Appliances of Generative AI-Powered Language Tools in Academic Writing: A Scoping Review

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ABSTRACT

Introduction: Academic writing is getting through a transformative shift with the advent of the generative AI-powered tools in 2022. It spurred research in the emerging field that focus on appliances of AI-powered tools in academic writing. As the AI technologies are changing fast, a regular synthesis of new knowledge needs revisiting.

Purpose: Though there are scoping and systematic reviews of some sub-fields, the present review aims to set the scope of the research field of research on GenAI appliances in academic writing.

Method: The review adhered to the PRISMA extension for scoping reviews, and the PPC framework. The eligibility criteria include problem, concept, context, language, subject area, types of sources, database (Scopus), and period (2023-2024).

Results: The three clusters set for the reviewed 44 publications included (1) AI in enhancing academic writing; (2) AI challenges in academic writing; (3) authorship and integrity. The potential of AI language tools embraces many functions (text generation, proofreading, editing, text annotation, paraphrasing and translation) and provides for assistance in research and academic writing, offers strategies for hybrid AI-powered writing of various assignments and genres and improvements in writing quality. Language GenAI-powered tools are also studied as a feedback tool. The challenges and concerns related to the appliances of such tools range from authorship and integrity to overreliance on such tools, misleading or false generated content, inaccurate referencing, inability to generate author's voice. The review findings are in compliance with the emerging trends outlined in the previous publications, though more publications focus on the mechanisms of integrating the tools in AI-hybrid writing in various contexts. The discourse on challenges is migrating to the revisiting the concepts of authorship and originality of Gen AI-generated content.

Conclusion: The directions of research have shown some re-focusing, with new inputs and new focuses in the field. The transformation of academic writing is accelerating, with new strategies wrought in the academia to face the challenges and rethinking of the basic concepts to meet the shift. Further regular syntheses of knowledge are essential, including more reviews of all already existent and emerging sub-fields.

KEYWORDS

academic writing, artificial intelligence (AI), generative artificial intelligence (GenAI), AI-powered language tools, authorship

INTRODUCTION

Academic writing is an important component of knowledge production as well as scientific and academic communication (Tusting et al., 2019). It serves as an internationally admitted convention embracing activity, cognitive processes, "language rules, communication norms" (Nguyen et al., 2024), "structured expression of ideas, data-driven arguments, and logical reasoning" (Khalifa & Albadawy, 2024) and reporting of contributions to science and synthesis of knowledge. Higher education and science are essentially dependent of academic writing (Coffin et al., 2003). The latter embodies written communication within the

academia. The recent two years academic writing is going through an essential transformation in view of generative artificial intelligence tools widely applied to generate texts mimicking human writings (Mondal, 2023).

Artificial intelligence encompasses an array of technologies such as machine learning, natural language processing, large language models and others (Ou et al., 2024) that are successfully applied in academic writing. Natural language models have been developing since the 1960s when the first computer programme called "Eliza" was offered to explore the human-computer communication. In late 2010s, large language models actively began their development, resulting in ChatGPT breakthroughs. AI-based appliances for enhancing academic writing appeared prior to ChatGPT and new-generation generative AI-powered tools[1], including Grammarly (2009), QuillBot (2017), DeepL (2017), Dimensions (2018) and others. But it was ChatGPT 3.5 that offered a real advance in functions and high-quality generated text (Raitskaya & Lambovska, 2024).

With the advent of the new generation of generative artificial intelligence (GenAI) in 2022, especially with the breakthrough technologies of ChatGPT 3.5 and 4.0, the academia received smart tools that can perform numerous functions related to academic writing (Williams, 2024; Kohnke, 2024; Gunawan et al., 2024): text generation, grammar- and spelling-checking, citation- and reference-management, translation, editing, proofreading, feedback on writing, extraction of data, paraphrasing, reviewing articles, collaborative writing, annotation, and text coherence. Though some of them had been in use before 2022, the potential in all spheres has risen ever since. The technological shift signifies an AI-dominated age[2].

The impact of the GenAI-powered tools on academic writing is on the rise. Writings of various genres constitute an essential part of many professional activities, including those of writers, researchers, journalists, doctors, and teachers (Tikhonova & Raitskaya, 2023). From today's perspective, we might only guess an ultimate picture of GenAI spread. So far, it is obvious that these technologies would primarily be grasped within many professions and occupations, with education, science, and journalism as the frontrunners (Raitskaya & Lambovka, 2024). The emerging field of research is changing very fast. Though, following the advances needs regular reviewing to fix the new shifts and adjustments, the proficiency of GenAI tools in academic writing requires the academia "to critically reconsider concepts such as cocreation, ownership, and authorship" (Borkurt, 2023) as the new tools "disrupt both the ontology and epistemology of academia, science and teaching" (Borkurt, 2024).

Generative AI-powered tools implemented into academic writing give rise to numerous challenges and concerns (Yao et al., 2024; Kim, 2024). First, the issues of authorship and integrity have become a highly disputed interdisciplinary field. The arguments of opponents and proponents of granting authorship to AI inspire a general revision and transformation of the authorship concept on the ground that it embraces ownership, accountability, and the integrity of ideas (Amirjalili et al., 2024). One more aspect connected with authorship is author's voice that can be blurred by overreliance on GenAI language tools (Amirjalili et al., 2024). Second, to introduce progressive hybrid patterns of AI-human writing, researchers will have to study the subject in progress and find the optimal algorithms that require researching, teaching, academic writing practice, forging AI literacy and AI competence. Third, the progress in GenAI technologies is accelerating (Yao et al., 2024). It exacerbates potential negative effects that may be set off later with more research and empirical data on hand.

Starting with early 2023, the Scopus data base has been indexing publications on appliances of ChatGPT and GenAI-powered tools in academic writing. The emerging field requires regular revisiting for researchers to realize how new contributions may transform the research area and what new directions of research are forming. The reviews published in 2023 and 2024 focus on either a wider perspective, including academic writing as part of education, medicine, etc. (Ahn, 2024; Khalifa & Albadawy, 2024; Shorley et al., 2024) or on a narrowed context, e.g. optimizing the systematic reviewing process (Fabiano et al., 2024) and ethical dilemmas in using AI for academic writing (Miao et al., 2024). Having found a gap – a synthesis of knowledge related to appliances of GenAI-powered tools in academic writing, we aspire to make a review to add to the understanding of the field.

This scoping review aimed to explore the prevalent topics of the emerging research field of research on GenAI appliances in academic writing. To attain the objective, we were to reply to the following review questions:

RQ#1: What are the prevailing directions of research of the potential appliances of generative artificial intelligence (GenAI) tools in academic writing at university and in university science?

RQ#2: What are the major challenges and concerns related to GenAI appliances in academic writing?

RQ#3: What are the key approaches in research towards authorship and academic integrity in the context of academic writing?

