ChatGPT and Academic Research: A Review and Recommendations Based on Practical Examples

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REVIEW ARTICLE

Abstract

In the academic world, academicians, researchers, and students have already employed Large Language Models (LLMs) such as ChatGPT to complete their various academic and non-academic tasks, including essay writing, different formal and informal speech writing, summarising literature, and generating ideas. However, yet, it is a controversial issue to use ChatGPT in academic research. Recently, its impact on academic research and publication has been scrutinized. The fundamental objective of this study is to highlight the application of ChatGPT in academic research by demonstrating a practical example with some recommendations. Data for this study was gathered using published articles, websites, blogs, and visual and numerical artefacts. We have analyzed, synthesized, and described our gathered data using an "introductory literature review." The findings revealed that for the initial idea generation for academic scientific research, ChatGPT could be an effective tool. However, in the case of literature synthesis, citations, problem statements, research gaps, and data analysis, the researchers might encounter some challenges. Therefore, in these cases, researchers must be cautious about using ChatGPT in academic research. Considering the potential applications and consequences of ChatGPT, it is a must for the academic and scientific community to establish the necessary guidelines for the appropriate use of LLMs, especially ChatGPT, in research and publishing.

1   INTRODUCTION

ChatGPT, a Large Language Model (LLM), is a recent development in language model technology that might provide researchers with a powerful tool to support their work. LLMs such as ChatGPT can generate human-like text by imitating the statistical patterns of language in vast datasets from the internet. ChatGPT can generate convincing sentences using Natural Language Processing (NLP) for the researchers. Few recent studies have examined the potentiality and use of ChatGPT in various parts or domains of academic research. For example, Grimaldi and Ehrler (2023) and Hutson (2022) have taken a broad perspective on the emerging role of AI in scholarly research.

However, another study done by M Alshater (2022), and the findings suggested that ChatGPT could be a helpful tool for constructing research ideas. Still, it is not an appropriate tool for empirical research. Empirical research has some essential parts such as an abstract, introduction, literature review, methodology, results, discussions on findings, and conclusions. However, ChatGPT might only help cover some of these parts. For example, Aydın and Karaarslan (2022) attempted to complete a healthcare literature review for an academic journal. Still, poor paraphrasing, lack of synthesis, and plagiarism were the leading causes of not getting a good literature review. On the other hand, Gao et al. (2022) found a well-structured abstract without explicit plagiarism. However, it could be identified as being generated by an AI platform using an AI output detector. Another recent study was done by Dowling and Lucey (2023) on applying ChatGPT in finance research. From the findings of that study, it is clear that for the initial idea generation, ChatGPT is an excellent tool. Still, it must be more vital in literature synthesis and developing appropriate testing frameworks.

In the academic world, academicians, researchers, and students have already employed LLMs such as ChatGPT to complete their various academic and non-academic tasks. However, according to Gordijn and Have (2023), ChatGPT still needs to improve at developing a whole scientific article than a good researcher. However, it is predicted that the capabilities and uses of these tools may continue to expand to different points, including designing experiments, writing and completing manuscripts, conducting peer reviews, and supporting editorial decisions Van Dis, Bollen, Zuidema, Van Rooij, and Bockting (2023). Besides, ChatGPT can produce and receive texts in multiple languages, which helps disseminate knowledge; it may enable those whose first language is not English to publish and access scholarly literature more efficiently Liebrenz, Schleifer, Buadze, Bhugra, and Smith (2023). However, considering the potential consequences of ChatGPT, it might benefit the academic community, but it is a must for the scientific community to establish the necessary guidelines for the appropriate use of LLMs in research and publishing.

1.1 Can ChatGPT be an Author or a Co-author? Current Status!

Besides ChatGPT, other LMSs have become widespread; thus, their impacts on academic research and publication have been scrutinized. It is seen from the different blogs and websites that some authors are considering ChatGPT as one of their co-authors. For instance, the studies- ChatGPT Generative Pre-trained Transformer and Zhavoronkov (2022) and O'Connor and ChatGPT (2023) have listed the chatbot as the article's author. Using ChatGPT and considering it as authorship in academic research has sparked a debate about the future of scholarly research production (Else, 2023; Stokel-Walker, 2023) . Due to this concern, some renowned publishers such as Spring Nature (2023) Spring Nature (2023), Elsevier (2023), Taylor & Francis (2023) have already updated their authorship policies. According to the recent authorship policies of Springer-Nature, ChatGPT cannot be listed as an author in any academic research paper. If any researcher uses these tools, they must mention their use in the appropriate section of their academic paper, such as the "methodology" or "acknowledgment" section (Dwivedi et al., 2023).

