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Responsible Utilisation of AI in Academic Research Strategies for Preserving Scientific Integrity and Quality

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ABSTRACT

This article aims to investigate the impact of artificial intelligence (AI) tools on scientific research and their effect on its integrity and quality. It also aims to determine the most effective strategies for promoting the responsible utilization of AI tools in scientific research. To achieve these objectives, a qualitative exploratory design was employed to provide a comprehensive description and explanation of the practices and challenges faced by researchers and scientists. Data were collected using relevant literature reviews, and thematic analysis was used to achieve the research objectives. The findings indicate that while AI is effective and capable of improving the efficiency and quality of academic research, its misuse poses risks to research integrity and quality. Among the terribly significant dilemmas are over-reliance on AI and the fabrication and falsification of information. Therefore, universities need to establish clear guidelines to ensure the responsible use of AI, promote a culture of integrity in scientific research, and train researchers in AI ethics. Develop more specialized AI tools tailored to research and contexts. Prompt engineering is fundamental for researchers to achieve accuracy and obtain reliable results for their research. Finally, AI tools cannot replace humans in the field of research, but they can help produce high-quality research.

Keywords: AI responsible use, Research Integrity, Research Quality, Ethical Practice, Prompt Engineering

1. INTRODUCTION

With the onset of the first technological revolution at the end of the last century, research and theories focused on two main themes: the inclination towards technology and the desire to use it. At the dawn of the new millennium, astonishingly rapid technological development permeated all sectors and industries, including education. On November 30, 2022, OpenAI launched its transformative AI tool, ChatGPT, sparking a new technological revolution that astonished the world with its capabilities and advancements. This led to the recognition of AI as a vital engine of technological innovation in the Fourth Industrial Revolution. Instead of looking into people's intentions and willingness to use technology, the focus has shifted to recognising it as an important part of human existence. It is no longer possible to reject technology, especially AI. The balance between AI and diverse human functions has become a central theme in current discourse. As AI expands and permeates various aspects of life, especially education, many countries are encouraging its acclimatization into the educational context. The use of AI by teachers and students is becoming increasingly common across all educational settings. The incorporation of AI into scientific research has influenced research output, quality, and integrity. This paper aims to examine the influence of AI tools on the integrity and quality of scientific

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research within academia, while also formulating strategies to encourage the responsible and ethical utilisation of AI.

2. MATERIAL AND METHODS

To this end, a qualitative exploratory approach was adopted due to its ability to provide a rich description and interpretation of the practices and dilemmas faced by researchers and scientists in using AI tools. Multi-document analysis was used as the primary data collection method and triangulation source, utilizing peer-reviewed academic articles, research papers, book chapters, ethics committee reports, and institutional AI policies. AI tools (ChatPDF and ChatGPT) were employed to develop a research-quality checklist. ChatGPT was used to compare the literature itself, while ChatPDF was used to assess the literature's conformity to the six research quality criteria. Thematic analysis was used to examine how AI impacts the integrity and quality of research and to explore the best strategies for enhancing researchers' ethical and responsible experience in using AI in the research process. The main themes that emerged from this study are the responsible use of AI, scientific integrity, research quality, ethical practices, and research strategies and mechanisms.

3. AI'S RESPONSIBLE USE

3.1   Researcher Role Verses AI Role in Research

Western Sydney University (2025) defined research as "the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understanding (1). This could include synthesis and analysis of previous research to the extent that it leads to new and creative outcomes." This definition indicates that the core concept of scientific research is rooted in augmenting the researcher's knowledge with analytical reasoning and creativity, which collectively yield new insights and outcomes that advance the subject under investigation. AI systems rely on data-driven algorithms; however, they struggle to comprehend context when encountering novel material or situations that fall outside their training parameters. Therefore, AI is incapable of drawing conclusions or making decisions in complex circumstances (2). Moreover, AI systems are incapable of comprehending the complexities of life and society due to their absence of direct engagement with these events. This fact confirms that the researcher's role is indispensable in the field of scientific research, and its total dependence on AI may jeopardize innovation and advancement in this domain.