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[1] AI-powered language tools are software programmes/ applications that use AI methods to analyse or generate human language, including but not limited to writing assistants, machine translators, speech-to-text transcribers, and text generators (chatbots) (Ou et al., 2024).

[2] Gates, B. (2023). The Age of AI has begun. Gates Notes. https://www.gatesnotes.com/The-Age-of-AI-Has-Begun

METHOD

Protocol

Prior to starting the present scoping review, a research protocol was meticulously developed. The authors hereby certify that this review report constitutes a faithful, precise, and transparent description of the conducted review. No deviations from the protocol were registered. Any departures from the original study design were appropriately described. This scoping review is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for Scoping Reviews (Tricco et al., 2018), and the framework proposed by Arksey and O'Malley (2005).

Search Eligibility Criteria

In the present review, the problem, concept, and context (PCC) framework was applied to state the eligibility criteria and structure the review (Table 1).

Search Strategy

The search to attain the aim and to reply to the review questions was conducted as of October 24, 2024. The Scopus as one of the world's biggest high-quality databases was thoroughly searched to identify relevant publications subject to the eligibility criteria. The review questions, objective, and existing literature were studied to select the most appropriate keywords to achieve a search. The search was conducted using the keywords, i.e. "academic writing" AND "AI-based tools", "academic writing" AND "AI-powered tools", and "scholarly writing" AND "AI-based writing". Other potential keywords were applied in pre-protocol searches but failed to bring any relevant results. The full-text publications eligible for the review were identified after screening of the titles, keywords, and abstracts. All relevant documents with full texts were included in the review.

Study Selection

First, both authors identified research publications sticking to the eligibility criteria. After applying the Scopus filters

Table 1
Eligibility Criteria

Criterion	Inclusion	Exclusion	Rationale
Problem	GenAI appliances in academic writing	All publications going beyond	The review focuses on appliances of GenAI-based tools in academic writing. The problem is defined by the scope of such appliances
Concept	Academic writing	Other concepts	The aim of the review is to determine the trends of research on enhancing academic writing via GenAI
Context	Higher education and science	Other contexts	The review dwells upon the appliances of GenAI in academic writing in higher education and university science
Language	English	Other languages	The object of all research in focus is scholarly publications in English. The language choice is identified by its status as a lingua franca of international science
Time span	2023-2024	Previous years	The introduction of ChatGPT in 2023 started a new era of generative artificial intelligence that was widely spreading all over education and science
Types of sources	In the Scopus database all types of indexed publications relating to the theme	Unavailable sources, unavailable full texts	This review aims to get a comprehensive understanding of the field
Geographical location	Any location	None	Getting international perspective
Database	Scopus	Other bases than Scopus	Scopus was selected as it is widely recognized as the preferred source for scoping and systematic reviews, it has a reliable citation tracking and an impressive coverage of literature
Areas of Research	Social Sciences Arts & Humanities Medicine	Other areas	As the review focuses on the higher education and science contexts, publications rarely go beyond social sciences and arts & humanities. Though medicine is also under scrutiny as GenAI is widely introduced in research and academic writing within the field

(time span, subject area, language), each reviewer independently screened the titles, and then the abstracts and keywords of the identified documents. Second, each reviewer tagged the documents with "to include" or "to exclude" marks. In case of disagreement, the authors arrived at a mutual consent. No disputed issue required lateral expertise. The full texts were found via the publishers. Each full text was thoroughly read and independently analysed by each reviewer. Eligible publications were identified.

Data Extraction

The title and review questions were determined under the PCC framework. Pre-protocol searches made us identify the basic structure of the extracted data for the review:

1. data from the reviewed documents relating to the potential of GenAI-powered language tools for academic writing at university and in science;
2. data from the reviewed publications regarding challenges and concerns arising out of the appliances of such tools in academic writing;
3. data from the articles under review containing information on authorship and integrity issues relating to the

use of the GenAI-powered language tool in academic writing at large.

All raw data were double-checked by the authors. The extracted data were classified and formalized in the corresponding exhibits (Table 5 and Appendixes 2-3).

RESULTS

Search and Selection Results

The search results were finalised as of October 24, 2024. Initially, we found a total of 222 documents in the Scopus database. After we had applied the selected Scopus filters (language; social sciences, time span), the total decreased from 222 to 121 studies. Then we screened the titles and abstracts. 92 documents were deemed irrelevant and excluded from the review. As not all full texts were found, we analysed only 55 publications, with another 11 publications eliminated as non-eligible. The PRISMA flow-chart (Figure 1) depicts the whole identification and screening procedure.

Figure 1

Selection of Publications for the Review
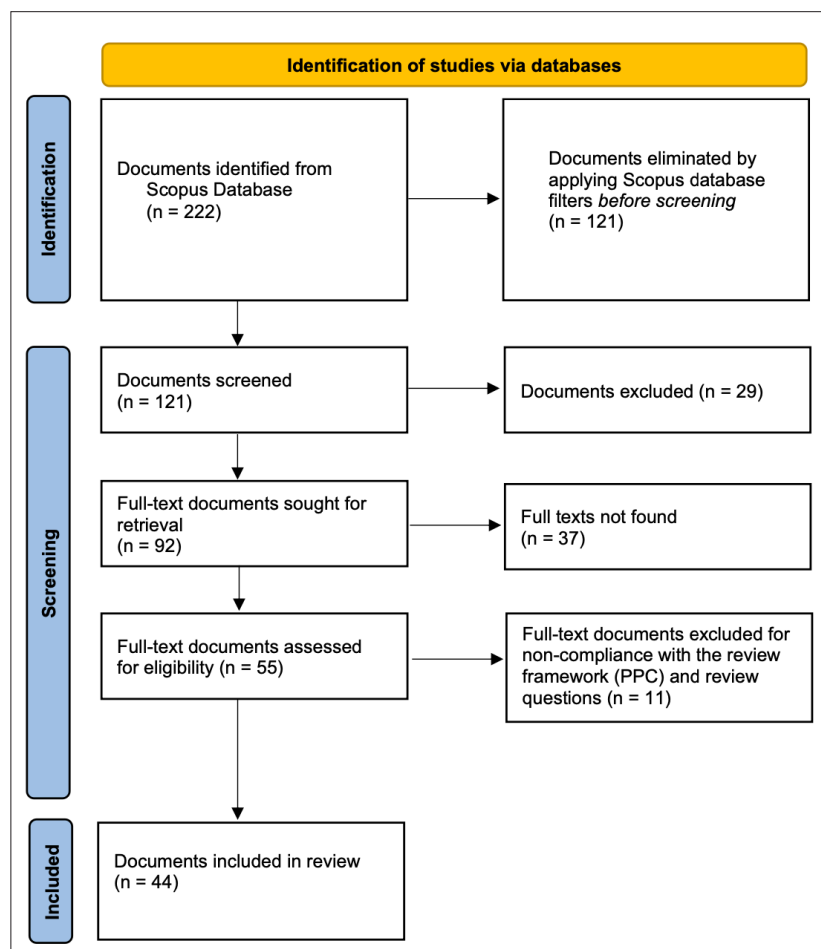
Documents Ultimately Included in the Review

The review yielded 33 articles, two editorials, and nine reviews meeting the objective and eligibility criteria (Table 2). For the complete metadata on the included documents, see Appendix 1.