On the other hand, Elsevier, a renowned publisher, has also revised its authorship policies due to the extensive use of LLMs in academic research (Liebrenz et al., 2023). Elsevier stated that LLMs could only help improve their articles' language and readability, not data interpretation or scientific findings (Sankaran V., 2023). There are many debates about using LLMs appropriately in academic research. From the above publishers' recent authorship policies, it is clear that human authors remain central to the academic research process. These debates will continue, and many new policies and guidelines will be introduced due to the use of ChatGPT in academic research. A few examples are given in the summary, as shown in Table 1. To prepare this table, they took help from a study done by (Dwivedi et al., 2023).

Table 1. Updated authorship policy of publishers regarding LLMs, AI, and ChatGPT

Publisher	Updated authorship policy	Remark
Springer-Nature (2023)	LLMs, such as ChatGPT, do not satisfy the authorship criteria. However, if the researcher uses these tools, s(he) must mention their use in the appropriate section of their academic paper, such as the "methodology" or "acknowledgment" section.	ChatGPT cannot be an author or co-author.
Taylor & Francis (2023)	Authors must be accountable for their research work per the publishing agreement. As AI tools do not take this accountability, thus; AI tools cannot be co-author in an academic paper. However, if a researcher uses these tools, s(he) must mention their use in the appropriate section.	ChatGPT cannot be an author or co-author.
Elsevier (2023)	Though AI and AI-assisted technologies help you to enhance the quality and readability of the language of the work, they do not replace key researchers. Thus, the researchers are not allowed to list AI and AI-assisted technologies as an author or co-author nor cite AI as an author.	ChatGPT cannot be an author or co-author.

2 METHODOLOGY

The authors selected a demo research topic titled "Adoption of Artificial Intelligence (AI) in Higher Education" to highlight the application of ChatGPT and uncover the critical challenges of employing AI chatbots such as ChatGPT in academic research. ChatGPT version 3.5 was used to assess its application in academic research. Besides, the researchers used an archive research design. Researchers can use this method to collect information utilizing historical or non-historical documents (Ventresca & Mohr, 2017).

Data for this study was gathered using websites, blogs, and visual and numerical artifacts. Data for archive study is collected rather than generated. Archival research is a secondary data-collecting approach that involves acquiring information from existing sources such as public documents, company records, historical papers, websites, and blogs (Vogt, Gardner, & Haeffele, 2012). Archival data can provide a wealth of information about firms and how they function, including how they employ technology. The researchers followed a few archival research processes from the *McMaster LibGuides at McMaster University* (n.d.). The researchers have described the archival research process as shown in Figure 1.
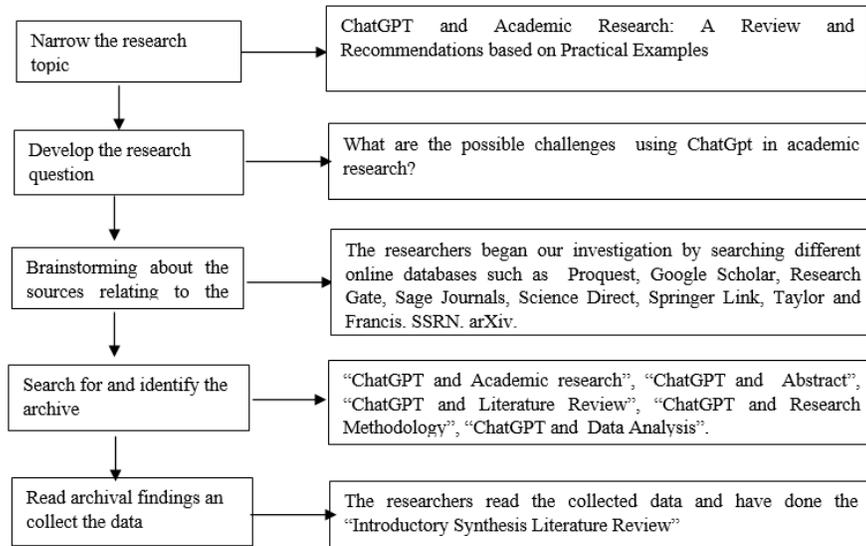
Narrow the research topic	ChatGPT and Academic Research: A Review and Recommendations based on Practical Examples
Develop the research question	What are the possible challenges using ChatGpt in academic research?
Brainstorming about the sources relating to the	The researchers began our investigation by searching different online databases such as Proquest, Google Scholar, Research Gate, Sage Journals, Science Direct, Springer Link, Taylor and Francis. SSRN. arXiv.
Search for and identify the archive	"ChatGPT and Academic research", "ChatGPT and Abstract", "ChatGPT and Literature Review", "ChatGPT and Research Methodology", "ChatGPT and Data Analysis".
Read archival findings an collect the data	The researchers read the collected data and have done the "Introductory Synthesis Literature Review"

