International Journal of Learning, Teaching and Educational Research
Vol. 25, No. 9, pp. 502-522, September 2026
https://doi.org/10.26803/ijlter.25.9.20
Received Jun 28, 2026; Revised Aug 12, 2026; Accepted Aug 28, 2026

Potentials of Artificial Intelligence in Enhancing Postgraduate Research Skills in Sustainable Language Education: A Systematic Literature Review

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Citation:
Noor, M, L, A, M., Isa, M, A., Sahrir, M, S., & Ghalib, M, F, M. (2026). Potentials of Artificial Intelligence in Enhancing Postgraduate Research Skills in Sustainable Language Education: A Systematic Literature Review. *International Journal of Learning, Teaching and Educational Research*, *25*(9), 502–522. https://doi.org/10.26803/ijlter.25.9.20

Abstract. Artificial intelligence (AI) has been utilized in multiple disciplines, including educational areas, to improve and expedite various tasks that were once considered to be time-consuming and exhaustive. In education, although extensive research has been conducted to examine the integration of AI in pedagogical designs and practices, research focusing on AI utilities in enhancing research skills among students, particularly postgraduates, remains inadequately investigated. This gap exists despite the fact that postgraduates are the central point of research work due to their substantial involvement in the thorough methodological process. Therefore, this review systematically examines the available evidence on AI's potential to improve postgraduates' research skills in sustainable language education. Guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), the review employed systematic searching strategies in Scopus, Web of Science, Google Scholar, and ERIC. A total of 22 articles were included and data from the selected literature were subsequently extracted and examined using thematic analysis, which revealed four major themes and 13 subthemes explaining the substantial potential of AI in this context. This diverse potential was discussed through the lens of the Sustainable Development Goals (SDGs) to illustrate how AI can sustainably support research skills development among postgraduates. Thus, by referring to this review, policymakers are encouraged to develop

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suitable programs, guidelines, and frameworks for postgraduates or novice researchers to use AI responsibly and thoughtfully to optimize their research-based tasks and academic writing.

Keywords: AI in language education; academic writing support; postgraduates; higher education; sustainability

1. Introduction

Artificial Intelligence (AI) is rapidly transforming the landscape of education. Beyond pedagogical usage, past research mentions its growing role in educational research, where AI tools are used for data collection, analysis, interpretation, and scholarly writing (Pham Bich & Pham Dao, 2024; Sharma et al., 2024). AI is used as a tool to support teaching, learning, and academic work, not merely as a technological innovation (Chen et al., 2020). For the purpose of helping with their academic writing process, students utilize AI for grammar correction (Ou et al., 2024), structuring and outlining (Zou & Huang, 2024), translation (Hegazy et al., 2024), and paraphrasing (Werdiningsih et al., 2024). These resources enhance writing abilities, self-efficacy, and comprehension of academic integrity when utilized as a supplement rather than a replacement (Chen et al., 2020).

AI also supports complex academic tasks such as writing and data analysis (Islam et al., 2025). By reducing human labour, it has automated data analysis processes (Sircar et al., 2021), enhanced precision, and improved efficiency. This automation helps students in analyze data in real time and allows them to focus on higher-order thinking and higher cognitive levels (Islam et al., 2025). In postgraduate studies specifically, AI is able to help students with the literature review, idea generation, data analysis, and critical thinking. AI tools also help postgraduate students extract findings, information, and insights from large datasets, manage references efficiently, conduct advanced analyses, and automate citation collection. This enhances the quality, coherence, and efficiency of academic writing (Pham Bich & Pham Dao, 2024).

In the contemporary higher education environment, research skills are among the most vital competencies for postgraduate students. These research skills commonly include critical thinking, literature review, problem-solving, data collection, data analysis, and communication, as frequently reported across both research-based and class-based programs (Vieno et al., 2022). However, postgraduate students frequently experience cognitive overload and time constraints as they juggle between employment, family responsibilities, and academic commitments (Tlali et al., 2022). Limited supervisory support due to supervisory workloads and delayed feedback can further slow research progress and increase frustration (Abeid et al., 2025). In this regard, AI has offered the potential to facilitate the automation of research skills development, allowing postgraduate students to focus more on advanced research skill when AI is employed as a supplement rather than a substitute (Rodafinos, 2025).