Bibliometric Characteristics of the Research Field

The 44 documents included into the present review were analysed on the following aspects: yearly distribution; types of documents; authors; countries of affiliation; journals; or-

Table 2
Documents included in the review

	Reference	Publication Title
		Articles & Editorials
1	Williams, 2024	Comparison of generative AI performance on undergraduate and postgraduate written assessments in the biomedical sciences
2	Kohnke, 2024	Exploring EAP students' perceptions of GenAI and traditional grammar-checking tools for language learning
3	Li et al, 2024	Exploring the potential of artificial intelligence to enhance the writing of English academic papers by non-native English-speaking medical students - the educational application of ChatGPT
4	Liu et al., 2024	The great detectives: humans versus AI detectors in catching large language model-generated medical writing
5	Johnston et al., 2024	Student perspectives on the use of generative artificial intelligence technologies in higher education
6	Mahapatra, 2024	Impact of ChatGPT on ESL students' academic writing skills: a mixed methods intervention study
7	Gralha & Pimentel, 2024	Gotcha GPT: Ensuring the Integrity in Academic Writing
8	Rafida et al., 2024	EFL students' perception in Indonesia and Taiwan on using artificial intelligence to enhance writing skills
9	Bolaños et al., 2024	Artificial intelligence for literature reviews: opportunities and challenges
10	Kraika & Olszak, 2024a	"AI, will you help?" How learners use Artificial Intelligence when writing
11	Rababah et al., 2024	Graduate Students' ChatGPT Experience and Perspectives during Thesis Writing
12	Ou et al., 2024	Academic communication with AI-powered language tools in higher education: From a post-humanist perspective
13	Yao et al., 2024	A Qualitative Inquiry into Metacognitive Strategies of Postgraduate Students in Employing ChatGPT for English Academic Writing
14	Morreale et al., 2024	Artificial Intelligence and Medical Education, Academic Writing, and Journal Policies: A Focus on Large Language Models
15	Kurt & Kurt, 2024	Enhancing L2 writing skills: ChatGPT as an automated feedback tool
16	Krajka & Olszak, 2024b	Artificial intelligence tools in academic writing instruction: exploring the potential of on-demand AI assistance in the writing process
17	Parker et al., 2024	Negotiating Meaning with Machines: AI's Role in Doctoral Writing Pedagogy
18	Kim, 2024a	Research ethics and issues regarding the use of ChatGPT-like artificial intelligence platforms by authors and reviewers: a narrative review
19	Alkamel & Alwagieh, 2024	Utilizing an adaptable artificial intelligence writing tool (ChatGPT) to enhance academic writing skills among Yemeni university EFL students
20	Kim et al., 2024	Exploring students' perspectives on Generative AI-assisted academic writing
21	Tarchi et al., 2024	The Use of ChatGPT in Source-Based Writing Tasks
22	Maphoto et al., 2024	Students' Academic Excellence in Distance Education: Exploring the Potential of Generative AI Integration to Improve Academic Writing Skills
23	Alea Albada & Woods, 2024	Giving Credit Where Credit is Due: An Artificial Intelligence Contribution Statement for Research Methods Writing Assignments

	Reference	Publication Title
24	Mohammad et al., 2024	Paraphrasing Prowess: Unveiling the Insights of EFL Students and Teachers on QuillBot Mastery
25	Amirjalili et al., 2024	Exploring the boundaries of authorship: a comparative analysis of AI-generated text and human academic writing in English literature
26	Bozkurt, 2024	GenAI et al.: Cocreation, Authorship, Ownership, Academic Ethics and Integrity in a Time of Generative AI
27	Nguyen et al., 2024	Human-AI collaboration patterns in AI-assisted academic writing
28	Kanddel & Eldakak	Legal dangers of using ChatGPT as a co-author according to academic research regulations
29	Malik et al., 2023	Exploring Artificial Intelligence in Academic Essay: Higher Education Student's Perspective
30	Utami et al., 2023	Utilization of artificial intelligence technology in an academic writing class: How do Indonesian students perceive?
31	Jarrah et al., 2023	Using ChatGPT in academic writing is (not) a form of plagiarism: What does the literature say?
32	Alberth, 2023	The use of ChatGPT in writing: a blessing or a curse in disguise?
33	Khaif et al., 2023	The Potential and Concerns of Using AI in Scientific Research: ChatGPT Performance Evaluation
34	Teng, 2023	Scientific Writing, Reviewing, and Editing for Open-access TESOL Journals: The Role of ChatGPT
35	Mahyoob et al., 2023	A Proposed Framework for Human-like Language Processing of ChatGPT in Academic Writing
	Reviews	
36	Ahn, 2024	The transformative impact of large language models on medical writing and publishing: current applications, challenges and future directions
37	Fabiano et al., 2024	How to optimize the systematic review process using AI tools
38	Khalifa & Albadawy, 2024	Using artificial intelligence in academic writing and research: An essential productivity tool
39	Miao et al., 2024	Ethical Dilemmas in Using AI for Academic Writing and an Example Framework for Peer Review in Nephrology Academia: A Narrative Review
40	Shorey et al., 2024	A scoping review of ChatGPT's role in healthcare education and research
41	Gunawan et al., 2024	ChatGPT integration within nursing education and its implications for nursing students: A systematic review and text network analysis
42	Imran & Almusharraf, 2023	Analyzing the role of ChatGPT as a writing assistant at higher education level: A systematic review of the literature
43	Tikhonova & Raitskaya, 2023	ChatGPT: Where Is a Silver Lining? Exploring the realm of GPT and large language models
44	Mondal & Mondal, 2023	ChatGPT in academic writing: Maximizing its benefits and minimizing the risks

ganisations (affiliations); research areas (though we limited this aspect to Social Sciences, Arts & Humanities and Medicine, documents tend to be classified in more than one area).

As ChatGPT 3.5 was introduced in late 2022, and the first research publications came into being as early as January 2023, we set the timespan covering 2023 and 2024. 2023 brought 10 documents, whereas 2024 accounted for 34 publications (though the annual statistics for 2024 are not complete yet). By type, the 44 documents broke down as follows: 33 articles, 2 editorials, and 9 reviews. The following journals brought out two publications each: *Contemporary Educational Technology*, *International Journal for Educational Integrity*, *International Journal of Artificial Intelligence in Education, Nurse Edu-*

cation Today, and *Open Praxis*. The other 34 documents were published in 34 journals, with one per journal.