The Merriam-Webster dictionary defines "researcher" as "one who observes or studies through close examination and systematic inquiry" (3). The Oxford dictionary, on the other hand, defines the term as "a person who studies something carefully and tries to discover new facts about it" (4). To study a phenomenon, the researcher must be close and precise to arrive at new facts and knowledge. AI encompasses a wide array of techniques used in decision-making across natural language processing, prediction, analysis, and data interpretations. Despite its immense capabilities, AI still lacks some deeper human abilities, such as critical thinking and reasoning, meaning-making, and the capacity for social interaction through understanding human emotions and interactions. This is because AI can only activate these capabilities in specific situations, such as decisions involving input and output data (5).

Since the essence of research is inherent in human nature, characterized by curiosity, exploration, and passion, rather than simply solving problems by inputting and outputting data, researchers cannot rely entirely on AI. AI cannot replace the role of the researcher or generate new research. Consequently, we need to focus on how to integrate the human element with AI tools to produce valuable research. Furthermore, many researchers believe that over-reliance on AI in the early

stages of a researcher's career can hinder the development of essential professional skills needed to conduct rigorous and independent research (6), (7). When a researcher uses an AI program to obtain ready-made answers, they deprive themselves of the opportunity for constructive, analytical intellectual effort that leads to genuine learning.

3.2   AI Integration in Scientific Research: Necessity or Choice?

One of the domains in which AI has firmly penetrated is education, as it has become an integral element of the educational process at all levels. Teachers came to rely on it in preparing lessons, assessments, tests, and presentations, and students began to depend on it in accomplishing their assignments, studies, and projects. This tendency persisted to the master's and doctorate degrees. AI has pervasively permeated all phases and facets of scientific research at higher education institutions. Research began to be authored by AI; it possesses the ability to compose study abstracts that surpass human capabilities (8) and conducts literature reviews with unique analytical and comparative skills. It became an alternative to the supervisor, as it can correct the research work and provide recommendations and comments on how he needs to improve the quality of the study. Additionally, AI has been used for formulating research titles, generating research questions, doing literature reviews, designing research methodologies, and reporting (9). It is now undeniable that several researchers have used and gained advantages from these contemporary innovations at different stages of their studies, with the primary objective of enhancing the quality of scientific research and expediting the writing processes.

The use of AI technologies has spread across a number of scientific research communities. For example, the Norwegian Research Council, which funds research, also funds machine learning and AI technologies within its research funding system to increase the efficiency of research [5]. The Organisation for Economic Co-operation and Development (OECD) has affirmed that, when used wisely, AI may aid researchers in many research tasks, such as literature reviews, data analysis (10), and result dissemination. It accelerates study writing and, due to its capacity to enhance research expertise and provide references, may aid in addressing intricate scientific and social issues (11). In Britain, the UK Research Institute (UKRI) has been focusing on the potential role of AI in scientific research and considered it a benefit for academic research, as it can "allow us to do research differently, radically accelerating the discovery process and enabling breakthroughs" (12).

Technological advancements, particularly AI tools, have long been used to enhance research writing and data analysis in academic research, such as proofreading software (13). Many university professors have advocated for the use of AI in publishing new articles and have even encouraged their students to use it to improve their academic writing. As a result, opposition to integrating AI into scientific research has begun to wane. Moreover, the new generation of students, raised in the technological era, are entirely dependent on technology, consider it essential to their existence, and imagine life impossible without it. According to Sobral and colleagues, "not using generative AI tools is unrealistic" (14). Therefore, institutions should focus their efforts on developing appropriate scientific guidelines, instilling a culture of integrity and ethics in academic research, and promoting the optimal use of AI.

4.   SCIENTIFIC RESEARCH INTEGRITY AND QUALITY

4.1   Scientific Research Integrity

Scientific integrity entails adherence to ethical and professional standards in the execution of academic research. It consists of a set of values, standards, and behaviours that guide researchers as they perform their work with honesty, accuracy, transparency, and objectivity (15), (16), (17).

The principles of integrity in academic research encompass honesty in all research facets; adherence to rigorous procedures that align with disciplinary standards and codes; care and respect for all participants and elements within the research framework; transparency, openness, and accessibility; reliability in research carried out; impartiality and independence; fairness in citation practices; accountability for individuals and organisations to foster a conducive research environment; and adherence to ethical norms (7), (18), (19), (20). A study by Galindo-Domínguez and colleagues found that the increasing use of various AI technologies has significantly led researchers to rely on these tools, as they enhance efficiency and assist in meeting submission deadlines. However, many academics are using AI and its tools without adequately reviewing the data obtained, which can result in plagiarism. The issues encompassed were found to be data falsification, plagiarism, data fabrication, and excessive reliance on AI-generated (GTP) chat tools to produce and rephrase search results to avoid plagiarism detection (21).

