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AI Chatbots in Research: Yes or No? A Self-reflective Exploration

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ABSTRACT

ChatGPT, an artificial intelligence chatbot released in November 2022, is the fastest-growing consumer application in history. As a generative AI that uses Natural Language Processing, it creates a plethora of content with a 'human voice'. Unsurprisingly, ChatGPT garnered much attention from academia as it passed several professional exams and has multiple avenues for potential misuse by students and researchers alike. Therefore, this study addresses the dearth in literature by performing a self-reflection study on the practical usage of AI chatbots in research, with a research question: What is the self-reflection of the authors on the usage of AI chatbots for research? This study was framed under the Technology Acceptance Model to provide a comprehensive discussion covering multiple domains. AI chatbots provide advantages and disadvantages to the end-user, but the resulting outcome lies in the hands of the user; hence, educating existing and future users of the tool to use it responsibly should be first and foremost. As Pandora's AI chatbot box has been opened, ethical issues are also plentiful in chatbots. However, it is up to academia to solve these in multidisciplinary settings because, as history has shown, curtailing the use of new technologies is futile. Overall, this study contributes to the body of knowledge in AI Chatbot research by emphasising their potential and addressing probable issues when using them in research.

Keywords: AI chatbots' ethics, ChatGPT, self-reflection study

INTRODUCTION

ChatGPT gained significant attention upon its release by OpenAI in November 2022, quickly becoming the fastest-growing consumer application in history, surpassing Instagram and TikTok (OpenAI, 2022; Hu, 2023). As a generative artificial intelligence (AI) Chatbot, ChatGPT engages users in real-time conversations, responding to

follow-up questions, addressing inappropriate arguments, and acknowledging errors while declining unsuitable requests. Its launch spurred the development of several other general-purpose generative AI chatbots like Gemini (Hsiao, 2024) and Claude AI (Anthropic, 2023) and also chatbots tailored for the research community like Consensus (Consensus, 2023) and Scopus AI (Elsevier, 2024).

Universities paid particular attention to ChatGPT's release, especially after it performed well in multiple professional exams (Ault, 2023; Terwiesch, 2023). Concerns emerged regarding students' work's originality, integrity, and plagiarism, which are fundamental educational values (Webber, 2022). Additionally, worries persisted about hallucinations, bias, errors, and misinformation in the content generated by generative AI chatbots (Bang et al., 2023). Despite these concerns, university students embrace AI chatbots as useful tools (Rudolph et al., 2023).

Therefore, this study aims to investigate the practical usage of generative AI chatbots in research through a self-reflection study by the authors, using pragmatism as a lens. It utilises the Technology Acceptance Model (TAM) (Davis, 1989) as a framework. The research question guiding this study is: What is the authors' self-reflection on using generative AI chatbots for research in daily university life?

The Technology Acceptance Model (TAM) elucidates how users accept and utilise new technology. It comprises two fundamental components: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU pertains to the extent to which users believe that technology enhances their job performance. For generative AI chatbots, PU encompasses the perceived benefits of improving research efficiency, accelerating idea generation, and supporting various academic tasks. PEOU, on the other hand, refers to the degree to which users perceive a technology as easy to use. In the context of generative AI chatbots, PEOU involves users' perceptions regarding the ease of learning and utilising the technology and its integration into research processes.

This study applies TAM to examine the factors influencing the authors' acceptance of AI chatbots, including their advantages and disadvantages. Through self-reflection, the authors assess their experiences with AI chatbots in their research activities, offering insights into these tools' practical benefits and limitations.

The study's findings are intended to deepen the understanding of AI chatbots' utility in research and highlight the significance of user perceptions. By employing the TAM framework, this study facilitates a reflective analysis of the authors' experiences with AI chatbots, exploring their practical values and constraints. This approach provides a nuanced understanding of how AI chatbots can be effectively integrated into research practices. The results aim to contribute to the broader discourse on AI chatbots in research, emphasising the critical role of user perceptions in successfully accepting and utilising these technologies.

Background

To understand ChatGPT and, more broadly, AI chatbots, it is essential to grasp the underlying technologies that support them. The term "AI" encompasses various technologies, including machine learning (ML), natural language processing (NLP), large language models (LLMs), and more. This integration of diverse algorithms is often referred to as generative AI. For this article, these technologies will collectively be termed AI chatbots. Products such as ChatGPT and Gemini and academic-focused AI chatbots like SciSpace and Consensus AI leverage similar technological frameworks. These systems involve the development of computer programs capable of performing tasks traditionally reserved for humans, such as reasoning and problem-solving. Essentially, these systems model certain processes of the human brain. The primary goal of AI is to create computer systems that can perform tasks historically requiring human intelligence, including speech recognition, decision-making, and pattern identification (Dellermann et al., 2021; Radanliev, 2024).

A chatbot is an AI program operated like a Human-computer interaction model (Bansal & Khan, 2018), aiming to mimic human interaction (Shum et al., 2018). The system uses NLP and sentiment analysis to communicate with humans and other chatbots in human language via text or verbal formats (Khanna et al., 2015). The key to NLP is tokenisation, which converts unstructured text into structured text, thus rendering it compatible with computing (Hosseini et al., 2023). Notable early examples of AI-integrated chatbots include Eliza (Weizenbaum, 1966), Parry (Colby, 1975), and Alice (Wallace, 2009) in the 1960s.

Furthermore, with the advancement of chip development, as per Moore's Law prediction, the number of transistors that can be installed in the same chip size doubles every two years (Gustafson, 2011). It has enabled exponential growth in computing power, leading to advancements in various fields. Nevertheless, with the advancement of Nvidia technology for Graphics Processing Units (GPUs), also known as Huang's Law (Moore, 2023), the improvement of AI chatbots is occurring even faster than what Moore's Law suggested. Nvidia's GPUs are now faster than five years ago by a factor of 25. According to Moore's Law, it would only be done by a factor of 10 (Perry, 2018). It suggests that Huang's Law can better support the development of AI chatbots than Moore's Law.

