Optimizing ChatGPT for scientific writing in the digital age

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ABSTRACT

The emergence of advanced artificial intelligence-based machines such as ChatGPT has brought about changes in the scientific writing process, especially among students. Aspects of originality, creativity, and quality of writing results in the scientific writing process need to be studied to maintain academic integrity, open up opportunities for idea development, and produce coherent and structured writing. This study aims to analyze the use of ChatGPT as a tool in the process of scientific writing in Indonesian, especially in writing the background of the problem for the preparation of the final project of Informatics Engineering study program students. This research is a descriptive qualitative research with content analysis approach. Sampling was done by *purposive sampling* technique. Sampling was done by *purposive sampling* technique. A total of 18 students of class R67 in semester VI of the Informatics Engineering study program, Indraprasta PGRI University Jakarta were selected because they routinely use ChatGPT in working on scientific writing assignments. Data was collected by reviewing documents in the form of the results of the task of writing the background of the problem made by students using ChatGPT as a tool in the Scientific Writing course. The use of ChatGPT in scientific writing offers significant benefits in terms of creativity and writing quality. The results show that this technology can make learning more efficient by creating new concepts and improving understanding of research ideas. In addition, ChatGPT also helps to produce quality writing. However, ethical issues related to academic integrity should be considered by analyzing the originality aspect through similarity check with turnitin application. Therefore, while ChatGPT provides many benefits in improving the academic writing process, it is imperative to balance these benefits with careful attention to ethical considerations to maintain academic integrity.

Keywords: ChatGPT, scientific writing, digital era

INTRODUCTION

Technological advances in the digital era have changed many aspects of human life, including education. The digital era emphasizes the use of digital technology to facilitate access to information, improve efficiency, and expand the reach of educational services (Gabriel et al., 2022). Digital technology has offered rich and interactive learning resources, as well as new opportunities for learning and self-development. By providing a variety of learning resources that can be accessed anytime and anywhere, digital technology can be used to improve the quality of learning (Rahmawati & Pranowo, 2022; Seraphine & Ginting, 2024) The approach to education and technology underwent a major change when the concept of the era of society 5.0 emerged. The society 5.0 era integrates technology with human values, placing humans at the center. This leads to the utilization of technology in education to improve the quality of learning, build 21st century skills, and prepare the younger generation to face the increasingly complex demands of society.

Various industries are now using artificial intelligence. This is driving social progress and economic growth, resulting in changes in productivity, lifestyles, and even the way humans learn (Yufei et al., 2020). In a consensus, UNESCO even suggested that all countries make appropriate policies and study effective strategies for implementing artificial intelligence in an effort to promote educational innovation. Education can help the development of human society by integrating artificial intelligence (Huang, 2019). In simple terms, artificial intelligence is a machine's attempt to mimic human intelligence using technology (Helm et al., 2020). Many aspects of society will be changed by this

technology, including education, economics, and socio-culture. Many new learning and product manufacturing techniques are emerging, as well as new fields of work that were never thought of before. In many ways, artificial intelligence is one of the most significant technological advances that could shape the future of society. Due to the rapid changes in technological evolution, it is important for society to utilize technological advancements in various fields when facing the era of society 5.0 (Fukuyama, 2018).

One such artificial intelligence-based product is ChatGPT which has the ability to understand human language, process questions, and provide contextual and relevant answers. ChatGPT is a chatbot developed by OpenAI. The technology is based on the *Generative Pre-trained Transformer* (GPT) architecture which is designed and trained using very large text and code datasets for natural language processing tasks such as text generation and language understanding. This makes ChatGPT capable of generating text that is similar to text written by humans. ChatGPT was trained with large amounts of text and data to be able to answer questions and produce coherent text in a wide variety of tasks and contexts. As a result, ChatGPT can understand the context of a question or task and provide accurate and engaging answers or text.

ChatGPT's services are evolving as technology advances at a rapid pace. In the near future, its contribution to education will continue to increase. It is undeniable that artificial intelligence technology is needed in education in the 21st century to ensure effective teaching and learning. This condition can be an opportunity and a challenge in learning. With ChatGPT, learning activities allow for a lot of linguistic use on user input and their interaction with the computer. This type of user and artificial intelligence-based tool interaction occurs when they click to get an appropriate response, choose to continue, or request information such as word definitions or additional notes on previously given input. This type of interaction teaches learners about the correctness of responses and gives them an understanding of the importance of using language to provide input requests to the computer. Both interactions have proven to be beneficial for both (Chapelle, 2008).

