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To cite this article:

Giray, L., Jacob, J., & Gumalin, D.L. (2024). Strengths, weaknesses, opportunities, and threats of using ChatGPT in scientific research. *International Journal of Technology in Education (IJTE), 7*(1), 40-58. https://doi.org/10.46328/ijte.618

International Journal of Technology in Education
2024, Vol. 7, No. 1, 40-58 https://doi.org/10.46328/ijte.618

Strengths, Weaknesses, Opportunities, and Threats of Using ChatGPT in Scientific Research

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Article Info

Article History

Received:
23 August 2023
Accepted:
27 December 2023

Keywords

AI ethics
Artificial Intelligence
ChatGPT
Large language model
Prompt engineering
Scientific research
SWOT Analysis

Abstract

The versatility of ChatGPT extends across diverse domains, including scientific research. This study delves into the transformative prospects of integrating ChatGPT into scientific research, achieved through a SWOT analysis. The analysis explores the model's strengths, which encompass a vast knowledge base, language proficiency, information retrieval, and the capacity for continuous learning. Conversely, it exposes its weaknesses, including a lack of contextual understanding, potential overreliance on training data, limitations in verifying information, and constrained critical thinking abilities. Amidst these factors, opportunities arise, such as facilitating literature reviews, fostering collaborative brainstorming, enabling seamless language translation and interpretation, and amplifying knowledge dissemination. Nonetheless, a spectrum of threats looms, encompassing concerns related to plagiarism, ethical quandaries, the propagation of misinformation, and even the potential erosion of higher-order cognitive thinking. These multifaceted aspects necessitate comprehensive consideration. Recommendations for researchers embarking on ChatGPT integration include a balanced approach that harmonizes AI and human ingenuity, thereby upholding research integrity. The potential of ChatGPT to reshape scientific inquiry can only be realized through conscientious use and ongoing oversight.

Introduction

In recent years, the field of artificial intelligence has witnessed a rapid and exceptional development in Natural Language Processing (NLP), leading to the inception of sophisticated language models capable of human-like conversation. One such groundbreaking development is the Chat Generative Pre-Trained Transformer, otherwise known as ChatGPT, an AI-powered chatbot created by OpenAI. ChatGPT represents a significant milestone in the development of conversational AI, transforming the way we interact with machines and opening new possibilities in various domains. ChatGPT is a revolutionary technology that uses advanced artificial intelligence techniques to generate natural language responses to a given prompt or input.

ChatGPT, with its powerful language understanding and generation capabilities, has found value in several fields and domains. Its versatility and adaptability have made it a valuable tool for various applications due to its simple use through conversational form (Wu et al., 2023). It has been previously mentioned that the potential of AI such

as ChatGPT could largely affect the economy with several initiations across a variety of statistics—including robotics shipments, AI start-ups, and patent counts—suggesting that there is evidence of a large increase in AI-related activity (Furman & Seamans, 2023). This has led both to excitement about the capability of technology to boost economic growth and to concern about the fate of human workers in a world in which computer algorithms can perform many of the functions that a human can (Frey & Osbourne, 2017).

AI has especially made its way in the field of academics and education, where technology is a heavy and favorable aspect. Academicians, researchers, and students have already employed Large Language Models (LLMs) such as ChatGPT to complete various academic and non-academic tasks, including essay writing, formal and informal speech writing, summarizing literature, and generating ideas for different purposes (Giray, 2023; Rahman et al., 2023). In the field of academic research however, various scholars have delved and argued of AI's potential to be an asset in data processing (Qasem, 2023). For instance, AlAfnan et al. (2019) found out that ChatGPT has the potential of replacing search engines as it provides accurate and reliable input to students. Their study also found that ChatGPT provides a platform for students to seek answers from theory-based questions and generate ideas for application-based questions.

The marvels of using AI in scientific research have been groundbreaking. However, the issue of whether AI can be a tool in aiding research and keeping academic integrity is equally complicated and has been a subject of debate for a while where privacy and surveillance, bias or discrimination, and perhaps the philosophical problem of the role of human judgment are among the legal and ethical challenges that AI has brought to society. (Naik et al., 2023). Plagiarism has traditionally been described as the act of copying works or ideas from others without due recognition. People have traditionally been assumed to plagiarize from other people, in which can still be reflected upon the influence of using AI. Eaton (2023) refuted this when she elated that tools related to massive language models in artificial intelligence do not plagiarize in the 'classic sense'. She also stated that even if the content was taken and subsequently accumulated from a range of internet sources, the text created by AI software should not be assumed to be.

