

The Anatomy of AI-Assisted Scientific Writing: Comparative Insights into Generative, Retrieval, and Language Enhancement Technologies

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ARTICLE INFO

Article History

Submission : 30-06-2025
Received : 02-07-2025
Revised : 26-04-2026
Accepted : 28-04-2026

Keywords

Artificial Intelligence,
Scientific Writing,
AI-Assisted Writing
Systematic Literature Review
Higher Education

DOI:

<https://doi.org/10.61994/jee.v4i1.1126>

ABSTRACT

The rapid advancement of Artificial Intelligence (AI) has transformed scientific writing practices in higher education by providing innovative support for literature exploration, content generation, paraphrasing, grammar correction, and manuscript refinement. Despite the increasing adoption of AI-powered writing platforms, comprehensive comparative studies examining their strengths, limitations, and educational implications remain limited. Therefore, this study aimed to investigate the roles, capabilities, and challenges of six widely used AI tools Perplexity.ai, Braintext, QuillBot, Claude, Gemini AI, and Grammarly in supporting scientific writing. This study employed a Systematic Literature Review (SLR) approach following the PRISMA 2020 framework. Relevant studies published between 2019 and 2025 were retrieved from Google Scholar, Scopus, ScienceDirect, SpringerLink, and Taylor & Francis Online. The initial search identified 126 records. After removing duplicate records, 108 studies were screened based on titles and abstracts. Subsequently, 78 full-text articles were assessed for eligibility, and 35 peer-reviewed studies met all inclusion criteria and were included in the final synthesis. The findings revealed four major themes: (1) efficiency and productivity enhancement, (2) improvement of writing quality and linguistic accuracy, (3) ethical and academic integrity concerns, and (4) pedagogical implications for higher education and English education. The review demonstrated that each AI platform offers distinct advantages in supporting scientific writing; however, no single tool comprehensively addresses all writing requirements. Furthermore, challenges related to hallucination, factual accuracy, transparency, and overreliance remain significant concerns. The study concludes that AI should function as a cognitive support tool rather than a substitute for human intellectual engagement.



Introduction

Education plays a fundamental role in preparing individuals to participate effectively in an increasingly knowledge-based and technology-driven society. In the twenty-first century, educational systems are expected not only to develop learners' subject knowledge but also to cultivate digital literacy, critical thinking, creativity, communication, and problem-solving skills. The rapid advancement of digital technologies has significantly transformed teaching, learning, assessment, and academic research practices across educational contexts. Consequently, educational institutions worldwide are increasingly integrating emerging technologies to support learning effectiveness and academic productivity.

According to UNESCO (2023), contemporary education must equip learners with digital competencies, critical thinking skills, and the ability to adapt to rapidly evolving technological environments. Similarly, Fullan and Langworthy (2014) argue that educational success in the twenty-first century depends on students' capacity to integrate knowledge, technology, and innovation in solving complex problems. These perspectives indicate that technology is no longer a supplementary component of education but an essential element of modern learning ecosystems.

Within the field of English Education, technological integration has become particularly important. English language learners and researchers frequently employ digital tools to support language acquisition, academic writing, reading comprehension, vocabulary development, and research activities. The emergence of Educational Technology has reshaped traditional approaches to English language teaching and learning by providing innovative opportunities for collaboration, personalized learning, and autonomous knowledge construction. Recent developments in Artificial Intelligence (AI) have further accelerated this transformation, offering sophisticated tools capable of generating, revising, summarizing, paraphrasing, and evaluating written texts.

In the field of English Language Education, technology-enhanced learning has become increasingly significant. According to Warschauer and Healey (1998), technological tools provide authentic language exposure and facilitate learner-centred environments that support language development. More recently, Chapelle (2017) emphasized that digital technologies have transformed language learning by enabling immediate feedback, collaborative learning opportunities, and greater learner autonomy. Consequently, English education has progressively shifted toward technology-integrated pedagogical approaches.

The emergence of generative artificial intelligence has introduced a new paradigm in academic writing support. Russell and Norvig (2021) define artificial intelligence as systems capable of performing tasks that typically require human intelligence, including language generation, reasoning, and problem-solving. Furthermore, Kasneci et al. (2023) argue that generative AI possesses substantial potential to support higher education by assisting learners in brainstorming, drafting, revising, and refining academic texts. Nevertheless, they

also emphasize that AI-generated outputs should remain subject to human evaluation and critical judgment.