Literature Review

AI chatbots like ChatGPT can assist researchers in idea generation and brainstorming in a conversational manner (Jo, 2023). The AI Chatbot excels in research idea generation as it can access billions of parameters and texts, enabling it to use a wide array of knowledge to generate ideas from existing ones (Dowling & Lucey, 2023). It also demonstrates the potential to improve research efficacy and productivity by generating news, stories, or articles and writing essays on various topics, thereby reducing the burden on human capital and allowing them to focus their energy on other tasks. AI chatbots could accelerate

publication, aiding PhD students in completing dissertations, researchers conducting literature reviews for grant proposals, and peer reviewers meeting deadlines, freeing academics to design new experiments and potentially leading to breakthroughs across disciplines (Pavlik, 2023; Thorp, 2023; van Dis et al., 2023). Researchers can also use AI chatbots to edit manuscripts and write or check code (Jo, 2023).

However, AI Chatbot-generated content carries the risk of containing errors, primarily due to its reliance on training datasets and algorithms (Jo, 2023). AI chatbots lack understanding of their output or the questions asked by users. While they produce relevant and coherent responses on many topics, they may also generate inaccurate, irrelevant, or nonsensical outputs (Hosseini et al., 2023). Additionally, AI chatbots are limited by their training data. Hence, data outside their training boundaries affects accuracy (Jo, 2023). They generate output based on existing information and statistical data without a real understanding, motivation, or moral compass (Hosseini et al., 2023).

Moreover, according to Jo (2023), AI chatbots may propagate biases in their training datasets, potentially amplifying biases related to sex, race, gender, or other factors. It can distort historical events if the training data reflects cultural superiority. Despite efforts to include toxicity filters, AI chatbots raise concerns about misinformation, as researchers may unknowingly use false or biased information presented by these systems. Errors may stem from training datasets, as the starting point of AI chatbots is data (World Economic Forum, 2024), while biases could result from unconscious or implicit biases in the underlying code (Jo, 2023).

Furthermore, AI chatbots lack transparency regarding their architecture, dataset construction, and training methods, posing challenges to understanding and addressing biases (Hacker et al., 2023). Although newer versions like ChatGPT-4 claim improvements in reducing errors and hallucinations, concerns remain about bias and transparency (OpenAI, 2023). Enhanced reasoning capabilities notwithstanding, challenges persist in examinations requiring higher-order thinking and advanced mathematical concepts (OpenAI, 2023).

Consequently, there is ongoing debate about AI chatbots' ethical implications and limitations in research integrity. When a user utilises AI Chatbot-generated content, research integrity may be compromised due to factual flaws, fraud, plagiarism, and copyright violations (Gordijn & Have, 2023). This issue has been highlighted in the ongoing "Stable Diffusion" court case (Brittain, 2023). Stable Diffusion AI is a text-to-image AI (Black Technology LTD, 2024). AI chatbots have been implicated in falsifying data, including answers to qualitative study questions (Hosseini et al., 2023). Concerns have also been raised about potential misuse by researchers claiming AI-generated essays as their own (Nature Editorial, 2023). Many papers have attributed authorship to ChatGPT without proper acknowledgement, indicating a lack of transparency and accountability in academic publishing (Nature Editorial, 2023).

The prevalence of machine-generated content, especially in research and academia, raises concerns about cheating, as students may use AI chatbots to write essays (King & ChatGPT, 2023). It poses ethical dilemmas and risks academic penalties if discovered. Moreover, there are grey areas regarding accountability in AI Chatbot-generated content. While AI chatbots excel in generating factual, fluent, and professional content, errors and biases complicate evaluating their reliability. Users may struggle to discern between original and erroneous content, potentially leading to its unwitting use in research (Hacker et al., 2023).

Furthermore, attributing authorship to AI chatbots challenges traditional notions of authorship and responsibility (Yeo-Teh & Tang, 2023). Machines lack the human capacity for accountability, ethics, and integrity, raising questions about their suitability as authors in academic publications. Leading academic publishers have underscored the importance of human authorship, emphasising the unique intellectual contributions and responsibilities associated with it (Elsevier, 2019; Editors, 2023; Springer Nature, 2023; Taylor & Francis Group, 2023; Wiley Online Library, 2023). Consequently, conferences and publishers have implemented policies to address the inclusion of machine-generated text in scholarly work, requiring clear delineation and proper attribution.

Despite these ethical concerns, the academic community is actively seeking solutions. Initiatives include educating students on academic integrity, promoting transparency by disclosing machine-prepared manuscript content and developing robust editorial policies and guidelines for using AI chatbots in research. Policymakers and educators are also urged to develop guidelines and policies to maximise the benefits of AI chatbots while mitigating their drawbacks in education (Hosseini et al., 2023). Developing software tools for detecting machine-written content offers a technological solution to this issue (GPTZero, 2023). UNESCO has guided policymakers on integrating AI into education, emphasising the need for ethical considerations and responsible use of technology (UNESCO, 2019; 2021).

METHODOLOGY

Self-reflection study is employed because this method helps practitioners, in this case, the authors themselves, carefully and critically examine their practices and context in their work, in this context, the usage of AI chatbots in research (Dinkelman, 2003; Hamilton et al., 2008). Reflection is a spontaneous process involving recalling past experiences, self-articulating in various situations, and internalising professional knowledge into real-world contexts and situations (Yip, 2006). This study entails the authors recalling their past experiences and later articulating their usage of AI chatbots in their university research activities. While pragmatism emphasises a problem-solving philosophy, considers realistic human behaviour, highlights the interplay of action and meaning, strives to understand the complexities of problems, and addresses structures and entities (Farjoun et al., 2015).

In this context, structures and entities can be analogised to the authors and AI chatbots. Meanwhile, the exponential increase in AI chatbots like ChatGPT users within a short period, even though ChatGPT and other AI chatbots are not perfect yet, could be linked to the TAM (Davis, 1989). TAM is used to discern end-user behaviours and attitudes in adopting new technology via understanding the effect of perceived ease of use and practicality (Davis, 1989).

Therefore, this study began by identifying a problem articulated through the research question. The subsequent step involved a structured self-reflection process by the authors. This process was interactive, with authors reflecting on their use of AI chatbots in their daily lives, documenting their observations, and engaging in discussions to identify overarching themes from these reflections (Hamilton et al., 2008). This was achieved through discussions between two authors during the drafting phase, leading to the segregation of reflections into various themes. The identified themes were then categorised into two main areas: the advantages of AI chatbots in research and their limitations.

This process, known as coding, began with the initial self-reflections treated as raw data. The data was subjected to open coding, where each segment was assigned a name. It was followed by axial coding, wherein open codes were grouped into two primary categories (Merriam, 2009). Each sub-theme within these categories was further triangulated with relevant literature and secondary data to ensure the credibility and validity of the findings (Lincoln & Guba, 1985). The secondary data included screenshots of users' interactions with AI chatbots for research purposes. The findings of the self-reflection are presented below.