Education is seen as an essential instrument for achieving the Sustainable Development Goals (SDGs) (Veckalne & Tambovceva, 2022). The 2030 Agenda for Sustainable Development highlights the importance of quality education, lifelong learning, and global citizenship education (United Nations, 2021). Access, quality (Khalil, 2025), inclusivity, and capacity building (Chang & Nkansah, 2024) are the four interrelated pillars that support sustainable language education within this framework. By ensuring fair access to educational opportunities, improving pedagogical quality, and creating inclusive environments that value linguistic and cultural diversity, it promotes sustainable development (United Nations, 2021) and enhances students' and teachers' abilities in a comprehensive and integrated way (Ge et al., 2023).

In education, the SDGs are being utilized progressively as a conceptual and interpretive framework. They serve as learning materials, a framework for institutional change, and an educational manual with a community orientation (Pham Xuan & Håkansson Lindqvist, 2025). At the same time, AI is seen more in terms of how it promotes sustainability than for its direct results. Several systematic literature reviews highlight how AI can help achieve the SDGs and sustainable development (Kulkov et al., 2024).

Even with the rising number of studies, research skills and AI are still mostly studied separately. Instead of particularly looking at AI in research education, many concentrate on AI in teaching or AI in research contexts (S. Wang et al., 2024; Zawacki-Richter et al., 2019). In systematic literature reviews (SLRs), the use of AI in education, particularly at the postgraduate level, and the sustainability/SDG framework are commonly found in separate pathways. Few reviews concurrently and openly examine AI, the SDGs, and postgraduate students. Consequently, the postgraduate level is still thought to be an under-researched topic (Bond et al., 2024).

Given this gap found in the literature, the current study aims to conduct an SLR that focuses on the potential of AI to enhance postgraduate fundamental research skills in sustainable language education. Moreover, a systematic literature review (SLR) is a comprehensive way of reviewing the literature based on an organized, replicable, and transparent procedure (Higgins et al., 2011). Notably, although the significance of this review concentrates on strengthening the research skills and academic writing of postgraduates, academicians and educators at the tertiary level can employ the findings from the current review to help them integrate AI-based research into their instruction and curriculum to further prepare students for future research.

Additionally, the findings can also benefit policymakers, such as postgraduate training centers in universities and higher education governmental bodies, by ensuring workshops and training comply with current AI usage in research and by supporting the development of a structured framework for AI integration in educational policies within higher education. Therefore, this review helps bridge the gap between institutional practice and broader educational policy to ensure a unified approach to AI integration in academia.

2. Methodology

2.1 Review Protocol – PRISMA

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) developed by Moher et al. (2009) and Page et al. (2021) was referred to and adapted as the primary protocol of the current review due to its flexibility to be employed in multiple areas, including education. The authors also employed established guidelines by Shaffril et al. (2021) and Xiao & Watson (2019) in the process of conducting the review. Based on the review protocol and established guidelines, five primary procedures were conducted in this review, namely review protocol selection, research question formulation, systematic searching strategies, quality appraisal, and data extraction and analysis.

2.2 Formulation of Research Question

The research question was developed through PICo mnemonic recommended by Lockwood et al. (2015), whereby it is based on three aspects: Population (P), Interest (I), Context (Co). Based on the review context, three elements were selected, namely postgraduate students (Population), potential of AI in enhancing research skills (Interest), and sustainable language education (Context). As a result, the research question developed in this review is: What are the potentials of AI in enhancing postgraduate research skills in sustainable language education?

2.3 Systematic Searching Strategies

To initiate literature identification, the review underwent systematic searching strategies which included three main phases (i.e., identification, screening, and eligibility) as illustrated in Figure 1.