The total number of authors was 156. The most prolific researchers were J. Krajka and I. Olszak who co-authored two out of 44 articles. The remaining 154 researchers participated in one article each either as an author or co-author. Every publication in the review had an average of 3.5 authors. Only six documents were written by a single author. The authors had 102 affiliations, including three authors affiliated with the Hong Kong Polytechnic University, two authors from each of the three universities – Uniwersytet Marii Curie-Sklodowskiej w Lublinie, University of Liverpool, and Uniwersytet Marii Curie-Sklodowskiej w Lublinie. The remaining 98 affil-

iations were represented by one author each, though some authors had more than one affiliation.

Geographically, the breakdown of the publications under review embraced the USA with three documents, China, Hong Kong, and Indonesia, with four documents each, and Saudi Arabia with two publications. The remaining 10 countries had one publication each. Though 39 (48.1 %) out of 44 publications belonged to Social Sciences, they and the remaining five documents were simultaneously attributed to other areas: Computer Science (11 documents or 13.6 %), Arts & Humanities (7 documents or 8.6 %), Medicine (6 documents or 7.4 %), Engineering (4 documents or 4.9 %), Business, Management and Accounting (3 documents or 3.7 %), Psychology (3 documents or 3.7 %), Nursing (2 documents or 2.5 %), and Other areas (6 documents or 7.4 %).

Hypothetical Thematic Clusters

While pilot-searching the Internet, we outlined probable thematic clusters that were tested and explored during the search, identification, screening and eliminations of the documents subject to the eligibility criteria. After we had iteratively revised the clusters, the following thematic clusters were finalised for the present review: (1) AI in enhancing academic writing; (2) AI challenges in academic writing, and (2) Authorship and integrity related to GenAI appliances (Table 3). Clusters 2 and 3 cover all aspects of challenges and concerns arising out of applications of the language tools in academic writing. The clusters fully conformed to the review questions and covered the main findings of the 44 selected documents.

Table 3

Hypothetical Thematic Clusters

Thematic cluster	Cluster Description
1.	Cluster One
AI in enhancing academic writing	In the context of generative AI appliances: general issues of enhancing academic writing; strategies followed in academic writing; writing articles and literature reviews; GenAI-based feedback on academic writing at university courses
2 Cluster Two	
AI challenges in academic writing	Challenges and pitfalls brought about by GenAI appliances in academic writing
3 Cluster Three	
Authorship and integrity related to GenAI appliances	Issues of authorship and plagiarism of texts produced by GenAI

Figure 2

VOSviewer Visualization of the Review Thematic Clusters

Some of the 44 publications focus on AI aspects other than academic writing, being complex in their scope (Johnston et al., 2024; Ou et al., 2024; Morreale et al., 2024; Maphoto et al., 2024; Shorley et al., 2024; Tikhonova & Raitskaya, 2023). Though they contain some findings that go beyond the present review, the extracted data were in compliance with the research objective and review questions.

The VOSviewer software's analysis of the metadata from the 44 selected publications mapped out a structured landscape of thematic clusters, each colour-coded to denote a specific domain of the review (Figure 2). The density of terms start-ed from 4. The software forked out five clusters. The clusters partially overlapped. The purple cluster covered integrity and authorship issues of appliances of AI-powered language tools. It also included journal practices related to AI-powered text. The red cluster focused on integrity, research papers, medical writing, and academic journals. The green cluster mainly represented perceptions, teaching, university issues, obstacles, open IA, creativity. The blue cluster comprised higher education, generative AI, academic writing process, advantages, and perspectives. The yellow cluster is densely interrelated with the purple, blue and red clusters, focusing on generative AI, risks, reference and reliability aspects.

Table 4

Mapping the publications to the clusters

SN	Authors and Year	Cluster 1 AI in enhancing academic writing	Cluster 2 AI Challenges in academic writing	Cluster 3 Authorship and Integrity
1	Williams, 2024	✓	✓	
2	Kohnke, 2024		✓	
3	Li et al, 2024	✓		
4	Liu et al., 2024		✓	✓
5	Johnston et al., 2024	✓		
6	Mahapatra, 2024	✓		
7	Gralha & Pimentel, 2024			✓
8	Rafida et al., 2024	✓		
9	Bolaños et al., 2024	✓	✓	
10	Kraika & Olszak, 2024a	✓		
11	Rababah et al., 2024	✓	✓	
12	Ou et al., 2024	✓	✓	
13	Yao et al., 2024	✓	✓	
14	Morreale et al., 2024		✓	✓
15	Kurt & Kurt, 2024	✓	✓	
16	Krajka & Olszak, 2024b	✓	✓	
17	Parker et al., 2024	✓		
18	Kim, 2024			✓
19	Alkamel & Alwagieh, 2024	✓		
20	Kim et al., 2024	✓		✓
21	Tarchi et al., 2024	✓		
22	Maphoto et al., 2024	✓		
23	Alea Albada & Woods, 2024	✓		✓
24	Mohammad et al., 2024	✓		
25	Amirjalili et al., 2024		✓	✓
26	Bozkurt, 2024			✓
27	Nguyen et al., 2024	✓		

SN	Authors and Year	Cluster 1 AI in enhancing academic writing	Cluster 2 AI Challenges in academic writing	Cluster 3 Authorship and Integrity
28	Kanddel & Eldakak			✓
29	Malik et al., 2023	✓		
30	Utami et al., 2023	✓		
31	Jarrah et al., 2023			✓
32	Alberth, 2023	✓	✓	
33	Khaif et al., 2023	✓		
34	Teng, 2023	✓		
35	Mahyoob et al., 2023	✓		
36	Ahn, 2024	✓		
37	Fabiano et al., 2024	✓		
38	Khalifa & Albadawy, 2024	✓	✓	
39	Miao et al., 2024			✓
40	Shorey et al., 2024	✓	✓	
41	Gunawan et al., 2024	✓		
42	Imran & Almusharraf, 2023	✓		
43	Tikhonova & Raitskaya, 2023	✓	✓	✓
44	Mondal & Mondal, 2023	✓	✓	
	TOTAL	**35**	**16**	**12**

Given the difference of the initial inputs, the hypothetical clusters differ from the software clusters. The VOSviewer was limited to the meta-data of the publications (titles, abstract, authors' keywords), whereas the reviewers analysed full-text publications. Overlapping of clusters also underlay the variances in clusters by the reviewers and the software. The reviewers enlarged the clusters as compared to the VOSviewer analysis.