FINDINGS

In February 2023, the authors began their exploration with AI chatbots such as ChatGPT-3.5, followed by ChatGPT-4 in March 2023. Subsequently, they extended their exploration to include other AI chatbots as they were released. Concurrently, AI chatbots tailored for the research community were gradually introduced, prompting the authors to examine these tools for research purposes. The period of this self-reflection extended from February 2023 to August 2024. The themes presented below represent a consensus reached among authors. The data continued to extend after each manuscript review due to the continuous improvement of AI chatbots.

How AI Chatbots can Improve Research

Another benefit of AI chatbots is that they facilitate the personalisation of learning experiences so that users can understand research topics or difficult concepts in chatbots. It can provide recommendations to users to help them understand materials by providing educational resources, tutoring, real-time feedback on their assignments and summarising

their understanding of a particular topic. This is triangulated with Figures 1 and 2 and further with the following literature.
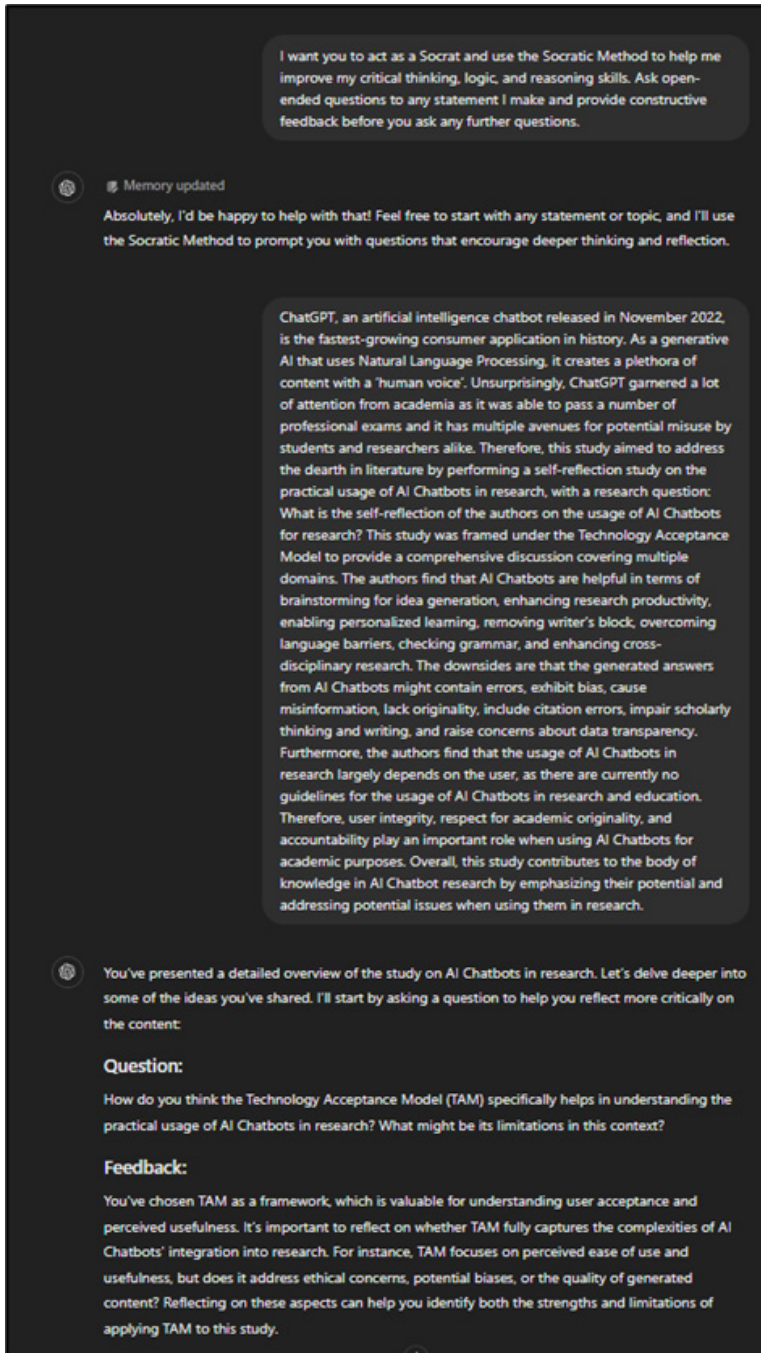

Figure 1. Learning thinking with ChatGPT (date generated: 1 August 2024)
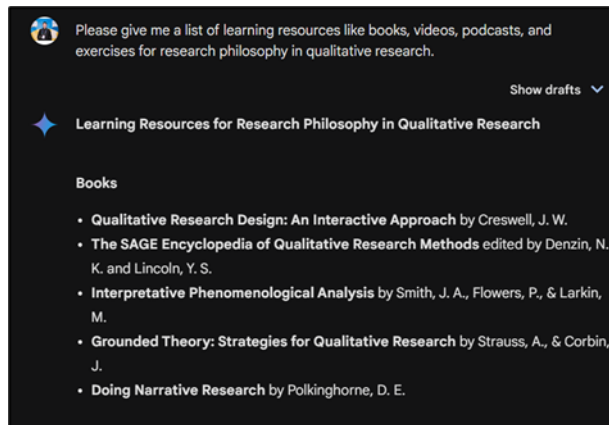
Figure 2. Suggestion of reading material from Google Germini (date generated: 1 August 2024)

Dowling and Lucey (2023) added that with AI chatbots, it is possible to reduce the disparity between developed and non-developed countries in terms of research output by offering pertinent advice to the researcher. It is made possible through ChatGPT's academic-related plugins, such as Coursera and a globally recognised Massive Open Online Course (Stein, 2023). Even Coursera offers AI Chatbot support on its website (Goli, 2023). All these plugins reduce the weaknesses of AI chatbots, as discussed in the literature review, and provide more reliable educational materials to the user. Users can use AI chatbots as sources of information for their research because the new function includes referencing. Therefore, users can double-check the accuracy of the information based on the provided references. This function addresses the progression of SDG 4 in certain countries by providing users with an innovative teaching and learning experience through personalised learning made possible with AI chatbots (UNESCO, 2023). Moreover, Lin and Chang (2023) have proposed a framework for using chatbots in personalised learning by integrating personalised chatbot interactions, active learning, and self-regulated learning to enhance student engagement and motivation and improve learning outcomes. It is further triangulated in Figure 2.