Nicholas et al.'s study focused on research integrity and misconduct from the perspective of researchers who express their views and practices related to these issues (22). The study primarily used interviews, drawing a convenience sample from 91 early-career researchers across all disciplines and six countries. Three-quarters of participants stated that they were fully aware of research misconduct and questionable practices. Such misconduct is a major indictment of the academic system, and the main blame lies with the speed at which researchers publish, and the volume of research papers produced. Despite their belief that they understand the issues and know how to mitigate risks; they sense that the situation is rapidly deteriorating. Wilson & Burleigh confirmed that, GAI is becoming increasingly prominent in higher educational institutions due to its ability to generate research data and scholarly articles nearly instantly (23). The rapid generation of research data undermines traditional standards for academic rigour and integrity.

4.2   Scientific Research quality

According to Denison, research quality is put thorough accuracy, originality, and relevance, and to achieve this, the researcher should follow some specific standards to ensure the validity and reliability of their results and findings. Denison's study indicates that to advance knowledge or identify trends and patterns or develop new theories and approaches to solving problems (24), the quality research is fundamental, and he highlights the research quality standards as follows: 1)Having a well-defined research topic and a clear hypothesis, 2) ensuring transparency, 3) using appropriate research methods, 4) authenticity of responses, 5) assessing limitations and the possible impact of systematic bias, and 6)conducting accurate reporting. He also highlighted that peer reviewing by experts, researcher qualifications, and study design, can ensure the reliability of research, while funding source and statistical significance could affect the credibility of research.

When compare these standards to the previously described literature in scientific research integrity, namely The European Code of Conduct for Research Integrity (ALLEA), The UK Research Integrity Office (UKRIO), and The American University of Ras Al Khaimah (AURAK) (21), (22), a structural relation between Integrity and quality in the scientific research context is clearly released in ensuring transparency, authenticity of responses, and systematic bias. As transparency is part of the outlined principles and values guiding ethical and professional standards.

Table 1 Research Quality Checklist in the Age of AI-generated Assistance Research (24), (25), (26), (27), (28)

The criteria	The Question to be answered	Answer
1. Having a well-defined research topic and a clear hypothesis	Is your research topic specific, novel, and grounded in existing literature?	☐
	Is the hypothesis clearly stated, testable, and falsifiable?	☐
	Have you avoided post-hoc hypothesis generation?	☐
	If AI was used in defining the topic or hypothesis, have you critically reviewed and validated its suggestions?	☐
2. Ensuring transparency	Have you disclosed all AI tools used, including versions and purposes?	☐
	Is the methodology, including AI assistance, fully documented and reproducible?	☐
	Did you explain your data sources, selection criteria, and analytic methods clearly?	☐
	Can other researchers replicate your results?	☐
3. Using appropriate research methods	Are the chosen methods rigorous, suitable for the research question, and ethically sound?	☐
	Is there human oversight in all AI-assisted analysis?	☐
	Are multifactorial models used to avoid oversimplification?	☐
	Are AI methods (e.g., ML, NLP) applied appropriately and with awareness of limitations?	☐
4. Authenticity of responses	Have you verified the accuracy of AI-generated content (e.g., citations, text, summaries)?	☐
	Have you ensured originality and avoided template-like or formulaic structures?	☐
	Are you safeguarding participant privacy and data integrity?	☐
	Are all sources and inputs correctly attributed and ethically used?	☐
5. Assessing limitations and the possible impact of systematic bias	Have you acknowledged the limitations of AI tools and datasets?	☐
	Have you clearly justified any data selection or exclusion?	☐
	Have you assessed and disclosed risks of bias, overfitting, or data dredging?	☐
	Have you included correction methods (e.g., FDR) where multiple testing is involved?	☐
	Have you discussed how limitations may affect the study's conclusions?	☐
6. Conducting accurate reporting	Is the research report clear, accurate, and free from distortion?	☐
	Have you included transparent details on the use of AI in the study?	☐
	Are all claims supported by credible citations and data?	☐
	Have you archived your data/code and allowed for peer/statistical review?	☐
	Have you clearly described variables and how they were measured?	☐
	Are visual aids (charts, graphs, tables) accurate and aligned with your findings?	☐

Note: This standard was designed based on the six criteria identified by Denison (24) and others (25) (26) (27) (28) and complemented by the authors of this paper. They are designed as a reference to help researchers maintain high standards of quality, ethics, and transparency when using AI tools in scientific research.

