertwining with cognitive enhancements observed in critical thinking, problem-solving, and creativity. The results depicting ChatGPT's influence on the learning process are presented in Fig. 6.

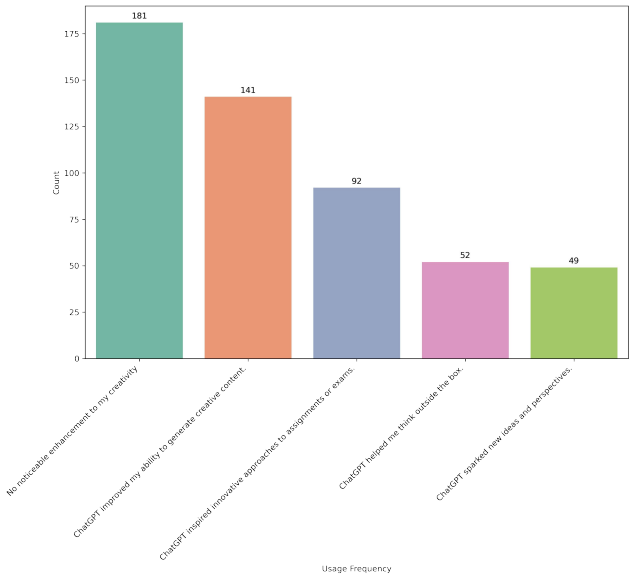

Fig. 5. ChatGPT's impact on creativity in academic tasks.

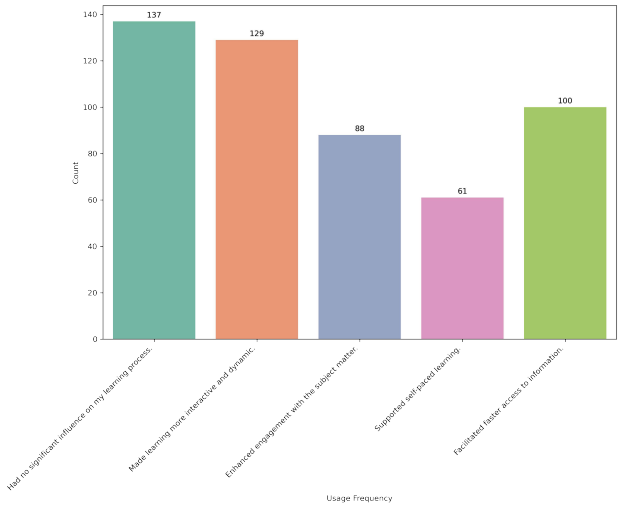

Fig. 6. Perspectives on ChatGPT's influence on learning.

The survey aimed to gather recommendations based on the awareness and perceptions of the respondents. These recommendations fall into the following categories:

Restrictions and Guidance: The sentiments expressed by respondents underscore a unified call for restricting ChatGPT's functionalities. Specifically, 48 individuals advocated for limitations, preferring that ChatGPT refrain from providing comprehensive solutions but rather offer guidance or hints. Alongside this, 16 participants emphasized the necessity of implementing restrictions on ChatGPT. Additionally, 40 respondents highlighted the importance of

ChatGPT abstaining from delivering complete answers. Another group of 32 proposed a shift in ChatGPT's focus, suggesting it should prioritize providing explanations or mathematical reasoning instead of outright solutions.

These collective opinions indicate a consensus among respondents toward curbing ChatGPT's capabilities, urging it to prioritize guidance, hints, or explanations over furnishing direct solutions. This collective emphasis aims to preserve academic integrity and cultivate an educational atmosphere where comprehension takes precedence over the mere provision of answers.

Usage for Referencing and Learning Enhancement: Another noticeable trend comes from 64 correspondents who suggest leveraging ChatGPT for suggesting references and providing guidance on data. This reflects an interest in utilizing ChatGPT as a resource to aid learning and enhance understanding by offering additional references and data-related support.

Instructor Supervision and Interaction: A substantial number (84) highlighted the importance of using ChatGPT under the supervision of instructors. This indicates a desire for accountability and guidance from educators while utilizing the tool. Additionally, the suggestion for ChatGPT to accept and generate images (28) implies an interest in more interactive and visual learning experiences.

Format and Simplification: Some recommendations (16) focus on the format of information, suggesting simplifying topics into bullet points. This indicates a preference for concise and organized content presentation.

Moreover, it's noteworthy that 164 respondents did not provide any specific recommendations in the survey. By categorizing these recommendations, it's evident that there's a strong emphasis on responsible usage, guidance rather than direct solutions, support for references and data, the importance of instructor involvement, and interest in more interactive learning formats. These patterns suggest a nuanced understanding among respondents regarding the appropriate and beneficial use of ChatGPT in an educational context.