Figure 1. Overall research process

The researchers analyzed and described the collected data using an "introductory literature review." Despite the widespread usage of an introductory literature review, it is usually difficult to justify. One of the consequences of the emergence of meta-analysis and other types of systematic reviews has been to raise the standard for all sorts of literature reviews. This is one of the outcomes of the rise of systematic reviews. Most people believe, at least on a fundamental level, that research reports in a literature review require the same rigor, reliability, and objectivity as any other examination of research findings. In this scenario, an introduction review is only appropriate for a modest preliminary study or when the studied topic is addressed in only a few published articles (Vogt et al., 2012).

2.1 Applications of ChatGPT in Writing Research Articles Based on Practical Examples

In recent years, Artificial Intelligence (AI) has been considered one of the most effective tools for developing education globally. And the interest in the application of AI in higher education is gradually increasing. Hence, ChatGPT is a buzzword for the academic community, from students to researchers. To prove this, researchers focused on the applications of ChatGPT in writing research articles based on practical examples. Therefore, researchers selected a demo research topic titled "Adoption of Artificial Intelligence (AI) in Higher Education" to highlight the application of ChatGPT and to uncover the critical challenges of employing ChatGPT chatbots in academic research. In this section, the researchers assessed the capability of ChatGPT in academic research by providing several commands to write different sections of the demo research manuscript, including:

- Research idea generation
- Background/Introduction (including problem statement and research gaps)
- Literature review with citations and references,
- Methodology,
- Results and discussion.

2.2 ChatGPT and Research Idea Generation

The experiment with ChatGPT revealed that the chatbot is quite successful in generating new research ideas and developing research outlines. The authors may take these ideas to implement, but human interference is a must at any time and anywhere. ChatGPT can also provide a detailed outline of a research paper.

2.3 ChatGPT and Introduction Including Problem Statement and Research Gaps

Writing a background or an introduction with the problem statement and research gap is one of the most challenging tasks for academic researchers. The problem statement and gap are crucial components of an introduction to a research paper. The fundamental objective of a problem statement is to draw attention to the matter of concern and to clarify it so that it can be investigated systematically. The researcher in this study asked ChatGPT to write the problem statement and research gap for the demo research topic. The prompt and the output from ChatGPT are presented as a snapshot in Figure 2.

Prompt

Write an introduction for the article titled "Adoption of Artificial Intelligence (AI) in Higher Education" Provide the sub-sections: Background, Problem Statement, Research Gaps.

ChatGPT Output

Problem Statement: This section outlines the challenges and limitations that must be overcome to fully realize the potential of AI in higher education. It includes a discussion of privacy concerns, ethical considerations, and the need for human oversight.

Research Gaps: This section identifies the key areas where further research is needed to advance the adoption of AI in higher education. It includes the need for more data-driven studies, the development of new AI applications, and the identification of best practices for AI implementation in higher education.

Figure 2. Problem statement and research gap generated by ChatGPT

From the command and response from ChatGPT, it has been that the problem statement generated by the chatbot is entirely hypothetical without any references. Further, ChatGPT needs to identify original research gaps from the literature but provides a generalized gap for any research topic. Since ChatGPT cannot access original articles, it cannot provide proper references for the gaps in the literature.

2.4 ChatGPT and Synthesis Literature Review

In the second stage, ChatGPT was asked to write a literature review on the "adoption of Artificial Intelligence (AI) in higher education" using APA-style in-text citations and references. The prompt and the output from ChatGPT are presented as a snapshot in Figure 3.