Potential of GenAI-Powered Language Tools for Academic Writing at University and in Science

The raw data on GenAI-powered language tools in academic writing extracted from the reviewed publications are stated in Table 5. In describing this direction of study, we boiled down the most prominent features and characteristics articulated in the reviewed publications to the following:

General Issues of GenAI-Powered Language Tools

Gunawan et al. (2024) mark that academic writing is the pre-dominant cluster when it comes to GenAI applications in higher education. In many contexts, researcher focus on AI-powered language tools as they are easily accessible and

user-friendly for students and researchers (Ou et al., 2024; Kurt & Kurt, 2024; Krajka & Olszak, 2024a). A wide integration of such tools in academic writing presents a paradigm shift (Nguyen et al., 2024). The whole writing process is being transformed and reinforced (Ou et al., 2024). Researchers pointed out that AI provides "dynamic, responsive learning environments and bespoke educational experiences" (Malik et al., 2023). Unfortunately, no research on AI-powered translation was found and included in the review. This sub-field is evolving rather successfully, but this review considered only translation as function of GenAI-powered language tools (Amirjalili et al., 2024; Alberth, 2023; Imran & Almusharraf, 2023; Li et al., 2023).

Strategies in Academic Writing and Hybrid Writing

To be better equipped with "competencies sufficient to navigate this new terrain" (Parker et al., 2024), students or users should follow prudent strategies that were suggested in several research papers (Kraika & Olszak, 2024a; Yao et al., 2024; Mohammad et al., 2024; Nguyen et al., 2024; Mahyoob et al., 2024). Those articles add to the bulk of the reviewed publications on enhancing academic writing with GenAI tools. Some of the documents in this cluster dwelt upon hybrid or entirely AI-powered writing of specific assignments, articles and reviews (Li et al., 2024; Bolaños et al., 2024; Williams, 2024; Alea

Albada & Woods, 2024; Tarchi et al., 2024). Hybrid forms of writing offer appliances of the language AI-powered tools not in text generation but in "writing structure, relevant sources, and new insights about the topic" (Alberth, 2023). Some problems in academic writing may be overcome via AI-powered tools, including typos, spelling errors, and grammar mistakes (Kim et al., 2024b), proper referencing practices (Jarrah et al., 2023), data summarization (Shorley et al., 2024), morphological analyzers, speech recognizers, text classifiers (Mahyoob et al., 2023) and others. Studies of specific GenAI-powered language tools are rare (Krajka & Olszak, 2024b; Mahyoob et al., 2023; Mohammad et al., 2024) as the technology terrain is evolving with information getting outdated fast.

Providing Feedback to the Users

Mahapatra (2024) notices that AI-driven tools that had been introduced before ChatGPT 3.5 were successful at "providing immediate feedback" to students, language learners and authors. The potential of the new technologies is higher because GenAI-powered tools are trained on big data corpora and are capable "to identify complex language patterns" (Kurt & Kurt, 2024). The learners may manipulate by wording prompts and look for a feedback they personally need (Kurt & Kurt, 2024).

Literature Review Generated with GenAI-Powered Language Tools

In this review, we are limited to the appliances of GenAI-powered language tools in academic writing, we still suppose that there is an essential aspect for both academic writing and research. It is a literature overview that constitutes an integral part of any research paper. According to the reviewed documents, we are "moving towards semi-automatic creation of literature reviews" (Bolaños et al., 2024). Kim et al. (2024) admit using AI in literature review at several stages (identifying relevant publications, supplying background information, summarizing texts and others).

GenAI-Powered Tools as Assistants

Another important issue in enhancing academic writing is a potential of GenAI-powered tools that may assist in writing an article in compliance with the best standards of the academia. Today, such a task is not possible (Nguyen et al., 2024). Liu et al. (2024) doubt that a credible academic article can be created by GenAI as there are no well-established discipline-specific large language models. They also note that AI-generated articles offer "superficial discussion" without evidence and suffer from redundancy (Liu et al., 2024).

Major Challenges and Concerns Related to GenAI Appliances in Academic Writing

Khalifa and Albadawy (2024) indicated the major ethical challenges arising out of the AI-human interrelation in research. They are "the importance of human intelligence in research and the limitations ...[of] AI tools ... in guiding research ideas and design" (Khalifa & Albadawy, 2024). The challenges associated with the appliances of GenAI language tools in academic writing (Appendix 2) range from basic and profound in nature (authorship and integrity, overreliance on AI, equity issues, lack of transparency, absence of long-term memory in dialogue in GenAI-powered language tools, problematic identification of AI-generated text) to more specific (propensity to generate inaccurate references, false or biased content, lack of author's voice in AI-generated texts, inability to create credible academic texts).

Key Approaches Towards Authorship and Academic Integrity in the Context of Academic Writing

The issue that is the core of many challenges and concerns is the characteristics of the AI-generated text. Researchers make attempts to define or evaluate its originality and authenticity (Yao et al., 2024). The multiple stances regarding authenticity and related issues result from the lack of transparency in content generation (Shorey et al., 2024). Rephrasing of various concepts may be perceived as new ideas as AI-generated text tends to be deficient in references. AI-generated texts, including articles, abound in "information repetition, nonfactual inferences, illogical reasoning, fake references, hallucination, and lack of pragmatic interpretation" (Mahyoob et al., 2023).

Some researchers link authorship with the author's voice. In academic writing the concept "voice" is constructed by "genre and community constraints in academic writing"(Amirjalili et al., 2024). Amirjalili et al. (2024) see "the notion of voice as an extension of the human author". The author's voice is determined by the use of lexical selections, syntactic structures, hedges, boosters, and personal pronouns as measurable indicators of an author's presence and position. Amirjalili et al. (2024) offered the voice intensity rating scale that included assertiveness, self-identification, "reiteration of the central point", authorial presence and autonomy of thought. In their research, a deep analysis of human-like writings by ChatGPT showed that there were problems with "register, cliched language, and a lack of nuance" (Amirjalili et al., 2024).

Table 5

Enhancing academic writing with Generative Artificial Intelligence: Raw Data from the documents under review