And authenticity is further undermined by plagiarism, avoiding AI generated detection, falsified, and fabricated responses (24), with the use of AI tools, there's a risk participants might submit responses that aren't their own, and making sure that responses are authentic has become so integral to quality research. While systematic bias is addressed in reflection on the systemic pressure to publish quickly, which leads to bias and misconduct, when researchers acknowledge the problem but feel the situation is rapidly deteriorating.

Complimentary to Denison's standards with the consideration of integrity and quality correlation in scientific research, and in a realm of greater and rapid transformation of digital age to AI-generated assistant or driven research activities (24). There is a need to more comprehensive and multidimensional understanding of research quality criteria. This could be synthetised from fundamental works of UKRIO and ALLEA (see the checklist for the criteria evaluation in Table 1 above).

5. AI CHALLENGES IN SCIENTIFIC RESEARCH

AI techniques include drawbacks that might prevent the development of valuable research. It could contribute to academic fraud, undermining the trustworthiness and quality of research, as well as negatively impacting the reputation of academic institutions (22). Despite the large number of AI tools and applications available, there is still restricted availability of AI systems specifically built for academic research. The majority of current AI technologies are multifunctional and primarily designed for commercial use and investment purposes, which renders them unsuitable for research applications (29). Consequently, certain options may not meet the criteria for scientific research integrity.

On the other hand, concerns exist around amplified prejudice, data privacy difficulties, and persistent data mistakes (30). The ambiguity in their decision-making processes undermines both openness and accountability (31). Additionally, AI does not possess the profound understanding of complex scientific concepts that human competence provides in the research domain (32). Challenges resulting from this constraint could hinder its efficiency in disciplines necessitating complex interpretation, such as medicine, environmental science, and engineering. Moreover, the development and training of most large language models (LLMs) in English limits their effectiveness in non-English contexts. Likewise, when AI is employed to generate research in disciplines such as law and sociology for certain non-English-speaking in nations where English-language-based AI tools are predominant, research may yield inadequate results (29). For instance, in Arabic research, AI tools produce a constrained literature review compared to their output in English literature reviews.

Some AI programs may produce texts that are difficult to classify as plagiarised (33). On the other hand, self-plagiarism is a practice that some researchers may engage in to augment their scientific articles for career progression and acknowledgement. They reproduce their previous publications using AI. This action presents an ethical challenge in academia (34). Furthermore, the concept of "humanising" tag information poses a challenge because other AI systems may still recognise it as machine generated (13). Many studies have been conducted to examine the effectiveness of plagiarism detection techniques in identifying AI-humanized texts that imitate human writing. The findings indicated that several AI detection tools are ineffective at identifying texts generated by AI humaniser tools (13). These challenges could pose critical difficulties for reviewers when evaluating research papers.

Many personal factors impact the use of AI in scientific research, as it may foster academic fraud. These factors include fear of failure, inadequate self-discipline, and pressure from deadlines (21). Increasing publications is crucial for career advancement and recognition. On the other hand, many master's students have limited knowledge about research integrity culture (35). Numerous

studies stated current approaches to ethics education do not adequately address integrity issues associated with the use of AI in academic research (32). Additionally, inexperienced master's and doctoral students need to publish, and the rise of predatory journals allows publication without sufficient research quality (36). Furthermore, the indiscriminate use and complete reliance on AI in academic writing undermine students' basic writing, analytical, and critical thinking skills. Aljuaid's study examines the use of AI in academic writing by analysing 43 studies (37). The study revealed that the use of artificial intelligence in scientific writing lacks essential skills such as critical thinking, originality, creativity, and ethics, which could negatively impact students' research writing abilities. The study concluded that while artificial intelligence contributes to improving academic writing, it is not expected to replace traditional courses in the near future.