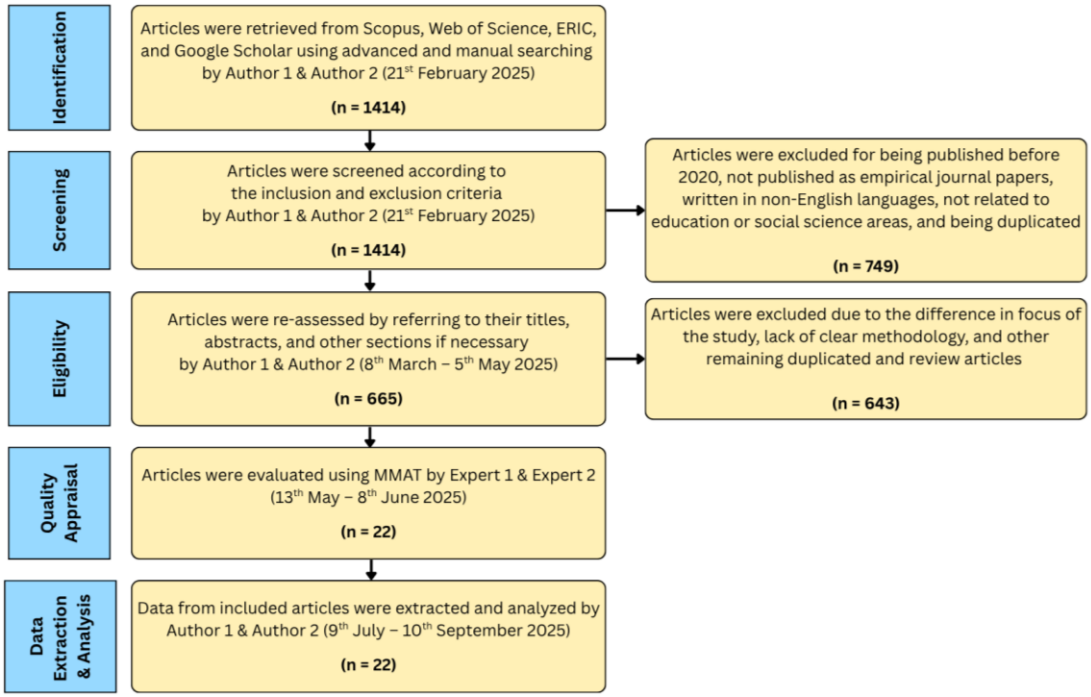


Figure 1: Flow diagram of the review

2.3.1 Identification

Throughout this phase, main keywords were selected from the research questions and were subjected to an enrichment and diversification process before being used in the databases for literature retrieval. The identified main keywords were potential, artificial intelligence, postgraduate, research skills, sustainability, and language education. The authors used an online thesaurus, past articles, and AI platforms (i.e., ChatGPT and DeepSeek) to enrich and diversify the keywords. AI was relevant to use in the identification process because of its capability to expedite keywords identification and refine search queries (S. Wang et al., 2023). The authors reviewed identified keywords across all methods.

Furthermore, Scopus, Web of Science, the Education Resources Information Center (ERIC), and Google Scholar were used to retrieve relevant literature. Scopus and Web of Science were chosen as the primary databases because of their substantial benefits such as large multidisciplinary coverage, advanced searching features, and high-quality publications (Gusenbauer & Haddaway, 2020; Martín-Martín et al., 2018). In addition, ERIC and Google Scholar were employed as supplementary databases due to their advantages including specialized coverage, extensive collection of publications, and public accessibility (Gusenbauer, 2018; Haddaway et al., 2015; Newman & Gough, 2020).

The authors employed both manual (e.g., handpicking and snowballing) and advanced (e.g., search strings) searching techniques across all selected databases. During advanced searching in Scopus and Web of Science, the authors developed search strings through a combination of selected keywords, phrase searching, field codes, truncation, wildcards, and Boolean operators. Table 1 presents the search strings used in this phase. As a result, 1414 literature were selected for the screening process.