GenAI Potential	Reference	Raw Data
Predominant cluster in literature reviews of GenAI applications in education	Gunawan et al., 2024	"Academic Writing" is the predominant cluster, constituting 39 % of total nodes, and signifies a novel contribution to the literature. The study emphasizes the strong influence of ChatGPT in enhancing academic writing skills among nursing students
AI-powered language tools (AILTs)	Ou et al., 2024	AILTs (i.e., ChatGPT, Grammarly and Google Translate) in academic writing, showing their utility as part of a spatial repertoire in enhancing students' academic communication performance and facilitating personal language development
		The proliferation of AILTs has transformed students' everyday academic writing process into an additional learning space and bestowed upon students a novel identity of spatially advised learners, empowering them to acknowledge AI's facilitating role for personal competence enhancement while remaining aware of its inherent limitations
	Yao et al., 2024	… the students effectively employed ChatGPT to generate ideas, create outlines, revise the content and proofread their manuscripts…
		The students recognised several strengths of ChatGPT in the context of academic writing, including its efficient responsiveness to human instructions and proficiency in language revision
	Kurt & Kurt, 2024	ChatGPT can generate grammatically correct essays, suggest essay topics, create outlines (Barrot, 2023), help generate ideas (Lingard, 2023),T adjust text difficulty to learners' proficiency levels (Bonner et al., 2023), and facilitate guided writing (Kohnke et al., 2023)
	Krajka & Olszak, 2024	A range of intelligent CALL tools, supported by artificial intelligence, can be used to assist foreign language writing teaching and learning. Pokrivcakova (2019) [offers] a comprehensive overview of such applications, enumerating a) personalised learning materials, b) machine translation tools, c) AI writing assistants, d) chatbots, e) AI-powered language learning software (platforms and apps), f) intelligent tutoring systems (ITS), g) intelligent virtual reality (IVR) applications
	Nguyen et al., 2024	The integration of state-of-the-art AI-assisted writing assistants into the academic writing process represents a paradigm shift. These tools not only provide assistance in drafting and revising text but also in conducting literature reviews and synthesising information, which are critical components of scholarly writing
	Alkamel & Alwagieh, 2024	The development of artificial intelligence (AI) has facilitated the creation of highly advanced language and writing tools that possess enhanced capabilities and effectiveness. (Geitgey, 2018; Brown et al., 2020)
	Mondal & Mondal, 2023	Its [ChatGPT] ability to generate human-like text, answer questions, and summarize information has made it a valuable resource for researchers and academics across a wide range of disciplines. ChatGPT can assist in tasks such as literature review, data analysis, and even writing entire sections of academic papers
Strategies for applying GenAI	Parker et al., 2024	…the goal is to equip doctoral students with competencies sufficient to navigate this new terrain confidently and responsibly…
		…a prudent strategy that (a) recognizes the potential synergy of human-AI interactions, (b) values the potential innovative partnerships, and (c) maintains ethical academic standards…
		Given the hybrid human-AI writing process that evolved through students' collaboration with AI, there is an urgent need for institutions to develop clear and prominently displayed policies regarding ethical AI use and academic integrity…

GenAI Potential	Reference	Raw Data
Strategies for applying GenAI	Kim et al., 2024	… this study found a strong need to develop students' capacity for prompt engineering, the process of crafting, optimizing, and employing text that can be interpreted and understood by GenAI. This would enable improved communication with GenAI to harness its capability to perform tasks (e.g., generating educational content) as intended, and ensure accurate, relevant, and quality outcomes
	Tarchi et al., 2024	Eager and Brunton (2023) suggested how the efficacy of AI in education may depend on the ability to write effective prompts for use with conversation-style AI models
	Nguyen et al., 2024	Our study shows that the higher-performing doctoral students' engagement in AI-assisted writing is multifaceted, suggesting a higher familiarity with the tool. The observed sequence of actions, starting with prompting the GAI-powered tool for content and subsequently searching articles, reflects a proactive approach to information gathering. This tactic, contrasting with merely waiting for generated responses, optimises productivity and stimulates cognitive processes. The subsequent sequence of reading, copying, pasting, and editing or integrating content indicates a methodical approach whereby the students critically assess, adapt, and incorporate the AI-generated material into their writing
	Alberth, 2023	The idea is not to rely solely on the application to write an entire research paper, but rather to use it as a tool for gathering necessary information such as the writing structure, relevant sources, and new insights about the topic. Authors may also ask ChatGPT to provide feedback on their draft papers
Enhancing academic writing	Kohnke, 2024	Research indicates that tools such as Grammarly, which provides AWCF, enhance the accuracy of student writing, metalinguistic awareness and self-directed learning (Barrot, 2023b)
	Kim et al., 2024	Expanding beyond an automated evaluation and correction, AI writing systems facilitate students' metacognition by allowing them to identify and correct language errors (Fitria, 2021), notice dissonance in their writing (Gayed et al., 2022), and improve their manuscript's overall clarity and coherence (Liu et al., 2023)…
	Mahapatra, 2024	Yan (2023) has reported benefits to students' writing skills through its use, he has also warned that its use can threaten academic honesty and ethicality in writing…
	Rafida et al., 2024	AI also improves academic writing among EFL students, including task completion, citation accuracy, and sentence construction (Pitychoutis, 2024; Setyowati et al., 2023)
	Parker et al., 2024	This evolution in writing practices signifies a shift towards a more integrated, collaborative approach to academic writing, where AI tools are not mere aids but partners in the creative process
	Kim, 2024	In writing articles, AI can be utilized for accurate translation,

grammatical correctness, and idea generation, as well as for summarizing content, and crafting conclusions (Kim, 2024a) |
| Enhancing academic writing | Malik et al., 2023 | AI, with its groundbreaking technologies and adaptive learning mechanisms, enriches academic writing by providing dynamic, responsive learning environments, and bespoke educational experiences. It delves into the intricacies of language acquisition and offers tailored solutions, making the processes inherent in academic writing more streamlined and intuitive

The data also reveals that many students appreciate AI's role in suggesting appropriate essay ideas (67 %), extracting meaningful data from large datasets (69 %), and analyzing data for data-driven writings (70 %). Furthermore, a considerable percentage of respondents acknowledge AI's contribution to ensuring uniqueness and avoiding accidental plagiarism (73 %), improving language by providing sentence recommendations (75 %), and enhancing article quality by spotting flaws (83 %)… |
| | Alberth, 2023 | McFarlane (2023), the current version of the chatbot can assist with academic writing in two ways. The first way is that when the author conducts a literature review and takes brief notes or bullet points for each reference, they can request ChatGPT to arrange and convert these notes into a well-structured text. The second way is that ChatGPT can be useful for sorting and managing references and citations |