One of the critical challenges for AI users in research is the formulation of commands (Prompts). In scientific research, the prompts for AI algorithms are crucial for acquiring precise information (38), (39). If a researcher fails to determine the type of reference required, AI systems may generate research articles using any source, ignoring the importance of scientific rigour in directives. Khalifa and colleagues conducted a study that utilised ChatGPT for creating scientific research (40). The study found that it is necessary to offer comprehensive prompts to enable the program to generate high-quality research suitable for publication in high-impact journals. The study results also revealed that ChatGPT's weakest research aspect was the literature review.

5.1 AI Tools Dilemma in Scientific Research

However, the use of AI tools in scientific research has led to several ethical dilemmas, including data falsification and plagiarism using AI algorithms. Some AI programs may cite low-quality research papers and sometimes refer to information from websites, which is unacceptable in academic research. Furthermore, AI tools do not provide information about the quality of the articles used (41). AI developers have focused on creating algorithms specialized in scientific research without adhering to the importance of verifying the quality of scientific sources. Moreover, algorithms trained on materials that reflect fundamental societal biases pose significant concerns (42). Danler and colleagues conducted a study to identify the outputs of artificial intelligence (AI) tools and assess the reliability of their sources. The study focused on open-source AI tools available for academic writing and research, excluding commercial tools. These tools were categorized according to their functionality and effectiveness in assisting researchers with various research tasks, such as analyzing scientific literature. The results revealed several characteristics inconsistent with the quality of scientific research. The researchers found that some AI tools relied on non-academic sources, while others relied on outdated information. Most tools also exhibited a lack of transparency in their source selection (43). Furthermore, studies have shown that in an AI-friendly environment, it can be difficult for learners and researchers to distinguish between AI assistance and AI-assisted plagiarism (33), (44).

Some AI tools, such as ChatGPT, construct the reference similarly to an algorithmic process by aggregating authors, titles, and related journals of interest. In his study, Hoffer requested that ChatGPT provide answers along with its references (41), but only 6 (20%) of those were found to be valid. The study concluded that ChatGPT cannot understand the term "references" in the academic sense.

The proliferation of misleading academic publishing is considered one of the greatest dilemmas and a difficult challenge to manage, posing a threat to research integrity. Predatory journals and conferences that exploit the situation persist in growing and thriving despite attempts to counteract them (36). They give preference to publications without scrutiny for quality or integrity, and many are unrelated to scientific research; they are simply investment companies that exploit researchers' need to publish (36), (45).

6. STRATEGIES TO IMPROVE RESPONSIBLE AI USE IN ACADEMIA

The European University Institute (EUI) has delineated three fundamental principles for the application of AI in scientific research, grounded in ethical standards of usage. The principles are (a) knowledge and self-awareness, (b) individual accountability, and (c) interdisciplinary variety. Self-awareness enables comprehension of the consequences and hazards linked with AI use. Individual accountability means the researcher is wholly accountable for adherence to ethical guidelines when using AI tools. Diversity within scientific disciplines necessitates the development of specific criteria tailored to the unique requirements of each discipline when utilisation AI in research (46).

Numerous studies on the ethics and integrity of using AI for research have concluded that to guarantee ethical and transparent research practices, it is necessary to raise ethical standards and build a Culture of Integrity in Academia (31). Developing strategies is essential for assessing academic integrity. This involves evaluating current educational practices and formulating robust guidelines that focus on the ethical foundations of artificial intelligence (AI) in academic research (33). This includes establishing rigorous review policies and designing new algorithms based on transparency and auditability (17), (32). Furthermore, efforts must be made to enhance the skills of academic researchers (16). To achieve these goals, clear protocols must be established for the use of AI in data analysis and dissemination (47). Many researchers have called for the creation of collaborative frameworks between countries and scientific institutions to develop coherent international ethical standards for AI research (16), (30). Therefore, it is crucial that academic institutions emphasize the need for mandatory training for researchers to develop their ability to understand the problems associated with the misuse of AI, with a focus on AI ethics and integrity in scientific research. It is essential to establish robust norms that promote ethical AI development and include diverse data, ensuring fairness and inclusivity for all individuals (48).