Table 1: The search strings

Databases	Field	Search String
Scopus & Web of Science	Title, Abstract, Keywords, Topic	(("potent*" OR "capabl*" OR "capabil*" OR "able*" OR "abilit*" OR "effect*" OR "impact*" OR "implicat*" OR "influenc*" OR "benefit*" OR "advantag*" OR "use*" OR "usag*" OR "utiliz*" OR "utilis*" OR "apply*" OR "appli*" OR "role*") AND ("artificial* intelligenc*" OR "AI" OR "machine learning" OR "LLM" OR "GenAI" OR "chatbots" OR "ChatGPT") AND ("post*graduat*" OR "graduat*" OR "Ph*D*" OR "doctor*" OR "master*" OR "tertiar* educat*" OR "tertiar* level*") AND ("research* skill*" OR "scient* research*" OR "writ* skill*" OR "think* skill*" OR "analyt* skill*" OR "idea* develop*" OR "research* design*" OR "content* develop*" OR "text* structur*" OR "literatur* review*" OR "literatur* synthesis*" OR "data* manage*" OR "data analys*" OR "edit*" OR "review*" OR "publish*" OR "communicat*") AND ("sustainab*" OR "sustain* developmen* goal*" OR "SDG*") AND ("languag* educat*" OR "languag* learn*" OR "languag* teach*" OR "languag* pedag*" OR "second* languag* educat*"))

2.3.2 Screening

The screening phase involved a procedure whereby the inclusion and exclusion criteria for literature selection were determined to minimize the number of irrelevant articles collected during the identification phase. As shown in Table 2, five inclusion criteria were specified based on the research question as outlined by Kitchenham & Charters (2007).

Table 2: The inclusion and exclusion criteria of the review

Criteria	Inclusion	Exclusion
Timeline	2020-2024	From 2019 and preceding years
Publication type	Empirical articles	Review papers, proceedings, books, chapters in books, etc.
Study sample	Postgraduates	Undergraduates, secondary and primary students
Language	English	Non-English literature
Subject area	Education and Social Science	Other than education and social science areas

First, the review only selected articles published in the last five years (i.e., 2020 to 2024), since the timeline aligns with the study maturity of AI in language education (Alexander, 2020; Kraus et al., 2020; Lubis et al., 2024). Second, only empirical articles were included to ensure appropriate data synthesis. The review prioritizes empirical articles over other types of literature, such as book chapters, as they may risk not undergoing a standardized peer-review process similar to journal articles. The review also only focused on postgraduates as samples for the studies to ascertain that the identified potential, in practice, reflect their usage in postgraduates' research skills enhancement.

To ensure accessibility of articles' findings, the review only selected articles published in English (Linares-Espinós et al., 2018; Okoli, 2015). The last criterion is the subject area whereby the authors only included articles in language education and social science to minimize irrelevant articles. The screening process was implemented automatically using screening features within the databases. The procedure excluded 749 articles, and the remaining 665 articles were included for further screening.

2.3.3 Eligibility

In this phase, the authors re-screened the included articles by examining the titles and abstracts. If deemed necessary, the authors also screened the methodologies, findings, and discussions to further verify the relevance of the articles to be included in the review. Consequently, 643 articles were excluded due to a different study focus, absence of a clear methodology, article duplication, or because they were review articles. Only 22 articles remained for quality assessment.

2.4 Quality Appraisal

The remaining articles were appraised for quality by two experts independently using the Mixed Methods Appraisal Tool (MMAT) developed by Q. N. Hong et al. (2018). All criteria were answered based on three options, namely Yes (1.0

mark), No (0.0 marks), and can't tell (0.5 marks). The decision on article inclusion was based on the average score of the criteria fulfilled by the articles, with articles achieving an average score of 2.5 accepted for inclusion. As presented in Table 3, all selected articles passed the minimum average score of 2.5. Although MMAT discourages an overall numerical score, the reason for this decision is to set an objective threshold that enables replicability and transparency of the quality assessment in this review. In addition to that, the threshold was set to 2.5 as it indicates that the study has met at least 50% of the quality criteria, thus excluding articles with lower quality that may weaken the final synthesis.