The presence of ChatGPT as a form of technological development has a significant impact on the world of education, especially higher education which is closely related to the scientific writing process. At the higher education level, one of the most needed skills, along with reading, is academic writing due to its importance in knowledge construction. Scientific writing is the formal language for disseminating scientific knowledge generated from research (Drennan, 2017; Fabián, 2017; Montes-Zambrano & Reyes-Meza, 2022). Scientific writing is not an easy practice to tackle, especially for students who are just starting out in the world of research generally have little previous experience in the field of writing, which causes difficulties in writing research results. A study of scientific writing in university students detected difficulties in the presentation of scientific texts, such as errors of coherence and conformity to the logic of research and informal language used by the author, little time for writing, basic concepts of research methodology, and little knowledge of grammar rules (Montes-Zambrano & Reyes-Meza, 2022).

The learning process of scientific writing in higher education should be managed effectively. This will enable students to become more independent in thinking, understand the relationship between concepts and materials, communicate orally, develop their own knowledge and skills, and solve problems that arise when writing scientific papers (Supriyadi, 2015).

Technological developments in this digital era provide both opportunities and challenges for researchers to maintain academic integrity (Agussalim & Handayani, 2023; Febrian et al., 2024). Although technology provides convenience, the quality of scientific work remains a major concern. To achieve quality standards, researchers must understand that plagiarism and non-compliance with scientific writing requirements can be obstacles. Therefore, it is important to carefully consider the ethical issues associated with ChatGPT. According to Faiz & Kurniawaty (2023), ethics and morals are essential when using AI to maintain academic values. Supported by contemporary technological advances, the focus of education in the era of revolution 5.0 is to build human beings who have reason, knowledge, and morals (Dewirahmadanirwati, 2021).

In addition, Habib et al. (2024) highlight that ChatGPT, which is a machine powered by big language models and generative intelligence, raised the interest in the relationship between human and machine-based creativity and led to new investigations. The research conducted by Stevenson, et al. compared ChatGPT-3 results with those produced by humans without the aid of artificial intelligence. The study found that humans had better original creative outcomes than GPT-3, despite the availability

of a more advanced and potent version of the software. However, they also stated that even though humans have more original results than ChatGPT-3, GPT-3 responses are still applicable (Stevenson et al., 2022). According to Vinchon et al. (2023),"we are in a new era, assisted creativity". It means that efforts are needed to balance the contribution of technology and the role of human creativity in the process of creating student papers (Sufendi & Kamal, 2023).Therefore, in an era of ever-evolving technology, essential components in shaping relevant and quality scholarly work are an awareness of the impact of technology on academic integrity, an emphasis on preventing plagiarism, and a commitment to writing standards (Febrian et al., 2024; Melati et al., 2023).

The main challenges of using ChatGPT in higher education today include data integrity and the ability to distinguish between writing generated by ChatGPT and humans. Although originality and reliability of information in scientific research should already be a major concern, students are reported to frequently use ChatGPT to write abstracts. This practice may result in the loss of students' ability to critically search, analyze and generate information. While there are concerns that ChatGPT technology will replace the role of humans, the ability to create new knowledge through scientific research remains in the human domain. ChatGPT can help with data collection and text generation well, but creativity and critical thinking are still the main strengths of humans (Ocampo et al., 2023). This is in line with research that highlights the importance of developing guidelines and best practices for the use of AI in academic research to maintain the integrity and quality of scholarly work. While ChatGPT has great potential to support academic work, it is important to address ethical concerns and negative impacts for its benefits to be fully realized (Qasem, 2023).

In the context of Indonesian language learning, ChatGPT is ensured to improve the understanding of technical concepts of Indonesian language, namely reading, writing, and communication skills. When searching for information using ChatGPT, students need writing skills, problem-solving skills, and literacy skills through giving prompts (Resky et al., 2023; Setiawan & Luthfiyani, 2023). When interacting with ChatGPT, language serves as a thinking tool that can build students' active participation in discussions with the artificial intelligence machine. Language could offer a logical approach to the learning process. As a scientific tool, language plays an important role in ensuring that scientific activities are carried out in an appropriate manner. By using language, scientists can develop and disseminate knowledge to enrich the mindset of a country's society. Language is no longer seen as a means of communication, but as a reflection of a society's culture and thinking (Buyung & Burhanuddin, 2023; Pujiono & Widodo, 2021) Based on those explanations, this study was conducted to analyze the process and results of scientific writing made by students with the help of ChatGPT, based on aspects of originality, creativity, and writing quality, as a form of contestation and constellation of Indonesian language in the process of scientific writing in the digital era.