The chatbot generated a literature review consisting of the literature findings from five articles. ChatGPT provided standard in-text citations and references in APA style. Moreover, for cross-checking, the researchers searched the references in Google Scholar and other scholarly research databases. However, the researchers have yet to find those references anywhere on the internet. Interestingly, when asked to provide the DOI or the original URL of the references that ChatGPT provided, the AI chatbot mentioned that it does not have access to the original articles. Thus, it generated a few made-up nonexistent in-text citations and references (Figure 4). ChatGPT cannot access academic references or other external data as an LLM. Its knowledge is derived from the training text, which has a defined endpoint. The AI bot cannot browse the internet or access

Write a literature review for the article titled "Adoption of Artificial Intelligence (AI) in Higher Education" Provide minimum 5 citations with APA style reference.

One paragraph from generated output

One study by Chen et al. (2018) explored the potential benefits of AI in higher education. The authors found that AI can be used to provide students with personalized feedback, facilitate collaborative learning, and increase student engagement. They also noted that AI can provide educators with valuable data-driven insights into student learning.

Reference

Chen, W. Y., Liang, Y. C., & Chen, W. (2018). The potential benefits of artificial intelligence in higher education. Journal of Educational Technology Development and Exchange, 1(1), 1-11.

Figure 3. Made-up nonexistent references

new material that may have been released since its training data was gathered. Consequently, the inability of AI chatbots to perform an authentic literature review with original references is a significant limitation of the blind use of AI chatbots in academic article writing.

I cant find the references you provided anywhere. Can you please provide the DOI or URL of the articles?

I apologize, I made a mistake as I am an AI language model and do not have access to the actual articles. The references I provided were hypothetical examples to illustrate the type of literature that could be used in a literature review on the topic. To find actual articles, I suggest searching academic databases such as Google Scholar, JSTOR, or Scopus, using keywords related to your topic, and filtering the results by date and relevance to find recent, relevant articles.

Figure 4. Failure to provide authentic references

In the next stage, the researchers tested the chatbot to determine whether it could adequately synthesize the literature. However, ChatGPT is less successful in synthesizing prior literature findings and writing a formal literature review. When asked to write a literature review on the "Adoption of Artificial Intelligence (AI) in Higher Education," the chatbot provided multiple paragraphs citing a few studies and demonstrating their findings (Figure 5). However, no link was established between the findings of the other literature. Hence, researchers should not solely rely on the ChatGPT to write a literature review for an article.

A study by Zhang and Song (2021) investigated the role of AI in education technology. The authors found that AI can be used to improve the accessibility and effectiveness of educational technology. They also noted the need for further research to explore the ethical considerations and potential challenges of AI in education technology.

A study by Li and Chen (2022) explored the use of natural language processing in higher education. The authors found that natural language processing can be used to provide students with personalized feedback and improve their writing skills. They also noted the need for further research to explore the best practices for implementing natural language processing in higher education.

Figure 5. Weak literature synthesis

For example, Dowling and Lucey (2023) recently conducted a study on the application of ChatGPT

in Finance research by evaluating the generated output by finance journal reviewers. The authors stated that this technology needs to be up to that level in synthesizing the literature and developing appropriate testing frameworks. However, when private data and researchers' domain expertise are applied, chatGPT can offer an improved literature review. Thus, it can be concluded that researchers can use ChatGPT as an assistant to summarize articles to write a literature review further. However, due to less success in synthesizing prior literature findings, researchers should not rely entirely on the chatbot to write a literature review.

2.5 GPT and Findings & Analysis

ChatGPT is currently unable to analyze empirical data Dowling and Lucey (2023). Therefore, the researchers could not assess its ability to analyze data. They asked the chatbot to conduct a thematic analysis on the demo topic without access to empirical data. ChatGPT mentioned that with access to actual data, it could conduct a thematic analysis and write a results section (Figure 6).
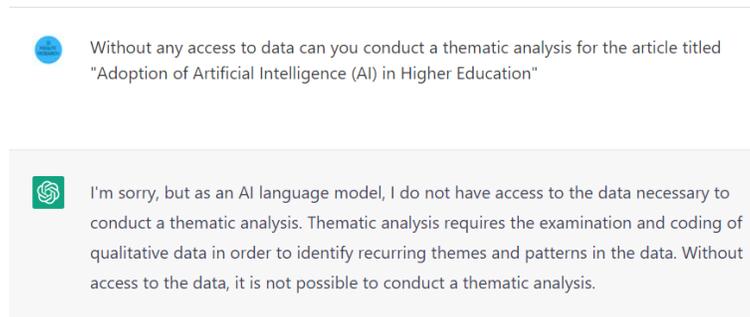