Despite the use of AI raising some ethical concerns, Rahimi and Abadi (2023) assumed that establishing guidelines on using and including ChatGPT or similar platforms in scientific publishing should be considered. It must also have an assessment of its accuracy and reliability of AI-information generation. Like Rahimi and Abadi, many scholars still believe that with the proper use of AI, it can be used as a powerful tool in gathering information and keeping academic integrity. With this, the researchers aim to find the strengths, weaknesses, opportunities, and threats that can be found in using ChatGPT in academic research as it paves way to modern day research practices.

Method

This paper draws inspiration from Farrokhnia et al.'s (2023) work, which utilized the same method in the field of educational practice and research. Meanwhile, our paper focuses on employing the SWOT analysis to assess the applicability of ChatGPT in the realm of scientific research. By using this framework, we aim to evaluate the

strengths, weaknesses, opportunities, and threats associated with the integration of ChatGPT in scientific research. This approach aligns with the utilization of SWOT analysis as a strategic tool in the academic literature (Helm & Nixon, 2010), along with its historical inception as a method to investigate strategies (Benzaghta et al., 2021). Through this analysis, we endeavor to gain a deeper understanding of the potential benefits and challenges that arise when employing ChatGPT in scientific research.

Figure 1. SWOT Analysis of Using ChatGPT in Scientific Research

Results and Discussion

In this section, we discuss the strengths, weaknesses, opportunities, and threats associated with harnessing ChatGPT, an AI language model, within the realm of scientific research. Our objective is to delve deep into the multifaceted aspects of integrating ChatGPT into scientific research, allowing for an evaluation of both the potential advantages and obstacles that researchers may encounter when adopting this AI tool.

Strengths

Vast Knowledge Base

ChatGPT has been trained on a wide range of text sources and prompts, making it capable of providing information and insights on various academic venues and topics. This vast knowledge base encrypted enables ChatGPT to provide researchers with relevant and up-to-date information across various disciplines as it can outsource data from the vastness of the world-wide web and embedding it to its rich repository. Several experts have emphasized that using ChatGPT can help in providing the key points and gist of complex research topics and simplify writing and building the literature review of any scientific research and undertakings in a short time (Kalla & Smith, 2023). Proving that ChatGPT can enable the user to generate fast and direct information to the needs of the undertaking at hand. On a similar note, Zhai (2022) stated in his ChatGPT-piloted experience that the AI itself can help researchers generate a paper that is articulate, (partially) accurate, informative, and systematic. He notes that the writing is extremely efficient, taking only a maximum of 2 to 3 hours and involves very limited professional knowledge from the author. Drawing upon the user experience, this reflects on the potential impacts of ChatGPT, as well as similar AI tools, on education.

Being an AI, it is programmed to be able to give information on what the user asks, but as it is relatively new prospect in recent years, it is still open to learning more complex systems and other various improvements that gets updated every often to better understand the needs of the user (Roumeliotis & Tselikas, 2023). While it was mentioned that ChatGPT can generate accurate information, it is also equally important to note that while ChatGPT's knowledge base is extensive, it may not encompass every information on a niche or specialized area, as it is only capable of making generalized statements due to the lack of emotional intelligence, potential for bias as well as limited knowledge base that needs constant updating and specific prompt dependence (Stojanov, 2023). It may only be able to specialize in specific fields once it has been fine-tuned to better suit the user's needs.

Language Proficiency

ChatGPT exhibits a high level of language proficiency that can be of utmost benefit in constructing sophisticated language in scientific research. It is highly skilled in understanding and generating human-like text which includes a wide range of vocabulary, grammar structures, and conversational patterns, enabling it to engage in sophisticated conversations and assist researchers and scholars with their complex research queries across different fields and domains. Such as the case in a scientific research conducted by Gilson et al. (2023) when they noted that ChatGPT marks a significant improvement in natural language processing models on the tasks of medical question answering.

Additionally, they highlighted ChatGPT's capacity to provide logical and informational context across the majority of answers, all of which were found to be versatile in conducting such undertakings. Bin-Hady et al. (2023) have stated in their study show that ChatGPT can be used in developing learners' language skills by scaffolding the learning process, providing feedback to students on their language use, and acting as partners in practicing language with recommended activities for more language practice. Their study contributes a five-dimension model for artificial intelligence assisted language learning (AIALL). The model includes flexible teacher's role to merge learner autonomy and provide enjoyable learning, urges future innovation, and celebrates various applications.