Previous studies have found the benefits and drawbacks of using ChatGPT in learning and scientific writing. However, some research gaps still need to be investigated. Research on the level of originality of scientific writing produced with the help of ChatGPT by using plagiarism checking applications and how students can ensure the writing remains original. In addition, research needs to be done on the use of AI to enhance students' creativity without compromising their ability to develop original ideas. In addition, research needs to be done on the integration of AI in learning to support quality scientific writing outcomes. The purpose of this study is to fill this gap by looking at the process and results of scientific writing created by students with the help of ChatGPT based on aspects of originality, creativity, and writing quality.

METHOD

This research is classified as a type of qualitative descriptive research with a content analysis approach. Qualitative research is conducted to analyze and understand the meaning of individuals or groups related to social or human problems (Creswell & Creswell, 2018). In the context of this research, the social phenomenon studied is about the use of ChatGPT in the scientific writing process carried out by students. With a content analysis approach, the research was conducted to assess the results of students' assignments in the scientific writing process with the help of ChatGPT.

Sampling was done by purposive sampling technique. Purposive sampling is a sampling method in which the researcher must determine in advance the boundaries of the characteristics to be taken for research (Supardi, 2015). The number of samples taken by purposive sampling was 18 people who were students of class R67 semester VI of the Informatics Engineering study program, Indraprasta PGRI University Jakarta

who were accustomed to using ChatGPT in working on college assignments. The sample selection was carried out to ensure that the research subjects had sufficient experience in using ChatGPT.

The data was collected using document review and in-depth interview methods. Document review was conducted to analyze the results of assignments limited to writing the background of the problem created by students using ChatGPT as a tool in the Scientific Writing course to assess aspects of originality, creativity, and writing quality of the background of the problem. First, to assess the originality aspect, the students' assignments were checked with Turnitin which provides an objective similarity score to assess originality based on widely accepted standards.

The second aspect studied is the creativity aspect. The aspect of creativity assessed in this study is the creativity shown by students when they interact with ChatGPT in the background writing process. The generation of text generated by ChatGPT depends on the request submitted by the user. Therefore, in interacting with ChatGPT, students must have creativity when submitting requests, questions, or commands to ChatGPT. The assessment of creativity aspect is in accordance with the creative indicators according to Widodo & Wardani (2020) which consists of three indicators, namely 1) students are able to create or generate ideas, 2) students are able to modify ideas, and 3) students are able to analyze, evaluate, and construct ideas to improve the quality of writing. These indicators are assessed on a scale consisting of scale 0, scale 1, scale 2, scale 3.

Table 1. Indicators of Creativity Aspect

Scale	Indicators
0	Students that used ChatGPT to assist in writing the problem's history were unable to complete any of the creative indications.
1	Students who used ChatGPT to assist in writing the problem's history were only able to complete the first indicator.
2	With ChatGPT's assistance in writing the problem's history, students were able to meet both the first and second indications.
3	With ChatGPT, students can use the first, second, and third indicators to assist write the problem's history.

Third, the assessment for the quality aspect of writing is applied in accordance with the material presented in the Scientific Writing course in the background writing section in the Informatics Engineering Study Program at Indraprasta PGRI University. The structure of the background of the problem consists of a description of the general situation, the special situation, the reason for choosing the research location, a description of the existing problems at the research site, and a solution plan for the existing problems (Sumaryoto et al., 2023). The background must be organized according to this structure in order to create a coherent background. The indicators for assessing the quality of background writing are based on the completeness of the background structure and the coherence of the paragraphs. The writing quality assessment indicators are outlined in the following rating scale.

Table 2. Indicators of Writing Quality Aspect

Scale	Indicators
0	The background does not match the background writing material, so it is not coherently organized.
1	The background is only composed of several parts based on the background material and is not coherent.
2	The background is composed of several parts based on the background material, but it is coherently organized.
3	The background is fully organized according to the background writing material and has been arranged coherently.

Furthermore, in-depth interviews were conducted with students to confirm the results of the document review that had been obtained previously. This study used triangulation data validation. Data triangulation was carried out by combining various data sources and methods, namely data collected from student assignment documents, in-depth interviews with students, and the results of checking with Turnitin. This method helps to understand how the use of ChatGPT on aspects of originality, creativity development, and achievement of the quality of student scientific writing results.