Collaboration between AI and human experts is crucial for bridging these gaps and improving decision-making. By combining the advantages of both AI and human knowledge, we can effectively and ethically address the complexity of these fields (15). Therefore, researchers must address the limitations of AI in understanding complex scientific information, which relies on human expertise in research. This entails formulating methodologies to detect AI-generated content and differentiate between texts produced by humans and those generated by AI. Furthermore, all AI-sourced references must be verified, as AI is accountable for the information and references it provides.

For AI ethics research, Lin outlined five specific objectives for ethical AI use: "1) understanding model training and output, including bias mitigation strategies; 2) respecting privacy, confidentiality, and copyright; 3) avoiding plagiarism and policy violations; 4) applying AI beneficially compared to alternatives; and 5) using AI transparently and reproducibly (49). The study by Ahmed et al. highlighted the imperative of equipping students with learning environments by providing various artificial intelligence tools in educational settings and developing students' skills in using artificial intelligence tools (50). They also pointed to the importance of integrating ethical considerations into the use of AI in scientific research, particularly with regard to scientific publication.

Prompt Engineering, also known as prompts, involves linguistic instructions formulated in a specific style. Predefined language or linguistic models serve as the basis for these prompts. These prompts serve as instructions or inputs for AI tools, and they can produce more accurate results when they are specific. Therefore, Prompt Engineering is essential in guiding AI algorithms to generate responses and achieve the results the user needs (38), (39), (51). It is considered fundamental to the quality and effectiveness of the commands given to AI. According to Korzynski et al., it assists in the attainment of the desired rapid response, the allocation of time and effort, and the production of more gratifying outputs that better align with the user's requirements [52].

It provides researchers with the opportunity to achieve greater accuracy in their research results, obtain more substantial responses, and deliver reliable outcomes. Furthermore, artificial intelligence plays a significant role in improving analytical efficiency, the ability to effectively analyze large amounts of data, and the extraction of patterns and relevant information in a short time by guiding language models (39).

There is a pressing need to establish a research culture among researchers that promotes artificial intelligence techniques in academia and focuses on ethical and beneficial practices. The focus should be on what we want for the future; therefore, there is a need to adopt a realistic view of what AI can and cannot do. It is crucial to distinguish between truly effective search practices and measurable search outcomes. Identify the skills, resources, and capabilities needed to handle generative AI; examine the biases of generative AI attributed to training datasets and processes (42). Explore the most appropriate commercial and societal contexts for generative AI implementation; identify optimal combinations of human and generative AI for various tasks. Moreover, identify methods for evaluating the accuracy of texts produced by generative AI and uncover the ethical and legal issues related to its use in different contexts.

This development revolutionised the academic landscape and raised concerns about the quality of scholarly work and the necessity of human oversight in research. As AI technology evolved, it grew increasingly important for institutions to set criteria to preserve ethical standards.

7. RECOMMENDATIONS

At the researcher level, the researchers should improve their skills to recognize the effective AI tools for research quality. They need to learn and train in employing and formulating AI prompts to achieve the best results for their research. Researchers must know all the principles and ethics of using AI tools for research writings.

At the institutional level, universities and academic entities must establish guidelines for AI tools in research writing. Providing training programs to improve researchers' skills and promote researcher integrity cultures. Additionally, universities should take action against the misconduct or misuse of AI tools. They should adopt initiatives to encourage the development and innovation in the field of generative AI systems for scientific research.

At the education ministries level, they should finance the initiatives for AI scientific research and provide a budget for new AI innovations. Additionally, to control the fabrication, falsification, misinformation, and bias associated with generative AI tools, there is a need for international standards for AI ethics and regulation.

8. CONCLUSION

An intelligent researcher is one who knows how to utilise AI tools in a balanced manner, understanding the concept, developing it in his own style, and adding to it with his own knowledge. Using these tools is acceptable, but it's illogical for a researcher to be a mere transmitter, not thinking about or reviewing what is presented to him. Education is fundamentally based on developing skills, not simply submitting his or her research. Therefore, even if there are many available resources, the true criterion is the researcher's honesty with himself and the depth of his genuine desire to learn. These guidelines are essential for preserving the integrity and quality of research while using the potential of AI in rewriting procedures. This balance guarantees that the final result adheres to the utmost standards of academic research while benefiting from the speed and precision offered by AI tools.

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