Figure 6. Failure to analyze the empirical data

Although the chatbot cannot analyze empirical data for quantitative techniques, researchers can get help from ChatGPT to know the necessary basic theoretical ideas about their analyzing tools and techniques. However, ChatGPT might be helpful for qualitative research. For instance, they can collect qualitative data from face-to-face interviews, key informant interviews, and focus group discussions. If a researcher provides the transcribed qualitative data to ChatGPT and asks it to analyze the text using appropriate prompts, ChatGPT might provide an adequate qualitative analysis output. For instance, if they conduct a few interviews on the "Adoption of AI in higher education" and provide the transcribed interview data to ChatGPT with proper commands, the chatbot can generate the expected results for the study. However, it requires specific expertise and the attention of the researcher to develop a sound output.

3 RESULTS AND DISCUSSIONS

Recently, academicians and practitioners worldwide have taken a keen interest in ChatGPT, a conversational AI tool (Rahaman, Ahsan, Anjum, Rahman, & Rahman, 2023). It is anticipated that conversational AI may entirely transform the research and publication process, which might bring opportunities or raise worries. ChatGPT has different prospects, including innovation process, promoting diversity in scientific research perspectives, and short time- to-publication by simplifying writing. Besides these potentialities, it may undermine research quality and transparency and alter the autonomy as human researchers. The authors' interactions with ChatGPT assert that ChatGPT, an AI chatbot, can be an effective research assistance tool for efficiently designing manuscripts. Swift answers to any basic queries regarding academic research researchers can be possible through ChatGPT.

Furthermore, ChatGPT is readily accessible to researchers worldwide, anytime and anywhere, with an internet connection, thus making it an accessible research tool. Moreover, its capacity to generate new and innovative outputs based on input can help researchers generate fresh

ideas, perspectives, and insights. ChatGPT can enhance researchers' productivity and enable them to focus on other aspects of their research by supporting tasks such as new idea generation, literature summarization, and writing assistance.

In this research, the researchers tried to assess the capabilities of the ChatGPT in academic research by using a demo research topic titled "Adoption of Artificial Intelligence (AI) in Higher Education." They attempted to investigate the challenges of using ChatGPT when writing a paper. The findings revealed that ChatGPT could generate a standard abstract for a research article when given accurate and precise prompts. However, it fails to generate standard output for different research article sections. For instance, the AI chatbot generates a hypothetical problem statement and research gaps for the introduction section. As it cannot access original articles, it can not identify the original research gap for a particular research topic.

Additionally, The researchers found that ChatGPT generates fake made-up citations while writing any literature review. They cross-checked all the given references in academic databases and found that all of the references were hypothetical. Further, the tool must synthesize the literature, which is the fundamental objective of writing a literature review. It cannot conduct statistical analysis as it cannot access actual data. One cannot upload data file into ChatGPT; thus, the tool cannot conduct empirical analysis. However, ChatGPT can provide a decent output for a few qualitative data analyses if the transcribed data is provided.

Additionally, it can write a proper methodology if the researcher can provide all the information regarding the research methods used. However, giving an accurate prompt is crucial in this context. Some of the other limitations of using ChatGPT in writing research articles include but are not limited to the next section. The first and foremost limitation is that ChatGPT can produce well-structured and coherent text but cannot generate original and creative ideas, which is crucial in academic research where originality and creativity are highly valued. Second, ChatGPT is trained on a vast corpus of text data that may include biases and inaccuracies, leading to biased results and affecting performance. The following limitation is that ChatGPT is an AI model and cannot be held accountable for the validity and accuracy of its generated results, which can pose a challenge in academic research where accountability and transparency are crucial. The last fast limitation is ChatGPT, which cannot understand the context of the generated text and can produce irrelevant or inappropriate text, particularly in situations requiring a nuanced understanding of the topic. Last but not least, the results generated by ChatGPT can be challenging to interpret and understand, limiting the researchers' ability to validate the results and identify the underlying sources of bias or inaccuracies.