RESULTS AND DISCUSSION

Originality Aspect

In this study, supervision measures were carried out to assess the originality aspect. The originality aspect was assessed by using the Turnitin application to obtain similarity numbers on the background writing produced by students as an assignment in the Scientific Writing course by utilizing ChatGPT as a tool. Turnitin can detect plagiarism by showing the similarity of writings called similarity numbers. This is done to see whether the results of background writing with the help of ChatGPT produce writing with a high level of plagiarism or not because the similarity number is made based on the level of similarity with other published scientific works. In the end, this similarity number shows the originality aspect. The similarity percentage limit in this study is 25% according to the similarity index threshold based on the color generated by the Turnitin application.

Table 3. Originality Aspect

	Amount of Data	Percent
similarity below 25%	15	83.3%
similarity above 25%	3	16.7%
Total	18	100%

Table 3 shows that, from the results of the Turnitin application, the majority of students (83.3%) produced background writing with a similarity level below 25%, which means that the results of the background writing written by students with the help of ChatGPT are still below the similarity index limit. These results are in accordance with the results of research conducted by Daulay & Pasa (2015). They emphasize that supervisory measures are necessary to prevent cheating. For example, lecturers should increase the strictness of their assignment system to their students by using *software* that can check the level of plagiarism of scientific writing assignments. By improving the education system and evaluation process, it is expected that the use of ChatGPT will not violate academic ethics such as plagiarism.

Academic fraud is the biggest threat today. Daulay & Pasa mentioned that academic ethics that must be held by students are true; actually, create and complete assignments, essays, and scientific papers based on their own thoughts; honest; honest about the results of assignments and scientific papers; and do not manipulate data or commit plagiarism. Therefore, awareness of plagiarism prevention in the process of scientific writing in higher education must be increased (Pahamzah et al., 2022). The results of interviews with students stated that they reorganized the results of text generation from ChatGPT and added information from other sources, such as scientific articles to produce background writing. This shows that students still pay attention and maintain their academic integrity in scientific writing by using ChatGPT tools ethically.

The use of ChatGPT in education does raise concerns due to the potential for violating academic rules and ethics, issues of plagiarism, and the decline of critical thinking, and creativity. Concerns about the use of ChatGPT for fraud and plagiarism arise because of the generation of such fluently crafted and well-written texts (Loh, 2023; Maulana et al., 2023). Stokel-Walker argues that ChatGPT is an AI chatbot that can create text very intelligently to answer user requests, such as homework assignments and exam-style questions. Some academics have called this bot the death knell for conventional educational assessment methods as the answers provided are clear, researched, and heavily referenced (Stokel-Walker, 2022).

Therefore, users, especially students, should consider ethical aspects when using ChatGPT as a support tool in scientific writing. They should ensure that ChatGPT contributions are integrated in an ethical manner. This is necessary to ensure that the results still reflect the student's personal understanding and efforts and do not raise doubts about academic integrity. With these ethical aspects in mind, ChatGPT can be a useful tool in the learning process of scientific writing (Azahra et al., 2023).

Creativity Aspect

The second aspect assessed in this study is the creativity of students in writing the background of the problem by utilizing ChatGPT as a tool. The assessment of this aspect of creativity is in accordance with the creative indicators according to Widodo & Wardani (2020) which consists of three indicators, namely 1) students are able to create or generate ideas, 2) students are able to modify ideas, and 3)

students are able to analyze, evaluate, and construct ideas to improve the quality of writing. These indicators are assessed on a scale consisting of scale 0, scale 1, scale 2, scale 3. Based on these indicators, the research results obtained for the creativity aspect are presented in the following pie chart.
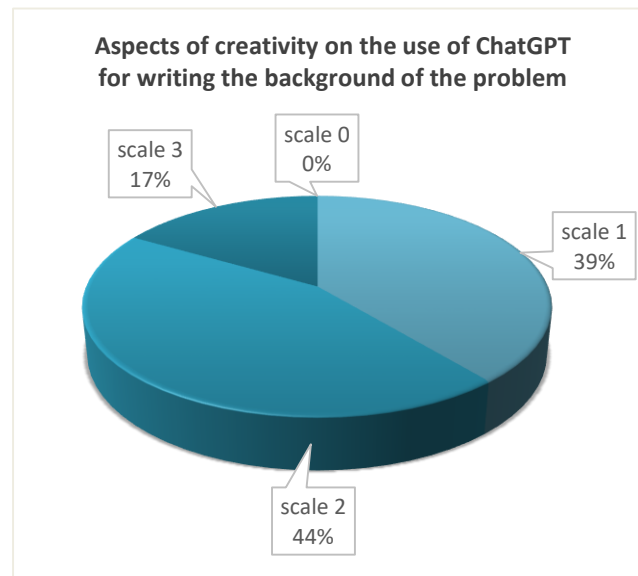