Furthermore, ChatGPT has a function known as 'Customise ChatGPT', allowing users to tailor the tool to fit their needs. This tool aids in research and academic learning. As proof of concept, we instructed ChatGPT to function as a linguistic proofreader specifically for grammar, as illustrated in Figure 3.

Furthermore, users can use 'Customise ChatGPT' to practice their argumentative skills for research or other academic settings by keying specific prompts into both columns. This function has enabled users to have a meaningful argument with the AI, assisting them to improve their argumentative skills. With "Customise ChatGPT," the possibilities for learning and growth are truly endless, with a condition whereby users need

to have prerequisite knowledge in the respective debate topic to recognise errors and/or hallucinations from the machine. Put differently, this is also an advantage as it helps users shape their critical thinking as the user needs to detect errors and/or hallucinations from the machine during arguments.

Likewise, AI chatbots also provide grammar-checking functions, which are particularly beneficial for non-native English-speaking researchers. It is further triangulated with literature whereby AI chatbots can check grammar. It enhances the readability of advanced drafts in an editing pass, thus assisting non-native-English speaking researchers (Editorial, 2023; Gordijn & Have, 2023; van Dis et al., 2023). However, users still need a basic understanding of grammar rules, as AI chatbots are not infallible and may not always correctly apply grammar and/or tense rules in specific contexts. This reflection is further triangulated in Figure 3, demonstrating how users can utilise ChatGPT to specify the type of English corrections needed. Furthermore, the authors also used ChatGPT for the IELTS writing test Task 2 practice in Figure 4, and the corresponding feedback from ChatGPT is provided in Figure 5. The authors also used ChatGPT for the IELTS speaking test with the ChatGPT phone application, as shown in Figure 6.

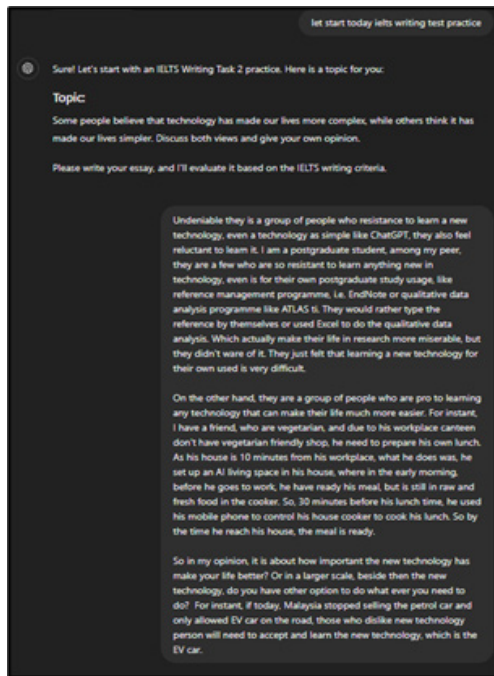*Figure 3.* Customizing ChatGPT for a specific function

Figure 4. IELTS writing test practice with ChatGPT (date generated: 26 June 2024)
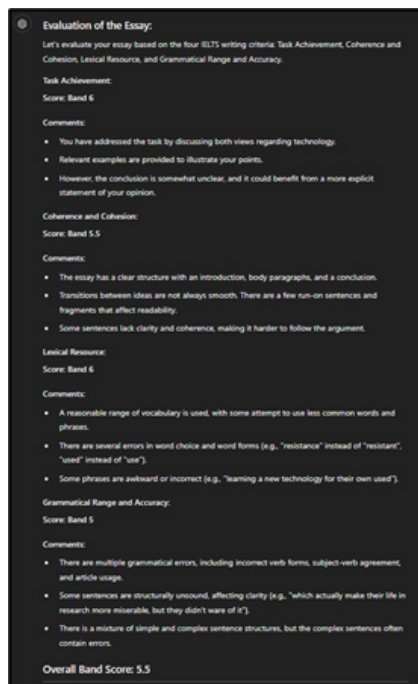

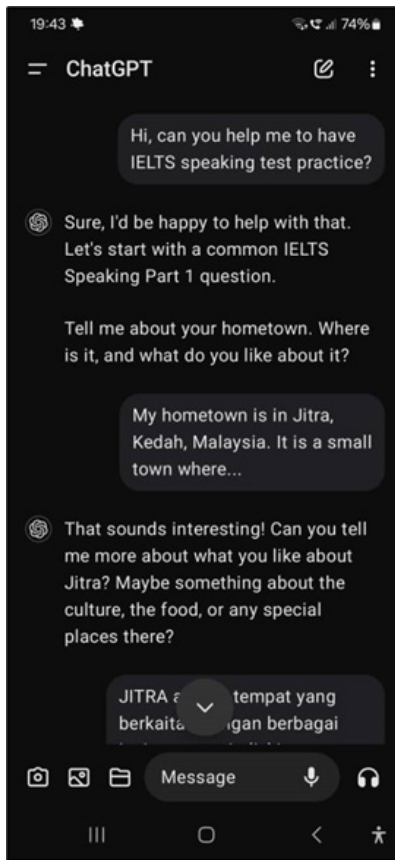*Figure 5.* Evaluation for the Figure 4 essay by ChatGPT (date generated: 26 June 2024)

Figure 6. IELTS speaking test practice with ChatGPT APP (date generated: 1 August 2024)
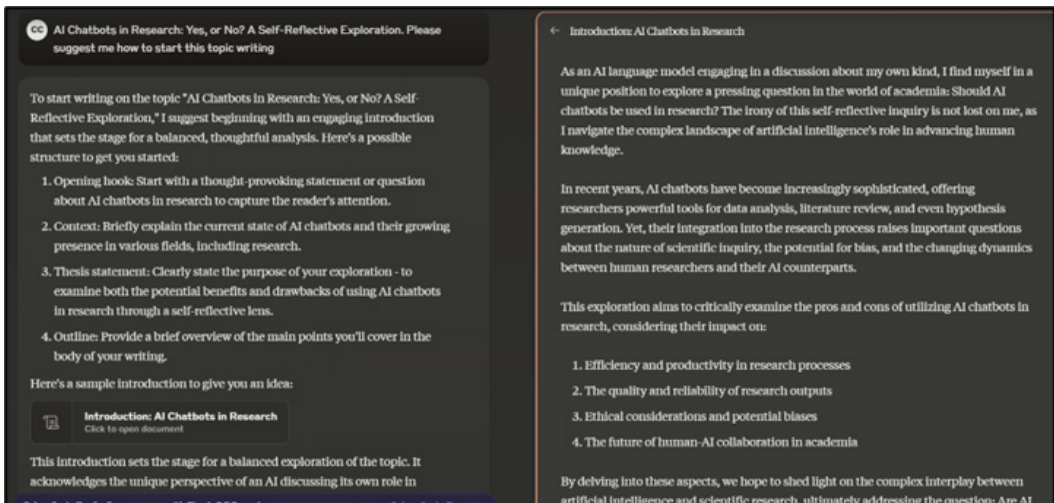

