ORIGINAL PAPER

Incorporating AI into Scientific Writing: A Matter of Urgent Discussion, Setting Boundaries and Defining Policies

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Abstract

After the introduction of ChatGPT in 2022, the future of Artificial Intelligence (AI) that once seemed distant is now almost here. Currently, we are in an era where generative AI has become the norm, and welcoming the usage of Natural Language Processing (NLPs) into scientific writing causes panic among scientists, healthcare workers and researchers alike. While many researchers denounce the integration of AI systems, some understand that AI is here to stay and has its benefits. It helps decrease the time required to produce a paper while making organisation, formatting, corrections and summarisation smooth without mind-numbing efforts. While the benefits make research sound like an easy task, limitations such as falsification of data and the introduction of paper mills that produce huge amounts of fake research papers need to be controlled. There is an urgent need to set ethical guidelines and rules that can help reduce the ambiguity surrounding AI development and integration. This research article dives deeper into the advantages, disadvantages, and ethical considerations that accompany AI development. What should be our job as researchers in this moment of ambiguity is the question to ask.

"Everything that civilisation has to offer is a product of human intelligence; we cannot predict what we might achieve when this intelligence is magnified by the tools that AI may provide, but the eradication of war, disease, and poverty would be high on anyone's list. Success in creating AI would be the biggest event in human history. Unfortunately, it might also be the last." -Stephen Hawking

With statements like the above, fear of AI has been set deep into the human psyche. Uncertainty lies in the eye of the beholder. AI has been predicted to replace jobs, eliminating human intervention. But is this one-sided fear rational? AI like any other technologically advanced instrument isn't a simple black-and-white entity that will either harm or benefit us. In reality, it also possesses the power to affect humanity if understood and operated ethically positively.

AI is a subfield of computer science that engages in intelligent machine behaviour. According to Dong et al. (2020), it comprises the software and hardware in an artificial entity's brain.

AI was first coined in the year 1956 at the Dartmouth conference by Marvin Minsky, John McCarthy, Claude Shannon, and Nathan Rochester of International Business Machines Corporation (IBM) (McCarthy et al., 2006). Since then AI has seen a slow increase in growth, a term known as AI winter until recently (Muthukrishnan et al., 2020). Often, people confuse AI with automation. It is important to note that while automation requires machines to complete tasks based on an explicit set of established rules, AI refers to intelligent machines that can simulate human behaviour and might even go beyond it in the future. AI systems can be further classified as strong or weak AI (Dehouche, 2021). Strong AI is a hypothetical form of AI known as Artificial General Intelligence (AGI) which has intellectual capabilities equal to a human being. Meaning they can think novel thoughts, solve problems, and understand complex concepts at a humane level (Grace et al., 2018). Weak AI or narrow AI refers to already existing forms of AI like self-driving cars, AI virtual assistants, and AI image generators to name a few.

The theoretical basis underlying the operation of a weak AI tool depends on pattern recognition and prediction. The machine is programmed to produce outputs based on existing data sets (Chetwynd, 2024). Most of the AI tools available today are developed on the principles of Natural Language Processing (NLP) which takes into consideration the interaction between human and computer speech.

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Figure 1
Artificial Intelligence and its Types
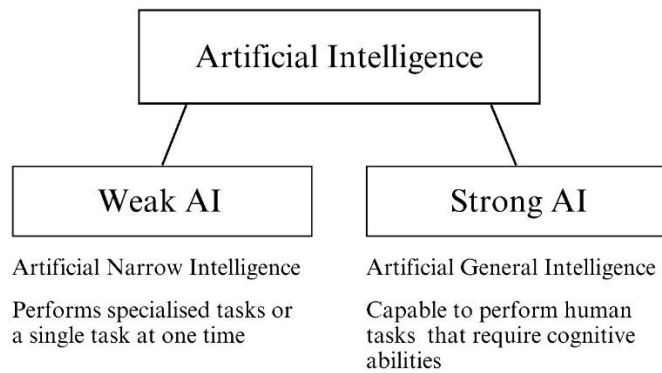
NLPs help understand, interpret and generate human language. Large Language Models (LLM) are a part of NLP that processes large bodies of data to assist in the generation of new content when demanded (*Artificial Intelligence (AI) in Decision Making*, 2021). While the above-mentioned terms were a thing of the future, the release of OpenAI's ChatGPT in 2022 paved the way for generative AI models to emerge as the new mode of content generation (Gao et al., 2022). An obvious effect was seen in the field of scientific research and development when generative AI models started producing both positive and negative changes to the way a person perceived and developed research.