GenAI Potential	Reference	Raw Data
Enhancing academic writing	Tikhonova & Raitskaya, 2023	…the technologies are advantageous for non-native English-speaking authors or even native speakers as they may avoid weaknesses in their submissions related to the language quality…
Assistive tools that improve writing skills	Li et al., 2024	The results from the participants' two-week unrestricted usage of the AI model ChatGPT to enhance their assignments indicated a noticeable improvement in the quality of student papers. This suggests that large language models could serve as assistive tools in medical education by potentially improving the English writing skills of medical students
	Alkamel & Alwagieh, 2024	While ChatGPT can provide valuable support in academic writing, it is important for students to view it as a tool to enhance their skills rather than a replacement for their own efforts.
		Students should use ChatGPT to gain insights, learn from its suggestions, and improve their writing, but they also should strive to develop their own critical thinking and writing abilities
	Tarchi et al., 2024	The potential of ChatGPT Firstly, it enhances efficiency by significantly reducing the time and effort required for content creation, benefiting both students and educators (Lund et al., 2023; Yan, 2023). Secondly, it provides ideation support by suggesting new ideas and perspectives for writing assignments (Kasneci et al., 2023; Taecharungroj, 2023). Additionally, it offers invaluable language translation assistance, helping non-native language students ensure accuracy and grammatical correctness in their writing (Lametti, 2022; Lund & Wang, 2023; Stacey, 2022; Stock, 2023)
	Imran & Almusharraf, 2023	These points would help in understanding its [ChatGPT] use in writing as an assistant and AI tool.
		1. Increased efficiency: ChatGPT's invention can reduce the time and effort required to generate written content…
		2. Idea generation: ChatGPT can help students generate new ideas for their writing assignments by suggesting topics, themes, and perspectives that they might not have considered otherwise (Kasneci et al., 2023; Taecharungroj, 2023).
		3. Language translation: ChatGPT can translate text from one language to another, which can be useful for students who are writing papers in a language that is not their native tongue. This can help students ensure that their writing is accurate and grammatically correct (Lametti, 2022; Lund & Wang, 2023; Stock, 2023).
		4. More accurate and consistent content: With the ChatGPT invention, there is a higher likelihood of producing accurate and consistent content…
		5. Improved collaboration: ChatGPT can also facilitate collaboration among students and educators
	Mahapatra, 2024	ChatGPT …offers advice regarding various structural aspects of a text and translate it (Imran & Almusharraf, 2023), and facilitate guided writing (Kohnke et al., 2023)…
Quality of the writing	Rababah et al., 2024	[The] findings suggest that postgraduate students at Jadara University hold favorable views regarding ChatGPT's utility, ease of use, impact on thesis completion speed, and the quality of work it produces
		…using this tool reduces the time spent on literature review and referencing, improves readability, enhances the quality of the thesis, and provides valuable research ideas
		The findings suggest that students view ChatGPT as a beneficial tool that enhances the writing process, writing quality, knowledge retrieval, and the generation of new ideas.
	Nguyen et al., 2024	While AI, particularly in its generative form, does not possess the ability to fully synthesise literature or independently engage in critical writing, it has shown considerable proficiency in aiding these processes. Specifically, generative AI can assist by aggregating and summarising relevant literature and generating written content based on specific prompts

GenAI Potential	Reference	Raw Data
Text generation – Proofreading and Editing – Summarizing the texts – Translation and interpretation Paraphrasing	Shorey et al., 2024	In healthcare research and academic writing, ChatGPT's value is evident in aiding manuscript drafting/composition, data summarization and citation management (Lund et al., 2023; Sallam, 2023)
	Williams, 2024	…the AI tools were able to generate essays that generally met the scientific accuracy criteria for both undergraduate and postgraduate levels
	Gunawan et al., 2024	ChatGPT has…potential as a tool for generating written content, reviewing articles, and collaborative writing exercises (Sun and Hoelscher, 2023)
		ChatGPT could also proofread and edit sentences, identify grammatical errors, paraphrase, improve writing quality, and summarize the texts (Castonguay et al., 2023; Sun and Hoelscher, 2023)
	Kim, 2024	… ChatGPT has been noted for producing more refined sentences more quickly than traditional English proofreading services, making it a valuable tool for language editing (Kim, 2023)…
	Kim et al., 2024	An evaluation of Wordvice AI, a proofreading tool, highlighted that the tool could outperform the built-in proofreading abilities of Google Docs or Microsoft Word, but still only managed to identify 77% of what was identified by a human proofreader (Heintz et al., 2022)
		…AI may be able to support typos, spelling errors, and grammar mistakes…
	Mohammad et al., 2024	Numerous studies suggest that online paraphrasing tools such as paraphrase-tool.com, QuillBot.com, prepotseo.com, and spinbot.com can be beneficial in addressing students' challenges in academic writing
	Jarrah et al., 2023	AI tools can streamline the process of citation and referencing by automatically generating accurate citations based on given referencing styles. This reduces the likelihood of citation errors and helps students maintain consistency and adhere to proper referencing practices
	Kim et al., 2024	AI writing systems also offer real-time translation and interpretation services. This enables students to overcome language barriers to access and assimilate content in multiple languages and learn diverse perspectives (Salvagno et al., 2023)
Feedback on writing	Kohnke, 2024	By providing immediate and clear feedback, GenAI tools reduce extraneous cognitive load, allowing students to focus more on content and higher-order writing skills. This can lead to more efficient learning and better retention of writing strategies (Paas et al., 2003)
		Compared to traditional grammar-checking tools, GenAI tools go beyond simple error correction to provide detailed explanations of linguistic rules, potentially enhancing students' overall language proficiency (Dizon & Gayed, 2021; Tan, 2023)
		These tools support self-regulated learning (SRL) by providing immediate feedback that helps students monitor and control their learning (Chiu, 2024; Zimmerman, 2000)
Feedback on writing	Mahapatra, 2024	With the proliferation of AI-driven tools such as Grammarly, QuillBot, Copy.ai, Word-Tune, ChatGPT, and others, it has become easier for students to obtain feedback on their writing (Marzuki et al., 2023; Zhao, 2022)…
	Rafida et al., 2024	These tools offer real-time feedback on grammar, structure, and style, systematically improving skills (Ahmad et al., 2023; Khotimah et al., 2024)
	Kurt & Kurt, 2024	Trained on extensive text corpora, these LLMs can identify complex language patterns and offer more detailed and contextually relevant feedback. In contrast to traditional AWE systems, LLMs use a natural language interface that simplifies and enhances the
		feedback process (Kasneci et al., 2023)…
		Its interactive and adaptable nature allows users to gain expertise in manipulating and accessing the kind of feedback they are seeking… Given the critical role of feedback in L2 writing and ChatGPT's potential to offer high-quality feedback on mechanics, styling, content, and organization, its integration as an automated evaluation tool is seen as promising for L2 learners' writing development (Guo & Wang, 2024)