Table 3: Results of the quality appraisal

Studies	Research Design	Average Score	Inclusion in the Review
Nazari et al. (2021)	QN (R)	5.00	Included
Dai et al. (2023)	QL	5.00	Included
Darwin et al. (2024)	QL	5.00	Included
Mohammed et al. (2023)	QN (D)	4.75	Included
Zou & Huang (2024)	QL	5.00	Included
Abdulah et al. (2024)	QN (D)	5.00	Included
Roman-Acosta et al. (2024)	QN (D)	3.50	Included
Aguirre-Aguilar et al. (2024)	QN (D)	4.50	Included
Alshwiah (2024)	QL	4.00	Included
Bouzar et al. (2024)	QN (D)	5.00	Included
Chauke et al. (2024)	QL	5.00	Included
Chia et al. (2024)	QN (D)	5.00	Included
Elkatmış (2024)	QL	3.50	Included
Essien et al. (2024)	MX	5.00	Included
Hegazy et al. (2024)	QN (D)	5.00	Included
Kumar & Gunn (2024)	QL	4.75	Included
Nemt-allah et al. (2024)	QN (D)	5.00	Included
Ou et al. (2024)	QL	5.00	Included
Picciano (2024)	QL	2.75	Included
Rababah et al. (2024)	QN (D)	4.50	Included
Suglo et al. (2024)	QN (D)	4.00	Included
Werdiningsih et al. (2024)	QL	5.00	Included

Note. QN (R) = Quantitative Non-Randomized Controlled Trials; QL = Qualitative; QN (D) = Quantitative Descriptive; MX = Mixed-Methods

2.5 Data Extraction and Analysis

The data extraction procedure was conducted on the articles' abstracts, findings, discussion, and other sections, if necessary, by two authors. Data were extracted if they could address the research question of the review. The process was conducted manually by collating them in a data extraction table.

Regarding data analysis, due to the review grounded in an integrative review, Whittemore & Knafl (2005) recommend the use of qualitative analysis to facilitate iterative data comparison across varied research methodologies. Therefore, thematic analysis was selected due to its flexibility in handling data of varied depths and richness (Flemming et al., 2019). The six steps of thematic analysis established by Braun & Clarke (2006) were used in the data analysis procedure.

Throughout this process, the authors iteratively and manually read, coded, grouped the data, refined themes, and discarded irrelevant data. Consequently, the analysis yielded four themes and 13 subthemes. The developed themes and subthemes were presented to an expert to obtain validation.

3. Results

The section presents the background of the selected studies and four major themes derived from the thematic analysis of 22 articles.

3.1 Background of the Included Studies

The qualitative synthesis was derived from 22 included articles. In relation to research designs, it was recorded that 11 articles employed quantitative designs, 10 studies used qualitative approaches, and only one study adopted mixed-methods design. Regarding the year of publication, most of the articles (18 out of 22) were published in 2024, three articles were published in 2023, and only one article was published in 2021. Furthermore, in terms of AI tools examined in the studies, 15 articles focused on ChatGPT, one article examined three AI tools used in literature reviews (i.e., Litmaps, Scholarcy, and Scite), one study focused on Grammarly, and two articles examined multiple AI tools (e.g., ChatGPT, ChatPDF, OpenAI Playground, Quillbot, Grammarly, Bard, Wordtune, Asper, Gemini, Perplexity, and DeepAI) to identify commonly used applications among their sample. The remaining three articles investigated AI in general terms without specifying any AI applications.

3.2 Themes and Subthemes

As shown in Figure 2, the qualitative synthesis yielded four major themes and 13 subthemes. The following section reviews the entire themes and subthemes derived from the included articles.