Figure 1. Creativity Aspect

Based on Figure 1, it can be stated that students have been able to meet the creativity indicators in accordance with the assessment on scales 2 and 3, namely being able to generate and modify ideas, as well as analyze, evaluate, and construct ideas to get ChatGPT responses that suit students' needs for background writing, with a total percentage of 61.1%. This result is in accordance with the theory conveyed by Kanematsu & Barry (2016), the creative process involves synthesis, analysis, and evaluation, which are higher levels of thinking that allow individuals to generate original ideas and solutions.

These results are reinforced by the results of interviews conducted with students. They stated that they were happy with the use of ChatGPT and believed that ChatGPT could help to access information more efficiently, develop ideas they had previously had, and help them with their assignments. This is consistent with the results of a study conducted on students in Australia to look at the relationship between creativity and AI. Interviews with students showed that students who had a better understanding of AI had a positive attitude about integrating AI into their learning process (Marrone et al., 2022). Other research results explain that AI generators help to initiate ideas. Without AI generators, ideas are initially difficult to come up with and when AI generators generate ideas, the students are able to come up with more ideas (Habib et al., 2024). In other words, AI is not an independent creator, but rather a collaborative agent. The use of ChatGPT can change the way students organize the background of their scientific work. New concepts and ideas can emerge and take shape through the interaction between students and technology. This process can enrich the academic writing process. By using ChatGPT, students can develop new ideas and investigate the context of their research. By providing information about the research topic, they can receive responses that expand their understanding of the background of the problem they are facing.

Writing Quality Aspect

The last aspect assessed in this study is the quality of the background writing produced by students by utilizing ChatGPT as a tool. The assessment of writing quality aspects is applied in accordance with the material presented in the Scientific Writing course in the background writing section. Indicators for assessing the quality of background writing are based on the completeness of the background structure and paragraph coherence. The indicators of this writing quality assessment are described in the following rating scale: scale 0 indicates that the background is not in accordance with the background writing material so that it is not coherently arranged; scale 1 indicates that the background is only composed of several parts based on the background material and is incoherent; scale 2 indicates that the background

is composed of several parts based on the background material, but has been arranged coherently; scale 3 indicates that the background is completely arranged in accordance with the background writing material and has been arranged coherently.

The research findings for the writing quality component are shown in the following pie chart based on these indicators.
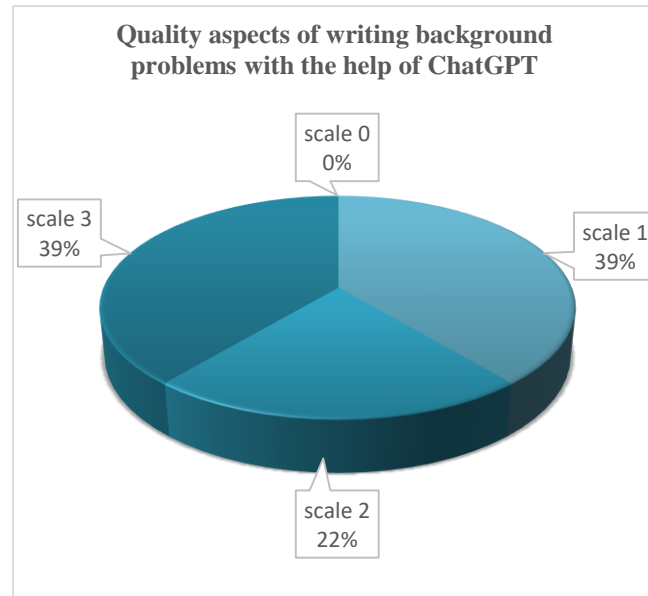

Figure 2. Writing Quality Aspect

The quality aspect of background writing is obtained by analyzing the content of the background writing produced by students with the help of ChatGPT. The quality of background writing is adjusted to the background writing material provided in the Scientific Writing class. The result is that most students have been able to produce background writing that is in accordance with the material with a total percentage of 61.1%. Based on the results of interviews with students, they mentioned that the process of preparing the background of the problem is still based on the guidelines taught in scientific writing classes. Then, they use ChatGPT as a tool to develop the content of each paragraph according to the structure of the background of the problem. This shows that ChatGPT integration is adjusted to the background writing material to produce a coherent background so that it can produce quality background writing in accordance with the material provided in the Scientific Writing course. This is in accordance with the statement of Munawar et al. (2023). He stated that the use of ChatGPT can improve the quality of manuscripts and documents.