Research involves the process of hypothesis formulation, collection of data and result interpretation that eventually is all presented via scientific writing and report publication. Therefore scientific writing needs to be detailed, clear and easily understood. It enables the scientific community to stay updated on the developments in their respective fields. However one knows that this process is lengthy and time-consuming. Generative AI can make this tedious process a fast and minimal-effort task. AI can enhance both the quality and efficiency of scientific writing (Cooperman & Brandão, 2023b). Apart from tasks such as grammar and vocabulary checks, AI tools like ChatGPT, Google Bard, Bing and other LLMs help perform plagiarism checks and provide a wide range of data sets required for writing a research manuscript (Kacena et al., 2024). A wide range of studies shows that currently AI has been and can be used for draft generation, summarisation, and language translation which quickens the process of research while making knowledge accessible around the world, especially for scientists who are non-native English speakers.

Unfortunately, it also brings forth a cautionary stance as many researchers believe that implementing AI into scientific writing is the writer's choice. AI can't be held accountable for falsifying information or spreading misinformation and therefore the writer needs to ensure that the quality of the paper is not compromised while referencing AI tools (Pratiwi et al., 2023). They can also be used for producing fake or low-quality papers (Castellanos-Gomez, 2023). One such threat is from "paper mills" that are known for generating low-quality research papers using AI tools like ChatGPT while pretending that such papers are reliable and of higher quality (Castellanos-Gomez, 2023).

The biggest debate around the integration of scientific writing and AI is the decision regarding AI's authorship over the content it produces. These systems use Natural Processing Language (NLP) that mimics human language which after all is reliant on pre-existing data. Consequently, it lacks originality and human voice. So researchers are still figuring out the ethical considerations regarding AI and its authorship.

While some publication houses like Elsevier have already started forming rules and regulations regarding the extent of involvement of AI, journals like Science are completely banning AI usage while Nature remains firm on its decision to not accept such software as a co-author but can be used for research with human control (Cooperman & Brandão, 2023b).

Benefits, Limitations and Ethics

We have been taught that anything in moderation is key and beneficial while excess causes hindrance. The same applies to the current models of generative AI which have their benefits as well as liabilities especially when it comes to scientific writing. Scientists are currently assessing the advantages against the possible drawbacks to conclude the role of how, when, and why of AI integration into the research process.

Limitations

Salvagno et al. (2023) provide the following limitations that accompany ChatGPT. First is the lack of ability to produce novel ideation. A human input will always differ from that of a machine as it can guarantee credibility, accuracy and coherence. Therefore even though AI can't produce new ideas, this limitation ensures that authors do not completely rely on AI systems for creativity. This drawback can help draw a line between assistance and dependence because over-reliance might lead to inhibition in human creativity and critical thinking. GenAI also can't process complex concepts that are integral to scientific research and therefore it limits the accuracy of the data retrieved. To overcome this setback, researchers must provide additional context with their writing and ensure that their literature weighs accuracy. This way the researcher is accountable for his work while making the research process faster when using AI assistance (Ciaccio, 2023).

Another drawback argues that the summary and paraphrasing provided by an AI system is generic, unsatisfactory and lacks depth. This is because these systems rely on machine learning

that is designed to identify patterns and language relationships. Due to this one can't critically analyse the information deduced because it would lack credibility. Especially for complex sections like literature reviews and meta-analyses, one can't rely completely on AI-generated text. This is also because AI systems often plagiarise their content from already available information while not giving due credit to the authors. A lack of credibility leads to a belief that such information has been influenced by biases or errors. Although these systems don't have their preferences, the data set that they extract their information from can be discriminatory or lack inclusivity resulting in unreliable feedback or suggestions. Questions arise on who should be held accountable for the errors and biases made by AI. This setback requires further research and development of AI bots that produce reliable content for scientific research.