Artificial intelligence (AI) has become a crucial component of the digital revolution in education, particularly in academic writing. AI writing tools are based on computational linguistics and natural language processing (NLP) and are intended to replicate human-like communication, aid with content development, and improve textual correctness (Russell et al., 2021). According to Kim et al. (2022), learning is most successful when learners are provided with proper tools and scaffolding, implying that AI can function as a cognitive partner in writing growth. This is consistent with digital literacy theory, which stresses the capacity to navigate, analyze, and use digital technologies responsibly in information production (Sharma et al., 2016).

Several empirical studies have examined the benefits and drawbacks of AI use in academic settings. Furthermore, Almaiah et al. (2022), found that AI technologies considerably reduce instructors' workloads and increase production by automating writing and feedback. Similarly, Giglio and da Costa, (2023) observed that tools such as Grammarly increase not only grammar but also writing clarity and consistency. On the other side, Aljuaid (2024) expressed worry about the negative consequences of over-reliance on AI, including its influence on students' critical thinking and inventiveness. Chen et al. (2024), emphasized the necessity of openness and ethical acknowledgment in AI-assisted writing for scientific integrity. Advanced features like contextual awareness, ethical design principles, and interaction with academic databases are provided by newer AI tool like Claude and Gemini AI (Adetayo et al., 2024; Perera & Lankathilake, 2023). Although these tools mark a change from basic editing help to a more comprehensive writing aid, human inspection is still necessary to ensure that the generated text is accurate and pertinent.

Perplexity.ai, as investigated by Perera and Lankathilake (2023), is particularly good for rapid information retrieval with source citations, but lacks depth in content development. Braintext, according to Nie (2021), automates article structure and delivers fundamental material, but it may fall short of building complex arguments. Meanwhile, QuillBot allows paraphrase and grammatical correction, however it occasionally sacrifices meaning and scholarly tone (Amanda et al., 2023). Despite the expanding number of tools and research, there is still a scarcity of literature carefully comparing different platforms side by side, with an emphasis on academic value, usability, and ethical concerns. Most present research focuses on a single tool or application, rather than providing a comprehensive picture that would assist educators and researchers in selecting tools that are suited for their academic writing aims.

From a theoretical perspective, Vygotsky's concept of scaffolding suggests that technological tools should support rather than replace learners' cognitive engagement. Likewise, Grubaugh et al. (2023) maintain that AI should function as a cognitive scaffold that enhances knowledge construction while preserving learners' active intellectual participation. Therefore, understanding the comparative capabilities and limitations of

different AI writing platforms becomes increasingly important to ensure that technological assistance contributes to learning development rather than fostering dependency.

This study evaluates six popular AI platforms Perplexity.ai, Braintext, QuillBot, Claude, Gemini AI, and Grammarly in order to fill a major vacuum in the literature on the rapid acceptance of AI in academic settings and the dearth of thorough comparative research. In addition to highlighting each tool's advantages and disadvantages, the goal is to examine how they could affect academic writing, taking into account any potential pedagogical or ethical ramifications. The goal of this study is to support the more responsible, effective, and knowledgeable use of AI in scientific writing by combining practical tool analysis with current results. The growing presence of AI technologies has substantially influenced academic and scientific writing practices. Scientific writing is recognized as one of the most challenging academic skills because it requires extensive literature exploration, critical evaluation of sources, coherent argument development, academic language proficiency, citation management, and adherence to ethical standards. Traditional scientific writing processes often require considerable time and cognitive effort (Pagliaro, 2020; Zhao, 2023). As a result, researchers, lecturers, and students have increasingly adopted AI-powered writing assistants to improve efficiency and productivity.

Recently, several AI-based platforms such as Perplexity.ai, Braintext, QuillBot, Claude, Gemini AI, and Grammarly have gained considerable attention in academic environments. These platforms provide different forms of assistance ranging from information retrieval and literature exploration to content generation, paraphrasing, grammar correction, citation support, and manuscript refinement. Their growing popularity reflects the increasing demand for intelligent technologies capable of supporting scientific communication and academic publishing.