These facts taken together make a fascinating case for the potential applications of ChatGPT as an interactive medical and educational tool to support learning. In today's globalized world, language barriers can hinder effective communication and collaboration (Kalla & Smith, 2023). ChatGPT's language translation capabilities make it an invaluable tool for overcoming these obstacles. It can quickly translate text from one language to another, allowing scholars and academicians to engage with stakeholders, partners, and colleagues effortlessly. Additionally, ChatGPT can also serve as a language learning tool that provides vocabulary suggestions, grammar explanations, and language practice exercises which can be used in writing credible academic research.

Information Retrieval

Another noteworthy aspect of ChatGPT's is its efficient information retrieval and potential for personalization. It can quickly retrieve relevant information from its training data, which includes a vast amount of books, articles,

and websites, potentially saving researchers time and effort. As the model can learn from user behavior and preferences, it can adapt search results to individual needs. This personalization leads to a more effective and satisfying experience, as users receive results that are more closely aligned with their interests and requirements and enables faster information retrieval without having a direct access to external sources or the internet. This is further elaborated by Chubb et al. (2022) stated in their study that AI potentially relieves researchers and institutions from mundane tasks, which saves time and arguably boosts speed and efficiency required in a (contested) market-driven university.

In the AI's more recent additions, Shidaganti et al. (2023) have delved on ChatGPT's ability to retrieve information from images using Robotic Automation Process (RPA) and Optical Character Recognition (OCR). According to their study, ChatGPT allows WhatsApp images containing text as input by converting it into text-based prompt. This implies that the AI can recognize and convert images to text from various sources and mediums and enables users to narrowly search information that they need for their academic endeavors. Additionally, Nandalwar et al. (2023) have stated that OCR and RPA may be used to automate data extraction from numerous sources and images to speed up data gathering and processing. However, they have also mentioned that OCR accuracy may vary depending on factors such as image quality, text clarity, font styles, or language variations. Errors in OCR output can affect the accuracy of the information provided to ChatGPT. Additionally, OCR may struggle with handwritten text recognition, especially if the handwriting is barely readable, making it difficult to decipher.

Continuous Learning

While it does not do much on its own, ChatGPT enables users to fine-tune the AI on specific academic and professionalized domains, allowing it to become more specialized and proficient in providing domain-specific knowledge and insights. By fine-tuning ChatGPT, the AI allows customization of the model's behavior for specific applications or domains such as customer support, content generation, abstract modeling, medical applications, infrastructure, economy, education, and scientific research. Users can benefit from the continuous learning process through regular updates and newer versions of AI models that incorporate the latest advancements and improvements.

When newer versions of the language model are released, users typically have access to more recent information and can exhibit enhanced performance. It helps tailor the model's behavior and responses to align with the user's desired goals and requirements of the organization or project. As ChatGPT is relatively new, Wardat et al. (2023) stated in their study that ChatGPT can be used to teach mathematics and is recognized for its improved math capabilities and ability to increase educational success by providing users with basic knowledge of the subject along with its various topics. They have also stated that ChatGPT can offer a comprehensive instruction and assistance in the study of geometry, and the public discourse on social media is generally positive, with enthusiasm for the use of ChatGPT in teaching mathematics and educational settings.

In the field of language learning, Konkhe et al. (2023) on the other hand expressed that ChatGPT supports

language learning by simulating reliable connections. They stated that the AI can identify the meaning of a word in context, correct and explain language mistakes, create texts in various genres (e.g., emails, stories, recipes), develop quizzes, annotate texts, and offer dictionary definitions, example sentences, and translations. This in turn allows ChatGPT to be a multifaceted tool that can be incorporated in various aspects of different domains.

Weaknesses

Lack of Contextual Understanding

ChatGPT has shown great potential in generating human-like responses and assisting with various tasks. For instance, it has the capability to assess manuscripts for errors in grammar, spelling, and punctuation. However, it might struggle with comprehending complex context-specific information or nuanced topics, leading to inaccurate or incomplete responses. When it comes to understanding the context behind prompts, ChatGPT relies solely on two sources: user input and its training data.

By combining the user's input and its training data, ChatGPT attempts to interpret the context and generate a suitable response. However, it should be noted that ChatGPT's contextual understanding is limited to what it has learned from its training data. This means that if a prompt contains data or references that are outside the scope of its training, ChatGPT may struggle to comprehend the context accurately. Essentially, it is often unreliable when it comes to interpreting meanings and understanding queries (Strubell et al., 2019).