A real threat that emerges from these systems is the production of fake papers that may go unnoticed and get accepted as reliable literature. As mentioned above, "paper mills" are specific units that control the development of such literature which hampers the integrity of the scientific community. Today, these mills are trained to avoid detection which leads to increased stress and fear among publishers. If not in the form of an inaccurate paper, AI systems can furthermore be used to maladaptively distort or manipulate data (Gilat & Cole, 2023). For example, Cooperman and Brandão (2023b) cite a study where ChatGPT, who previously had limited data available before September 2021, was asked to provide information regarding the recent findings, it was noted that it simply fabricated the results to match the asked question (Cooperman & Brandão, 2023b).

Another limitation is the AI's black box system. AI algorithms and neural networks are based on a "Black Box" system whose working isn't even transparent to the experts and designers in the field. The training modules for the algorithms are kept confidential by the companies to protect the systems from being modified by external threats. These black boxes are a cause of worry as people find it difficult to trust a technology that lacks clarity over the underlying principles used to produce outcomes. Without clear knowledge about the actual data set, scientists, healthcare workers and authors are sceptical towards the integration of AI and science (Chetwynd, 2024).

AI is also prone to making mistakes just like humans. This phenomenon is termed AI hallucinations. The AI model generates falsified text which it tries to pass off as an authentic piece of literature. A study done by Alkaissi and McFarlane (2023) conducted a series of exercises where they ran text prompts through ChatGPT in which the algorithm provided inaccurate statements for subject areas that were

well-researched and provided lengthy articles for areas that lacked information. This proves that AI can and will make mistakes when generating outputs. So how can one completely rely on what it has to say? One cannot, yet. Pratiwi et al. (2023) talk about the Domino effect which refers to a chain of reactions that follows a behaviour after a certain trigger initiates the process first. It is a road map that paves the way for the next step by observing codes or signals that when triggered follow a set of behaviours. Technological advancement can either produce positive or negative outcomes which might better an individual's behaviour or worsen it. When individuals take advantage of AI without regard for rules and regulations, either side of the coin can be flipped. One might even get so dependent on AI that human critical thinking might diminish leaving people to depend on AI for all tasks. So to avoid negative outcomes due to a domino effect, it is important that with the current prototype of AI, we as researchers start conversations that discuss policies and scientific frameworks that can be applied to AI system use for scientific purposes.

Currently, AI is in its initial stage where it is prone to inaccuracies and faults. But that doesn't mean it is the devil in disguise for the writing community. AI, with a lot of promise, should exist in collaboration with human intervention to remain a boon for the upcoming generation.

Benefits

Apart from the above-mentioned drawbacks, AI has shown promise by providing various benefits to the academic field. It has been guiding researchers in organising and developing the ideas already set in their minds. It can form the initial draft that acts as a guideline for the researcher to expand on. It quickens the process of reviewing literature, finding papers, summarising articles and detecting existing gaps. It is good at providing background to the research study which can be used in abstracts and discussions (Tatalovic, 2018). One might also use AI to stay updated on the current trends in their respective fields as it provides information on the go (Salvagno et al., 2023). During a research project, tasks such as editing, formatting, language comprehension and rewriting consume a large amount of time. These detailed integral steps can be handled by algorithms so that the researcher can focus on critical aspects of the study like result interpretation and data collection (Gilat & Cole, 2023). Overall AI can reduce the time and effort required for a paper publication while increasing efficiency. Presently, AI models might not be as advanced as one wishes yet these algorithms are being constantly modified to integrate more and more quantities of data. They will improve over time and hopefully find a way to be completely reliable for scientific purposes. Ciaccio (2023) mentions three key benefits of AI algorithms: enhanced efficiency, improved accuracy and increased clarity. They enhance the readability of scientific papers,

especially for non-native English speakers and scientists who struggle to get their work published due to a lack of resources. Del Giglio and Da Costa (2023) conducted a non-systematic review using the terms "Artificial Intelligence", "Scientific writing", and "Non-native speaking" to create results. They found that AI is a potential solution for improving scientific literature for non-native English-speaking scientists. AI tools like Elicit and Research-Rabbit are programs that help search for scientific papers, Sci-space Copilot is used for summarisation, Grammarly and Paper-pal help correct grammatical mistakes, while ChatGTP answers prompts and provides information that can be used for gathering knowledge about relevant topics.