Numerous previous studies have investigated the application of AI in education and academic writing. Almaiah et al. (2022) reported that AI technologies contribute positively to academic productivity by automating repetitive tasks and facilitating knowledge management. Giglio and da Costa (2023) found that AI-assisted writing tools significantly improve grammatical accuracy, language clarity, and writing coherence, particularly among non-native English writers. Similarly, Zhao (2023) highlighted the effectiveness of AI writing assistants in supporting English language learners during academic writing activities. Furthermore, Aljuaid (2024) demonstrated that AI technologies offer substantial benefits in writing instruction, including feedback provision, language enhancement, and writing support.

Meanwhile, Chen et al. (2024) emphasized the importance of maintaining research integrity and ethical responsibility when utilizing AI-generated content in academic publications. Despite these contributions, existing studies reveal several limitations. First, most previous investigations focus on a single AI platform such as Grammarly, ChatGPT, QuillBot, or Gemini AI rather than examining multiple platforms simultaneously. Second, many studies primarily explore pedagogical applications or users' perceptions of AI-assisted

writing instead of conducting systematic comparative evaluations of AI tools. Third, relatively limited research has comprehensively compared generative AI systems, retrieval-based AI platforms, and language enhancement technologies within a single analytical framework. Consequently, researchers, educators, and students still lack sufficient evidence regarding the comparative strengths, weaknesses, usability, and ethical implications of various AI writing platforms.

This limitation represents an important research gap. As the number of AI writing platforms continues to increase, users require comprehensive evidence-based comparisons to make informed decisions regarding tool selection and responsible utilization. Understanding the distinct capabilities of different AI systems is essential for maximizing their educational value while minimizing potential risks associated with misinformation, overreliance, academic dishonesty, and reduced critical thinking engagement. Therefore, this study seeks to address this gap by conducting a systematic literature review and comparative analysis of six widely used AI platforms, namely Perplexity.ai, Braintext, QuillBot, Claude, Gemini AI, and Grammarly. The study investigates their strengths, limitations, practical applications, and ethical considerations in scientific writing contexts. The findings are expected to contribute theoretically to the growing body of knowledge concerning AI-assisted academic writing and practically to assist educators, researchers, students, and policymakers in integrating AI technologies responsibly within higher education and scientific communication practices.

Academic writing and education are two areas that have been greatly impacted by the quick development of artificial intelligence (AI). For students, researchers, and academics, effectively creating high-quality scientific publications has become a significant issue in the age of digitalization and information overload (Akinwalere & Ivanov, 2022). Moreover, Pagliaro, (2020) mentioned the necessity to produce scientific papers fast and effectively in the digital era is a challenge in itself. Furthermore, with automated writing platforms, artificial intelligence (AI) technology is available as a creative remedy. In addition, Artificial Intelligence (AI) proves to be an important ally, streamlining these processes and improving the quality of scholarly work. Utilizing AI Tools in Academic Research Writing takes readers on a transformational trip through the symbiotic link between AI and academic inquiry, where the quest of knowledge intersects with cutting-edge technology (Srivastava & Agarwal, 2024). Traditional academic writing processes can require substantial time for reading, drafting, revising, and referencing (Zhao, 2023). This has encouraged the use of AI technologies to aid in the writing process.

AI tools have quickly become integrated into the various phases of the academic writing process (UNESCO, 2019). AI-powered systems such as Perplexity.ai, Braintext, QuillBot, Claude, Gemini AI, and Grammarly provide aid at various phases of the writing process. They help users generate research subjects, organize text logically, verify language and syntax, paraphrase for clarity and originality, and prepare citations by academic norms.

As a result, these features considerably increase writing efficiency, allowing researchers to concentrate more on content creation and less on technological challenges.

However, there are serious issues with the growing reliance on these technologies. The legitimacy of AI-assisted writing is a topic of increasing discussion, especially in relation to originality, plagiarism threats, and the decline of critical thinking abilities in students and beginning writers (Pedró, 2019). Furthermore, concerns about authorship integrity and openness in tool usage are examples of academic ethical issues that have gained attention (Misra et al., 2018). According to some academics, an over-reliance on AI might diminish writing's instructional value by turning it into a mechanical procedure rather than an intellectual pursuit.

This study is led by a number of research questions in light of the background mentioned above:

1. What are AI technologies' relative advantages and disadvantages when it comes to scientific writing?
2. How may AI be applied without sacrificing honesty and academic standards?
3. What wider effects may AI use have on the growth of critical thinking and self-sufficient writing abilities?