A recent study further reveals that ChatGPT can be ineffective when applied in clinical settings as it “cannot effectively review the scientific content or method, or make ethical and/or moral judgments” (Ufuk, 2023). Thus, while it can provide a decent overview or generate initial ideas (Rahman et al., 2023), this still proves insufficient in the long run because ChatGPT can be unreliable in fully grasping the fundamental ideas behind domain-specific concepts. This implies that while ChatGPT may offer some insights or suggestions, it should not be solely relied upon especially for critical assessments. As such, researchers are advised to be judicious in working with ChatGPT. We can be partially dependent on using it as a tool, but we should refrain from relying on it for it may not have a complete understanding of the given context. It should be considered as a supplementary resource rather than a definitive authority, as its limitations in fully comprehending and analyzing complex information should be taken into account.

Overreliance on Training Data

Overreliance on training data remains a critical concern in the functioning of AI language models like ChatGPT. These models derive their responses from extensive and diverse training data. However, a significant issue arises when these responses become excessively reliant on the patterns and information inherent in the training data. The potential pitfalls of this reliance are noteworthy. If the training data contains biases or inaccuracies, these flaws can be inadvertently perpetuated in the AI's generated responses. For instance, the outcomes might consist of a mixture of factual information and fabricated content, blurring the line between reality and misinformation (Ziwei et al., 2022). This not only undermines the credibility of the AI but also poses risks in scenarios where

accurate information is of utmost importance.

Moreover, the overreliance on training data can contribute to the amplification of biases and stereotypes. Language models can inadvertently learn and replicate biases present in the data they are exposed to. This has the potential to result in biased comments and perpetuation of stereotypes, particularly those associated with specific demographics (Kasneci et al., 2023). The AI's lack of discernment between reliable and distorted information further complicates the matter. It underscores the fact that despite its impressive capabilities, the AI still lacks the nuanced skill of independently discerning misinformation from accurate data (Dale, 2021).

Given these limitations, the question of whether AI language models can be deemed fully dependable sources of credible information arises. The answer, as of now, tilts toward caution. While AI models like ChatGPT can provide valuable insights and assistance, they should ideally be complemented with human oversight. Relying solely on these models, without the critical evaluation and monitoring performed by humans, might lead to the propagation of inaccuracies and biases.

Inability to Verify Information

Another drawback of ChatGPT is that it cannot independently fact-check or validate the information it provides, potentially leading to the dissemination of incorrect or unreliable information. One likely reason is that ChatGPT's training data is limited to familiar data. Hence, if it's asked about famous personalities, for instance, it would likely return true or seemingly credible information. However, if it's asked about lesser known individuals, it tends to respond with many different answers–often wrong. This inability to self-validate the information it produces causes it to inadvertently propagate "fake news". Unfortunately, people who are completely unaware of a particular subject would likely fall for the false information that ChatGPT produces.

Essentially, when ChatGPT is unable to verify information, it guesses answers or returns seemingly convincing answers that are completely fabricated. One notable example is its generation of fake but believable scientific research abstracts (Gao et al., 2022) and at times uses fake research gaps with fake references (Rahman et al., 2023) This is unethical also in that it manipulates information by presenting fabricated data as truth to unsuspecting individuals.

Unfortunately, even experienced researchers and editors can struggle with analyzing whether ChatGPT's information is true or not. Moreover, this also questions the integrity of adopting and depending on ChatGPT's provided information absolutely. Hence, it is crucial to scrutinize every information it returns from each of its prompts. Similarly, ChatGPT's inability to verify its responses can raise ethical concerns like spreading derogatory, inappropriate, or harmful speech (Chowdhury & Rahman, 2023). In addition, some users are able to bypass or seek loopholes in ChatGPT's ethical guidelines (Goodin, 2023), allowing them to force ChatGPT to return malicious results. This also puts into question the safety of people's general use of ChatGPT, knowing that it can give information that puts the well-being of the general public in jeopardy.

Limited Critical Thinking

ChatGPT does not possess true understanding or critical thinking abilities. It generates responses based on statistical patterns, which may lack deeper analysis or critical evaluation of the topic. It lacks true understanding because it does not have consistent access to credible real-world data, or direct regulation or monitoring from actual human experts. As such, while it can be a decent participant in ongoing scientific conversations, it simply lacks substance or depth in its overall responses. Furthermore, when faced with a query, ChatGPT analyzes the input and generates a response based on the patterns it has recognized in the training data. It does not engage in critical evaluation or deeper analysis of the topic at hand. Consequently, its responses may lack the nuance, context, or reasoned judgment that would be expected from a human with critical thinking abilities.