Based on the results of the above research, it can be said that the use of ChatGPT to help write the background of the problem as a form of Indonesian language contestation in scientific writing in the digital era because this artificial intelligence technology can provide significant benefits in the learning process of Scientific Writing in Indonesian. ChatGPT can provide relevant information according to the research ideas given by students. Furthermore, students can further explore their research ideas by utilizing ChatGPT's generative capabilities and natural language understanding, enabling them to generate richer and more targeted background issues. With the ability to access online resources directly and quickly, ChatGPT can help to generate creative and innovative ideas. This can help students to stand out in the contestation of Indonesian language use in scientific writing in the digital era.

In addition, the use of ChatGPT in scientific writing reflects the constellation between culture and technology. The integration of technology such as ChatGPT in education requires a balance with learning experiences so that students can keep up with the times while maintaining academic integrity, especially in scientific writing. Thus, the cultural constellation refers to how students adjust to new technologies such as ChatGPT, while still maintaining standards of originality, creativity, and writing quality.

Furthermore, the use of Indonesian in scientific papers that interact with contemporary technology provides an important understanding of how technology and culture influence and shape each other.

This is in line with the research findings which show that the era of technological disruption has a huge impact on Generation Z's cultural knowledge as they are raised in a highly connected environment, which affects the way they acquire, consume and understand information. Therefore, in order for them to keep up with the times and be able to gain meaningful learning experiences, a balance is needed between the use of technology and the acquisition of concrete learning experiences. Mentorship and character education are essential to help students cope with social and cultural changes in this era of industrial revolution. (Putri et al., 2024). ChatGPT can provide an important role as a tool in the scientific writing process for researchers. Ultimately, the results of scientific writing should come from and be expressed by sophisticated computers in human heads (Thorp, 2023).

The use of ChatGPT in scientific writing not only fulfills the urgent need to create coherent and structured texts, but also to improve the originality, creativity and quality of academic writing. Originality is guaranteed through rigorous similarity checks, ensuring that student work remains original and free from plagiarism. ChatGPT stimulates creativity by helping students generate and refine ideas, resulting in more innovative and original writing ideas. The quality of writing is improved as ChatGPT assists in directing thoughts coherently and structuring the text according to the standards of the material that has been provided in class. These three elements - originality, creativity and quality - are essential pillars of effective scientific writing, reinforcing each other to produce work that is informative, insightful and academically ethical.

By incorporating these aspects, students can achieve higher standards in academic writing, making ChatGPT a valuable tool in the learning process. However, educators and students must be vigilant of ethical use, ensuring that this technology serves as a tool to maintain the integrity and authenticity of academic work.

CONCLUSION

The digital age that emphasizes information technology has the potential to change the education system, offering various challenges and opportunities. Students can utilize this technology to enhance their skills in an innovative and inclusive manner. However, they must also adjust to the paradigm shift in scientific writing and understand how to utilize technology for academic purposes.

The use of ChatGPT in scientific writing, as part of the contestation of Indonesian language in the digital era, provides significant benefits in efficiency, creativity and quality of writing. This technology can enrich the learning process by generating new ideas and broadening the understanding of research ideas. However, it is important to pay attention to ethical issues related to academic integrity. The use of ChatGPT reflects the complex dynamics between the influence of modern technology and culture in education in the digital age. This study's results and suggestions give educators useful information to use new technologies to encourage creativity and originality in students. Learners clearly need to master writing skills, but also need to know how to utilize AI. This is supported by Marrone et al. (2022) who suggested in their research that the use of AI should be allowed and learners encouraged to use it in education. The integration of ChatGPT is helpful in structuring the writing and improving the quality of writing. As time goes by, artificial intelligence will continue to evolve and there will be more uses of AI in education in the future.

Future research can be conducted to compare ChatGPT and other AI-based text generation tools in supporting scientific writing to assess the advantages and disadvantages of each technology with a comparative study.

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