This study suggests a thorough comparative investigation of six AI platforms that are often utilized in academic writing in order to solve these issues. The research aims to offer insights that support authors in using these technologies responsibly by fusing a review of the literature with real-world assessments. The primary goal is to examine the benefits, drawbacks, and moral implications of using Perplexity.ai, Braintext, QuillBot, Claude, Gemini AI, and Grammarly to assist with scientific writing. Furthermore, without reducing the level of human intellectual involvement, the study seeks to provide educators and institutions with useful advice on how to incorporate AI into academic processes.

Constructivist learning theory and the idea of digital literacy serve as the foundation for this study. Constructivism suggests that AI should work as a scaffold rather than a replacement, emphasizing active knowledge production aided by tools and social interaction (Grubaugh et al., 2023). Frameworks for digital literacy also stress how critical it is to comprehend, assess, and use digital tools responsibly. According to Flanagin et al. (2023), maintaining the integrity of academic articles requires transparency in the usage of AI.

Method

This study employed a Systematic Literature Review (SLR) approach within a qualitative descriptive research design. A Systematic Literature Review is a structured, transparent, and reproducible method for identifying, evaluating, and synthesizing existing research evidence related to a particular topic (Kitchenham, 2004). According to Snyder (2019), SLR enables researchers to provide comprehensive knowledge synthesis while minimizing subjective bias during the review process. The qualitative approach was selected because the study aims to explore, compare, and interpret the characteristics, strengths,

limitations, and ethical implications of Artificial Intelligence (AI) tools in scientific writing rather than measuring statistical relationships among variables. As argued by Xiao and Watson (2019), qualitative evidence synthesis allows researchers to identify recurring themes, patterns, and conceptual relationships across previous studies.

Furthermore, this review adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological transparency, rigor, and replicability throughout the review process (Page et al., 2021). The PRISMA framework provides a systematic procedure for identifying, screening, assessing eligibility, and selecting relevant studies for inclusion in the review.

Systematic Literature Review Procedure

The review procedure was adapted from the systematic review frameworks proposed by Tranfield et al. (2003), Kitchenham (2004), and Page et al. (2021). These frameworks emphasize systematic searching, transparent selection procedures, critical evaluation, and comprehensive synthesis of research findings.

Stage 1: Formulation of Research Questions

The first stage involved establishing research questions that guided the entire review process. According to Kitchenham (2004), clearly formulated research questions serve as the foundation for systematic evidence collection and synthesis.

Stage 2: Identification of Relevant Studies

Relevant studies were identified through comprehensive searches in Google Scholar, Scopus, ScienceDirect, SpringerLink, and Taylor & Francis Online databases. Snyder (2019) suggests that utilizing multiple databases enhances the comprehensiveness and reliability of literature retrieval.

Stage 3: Screening and Eligibility Assessment

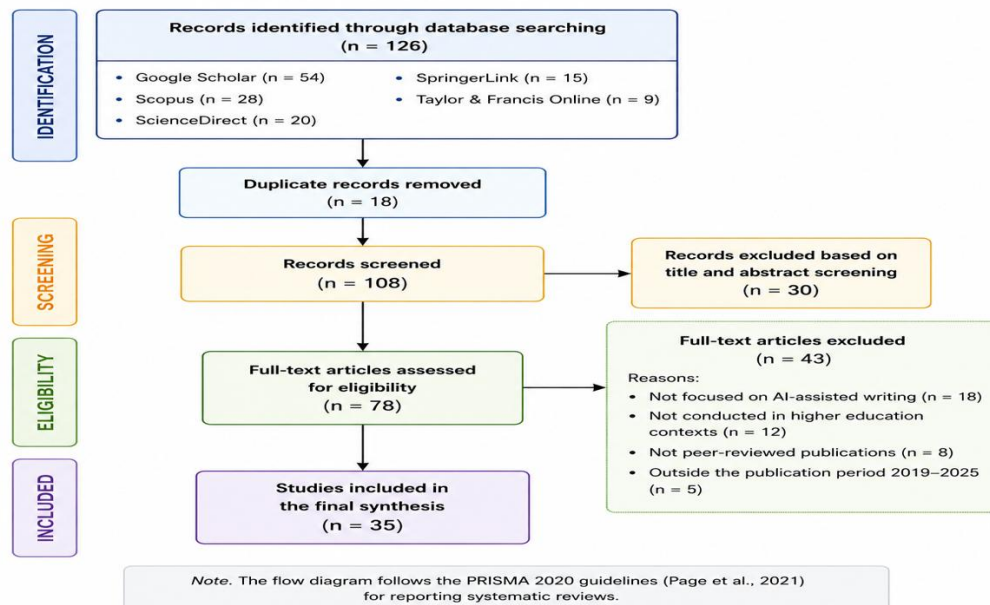
The retrieved studies were screened using predetermined inclusion and exclusion criteria. Page et al. (2021) emphasize that systematic screening procedures are essential for reducing selection bias and ensuring the quality of reviewed literature.