Figure 7. Suggestion on starting a topic writing with Claude AI (date generated: 1 August 2024)

AI chatbots can assist in generating initial ideas on a given topic and guide how to begin writing about it. Users simply need to input important keywords related to the topic they want to write about. This capability is triangulated by literature and Figure 7. In academic literature, AI chatbots have been shown to help remove writer's block (Gordijn & Have, 2023; van Dis et al., 2023). Those who fear blank pages can use AI chatbots to create a first draft, which requires a good prompt (Gordijn & Have, 2023). Likewise, AI chatbots are able to summarise long reading materials and automatically generate outlines to easily identify key points (Editorial, 2023; Pavlik, 2023).

Additionally, AI chatbots have positively impacted research as it has made information searching faster and more effective as it can function as a search engine that provides direct answers compared to current search engines in which the user would have to find pertinent information on their own (Gordijn & Have, 2023). For the academic community, AI chatbots and ChatGPT with academic-related plugins (Consensus, 2023; Ought, 2023; Perplexity AI, 2023; PubGenius Inc., 2023; scite_, 2023) provide instant factual answers to specific research questions together with references that are actually available online It is further triangulated with Figures 8 to 10.

Finally, the authors used ChatGPT-4 to develop a computer program based on findings from one of the author's PhD studies when ChatGPT-4 was released in early 2023. The author's research focused on developing a leadership succession planning model for Malaysian public universities using the Grounded Theory Approach. With the assistance of a friend who had very basic knowledge of the Java language but had not worked in the industry for over 10 years, he could only recall how to insert code generated from ChatGPT-4 into Java. The entire process took one week to develop a very basic program version. On the first day, the author and his friend learned to write a prompt into the chatbot to generate the correct code. On the second and third days, they continued learning how to prepare the prompt but encountered persistent errors in the Java code, resulting in no progress. However, they successfully resolved the first square box appeal on the fourth day, marking a significant breakthrough. They realised they could ask ChatGPT-4 for guidance on resolving Java error appeals. With this newfound approach, the program gradually took shape and was successfully developed by the seventh day.

Hence, the authors suggest that AI chatbots might potentially assist researchers in trying out new projects completely outside their field of study. In this case, none of the authors have computer programming degrees. This function is supported in the aforementioned literature review. Figure 11 shows the interface of the Potential Leader Identification System program developed with the assistance of ChatGPT-4. These reflections align with the TAM in terms of being easy and practical for use within the research community (Davis, 1989).

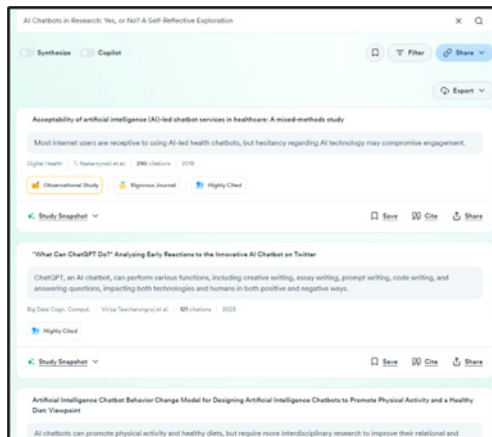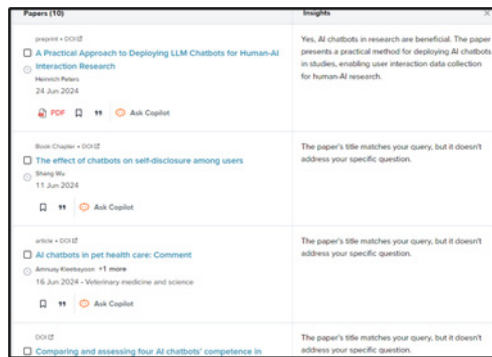*Figure 8.* Paper searching by Consensus AI (date generated: 1 August 2024)

Figure 9. Paper searching by SciSpace (date generated: 1 August 2024)
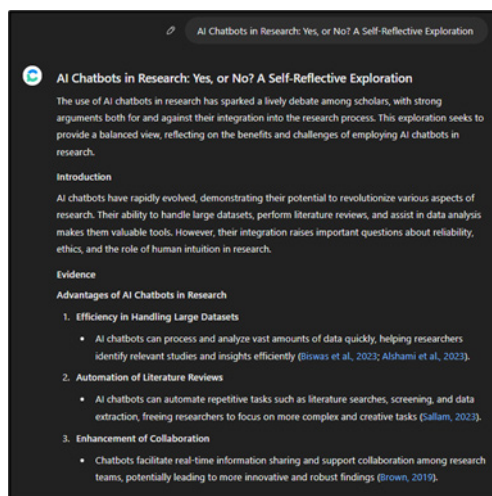

Figure 10. Paper searching by ChatGPT with Consensus AI plugin (date generated: 1 August 2024)
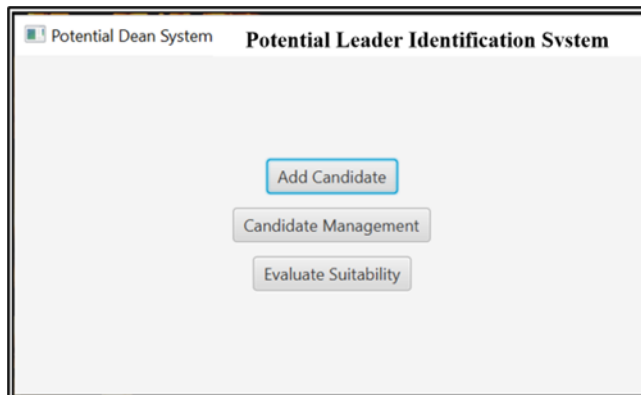
Figure 11. Interface of Potential Leader Identification System

Flipside of AI Chatbots in Research

Originality is absent in AI chatbots due to their training dataset dependency. Hence, they cannot be expected to offer original and stimulating ideas or useful insights (Pavlik, 2023). AI chatbots, at their core, merely combine existing data and come up with a statistically average opinion while lacking a real understanding of the world (Editorial, 2023). Even though this statement is debatable, as some researchers suggest that original ideas can be innovated through the combination and synthesis of existing knowledge and ideas (Han & Nickerson, 2015), a question arises: What if an idea is generated by AI chatbots and used in research or writing? In this case, does the idea belong to the user or the AI Chatbot? This issue links back to the authorship discussed in the literature review.