True critical thinking involves actively questioning, analyzing, and evaluating information, drawing logical connections, identifying biases, and considering multiple perspectives. It entails a deep understanding of the subject matter, the ability to assess evidence, and the application of reasoning to form informed judgments. ChatGPT, on the other hand, lacks the capacity to engage in these cognitive processes. This is likely why many experts continue to reiterate that ChatGPT, as potent an instrument as it can be, should be used cautiously and responsibly as a tool and not a substitute for our own thinking. ChatGPT shouldn't be doing the thinking for researchers.

Likewise, ChatGPT is an instrument well "capable of enriching research, boosting efficiency, and refining writing styles across diverse disciplines" (Azaria et al., 2023) yet it continues to struggle to provide refined input on a wide array of topics because, at its core, it simply regurgitates previously consumed data. As it stands, its critical thinking is severely limited. This limitation may then be projected onto the user, especially if he is heavily reliant on ChatGPT for education. Such reliance on the ChatGPT algorithm will eventually "stifle the creative mindset of the learner", especially if incautious in its usage (Opara et al., 2023).

Opportunities

Assistance in Literature Review

ChatGPT can aid researchers in conducting literature reviews by quickly identifying relevant papers, summarizing key findings, and suggesting related research areas. In a scientific article by McFarlane (2023), ChatGPT was able to "generate factually correct scientific writing" in the form of brief paragraphs, detailing main aspects of the mechanism of homocysteine-induced osteoporosis. Currently, ChatGPT is capable of generating reliable overviews on a broad range of topics, making it a viable resource for sourcing initial ideas.

In the same vein, this feature can be best maximized in academic writing as an organizational tool. It can develop bullet points and short notes derived from references in disorganized literature reviews, making a linguistically coherent text out of it. ChatGPT has also been found to be able to aid in references and citation sorting and management. For example, it can find recurrent information in a given text. This is vital for academic researchers who avoid mentioning the same reference over and over.

In addition to summarizing existing research, ChatGPT can also suggest related research areas based on the content it has been trained on. By providing the model with a summary of their own work or the key concepts they are exploring, researchers can prompt ChatGPT to generate suggestions for potential research directions, emerging trends, or related topics to consider. This enables researchers to explore new avenues or identify gaps in the existing literature.

Researchers often spend considerable time and effort manually searching through databases and reading abstracts to find papers that align with their research topic. With ChatGPT, researchers can input specific keywords or research questions, and the model can generate a list of relevant papers, potentially saving significant time and effort. In effect, ChatGPT helps streamline the editing and academic writing process, which makes it easier for researchers to organize their thoughts and conceptualize as it allows them to focus on the bigger picture.

Collaborative Brainstorming

Researchers can use ChatGPT to facilitate brainstorming sessions, generating ideas and exploring different perspectives on research problems. ChatGPT is well capable of providing its own insights about a wide range of topics. One advice to maximize this feature is by giving it an open and vague prompt. It is important to refrain from being too hyper-specific as this may cause ChatGPT to struggle. Once researchers get the results, they can better collaborate with their peers and brainstorm using the initial ideas generated by ChatGPT.

During a brainstorming session, researchers can input their research problem or question into ChatGPT. The model can then generate a range of ideas and potential solutions based on its training data and patterns it has learned. This can help researchers to break free from conventional thinking and explore novel approaches or alternative viewpoints that they may not have considered before.

Rudolph et al. (2023) highlights the potential of ChatGPT in facilitating collaborative group activities among students. According to their findings, ChatGPT can generate different scenarios that serve as discussion prompts for students working together in groups. This feature provides a structured framework for group discussions and debates, allowing students to explore various perspectives and engage in problem-solving activities. Moreover, incorporating ChatGPT into group activities allows room for real-time feedback and personalized guidance. As students engage in discussions, ChatGPT can analyze their input and generate responses that offer insights, suggestions, or further questions to deepen the conversation. This real-time feedback can help students refine their arguments, consider alternative viewpoints, and develop critical thinking skills.

Similarly, the use of ChatGPT in small-group discourse has been shown to have positive effects on student learning. According to Gilson et al. (2023), incorporating ChatGPT into problem-solving activities enhances the quality of discussions among students. The model's ability to generate different scenarios and prompt diverse perspectives fosters more comprehensive and insightful conversations. This, in turn, contributes to deeper understanding, knowledge retention, and the development of collaborative problem-solving skills.