Stage 4: Data Extraction

The selected studies were examined and coded according to publication information, research objectives, methodology, AI tools investigated, major findings, strengths, limitations, and ethical considerations. Xiao and Watson (2019) argue that systematic data extraction improves consistency and facilitates comparative analysis across studies.

Stage 5: Data Synthesis and Interpretation

The extracted data were analysed using thematic analysis. Braun and Clarke (2006) explain that thematic analysis enables researchers to identify recurring patterns and meaningful themes within qualitative data. The findings were synthesized into four major themes: efficiency and productivity, output quality and accuracy, ethical considerations, and pedagogical integration. The results of SLR could be seen at the figure below:



Source: Adapted from PRISMA 2020 (Page et al., 2021)

Thematic analysis was employed to analyse and synthesize the selected studies. Braun and Clarke (2006) describe thematic analysis as a flexible qualitative method for identifying, organizing, and interpreting recurring themes within a dataset. Through this process, the reviewed studies were categorized into common themes reflecting the educational, technological, and ethical dimensions of AI-assisted scientific writing.

The data were evaluated using a qualitative theme approach. Key themes were established by classifying and categorizing information from the literature and platform use. The information was combined to compare the usefulness, advantages, and limits of each AI technology. Ethical concerns such as authorship attribution and transparency were also investigated using established principles (Hosseini & Gordijn, 2020). This combination of literature study and real-time testing enables a comprehensive review that incorporates both theoretical understanding and practical experience with AI systems.

Results and Discussion

Results

To provide a clearer understanding of the distinctive functions and contributions of each AI platform, Table 1 presents a comparative overview of the major strengths, limitations, and potential applications of the reviewed technologies in scientific writing.

Table 1
 Comparative Overview of Generative, Retrieval, and
 Language Enhancement Technologies in Scientific Writing

AI Tool	Main Strength	Main Limitation	Best Use in Scientific Writing
Perplexity.ai	Literature retrieval	Source inconsistency	Literature exploration
Braintext	Draft generation	Limited academic depth	Initial drafting
QuillBot	Paraphrasing	Meaning distortion risk	Revision
Claude	Logical explanation	Hallucination risk	Content development
Gemini AI	Multi-purpose writing support	Factual inaccuracies	Idea generation
Grammarly	Grammar and style correction	Limited content generation	Final editing

As illustrated in Table 1, the reviewed AI platforms demonstrate varying levels of effectiveness across different stages of scientific writing. Retrieval-oriented tools such as Perplexity.ai excel in accessing and organizing information, while generative AI systems including Claude and Gemini AI provide substantial support for content development and idea generation. Meanwhile, language enhancement tools such as QuillBot and Grammarly contribute significantly to linguistic accuracy and readability. Despite these advantages, all platforms exhibit certain limitations related to content reliability, contextual understanding, or ethical concerns. Therefore, the findings suggest that effective scientific writing requires a balanced integration of AI assistance and human critical judgment to ensure academic rigor, originality, and research integrity.

Study Selection Results

Following the PRISMA-based systematic review procedure, an initial search across Google Scholar, Scopus, ScienceDirect, SpringerLink, and Taylor & Francis databases identified 126 potentially relevant publications. After removing duplicate records and screening titles and abstracts, 78 articles remained for further assessment. The full-text evaluation resulted in the exclusion of studies that did not specifically focus on Artificial Intelligence-assisted academic writing, scientific writing support, or higher education contexts. Finally, 35 peer-reviewed articles published between 2019 and 2025 met all inclusion criteria and were included in the final review.

The selected studies represented diverse geographical regions and educational contexts, providing a comprehensive perspective on the application of AI technologies in academic writing. The reviewed literature investigated various AI tools, including

Grammarly, QuillBot, ChatGPT, Claude, Gemini AI, Perplexity.ai, and other emerging generative AI platforms.

