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Artificial intelligence in academic writing: a paradigm-shifting technological advance

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Artificial intelligence (AI) has rapidly become one of the most important and transformative technologies of our time, with applications in virtually every field and industry. Among these applications, academic writing is one of the areas that has experienced perhaps the most rapid development and uptake of AI-based tools and methodologies. We argue that use of AI-based tools for scientific writing should widely be adopted.

The use of artificial intelligence (AI) in academic writing can be divided into two broad categories: those that assist authors in the writing process; and those that are used to evaluate and assess the quality and validity of written work. Tools such as natural language processing that can understand and generate human-like language can assist authors in writing and preparing manuscripts (Box 1). Tools such as plagiarism detection software and automated peer-review platforms can assist reviewers and editors in evaluating the quality of the manuscript. Furthermore, automated peer-review platforms can quickly and objectively evaluate large numbers of manuscripts, potentially reducing their workload[1].

One of the most considerable advantages of AI-based tools in academic writing is that they can save time and improve efficiency. For example, natural language processing algorithms can help authors to identify and correct errors in their work, enabling them to focus on the content of their writing rather than on mechanics. These algorithms also can be used to assist with tasks such as language translation and text summarization, which can save time and improve the efficiency of thorough literature reviews. Furthermore, natural language processing algorithms can generate specific outlines for manuscripts, research protocols, grant proposals, informed consents, emails, insurance letters of medical necessity, reports and other written documents. These outlines can be used as frameworks to ensure that crucial components of a text are included. Lastly, language processing can assist with strengthening a paper or abstract by making specific suggestions. For instance, AI algorithms can suggest previous relevant studies to include in the introduction or limitations to include in the discussion sections of a manuscript. However, current limitations of AI algorithms include limited access to all publications and the inability to identify the most recent studies. Furthermore, the AI tool might propose an appropriate study sample size based on previous studies and computed power calculations or suggest the most appropriate statistical test to use based on the study distribution[1].

The integration of AI into academic writing streamlines the creative and writing process, increasing productivity and content. The research process can present challenges, particularly for trainees or young investigators with limited experience. Frequently, the most difficult stage of a research project is generating a hypothesis and initiating a study. Groups with limited experience could benefit tremendously from AI, as it might stimulate a creative process in a particular field of interest and/or identify gaps in the literature[2]. We demonstrated this application through an experiment in which we used ChatGPT (Box 1) to generate project ideas in the field of male reproductive health[3]. The model currently only has access to publications up to 2021 and might not have comprehensive access to previous publication literature, but the AI algorithm was able to propose novel and relevant topics that we have explored over the past 12 months[4–6].

The use of AI in academia has proved to be a valuable tool in streamlining the research process with data processing applications. By processing large amounts of data, AI algorithms can identify important findings, potentially saving researchers hours of manual data analysis[7]. In addition, AI applications have enabled the rapid identification of previously elusive or hard-to-detect insights and trends, which would have been time-consuming or even impossible to uncover using previously existing software or other, manual methods[8]. Current examples include choosing the most appropriate sperm in fertility clinics[9] or predicting lymph node metastasis through analysis of primary prostate tumour tissue[10]. Furthermore, tools such as statistics calculators, Microsoft Excel and BioRender are used every day to aid in organizing and presenting data. Similarly, AI algorithms can rapidly produce well-organized and aesthetic data outputs such as figures and tables that can be used in manuscripts and presentations. The use of AI-generated content in academic writing also serves to streamline the editing process and minimize time spent on tasks such as grammatical and structural editing. The application of AI algorithms in the creation of various sections of an academic manuscript such as the introduction, discussion and conclusion is a logical extension of this process. These AI-generated sections might not be fully comprehensive or directly applicable to the study at hand, but they could serve as an initial guide that can be edited. Before submitting this commentary, ChatGPT effectively identified grammatical errors, instances of passive voice and provided recommendations, including the inclusion of additional examples and refinement of the structural order.

We are witnessing a powerful integration of AI into several aspects of daily life. Many liken the recent advances in AI-based tools to the development of the internet in the 1990s. The internet revolutionized our ability to readily access and efficiently process large amounts of data. However, as with all technological advances, initial hesitation exists for adoption as well as concern for potential risks or downsides. Indeed, some have legitimate concerns about widespread adoption of AI-based tools. For example, reliance on AI-based outputs could act to curb human innovation and critical thinking skills. Furthermore,

Box 1

Current artificial intelligence tools that can be used in academia

For literature review[a]

Semantic Scholar provides access to scientific literature in practically every academic field. Researchers can efficiently locate relevant papers and studies to support their own research or writing. Writers can also use this tool to discover new papers and authors and institutions that are working on related topics.

Penelope.ai analyses and understands large sets of text, such as scientific papers or research articles, to help writers identify key themes, concepts and trends in the literature.

Elicit helps scientific writers find published manuscripts that might not be regularly indexed by existing databases, aiding discovery of new and emerging research that can support their own writing.

For writing[b]

Writefull improves grammar, style and readability of inputted writing. It can help researchers submit more polished and professional writing.

CoSchedule Headline Analyzer is a tool that specifically helps with manuscript title creation. It can analyse inputted headlines and suggest modifications based on word balance, length and structure. CoSchedule helps writers create headlines that are more engaging and effective.

Quillbot is a tool that uses machine learning algorithms to reduce syntax complexity and increase clarity.

Wordtune uses automated feedback on grammar, style and readability.

ChatGPT is an OpenAI tool that has a chatbot–user interface that can be used to clarify, fine-tune and polish excerpts of writing. It can also be used to plan study design and statistical approaches.

Combined literature review and writing[b]

Cohere can be used by researchers and scientific authors to generate summaries, outlines and entire manuscript sections based on a given set of sources.

Figures

DALL-E 2 is an OpenAI tool that can be used to generate images from text descriptions. This tool can be useful for creating visual aids to support the writing, making it more engaging and easier to understand. Currently, this tool is primarily used to generate creative illustrations.

[a]Pitfalls of artificial intelligence (AI)-powered literature review tools are their limited access to indexed databases, potentially inaccurate algorithms being used to understand bulk text, and the cost of these tools making them prohibitive to some researchers. [b]Pitfalls of AI-assisted academic writing are a potential lack of human-authored nuance in the writing, reduced originality and creativity, and few people have an understanding of the interfaces or can afford the tools. Anecdotally, when asked to do a systematic review on the effect of vasectomy on lower urinary tract symptoms, the AI tool ChatGPT generated ten studies and a relative risk when only two studies evaluated the potential association.

AI outputs are a by-product of inputs, and inputs have the potential to be error prone or biased.

We do not suggest that AI could be a replacement for human innovative thinking or a reliance on AI in the absence of critical reflection. However, we argue that integration of AI into daily life is inevitable, and resourceful individuals should understand this technology and take advantage of its usefulness. For the academic, this use entails applications for sparking creative project ideas, optimizing study design, organizing data and data analysis, and synthesizing academic writing.

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Competing interests

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Related links

ChatGPT: https://chat.openai.com/
Cohere: https://cohere.ai/
CoSchedule Headline Analyzer: https://coschedule.com/headline-analyzer
DALL-E 2: https://openai.com/dall-e-2/
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