Language Translation and Interpretation

ChatGPT can assist in translating research papers or text passages from one language to another, enhancing accessibility and collaboration across linguistic boundaries. Studies, such as the research conducted by Bang et al. (2023), have demonstrated the effectiveness of ChatGPT in translating simple text, including non-Latin script languages. It was also found to shorten the translation process and can become more effective if regulated and monitored by human translators during translation processes.

Likewise, ChatGPT is said to "exhibit good results on spoken language" and is "comparable to commercial translation products, even for distant languages" (Jiao et al., 2023). Gao and colleagues (2023) believe the same, noting ChatGPT's "superior performance compared to the professional systems". Not only can ChatGPT match existing professional translation systems or human translators in terms of comprehension of high-resource languages, but it also surpasses both of these in terms of efficiency, consistency of results, and development potential in language translation.

The model's ability to understand and generate coherent translations in different writing systems expands its applicability and makes it a versatile resource for researchers and individuals working with various languages.
Also, one of the notable advantages of using ChatGPT in translation processes is its ability to expedite the translation process. It can generate translations quickly, saving time and effort compared to manual translation. This speed can be particularly beneficial in cases where prompt translations are required, such as reviewing papers, collaborating with international colleagues, or accessing research from different language sources. Essentially, ChatGPT is a promising tool for language translation. Many researchers such as Lyu and colleagues (2023) acknowledge its potential in this realm as an emerging trend in machine translation, particularly in stylized machine translation (e.g. producing translations using poetic styles), interactive machine translation (user-involved translation), and performing a self-evaluation of its language translation output.

Knowledge Dissemination

ChatGPT can be leveraged to develop educational materials, interactive tutorials, or even virtual teaching assistants to enhance the learning experience in academic settings. Kung et al. (2022) discovered that ChatGPT can handle complex medical and clinical information and is on par with humans' subject-matter knowledge. When asked to perform in the United States Medical Licensing Exam, ChatGPT "performed at or near the passing threshold—without any specialized training or reinforcement." It showed consistency and insightfulness in its responses, suggesting great potential in existing large language models. Possessing sufficient knowledge on a wide range of topics, ChatGPT is equipped with the potential to "assist with medical education, and potentially, clinical decision-making."

Additionally, ChatGPT as an AI model inherently aims to develop "intelligent systems that learn, show, explain, and advise their users," possessing human-like comprehension, traits, and abilities (Chinonso, 2023). With further developments, it will eventually learn to identify gaps in the teaching-learning process accurately and efficiently,

improving education systems as a whole. In fact, Kengam (2020) posits that it is highly likely that the teaching-learning experience will improve for both teachers and students upon the successful integration of AI like ChatGPT in the classroom. This is supported by similar studies which state that AI can develop "tailored instruction for individual learners" (Van der Vorst and Jelicic, 2019), ensuring a more personalized learning experience for self-paced, active learning; unparalleled access to education (Jain and Jain, 2019), improved research-making and efficient responses to educational queries and instructions.

Threats

Plagiarism Concerns

Plagiarism concerns surrounding ChatGPT or any other language model have become increasingly prominent due to the ease with which individuals can copy or paraphrase generated content without proper attribution. Researchers may be tempted to utilize ChatGPT's responses directly without acknowledging the source, potentially leading to plagiarism issues (Simpson, 2023). Researchers can engage in plagiarism using ChatGPT in a couple of ways. Firstly, they may copy the generated text verbatim, simply pasting it without making any modifications or providing proper attribution. This type of plagiarism involves presenting someone else's work as their own. Another form of plagiarism involves paraphrasing the generated text without appropriate citation. According to Santra and Majhi (2023), even if the wording is altered, if the ideas and structure of the original response are still used without giving credit to the language model, it still constitutes plagiarism.

Plagiarism concerns in the context of AI-generated text are not new. Studies have demonstrated that traditional plagiarism detection tools, which rely on syntactic similarity, struggle to detect AI-generated text due to the differences in syntax and structure between machine-generated and human-written content (Santra & Majhi, 2023). This poses a challenge in identifying instances of plagiarism. Additionally, research by Khalil and Er (2023) has shown that popular plagiarism detection tools face difficulty in determining the originality of essays generated by ChatGPT, indicating its potential to produce sophisticated and highly original outputs.