The thematic synthesis of the selected studies revealed four major themes: (1) Efficiency and Productivity in Scientific Writing, (2) Writing Quality and Accuracy Enhancement, (3) Ethical and Academic Integrity Concerns, and (4) Pedagogical Implications for English Education and Higher Education.

Theme 1: Efficiency and Productivity in Scientific Writing

One of the most frequently reported advantages of AI-assisted writing tools is their ability to enhance writing efficiency and productivity. Across the reviewed studies, AI platforms significantly reduced the time required for brainstorming, literature exploration, drafting, editing, and manuscript preparation.

Perplexity.ai demonstrated strong performance in literature retrieval and source identification, enabling researchers to access relevant references efficiently. Similarly, Braintext, Claude, and Gemini AI facilitated rapid content generation and structural organization, allowing users to produce preliminary drafts within a relatively short time. Grammarly and QuillBot primarily supported the revision process through grammar correction, paraphrasing, and stylistic enhancement.

These findings align with Almaiah et al. (2022), who reported that AI technologies improve academic productivity by automating repetitive tasks. Likewise, Srivastava and Agarwal (2024) argued that AI-assisted writing tools enable researchers to devote greater attention to conceptual development and critical analysis rather than technical writing issues.

From a constructivist perspective, AI tools may function as cognitive scaffolds that support learners during the writing process. Grubaugh et al. (2023) suggested that technological scaffolding can facilitate knowledge construction when learners remain actively engaged in evaluating and refining generated content. Therefore, AI should be viewed as a productivity-enhancing partner rather than a substitute for human intellectual effort.

Theme 2: Writing Quality and Accuracy Enhancement

The reviewed studies consistently demonstrated that AI technologies contribute to improvements in linguistic quality, coherence, and readability. Grammarly emerged as one of the most effective tools for grammar correction, sentence refinement, and tone adjustment. Similarly, QuillBot provided substantial support for paraphrasing and lexical variation.

However, the findings also revealed limitations regarding content accuracy and contextual understanding. Generative AI systems such as Claude and Gemini AI occasionally produced factually inaccurate information, unsupported claims, or fabricated references. Perplexity.ai generally provided source-supported responses, yet the quality of retrieved information depended heavily on the credibility of available sources.

These findings support the observations of Giglio and da Costa (2023), who concluded that AI technologies significantly improve language quality among non-native

English writers. Nevertheless, Kasneci et al. (2023) emphasized that AI-generated content should always undergo human verification because large language models remain susceptible to hallucinations and factual inaccuracies.

Consequently, although AI tools enhance linguistic quality, they cannot independently guarantee scientific validity. Human expertise remains essential for evaluating evidence, verifying citations, and ensuring the academic rigor of scholarly publications.

Theme 3: Ethical and Academic Integrity Concerns

Ethical considerations emerged as one of the most prominent themes in the reviewed literature. Researchers expressed concerns regarding authorship transparency, plagiarism, accountability, and the potential erosion of critical thinking skills resulting from excessive reliance on AI technologies.

Several studies indicated that students may use AI-generated content without fully understanding the underlying concepts, potentially compromising meaningful learning outcomes. Furthermore, the increasing sophistication of generative AI has created challenges in distinguishing human-authored content from machine-generated text.

According to Flanagin et al. (2023), transparency regarding AI usage is essential for preserving the integrity of scientific publications. Similarly, Chen et al. (2024) argued that responsible AI utilization requires explicit disclosure, verification of generated information, and adherence to established ethical standards.

From an educational perspective, Vygotskian learning principles suggest that meaningful learning occurs through active cognitive engagement. Excessive dependence on AI-generated outputs may reduce opportunities for critical reflection, analytical reasoning, and independent knowledge construction. Therefore, institutions should establish clear guidelines governing the ethical use of AI in academic writing.

Theme 4: Pedagogical Implications for English Education

The findings indicate that AI technologies possess considerable potential for supporting English language education and academic writing instruction. In particular, Grammarly and QuillBot provide immediate feedback that can assist students in developing grammatical competence, vocabulary usage, and writing fluency. Meanwhile, generative AI platforms such as Claude and Gemini AI support brainstorming, idea development, and organizational planning.

These findings are consistent with Chapelle (2017), who argued that technology-enhanced language learning environments can promote learner autonomy and facilitate language development. Similarly, Warschauer and Healey (1998) emphasized that digital technologies provide authentic opportunities for language practice and academic communication.