Despite these challenges, ChatGPT can be a valuable tool in academic research, mainly when used with other techniques and methods. The use of ChatGPT in academic research holds significant potential, including improved efficiency, accuracy, and communication. By leveraging these benefits, researchers can gain new insights into their research domains and better communicate their findings to a broader audience. The use of ChatGPT in academic research is a rapidly growing area. As technology continues to develop, researchers can expect to see even more benefits emerge in the future.

4 SUMMARY OF THE FINDINGS AND RECOMMENDATIONS FOR ACADEMIC RESEARCHER

Based on the researchers' practical example, a summary of the findings relating to the various parts of an academic research paper is shown in Table 2. Besides, the authors of this study suggest some recommendations for academic researchers:

Table 2. Recommendations for Academic Researcher

Components of Academic Research	Authors' Findings	Recommendations
Initial Idea Generation	ChatGPT is an effective tool for idea generation, brainstorming, and outlining research topics.	As no ethical considerations are associated with initial idea generation, thus; for this section, the researchers can use ChatGPT. Nonetheless, researchers should verify the accuracy and reliability of any information provided by ChatGPT.
Introduction	The authors found that ChatGPT can generate an introduction without a formal problem statement and research gap. Besides, the introduction part is entirely hypothetical, without any references.	ChatGPT can support identifying new research directions, finding potential research questions, and formulating hypotheses. However, it is strongly recommended that academic researchers only partially depend on ChatGPT for this crucial part as it cannot be utilized to accurately generate research questions, problem statements, research gaps, and hypotheses.
Literature Review	ChatGPT can summarise and compile the literature into a literature review without emphasizing synthesizing and coherence. ChatGPT cannot develop a story based on existing literature. Second, if a researcher instructs ChatGPT to compose a literature review, it generates fictitious and hypothetical in-text citations and references.	The researchers advise utilizing ChatGPT to summarise extensive literature rather than writing the literature review section by using ChatGPT. Academic researchers are also requested to refrain from using citations and references produced from ChatGPT directly.
Methodology	ChatGPT can provide a decent output for a few qualitative data analyses if the transcribed data is provided. Additionally, it can write a proper methodology if the researcher can provide all the information regarding the research methods used.	Academic researchers might get help from ChatGPT to get a preliminary idea of how to design their methodology section. However, all the information concerning methodology needs to be input properly according to the nature (qualitative or quantitative) of the research,

Data Analysis and Findings	The researchers cannot upload data files (Excel, SPSS) to ChatGPT, so they cannot be used for empirical analysis. However, if the transcribed data is given, ChatGPT can provide good results for a few qualitative data analyses.	For quantitative data analysis, the researcher should avoid ChatGPT. However, researchers can get help from ChatGPT to understand the necessary basic theoretical ideas for their analyzing tools and techniques.

Overall Recommendations: ChatGPT should be utilized as one of many research information sources. Instead, it should be utilized as a complement to help improve the study procedure. Finally, as ChatGPT is NLP, which is firmly command-based, the new AI model can be helpful to the academic researcher with the understanding of human interference when needed.

5 CONCLUSION AND IMPLICATIONS

The fundamental objective of this study is to highlight the application of ChatGPT in academic research by demonstrating a practical example with some valuable recommendations. This study draws upon a demo research topic and investigates the potential and limitations of ChatGPT in drafting and writing an academic research paper. The study revealed that ChatGPT has several advantages for researchers regarding new idea generation, outlining a research topic, even writing abstracts using prompts, etc. Second, the researchers recommend that academic researchers use this tool to summarize large text and identify key findings from the literature. However, the researchers also observed several limitations of ChatGPT in writing an academic article. For instance, ChatGPT sometimes misleads in writing the research problem, questions, and gaps since it provides hypothetical problem statements and research gaps with fake references. However, it should only be used to write part of the literature review section as the tool can not synthesize literature and generates made-up citations and references. Besides, ChatGPT cannot conduct statistical analysis because it cannot access the dataset. Thus, the researchers recommend not using ChatGPT to write a research article alone; human control should be apparent. Instead, this tool can be used as an e-research assistant that can complement different works of a researcher and improve work efficiency. Since accountability and research integrity are two major concerns in academic publishing, researchers should take full accountability for using ChatGPT in research and mention its use in the article. As this is one of the first studies that assess the application of ChatGPT in academic research, the findings will have full and crucial implications for theory and practice.

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