Strategic regulation and implementation of an ethical guide for AI usage will enhance the benefits currently provided by AI systems while reducing the limitations. We need to question where to draw a line between use and misuse rather than whether we should use the technology. (Chetwynd, 2024).

Ethical Considerations

The global AI market was at 136.55 billion USD in 2022 and is said to increase at a compound annual growth of 37.3% from 2023 to 2030 (*Artificial Intelligence Market Size,* n.d.). Therefore people must engage in discussions regarding the ethics of the field. Since AI is in its initial stage, no concrete ethical guidelines have been established yet. Researchers and scientists alike are engaging in discussions about whether AI should be a part of scientific writing and to what extent. Some journals like Elsevier, one of the largest publishers of academic papers and textbooks, have strictly established a policy regarding AI and its assisted technologies. They encourage writers to use AI but with certain criteria. Firstly, authors must only use AI to improve readability and language while ensuring human insight. Secondly, authors are responsible for the reviewing and editing process to avoid negative outputs from the AI models. Lastly, AI should not be listed as an author but one should disclose the use of it in their published work (*Responsible AI Principles | Elsevier Policy*, n.d.). Authors must be transparent about the use of AI to ensure credibility and good-faith reporting from their side. But they might not do so due to a fear of stigmatisation from the publication houses. This is why journals need to set criteria for AI integration that help researchers understand the current standing of AI content.

Elali and Rachid (2023) demonstrated that text created using AI tools was capable of deception even when AI detection tools were implemented. After running the AI text through an AI paraphrasing tool, the AI detectors still rated the text as human-generated at 88% and 78.5%. Questions can be raised on how to distinguish between AI and human text.

Gao et al. (2022) generated abstracts using ChatGPT for 50 medical papers. These abstracts were compared to the original ones. Results indicated that both human and AI detectors were able to distinguish ChatGPT abstracts with ease but none of them perfectly did the job. Some reviewers classified AI texts as humane and vice versa. ChatGPT was successfully able to generate abstracts by just using the title and the journal of the paper but lacked credibility when it came to the numerical data used in the generation (Gao et al., 2022). If this is the case, how will one distinguish AI content from actual data? The key is a need for full disclosure and transparency. Only when researchers feel safe from stigmatization will they reveal the AI sources used in their papers. An ethical author will strongly account for the use of AI. Some argue that to be an author of a paper one requires the act of writing as well as the responsibility for the information provided. According to the International Committee of Medical Journal Editors (ICMJE), authorship can be granted only if the following four criteria are met. First, the author should have a substantial contribution to the design, concept, analysis and interpretation of research data. Next, they should review the work for intellectual content and provide the final approval for the final publication. Lastly, the author will be held accountable for all aspects of the work ranging from accuracy to integrity (ICMJE | Recommendations | Defining the Role of Authors and Contributors, n.d.). Currently, LLMs do not meet the criteria for the above-mentioned authorship. ICMJE states that AI usage can be acknowledged in the paper manuscript so readers are aware of the programs used in paper production. Authors must ensure that all information obtained must be real and not deceptive.

Another ethical issue that one might face is unintentional plagiarisation by an AI system. AI works on the principle of pattern recognition due to which it could unintentionally use similar words published previously by an author whose work is easily accessible on the internet. Further, if the researcher doesn't assess the answers presented by an AI model he might risk claiming an idea as his which could not be the reality (Dien, 2023). Academic integrity is violated when someone copies the work of another individual without providing their views and due credit. To ensure that one doesn't make such a mistake it is essential to fact-check and examine the content provided by AI systems. And if doubt persists, it's better to use traditional research methods till AI advances to a more credible system.

AI hallucinations pose a threat to credibility. By producing biased or inaccurate results, AI often fabricates the content it provides. This causes falsified information to be published while the quality of research might degrade over the years. A study by Kacena et al. (2024) addressed the question of