However, educators should carefully design instructional activities that encourage students to critically evaluate AI-generated content rather than accept it uncritically. The

educational value of AI lies not merely in automation but in its capacity to stimulate reflection, revision, and higher-order thinking.

Therefore, successful integration of AI in English Education requires a balanced approach combining technological innovation, pedagogical guidance, digital literacy development, and ethical awareness. AI tools can help with writing teaching from an educational standpoint if they are carefully included. Particularly successful at prewriting activities like brainstorming and subject development were Perplexity.ai and Gemini AI. Students may observe instant gains and consider how they use language when revision and peer-review exercises are conducted in writing classes using QuillBot and Grammarly.

Bauer et al. (2025) contend that the use of tools as cognitive scaffolding leads to meaningful learning, and their results support this claim. But teachers need to strike a balance between autonomy and assistance so that pupils don't rely on AI exclusively but rather utilize it to develop their own critical and creative thinking skills.

Ultimately, the comparison study showed that each platform has distinct benefits even if no single platform fully covers all facet of scientific writing. A more effective and scholarly writing process may be achieved by combining several tools, such as Perplexity.ai for sourcing, Braintext for structure, and Grammarly for final polishing. To properly assist academic progress, however, the integration of these instruments has to be directed by human critical thinking, instructional strategy, and ethical awareness.

Discussion

AI as a Cognitive Partner Rather Than a Replacement for Writers

The findings indicate that Artificial Intelligence technologies have significantly transformed the scientific writing process by improving efficiency, reducing writing time, and facilitating access to academic information. However, the results suggest that AI functions most effectively as a cognitive partner rather than a replacement for human writers. This finding supports the constructivist perspective proposed by Vygotsky, which emphasizes that learning occurs through active engagement and cognitive interaction rather than passive acceptance of information.

The reviewed platforms demonstrated considerable potential in supporting different stages of scientific writing. Perplexity.ai facilitated literature exploration, Braintext supported draft generation, Claude and Gemini AI assisted idea development, while Grammarly and QuillBot enhanced linguistic quality. Nevertheless, the intellectual responsibility for evaluating information, constructing arguments, and synthesizing knowledge remained dependent on human users. This finding is consistent with Grubaugh et al. (2023), who argued that AI should function as a scaffold that enhances human learning rather than replacing cognitive processes.

The findings further suggest that the value of AI in scientific writing lies not only in automation but also in its ability to support higher-order academic tasks. Consequently,

effective AI integration requires active human participation, critical evaluation, and reflective decision-making throughout the writing process.

Balancing Writing Efficiency and Academic Quality

One of the most significant findings of this study is the positive contribution of AI technologies to writing efficiency and productivity. Researchers and students can generate outlines, identify relevant references, paraphrase information, and revise manuscripts more rapidly than through conventional writing processes. These findings support Almaiah et al. (2022), who concluded that AI technologies improve productivity by reducing repetitive and time-consuming academic tasks.

However, increased efficiency does not necessarily guarantee improved academic quality. Although AI systems are capable of producing coherent and grammatically accurate text, they occasionally generate inaccurate information, unsupported claims, and fabricated references. This phenomenon, commonly referred to as AI hallucination, remains one of the major challenges associated with generative artificial intelligence.

The findings reveal that linguistic accuracy and scientific validity are fundamentally different dimensions of academic writing. Grammarly and QuillBot effectively improve language quality, while Claude and Gemini AI support content generation. Nevertheless, none of these platforms can independently ensure the validity, originality, and scholarly rigor required in scientific publications. Therefore, human verification remains indispensable throughout the writing process.

This result reinforces the argument of Kasneci et al. (2023), who emphasized that AI-generated outputs should be treated as preliminary support materials rather than final academic products. Researchers must continue to evaluate evidence, verify citations, and critically assess the credibility of generated information before publication.

Ethical Challenges in AI-Assisted Scientific Writing

The increasing use of AI technologies has generated important ethical considerations within academic communities. The present findings demonstrate that concerns regarding plagiarism, authorship transparency, accountability, and academic integrity remain central issues in AI-assisted writing practices.

Although AI tools offer substantial benefits, excessive dependence on automatically generated content may reduce opportunities for critical thinking, independent analysis, and scholarly reflection. Such concerns have also been highlighted by Chen et al. (2024) and Flanagin et al. (2023), who stressed the importance of transparency and responsible disclosure of AI usage in academic publications.