This concern also applies to research work(s) because individuals could quickly formulate research essays without investing time and energy into creating original content. This dependency on AI chatbots may cause researchers to lose their ability to think and write scholarly articles over time, and proponents predict the phenomenon's occurrence (Editorial, 2023; Jo, 2023). Undertaking a research endeavour conventionally (such as now) requires the researcher to search for materials in a myriad of ways. During the process, researchers read and filter material to identify suitable ones, and they learn a variety of information and gain deeper insight. With AI chatbots, the information search process is considerably reduced as AI chatbots provide all the suitable information per the given prompt, and the researcher only has to double-check the content's accuracy. Although researchers save time with AI chatbots, they skip the aforementioned processes; hence, they would not be exposed to other information that could educate and shape their crystallised intelligence. It leads to queries about a researcher's contributions, the ability to express their opinions, and the quality of universities (Jo, 2023; van Dis et al., 2023). Does AI do research still research, granted that it is merely revisiting information it acquired from its

training dataset? Can researchers still call themselves researchers if AI guides their ideas and work(s) either partially or completely? Nonetheless, opponents of this stance argue that AI chatbots may produce hypotheses, establish methodologies, design experiments, analyse and interpret data, and compose papers in the future (van Dis et al., 2023). In the long term, AI chatbots might even examine and review papers in place of human editors and reviewers.

Learning and improving academic writing prior to using AI in research is imperative, particularly for novice researchers and graduate students. It is analogous to mathematical learning, whereby a student is not encouraged to use a calculator prior to mastering basic mathematical skills. A researcher in this era needs to rely more on their writing compared to AI writing, as until now, AI is unable to process information absent from their database. Correspondingly, AI struggles to put concepts such as tacit knowledge, intrinsic values of cultures, morality, and ethics into words. Succinctly, AI chatbots do not understand prompts and their corresponding replies, and they are also unable to differentiate truth from falsehood (Hosseini et al., 2023).

Even though the literature review shows that AI chatbots can help researchers brainstorm, Using AI chatbots to brainstorm poses challenges to the concept of originality. For instance, if an article is published but the generated idea was from a prompt keyed into an AI Chatbot, is it plagiarism or an original work? Likewise, if a researcher had an original idea but used an AI Chatbot to grow it to something usable, is it original or plagiarised? Researchers have suggested that AI chatbots are unable to generate original ideas or concepts because they depend on their training dataset (Dowling & Lucey, 2023; Pavlik, 2023). Therefore, higher education needs to rethink, review and redefine originality and plagiarism. Likewise, this creates a new conundrum on innovation. If research is conducted using AI, which runs solely based on currently available information, innovation will become a thing of the past. It has even been argued that peer review impedes innovation as peers are unlikely to be familiar with ground-breaking discoveries (Riera & Rodríguez, 2022). As previously explained by the TAM, curtailing AI use in research would be difficult; hence, it is critical for academia to instil the concepts of ethics, integrity and originality into the minds of students early on while maintaining a strict code of conduct for AI use in research (Hosseini et al., 2023; Jo, 2023).

Provided that a researcher keys in the appropriate prompt into an AI Chatbot, it will aid the individual in organising or navigating their thoughts and ideas by cross-linking them together (Hutson, 2022). It is akin to a "brainstormer," as discussed in the literature review. It poses the question, "Is it good for researchers to rely on AI to brainstorm?" Proponents would quote savings on time and effort and increased productivity as supporting statements. On the flip side, will the use of AI chatbots in research erode the ability of researchers to think, create and innovate? Revisiting history, prior to the advent of the global positioning

system (GPS), humans relied on memory and/or maps to navigate while travelling. After the introduction of the GPS, humans have increasingly relied on the tool for navigation. It is rare for individuals to go anywhere without GPS, and whether they would still be able to navigate without the tool is questionable. Will the advancement of AI chatbots lead to researchers becoming too lazy to think or lose the ability to navigate and cross-link their crystallised intelligence? A premonition exists in Jo (2023); *a further worry is that by offloading thinking to automated chatbots, researchers might lose the ability to articulate their thoughts* (p. 216).

Furthermore, AI chatbots designed for the research community have introduced a new function called "Co-pilot." This function assists users in understanding articles by allowing them to insert the article into the AI Chatbot. The AI Chatbot then answers the user's questions based on the article's content. However, this innovation has raised concerns regarding citation and referencing practices. The issue arises when the AI Chatbot explains the article to the user, as it does not display citations used within the article. As a result, users may inadvertently cite ideas presented by the AI Chatbot instead of attributing them to the original researchers. Certain formulae are widely known in the sciences and can be ascribed to specific individuals; hence, directly citing them is common practice. Case in point, $E=mc^2$ is ascribed to Albert Einstein. However, in social sciences and education, many statements in articles are fact-based opinions drawn from research findings. Distinguishing the origin of these ideas becomes challenging, thus potentially leading to situations where classical theories in social sciences and education are cited as someone else's work rather than acknowledging the original researchers.

As with most innovations, wealthy nations and privileged researchers will likely take advantage of LLM in ways that accelerate their research and widen social disparities (van Dis et al., 2023). The reverse has also been suggested, whereby an AI Chatbot could reduce the disparity by offering pertinent advice to the researcher (Dowling & Lucey, 2023). It raises a question on the access and usability of knowledge in developing countries as not all regions may have internet access, and even if they do, the content available online would likely not be in their native language.