The recommendations gathered from participants underline a unified call for responsible usage, guidance-oriented functionalities, and instructor supervision when utilizing ChatGPT. These collective sentiments emphasize the need to prioritize guidance and explanations over providing direct solutions, aiming to foster an educational atmosphere where comprehension and learning take precedence. Additionally, the interest in leveraging ChatGPT for referencing and learning enhancement, under instructor supervision, hints at the potential for AI integration to support and supplement educational practices. Overall, these findings contribute to the evolving landscape of educational technology by illuminating the nuanced dynamics of AI integration in learning environments. They underscore the significance of responsible AI usage, the multifaceted nature of technology's impact on cognitive skills, and the potential for AI to supplement educational practices under instructor guidance. This study provides insights into the intricate relationship between AI integration and cognitive skill development, paving the way for future explorations into optimizing AI's role in fostering dynamic and engaging learning experiences.

While this study offers valuable insights into the integration of AI, particularly ChatGPT, in educational settings, it is essential to acknowledge certain limitations. Firstly, reliance on self-reported data introduces the possibility of respondent bias or inaccuracies, potentially influencing the reliability of the findings. Secondly, the survey format employed may have constrained the depth of qualitative insights, potentially neglecting nuanced perspectives. Moreover, the sample composition, primarily comprising individuals with varying levels of engagement with ChatGPT, could result in a skewed representation of specific user groups [24]. The cross-sectional design of the study limits the ability to establish causality or investigate long-term effects, warranting caution in drawing definitive conclusions. Lastly, the study's focused scope on the perceived impact of ChatGPT within an educational context may inadvertently overlook broader applications or perspectives beyond this domain. Recognizing these limitations is crucial for contextualizing the findings and understanding the extent of the study's implications.

V. Conclusions

The analysis of interactions involving 515 respondents and ChatGPT unveiled diverse adoption levels, hinting at a burgeoning trend toward integrating AI-driven tools into education alongside distinct preferences among demographics. While perspectives on ChatGPT's impact on critical thinking, problem-solving, and creativity varied, the standout findings revolved around tangible improvements in cognitive domains. These findings strongly suggest ChatGPT's potential as an augmentative tool for enhancing learning capabilities across educational settings. Notably, the study revealed intriguing correlations among enhancements in critical thinking, problem-solving, creativity, and learning, hinting at an interconnectedness potentially influenced by ChatGPT. This implies a symbiotic relationship wherein improvements in one cognitive aspect might synergistically enhance others, thereby boosting overall learning abilities. Participants' recognition of increased engagement, self-paced learning, and efficient access to information further underscores ChatGPT's capacity to create interactive and effective learning environments.

In summary, despite the variance in perceptions, the consistent findings of substantial enhancements in cognitive domains substantiate ChatGPT's role as a valuable educational support tool. Its capacity to foster dynamic, engaging, and intellectually stimulating learning experiences is evident. These pivotal findings emphasize the urgency of further exploration and seamless integration of AI-driven tools in educational frameworks to optimize learning outcomes and facilitate adaptive learning environments, aligning seamlessly with the evolving landscape of education in a technology-driven era. However, it's crucial to acknowledge the study's limitations. Firstly, relying on self-reported data might introduce biases or inaccuracies in the findings. Secondly, while the survey format aimed for depth, it might have constrained nuanced qualitative insights. Additionally, the sample's skewed representation of varying ChatGPT engagement levels and the study's cross-sectional

design limit the scope to infer causality or long-term effects conclusively. Lastly, the study primarily focused on ChatGPT's impact within educational contexts, potentially overlooking broader applications or perspectives outside this domain. Understanding these limitations is essential for a comprehensive contextualization of the study's implications and to guide future research endeavors. Moreover, future investigations into ChatGPT's role in education could encompass a holistic exploration of its underlying functionalities driving cognitive development and learning. Thereby, a deeper dive into the specific features of ChatGPT that facilitate its perceived influence on cognitive abilities and learning processes holds promise for yielding valuable insights. Longitudinal studies tracking extended ChatGPT usage and its effects on cognitive skills and academic performance over time would provide a clearer picture of its sustained impact. Adopting a user-centric approach, focused inquiries into individual user experiences with ChatGPT could unveil personalized variations in its perceived effects on cognitive and learning domains. This tailored exploration stands to reveal nuanced user perspectives, potentially informing the development of more targeted and effective educational interventions. Furthermore, the ethical integration of AI models like ChatGPT into educational settings demands careful consideration. Evaluating the ethical implications associated with its usage and ensuring responsible deployment within educational frameworks are vital for maintaining integrity and safeguarding users' interests. Additionally, future research should emphasize optimizing ChatGPT's integration with existing pedagogical methods. Investigating strategies for its seamless integration into educational practices holds potential to enhance its positive impact on learning outcomes. This comprehensive approach to future investigations aims to maximize ChatGPT's potential benefits in education while addressing ethical concerns and customizing its implementation to suit diverse user needs and learning environments.

Conflict of Interest

The author declares no conflict of interest.

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