AI's ability to publish a full-length scientific review of the highest quality. While comparing three writing styles they wanted to evaluate whether the utilization of an AI system would save time in composing a research article. According to their hypothesis, human paper would take the most time while it would also be the most accurate one and would require the least changes. On the other hand, AI paper would require most changes but would produce the same paper in less amount of time. An intermediary paper consisting of an integration of human and AI tools will take intermediate time and require few changes. The results indicated that the AI-only group was the fastest in composition but had the highest number of mistakes as hypothesised. Human AI integrated paper required extensive reorganisation of paper. Another exploratory finding revealed that the reviewers found it easier to read AI-generated texts than human-generated texts as they were simplified. The Black Box system is a threat to the ethical use of AI as the inability to trust AI systems due to a lack of transparency causes difficulty in forming and maintaining regulations for a system that experts can't even understand fully. (Abd-Elsalam & Abdel-Momen, 2023). Abd-Elsalam and Abdel-Momen (2023) suggest opening the black box AI system but currently, this can't be done without sacrificing performance. It's a difficult goal but one can hope that someday this can be deemed possible when AI emerges as a completely reliable tool.

NLP systems continue to learn as they receive data constantly. But they aren't aware of the true meaning of this data. They completely rely on pattern recognition and are tasked to generate grammatically correct and appropriate texts. They are flawed due to their focus on just statistical relationships rather than the relationship between the world and the language it uses. Due to this, these systems cannot often apply common sense reasoning (Hosseini et al., 2023). Therefore it is important that when NLP is utilised to write excerpts in a research paper, the author thoroughly checks the content for accuracy and eliminates any bias. If errors or biases are found authors need to be held accountable. Disclosure of NLPs is a must and should be done to uplift scientific integrity. Hosseini et al. (2023) also mention that using NLPs for analysis of text, speech, interviews or surveys can raise an issue of integrity. Therefore researchers should not use NLPs to produce falsified data.

Lastly, Salvagno et al. (2023) believe that free-of-cost AI systems are beneficial to all but when this software will turn into paid models then that would contribute to the disparity between researchers with and without access to the AI model. With the rapid advancement in AI today, it is important to engage oneself in discussions that talk about ethical considerations and prospects of AI. AI is here and will continue to stay. So one must try to understand it rather than fear it.

Discussion

AI has arrived and so have people's opinions. Currently, there seems to be an ambiguous stance among researchers all around the world. While some accept the integration of AI and use it ethically, some researchers still reject it or engage in unethical usage.

AI provides many benefits that can make research writing a hassle-free and quick process. Based on the principles of Natural language processing and machine learning, which comprehend patterns and recognise gaps, AI has seen rapid growth in the last few years. By utilising AI systems like ChatGPT and Grammarly researchers can focus on the important parts of the research process like data collection and result formulation while AI can handle summarization, paraphrasing, grammar correction, initial draft formation, formatting and referencing. AI systems are a boon for non-native English-speaking researchers as well.

The benefits bring out the limitations as well. AI systems are prone to making errors which is termed AI hallucinations. These hallucinations cause the AI system to unintentionally formulate content that might be factually false and vice versa. AI systems also lack credibility, and accuracy without human intervention. Human and AI language are often difficult to distinguish yet some studies show that AI language is more generic and easy to understand while the same isn't true for human language. Another aspect of overreliance or a negative Domino effect due to AI systems can cause a rapid decline in human creativity and originality, especially if the AI systems further progress and develop into a current hypothetical concept of AGI that will be self-reliant.

Currently, researchers need to develop ethical regulations that ensure the moral use of the technology. Few journals like Elsevier and Nature have started defining the criteria for a paper to follow if they want their research to get published in their respective journals. Such steps are necessary to ensure the reduction of paper mills, falsified data, fake articles and maladaptive results that researchers might produce to enhance their papers. Guidelines and policies will ensure that individuals lose the use of AI and take up accountability for their work. For a researcher to integrate AI into their scientific writings they have to be honest and uphold scientific integrity. Without it, the field of science and research is seemingly exposed to threats from AI.

Future studies can delve deeper into what features of an AI algorithm could be required for scientific writing. For example, an AI model specifically developed to format a research paper into the required guidelines for the choice of journal. Or an AI system which has an open black box system so that humans can easily understand how that system works resulting in increased co-dependency between the two. When conducting any future research into the topics of machine learning or AI and its integration into the scientific community it would be beneficial if there is a collaboration between a tech developer who understands computer systems and a researcher who wants to voice out the needs of writers. This collective effort can increase credibility, and accuracy and build trust amongst researchers across the world.

Declarations

Conflicts of interest: The author has no conflicts of interest.

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