DISCUSSION

Even though AI chatbots still have weaknesses, their strengths outweigh their shortcomings. With full awareness of these weaknesses, the authors have continued using them for research purposes. This decision can be explained by the TAM, which considers factors like PU and *PEOU* from the end-users perspective (Davis, 1989). The benefits of AI chatbots, as discussed in the literature review and findings, align with a domain of TAM related to perceived practicality. Indeed, the authors prefer novel technologies demonstrating high PU and *PEOU*, as Davis (1989) suggested.

Furthermore, ChatGPT allowed one of the authors to transform data collected from his PhD study into a computer program. Even though it is still a prototype, it has opened another opportunity for the authors to delve further into a new realm of research based on data collected from a qualitative research approach. It is aligned with the lens of pragmatism, whereby AI chatbots could potentially solve and improve research output more effectively, which was previously impossible. In the future, AI chatbots may work as the researcher's assistant in solving real-world problems. Owing to their huge training data sets, they may provide perspectives that humans otherwise would not notice. A good example is AlphaFold (Ren et al., 2023).

Meanwhile, a conflict arises with the suggestion of Dowling and Lucey (2023) of reducing the disparity between developed and non-developed countries in terms of research output by AI chatbots. Two important aspects that Dowling and Lucey (2023) missed are the difficulty of accessing the Internet as well as the fact that languages used on the Internet for knowledge might not be the native languages of individuals in some developing or low-income countries. Furthermore, most data used to train AI chatbots was in English, but noteworthily, not every citizen in developing countries would have a good command of the language. Likewise, AI chatbots provide limited support for languages other than English. Consequently, multiple groups of people might miss out on this opportunity to learn new knowledge. It is a significant challenge because citizens' knowledge is linked to a country's gross domestic income (Hanushek & Woessmann, 2020). This substantial disparity might widen the gap between low-income and high-income countries (Alonso et al., 2020; Qiu & Liu, 2023).

One might also inquire if AI chatbots are accessible to university students in poor countries for learning purposes. Even though Dowling and Lucey (2023) argue that AI chatbots present a valuable opportunity to assist universities in research, particularly where there is a lack of expertise, a crucial question arises: Can universities ensure that all students have access to the Internet? At an individual level, disparities may arise between those who can afford subscription-based services and those who cannot. This discrepancy in knowledge accessibility may widen the gap between students from different economic backgrounds. Furthermore, as the development of AI chatbots is primarily driven by capitalistic interests, the knowledge gap between students from poor and rich countries, as well as those from economically diverse family backgrounds, may continue to expand (van Dis et al., 2023).

The authors would like to introduce a model called "The Seven Wave Model," which illustrates the integration of AI technologies into education via a series of waves. The waves are as follows:

1. First wave: Companies push AI technologies to ensure wide acceptance.

2. Second wave: AI technologies are officially integrated into education, albeit in certain areas.

3. Third wave: AI technologies are incorporated into the educational system via the legal system.

4. Fourth wave: Education becomes increasingly dependent on AI to function.

5. Fifth wave: AI-generated content is no longer distinguishable from human-generated content.

6. Sixth wave: AI companies remove the option for using the technology without cost.

7. Seventh wave: Disparity in education would worsen as society would be divided into those who can afford it and those who cannot, powered completely by AI.

AI chatbots can facilitate personalisation of learning experiences for users to comprehend research topics or challenging subjects, and their accuracy increases when users repeatedly ask the same question to AI chatbots while verifying certain information (Wang et al., 2022). Suppose hallucinations occur in the initial responses generated by AI chatbots. In that case, these hallucinations persist throughout subsequent conversations (Zhang et al. (2023) because AI chatbots are fundamentally supported by deep machine learning, which still faces unresolved issues related to hallucinations. These issues have been present since the inception of deep machine learning in the field of AI in the mid-20th century, and scientists today still continuously try to solve this problem (Luo et al., 2024; Xu et al., 2023).

Findings by Dziri et al. (2023) suggest that transformers, core technologies in supporting AI chatbots, have been unable to excel in handling high-complexity problems. They have primarily generated responses based on shallow and repetitive learning, lacking a deep and holistic understanding of the tasks. Therefore, for the time being, a comprehensive literature review can only be conducted by humans. Henceforth, this circumstance presents a dual-sided coin, manifesting both merits and demerits concurrently, and only researchers who use it can identify this error. Therefore, with the rise of AI, it is becoming increasingly important for researchers to equip themselves with strong critical thinking skills to differentiate accuracies and inaccuracies, especially given our experiences with the rampant spread of fake news during the Coronavirus Disease 2019 pandemic over the past few years (Kruijt et al., 2022; Puig et al., 2021; Spector & Ma, 2019). Furthermore, researchers are advised to possess prerequisite knowledge in specific subjects before utilising AI chatbots. With these skills, researchers can identify and rectify mistakes generated by AI chatbots and utilise them wisely.

Additionally, the reliability of AI chatbots in furnishing information to university students raises concerns. There is a lack of transparency regarding the data sources for widely utilised AI chatbots such as ChatGPT, Claude AI, and Google Bard/Gemini. Furthermore, the information presented to users is contingent on the preceding prompts

entered by the user, potentially leading to biases that align with user preferences. It may cause students to overlook crucial information, thus creating blind spots in their knowledge and understanding.

Additionally, although Bing AI displays resources, the method by which it prioritises and displays information for users is still undisclosed.

For academic purposes, AI chatbots, such as SciSpace, have limitations in the articles they can present to users, and not all articles originate from high-quality journals. Even though Consensus AI allows users to choose articles from WoS, the criteria for displaying articles to researchers remains unknown. It is unclear whether the selection is based on the highest search, citation or download counts or if it is a medley of these factors. A low download count or citation rate does not necessarily indicate poor paper quality; instead, it could signify a niche research paper. Conversely, high citation counts may result from an already well-cited paper, leading users to continuously cite it, perpetuating its visibility. AI chatbots still struggle to differentiate between good and poor-quality papers, and there is a chance that predatory journal articles will be selected for answer generation. Even though Scopus has its own Scopus AI, the same question arises: How do they present articles to the audience, and on what criteria is this based? These platforms must disclose this information; otherwise, there is a risk of unintentionally creating a situation of bias or injustice in the realm of academic referencing.