From an ethical perspective, the challenge is not whether AI should be used in scientific writing but rather how it should be used responsibly. The findings indicate that ethical AI utilization requires clear institutional policies, adequate digital literacy, and awareness of academic integrity principles. Authors remain fully responsible for the content they publish, regardless of whether AI tools contribute to the writing process.

Therefore, higher education institutions should establish explicit guidelines concerning acceptable AI practices, disclosure requirements, citation standards, and ethical responsibilities. Such measures would help ensure that AI serves as an instrument for academic enhancement rather than a source of academic misconduct.

Implications for English Education and Higher Education

The findings of this study have important implications for English Education and higher education more broadly. In English language learning contexts, AI-powered writing tools can provide immediate feedback, language support, and opportunities for autonomous learning. Grammarly and QuillBot, for example, may assist learners in improving grammatical accuracy, vocabulary choice, coherence, and academic writing conventions.

These findings support the work of Chapelle (2017) and Warschauer and Healey (1998), who argued that technology-enhanced language learning environments contribute to language development by providing meaningful interaction and timely feedback. Similarly, AI-assisted writing platforms can create opportunities for learners to engage in iterative writing processes that foster continuous improvement.

However, educators should avoid positioning AI merely as a shortcut for completing assignments. Instead, AI should be integrated into pedagogical practices that encourage critical evaluation, reflective thinking, and independent knowledge construction. Students should be trained not only to use AI tools effectively but also to assess the reliability, limitations, and ethical implications of AI-generated content.

Consequently, the successful integration of AI in English Education requires a balanced framework combining technological competence, digital literacy, critical thinking skills, and ethical awareness. Such an approach can maximize the educational benefits of AI while preserving the intellectual and creative dimensions of academic writing.

Overall, the findings suggest that Artificial Intelligence has become an influential component of contemporary scientific writing practices. While AI technologies offer substantial benefits in terms of efficiency, language enhancement, and writing support, their effectiveness ultimately depends on responsible human oversight. The future of scientific writing is therefore likely to be characterized not by the replacement of human writers, but by increasingly sophisticated forms of human–AI collaboration grounded in ethical awareness, critical thinking, and academic integrity.

Conclusion

The content of the conclusion is the answer to the research objectives, not a summary of the research results. Conclusions and suggestions are made in a concise, clear and concise manner based on the results and discussion.

This study aimed to investigate the roles, strengths, limitations, and ethical implications of six widely used Artificial Intelligence (AI) platforms Perplexity.ai, Braintext, QuillBot, Claude, Gemini AI, and Grammarly in supporting scientific writing. Based on the

findings of the Systematic Literature Review (SLR) and comparative analysis, it can be concluded that AI technologies have become valuable instruments for enhancing various stages of academic writing, including literature exploration, idea generation, drafting, paraphrasing, language refinement, and manuscript revision.

The findings reveal that each platform offers unique contributions to the scientific writing process. Perplexity.ai is particularly effective for information retrieval and literature exploration, while Braintext, Claude, and Gemini AI facilitate content generation and idea development. In contrast, QuillBot and Grammarly contribute significantly to language enhancement, grammatical accuracy, and writing clarity. Nevertheless, no single platform is capable of comprehensively addressing all dimensions of scientific writing. Consequently, the most effective approach involves the strategic and complementary use of multiple AI tools according to specific writing objectives and academic requirements.

Despite their advantages, AI technologies also present important challenges related to factual accuracy, hallucination risks, authorship transparency, academic integrity, and the potential reduction of critical thinking engagement. Therefore, AI should not be viewed as a replacement for human intellectual work but rather as a supportive technology that enhances academic productivity while preserving human responsibility for knowledge construction, critical evaluation, and scholarly decision-making.

Theoretically, this study contributes to the growing body of literature on AI-assisted academic writing by providing a comprehensive comparison of generative, retrieval-based, and language-enhancement technologies within a single analytical framework. Practically, the findings offer valuable insights for researchers, students, educators, and higher education institutions seeking to integrate AI technologies responsibly into scientific writing practices.

Finally, future studies are encouraged to conduct empirical investigations involving students, lecturers, and researchers to examine the actual effectiveness of AI-assisted writing tools in different educational contexts. Further research may also explore the development of ethical frameworks, digital literacy models, and Human–AI collaborative writing approaches that promote both academic excellence and responsible technology use in higher education.

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