GenAI Potential	Reference	Raw Data
The use of AI in Literature Reviews (SLRs) and other scholarly publications	Bolaños et al., 2024	The increasing role of AI in this field shows great potential in providing more effective support for researchers, moving towards the semi-automatic creation of literature reviews…
		AI [is applied] in the screening and extraction phases
		The other four tools (Covidence, PICOPortal, and EPPI-Reviewer, Colandr) undertake two AI-related tasks. They all classify papers as relevant/irrelevant, but also execute an additional task, such as identifying a specific type of paper (e.g., economic evaluation, randomised controlled trials, etc.) or categorising papers according to a set of entities defined by the user
		ExaCT, Dextr, and Iris.ai perform Named Entity Recognition (NER) Nasar et al. (2021) to extract various types of information from the relevant articles.
		Only two tools offer support for post-screening: Iris.ai and Nested Knowledge. Specifically, Iris.ai generates summaries from either a single document, multiple abstracts, or multiple documents… the summary is formed by generating new sentences that encapsulate the core information of the original text
	Kim, 2024	…researchers can use AI to discover, translate, and summarize articles and research trends, identify experimental methods and scientific knowledge, and compile results and statistics…
		In a hybrid narrative review case involving collaboration between humans and ChatGPT, the results highlighted both the effectiveness and the concerns associated with ChatGPT (Temsah et al., 2023)
	Kim et al., 2024	AI writing systems assist students in literature review by identifying relevant research articles (Behrooz et al., 2023), supplying background information on writing topics (Chichekian & Benteux, 2022; Rowland, 2023), summarizing texts (Behrooz et al., 2023), and providing recommendations tailored to students' preferences and search patterns (Chichekian & Benteux, 2022; Rowland, 2023).
	Khalifa & Albadawy, 2024	The synthesis of literature through AI, producing summary tables and comparative analyses, represents a revolutionary stride in automated literature synthesis, offering a comprehensive and nuanced perspective of existing research… AI's capability to identify gaps in literature is invaluable. Through advanced natural language processing, it can scrutinize thousands of documents, revealing overlooked or under-researched areas

Identifying AI-Generated Text

AI-generated text is detected by some software with a high probability (Liu et al., 2024). But no detector may infallibly identify such a text (Morreale et al., 2024). We found that in the reviewed publications a special attention was paid to detecting AI-powered texts as compared with human-produced writings (Liu et al., 2024). Generative AI generates texts similar to human writings, but the difference potentially may be detected in their perplexity (unpredictable and diverse text) and burstiness (complexity of sentences and rare words) of the text (Krajka & Olszak, 2024). Judging by the progress ChatGPT has been making lately, the AI text generation will become quite soon more identical to the human-produced writings or will conform to any identified parameters. Already at present, efforts are made to distinguish AI-generated from human produced texts. The afore-mentioned concepts of burstiness and perplexity lay the foundation for detecting AI-generated texts. Alexander (2023) points out that AI-generated text may have lower burstiness and lower perplexity than human writing as human writers may turn to rare words and more complex text due to "their complex thought processes and personal experiences" (Krajka & Olszak, 2024).

Inaccurate References and Non-Authentic Content

In many publications on ChatGPT and GenAI-powered language tools, authors write that AI generate "verbose overelaborate content and overused/repetitive phrases" (Shorey et al., 2024), inaccurate information (Yao et al., 2024), inaccurate citation (Rafida et al., 2024), hallucinate content, … unquoted material (Kim, 2023).

Limitations in Creating Credible Academic Text

At present, large language models are not discipline specific. It is the key reason for their inability to create high-quality research articles at a level comparable with publications in reputed journals (Lui et al., 2024).

DISCUSSION

In attaining the objective to determine the prevailing directions of research on GenAI appliances in academic writing in tertiary education and science, the present review revisited the three aspects. First, enhancing academic writing. The findings of the review essentially follow the publications that have been brought out for the 2-3 years (Tewari et al., 2021; Thorp, 2023; Misra & Chandwar, 2023). Some new aspects either arise or manifest themselves more vividly. The updated AI technologies improved many features helpful for academic writing and essentially expanded beyond automated correction and simple text generation.

When it comes to hybrid writing that is seen as a strategy incorporating the advantages that GenAI-powered language tools may offer to their users, the authors are mainly unanimous (Parker et al., 2024). In this kind of collaboration, humans "remain accountable for fact-checking, verification procedures, and truth-telling" (Eaton, 2023). And this approach eases many risks associated with AI-powered academic writing, especially those connected with plagiarism. In the reviewed publications, we saw several approaches to plagiarism. Jarrah et al. (2023) cited the authors that saw ChatGPT as a source of information that should be properly cited (Perkins, 2023; Okaibedi, 2023). But the problem with ChatGPT long-term memory in dialogues prevents users from citing the AI-generated text. It cannot be reproduced or found after the generation.

Part of the academic community treats plagiarism differently as a concept. It remains a disputable issue. Eaton (2023) comments on discarding the term "plagiarism" as it is used. There is no universally accepted definition of plagiarism. Many practices are considered as plagiarism, including contract cheating, academic outsourcing, any misconduct in the academia (Kandeel & Eldakak, 2024). Eaton (2023) offers post-plagiarism as the new concept of plagiarism that will transcend the previous concept. It implies that the academia in on the verge of philosophical revision of the concept.

Kandeel & Eldakak (2024) refer to the Terms of Use by OpenAI[3], an owner and creator of ChatGPT, regarding the services offered by ChatGPT, stating that the user is responsible for content that include both input and output. Moreover, the Terms of Use also incorporate a number of provisions that negate some ideas underlying research on authorship of AI-generated and hybrid-generated texts. The Terms of Use state:

1. You may not ...represent that Output was human-generated when it was not...

2. Output may not be unique and other users may receive similar output from our Services...

3. Output may not always be accurate...

4. Our Services may provide incomplete, incorrect, or offensive Output...

5. Any use of Outputs from our Services is at your sole risk...[4]

These clear-cut provisions eliminate partially arguments that ChatGPT may be approached as an author or co-author. Moreover, attempts to examine and prove that GenAI-powered language tools produce false or incorrect information and are not authors or vica versa are more about the scope and accuracy of wordings. Those attempts might precede the deeper and wider revision of the plagiarism concept.

CONCLUSION

The emerging field of generative AI-powered language tools is evolving, with the prevailing directions of studies: enhancing academic writing (functional aspects, content generation, assistance in writing, feedback on academic writing, learning environment for academic writing), hybrid writing as a form of the most efficient strategies in overcoming AI challenges and using the benefits of GenAI-powered language tools, challenged and concerns in the context of appliances of such tools, with a special focus on plagiarism issues of AI-generated content.

The findings proved that the previous directions of studies are still in place with some new accents, including perceptions of the strategies of appliances and hybrid academic writing as a new important concept.

The review has several limitations, including the search in one database and only for publications in English. Probably, some meaningful documents in other languages might have widened our perceptions of the research field. Further and regular (at least yearly) reviews are essential for the field that is evolving fast. New knowledge is added monthly, with an unclear though impressive perspective of the GenAI appliances in the long run.

DECLARATION OF COMPETING INTEREST

None declared.

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[3] OpenAI. Terms of Use. Updated Dec.11, 2024. http://openai.com/policies/row-terms-of-use
[4] Ibid.

AUTHOR CONTRIBUTION

Lilia Raitskaya: conceptualization; data curation; formal analysis; investigation; methodology; resources; software; validation, visualization; writing – original draft; writing – review & editing.

Elena Tikhonova: conceptualization; data curation; formal analysis; investigation; methodology; resources; software; validation; visualization; writing – original draft; writing – review & editing.

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