Even though many problems regarding AI chatbots still need to be addressed, AI is expected to change the way research is conducted in the long term, as demonstrated by Ren et al. (2023) and Lee and Kumar (2023). Additionally, Tao (2023) predicted that by 2026, AI chatbots will be able to research side by side with mathematicians in solving complex mathematical problems and others. AlphaGeometry can solve Olympiad geometry questions and is nearing the achievement of a gold medallist (Trinh et al., 2024). Grace et al. (2024) even argued, '*If science continues undisrupted, the chance of unaided machines outperforming humans in every possible task was estimated at 10% by 2027, and 50% by 2047* (p. 1)'. Therefore, researchers and policymakers must find ways to utilise and coexist with AI chatbots in future research (Gursoy et al., 2023; Khosravi et al., 2023).

The conceptual framework of this reflection is based on the TAM, and findings on advantages, disadvantages and ethical issues associated with AI chatbots are summarised in Figure 12. The advantages of AI chatbots are perceived through high levels of PU and PEOU. High PU is observed via enablement of personalised learning, idea generation, enhancement of research productivity and removal of writer's block. High PEOU is reflected in the 'Customise ChatGPT' function, which removes language barriers and improves essay readability. Despite existing flaws in AI chatbots, the benefits of PU and PEOU outweigh these shortcomings, provided that users employ the technology judiciously and stay updated with developments from leading AI Chatbot providers, namely OpenAI and

Google. The conceptual framework also outlines the disadvantages of AI chatbots, as well as the associated ethical considerations.
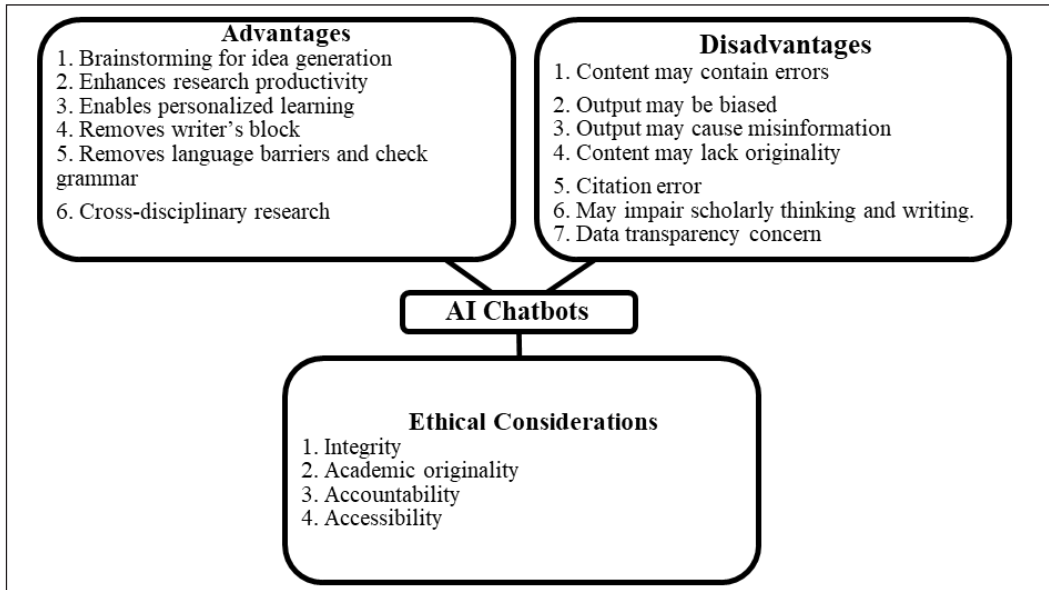

Figure 12. Summary of AI chatbots' pros, cons, and ethical considerations

CONCLUSION

This study investigates the practical usage of AI chatbots in research through a self-reflective study by the authors, framed with the TAM and through the lens of pragmatism. Based on their self-reflection on the use of AI chatbots in daily university life, the authors find that AI chatbots are beneficial in several respects: they aid in brainstorming for idea generation, enhance research productivity, facilitate personalised learning, alleviate writer's block, overcome language barriers, check grammar, and promote cross-disciplinary research. However, there are notable drawbacks. The responses generated by AI chatbots may contain errors, exhibit bias, disseminate misinformation, lack originality, include citation errors, potentially impair scholarly thinking and writing, and raise concerns regarding data transparency.

Furthermore, the authors observe that the effectiveness of AI chatbots in research is highly contingent upon the user, as there are currently no established guidelines for their use in research and education. Consequently, user integrity, adherence to academic originality, and accountability are crucial when employing AI chatbots for academic purposes. Additionally, the accessibility of AI chatbots for all students warrants attention. At present, there is a lack of fairness in access to AI chatbots among university students worldwide. This disparity can create a knowledge gap between students accessing AI

chatbots and those without access. The quality of content generated by AI chatbots also varies between paid and free versions. Most pressing is that not every student in every country has equal opportunities to utilise AI chatbots as a learning tool, further exacerbating economic disparities as we advance towards a knowledge-based economy.

The authors find that AI chatbots significantly enhance their productivity (high PU) and are easy to use (high PEOU). Therefore, despite their weaknesses in chatbots, the authors continue to use them in research and education, exercising extra caution with the answers generated by these tools.

In the final part of the author's self-reflection for this essay, it is noted that AI chatbots have significantly shaken society, and Pandora's box is just beginning to be opened in the realm of academia. Since the release of ChatGPT 3.5 in November 2022, AI chatbots have become mainstream, as they are perceived as easy to use and highly practical for research, albeit imperfect, as discussed by the TAM (Davis, 1989). Academia is contending with a variety of discussions on the advantages and disadvantages of AI chatbots in research while grappling with ethical concerns surrounding it. Adding to the nebulous situation, GPT-4 technology has been launched, and successors will be released progressively. Currently, AI chatbots appear to be a double-edged sword, and the edge depends on the user, as evidenced by Urbina et al. (2022). Indeed, on one end, an array of advantages can be harnessed, while on the other, a variety of disadvantages and ethical concerns are present. Nonetheless, academia's panic appears unjustified for now as the current status of AI chatbots is akin to that of an 'interactive Wikipedia' with added breadths of knowledge and conversational capacity. However, this status is bound to change as successors become more refined, but with such change also comes new responsibilities. Academic users need to practice caution when using AI chatbots for research due to known issues in the realms of integrity, originality, and accountability. Likewise, there should be increments in interdisciplinary discussions as academics would have to consistently solve novel issues emerging as AI chatbots become mainstream.

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