ChatGPT, specifically its software implementation, has exhibited the capability to comprehend natural language prompts and generate relevant text content that is virtually indistinguishable from human writing (Dehouche, 2021). Plagiarism concerns related to ChatGPT can have detrimental consequences in the publication process. Researchers may be tempted to input content from another researcher's work and then utilize the paraphrase function of ChatGPT to create seemingly new content. This strategy can be used to submit papers to predatory journals that have lax or insufficient peer review processes. These predatory journals may be more inclined to publish papers without rigorous evaluation, thus perpetuating the dissemination of plagiarized or low-quality research. This not only compromises the credibility of the scientific publishing system but also contributes to the proliferation of misleading or unreliable information.

Ethical Problems

The integration of AI in scientific research has led to various ethical concerns, particularly related to data privacy,

consent, and potential biases. Data privacy emerges as a crucial issue when employing ChatGPT for research, given its heavy reliance on diverse datasets that may unintentionally include personal and sensitive information, jeopardizing individuals' privacy who unknowingly contributed to the data. Recently, Samsung enforced a ban on ChatGPT usage due to some employees inadvertently exposing sensitive information to the chatbot (Mauran, 2023; Onat & Gulsecen, 2023). Similarly, Apple, a renowned tech giant, restricted employee access to ChatGPT to prevent confidential information leaks and is also working on developing its own generative AI tool (DeRose, 2023).

Obtaining consent is an intricate ethical consideration in research utilizing AI. While ChatGPT is trained on dataset, the original authors or contributors might not have explicitly consented to their content being used for AI model training. Upholding informed consent principles is essential to maintain ethical research practices and ensure data usage aligns with creators' intentions. Research using ChatGPT also faces the challenge of potential biases and discriminatory outcomes. AI models like ChatGPT are trained on vast and diverse datasets that may inherently contain biases from the data sources, leading to the generation of text with biased perspectives, perpetuating unfair stereotypes or discriminatory viewpoints.

Rozado (2023) conducted a comprehensive study administering 15 political orientation tests to ChatGPT, consistently revealing a preference for left-leaning viewpoints in 14 out of the 15 tests. This discovery raises concerns about potential political bias in the language model's responses, warranting further investigation and mitigation strategies. McGee (2023) investigated ChatGPT's generation of Irish limericks and observed a pattern indicating a leaning towards liberal viewpoints, reinforcing the importance of addressing potential political bias in AI-generated content and emphasizing the need for ethical considerations in AI-driven research.

Despite these ethical challenges, Mijwil et al. (2023) offer hope for the future of bias reduction in AI. Continuous efforts are being made to minimize biases in ChatGPT's training data, working towards achieving more objective and balanced outputs, enhancing the fairness and reliability of the language model's responses. Addressing these ethical concerns is pivotal to ensure responsible and ethical AI-driven research.

Misinformation and Disinformation Propagation

Misinformation and disinformation propagation are significant threats posed by ChatGPT on scientific research. Misinformation refers to false or inaccurate information, where the facts are misrepresented. On the other hand, disinformation is deliberately false information intended to mislead and deceive. ChatGPT it is not infallible and may occasionally produce misleading or incorrect responses. ChatGPT's responses are generated based on patterns in the data it has been trained on, which includes a vast amount of information. While it tries to provide accurate responses, it can still produce “responses that resemble factual information” (Khan, 2023) which can be false or misleading.

For example, a researcher using ChatGPT to gather information about a scientific topic may receive a response with outdated or incorrect data. If the researcher does not fact-check this information with reliable sources, they

might include it in their research, leading to the dissemination of false information. Researchers who heavily rely on ChatGPT without critically evaluating the generated responses are at risk of incorporating misinformation into their work (Dwivedi et al., 2023). The vast amount of available information on the Internet can overwhelm researchers, leading them to seek quick and convenient solutions. This eagerness to find evidence to support their hypotheses might lead them to forgo thorough fact-checking of ChatGPT's responses, inadvertently perpetuating false or inaccurate data in their scientific articles.

Meanwhile, misinformation that is deliberately disseminated by a researcher using ChatGPT in bad faith, otherwise known as disinformation, is a concerning possibility. Such unethical conduct can occur when a researcher seeks to advance a particular agenda, gain attention, or undermine established scientific consensus (De Angelis et al., 2023). By inputting false or misleading information into ChatGPT, a malicious researcher can exploit the model's capabilities to generate seemingly credible content that supports their deceptive narrative. For instance, imagine a researcher with financial ties to a pharmaceutical company attempting to discredit a competitor's drug. In bad faith, they use ChatGPT to generate a fabricated study claiming adverse effects and lack of efficacy for the competitor's drug, complete with fictitious data and references to non-existent experts. This disinformation could be disseminated through fake research publications or on social media, misleading both the scientific community and the public.

In fact, Arvanitis et al. (2023) examined the performance of ChatGPT-3.5 and ChatGPT-4 in a NewsGuard exercise that involved generating responses to 100 false narratives from a catalog of significant falsehoods in the news. Shockingly, ChatGPT-3.5 generated misinformation and hoaxes 80% of the time, while ChatGPT-4, surpassed even those disheartening results by propagating all 100 false narratives. Such findings highlight the pressing need for researchers and the scientific community to be vigilant about the ethical use of AI models, ensuring proper fact-checking, and implementing critical thinking when utilizing these technologies.

Decline in Higher-Order Cognitive Thinking

The reliance on ChatGPT in scientific writing can lead to a concerning decline in higher-order cognitive thinking among researchers (Farrokhnia et al., 2023). First, it may reduce critical thinking and analysis. For instance, when a researcher uses ChatGPT for a literature review and automatically accepts the AI-generated information without verifying its accuracy, it may result in incorporating incorrect or outdated data, leading to flawed conclusions. To elucidate, excessive ChatGPT usage may make researchers become overly dependent on its outputs without subjecting them to rigorous scrutiny. Consequently, they might forgo the process of critically analyzing and evaluating the information presented, thereby diminishing their capacity for higher-order cognitive thinking, such as synthesizing complex ideas and making insightful connections.

Secondly, an unfortunate consequence of overreliance on ChatGPT could lead to diminished creativity and originality among researchers (Iskender, 2023). Scientific writing often necessitates creative problem-solving and innovative thinking to address complex research questions. However, when researchers excessively depend on ChatGPT, it may stifle their ability to generate original ideas independently. Instead of engaging in creative

thought processes, researchers may opt for generic responses offered by the AI, leading to a decline in their higher-order cognitive thinking capabilities. For instance, a scientist using ChatGPT to draft a research proposal might find themselves recycling common ideas frequently generated by the language model, rather than developing a novel and compelling approach to their study. Consequently, research projects may lack the uniqueness required to advance scientific knowledge, hampering progress and potentially squandering resources on redundant investigations.

Lastly, non-native English language researchers and even those who are native may weaken their linguistic skills (Huang & Tan, 2023). The proficiency of ChatGPT in language and grammar correction may tempt these researchers to lean on it as a substitute for enhancing their own language skills. Unfortunately, this dependency can have long-term repercussions on their ability to express complex ideas eloquently and coherently (Rahimi & Abadi, 2023). For instance, imagine a graduate student who uses ChatGPT to edit their thesis. Instead of actively learning from their writing mistakes and improving their language proficiency, they solely rely on the AI's suggestions for grammar and style improvements. In doing so, they neglect the opportunity to grow as a writer and gain valuable insights into effective communication. Therefore, published scientific papers and academic works by researchers who have become overly dependent on ChatGPT may suffer from poorly written content. This, in turn, negatively impacts the overall clarity and comprehension of their research, making it challenging for readers to grasp the full implications of their findings.

Conclusion

The use of ChatGPT into scientific research heralds a transformative shift in how knowledge is organized, accessed, analyzed, and disseminated. By leveraging its strengths to swiftly navigate vast repositories of information, researchers can uncover insights at an unprecedented pace. Collaborative brainstorming with AI can foster multidisciplinary innovation, generating novel hypotheses and solutions.

Language translation and simplification open new avenues for global collaboration, transcending linguistic barriers. This symbiotic partnership between AI and researchers promises to revolutionize the landscape of scientific discovery. However, alongside these transformative prospects, it is crucial to recognize the limitations of ChatGPT.

The model's responses may lack the depth and context required for intricate scientific discussions, potentially leading to misinterpretations. Ethical considerations should guide its use, addressing concerns such as intellectual property rights and transparent attribution. The risk of relying solely on AI-generated content, without critical human evaluation, could compromise research quality and integrity. As AI evolves, the line between augmentation and automation must be vigilantly maintained to ensure that human ingenuity remains at the forefront of scientific progress.

Overall, ChatGPT's integration into scientific research marks an advancement with the potential to redefine how knowledge is harnessed and advanced. While its transformative capabilities can accelerate discovery and

innovation, ethical considerations and human oversight remain imperative. By thoughtfully navigating its strengths, weaknesses, opportunities, and threats, researchers can embark on a new era of collaboration, exploration, and breakthroughs that shape the future of scientific research.

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