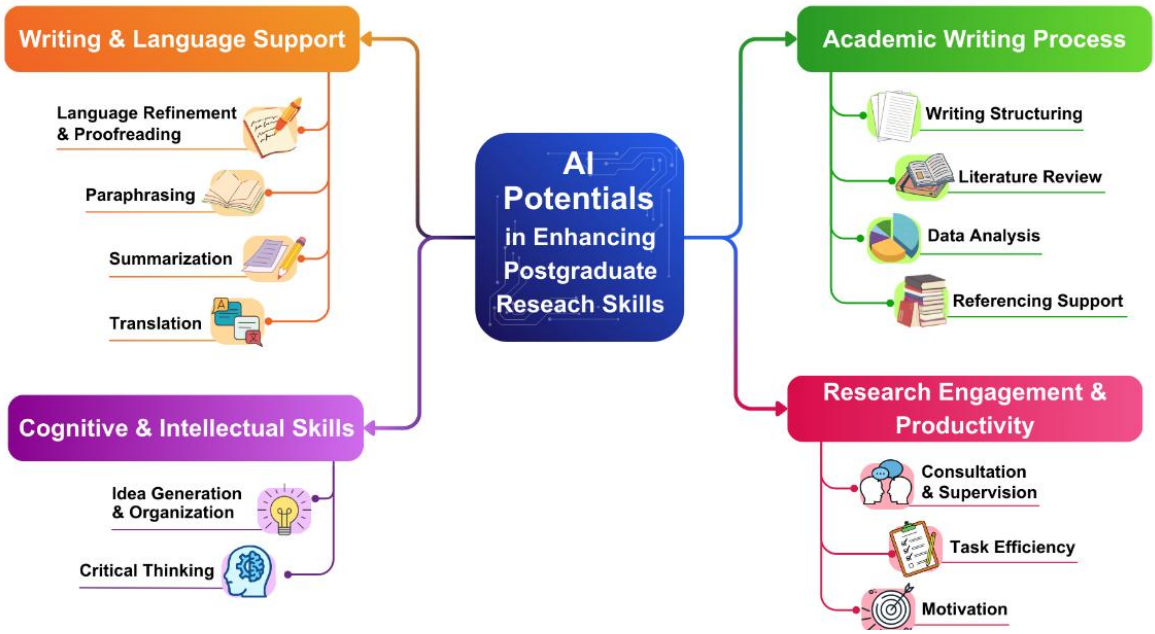


Figure 2: Infographic on the developed themes and subthemes

3.2.1 Writing and Language Support

Across the reviewed studies, AI has been shown to assist in proofreading tasks, including grammar checking, corrections, and spelling revision (Abdulah et al., 2024; Chauke et al., 2024; Chia et al., 2024; Dai et al., 2023; Elkatmış, 2024; Essien et al., 2024; Hegazy et al., 2024; Ou et al., 2024; Roman-Acosta et al., 2024). For instance, Grammarly highlights errors prior to submission (Nazari et al., 2021), while ChatGPT helps provide learning materials for grammar revision (Werdiningsih et al., 2024; Zou & Huang, 2024). Besides that, AI also demonstrates the ability to help students refine language in writing. For example, ChatGPT can recommend synonyms and improve vocabulary usage in writing (Ou et al., 2024; Werdiningsih et al., 2024). The tool is also able to improve language in sentence and paragraph structure as it has the ability to suggest alternative expressions, phrases, sentence structures, and help students write like a native speaker in different styles and tones through multiple text examples (Dai et al., 2023; Elkatmış, 2024; Ou et al., 2024; Zou & Huang, 2024).

Furthermore, AI was also found to help postgraduates paraphrase sentences, paragraphs, complicated ideas, or texts (Abdulah et al., 2024; Chauke et al., 2024; Chia et al., 2024; Hegazy et al., 2024; Nemt-allah et al., 2024; Werdiningsih et al., 2024). To appropriately strategize paraphrasing academic texts, Ou et al. (2024) recommend that students paraphrase their work in a sequenced manner through AI as it tends to make numerous changes to the original writing, which can result in a loss of the author's original writing style. Thus, it is suggested to paraphrase systematically through a sequence of prompts by dividing the text into smaller segments, formulating prompts that define the allowable alteration scope by the system, and later manually selecting the suggestions provided by ChatGPT (Ou et al., 2024).

In addition, AI-summarization utility assists students in handling extensive amounts of information from selected texts and simplifying it into core ideas, which improves comprehension and writing abilities (Chia et al., 2024; Mohammed et al., 2023; Picciano, 2024). The tools enable students to summarize the main ideas of literature, identify relevant quotes, find themes and patterns embedded in the passages, and produce a summary or report (Aguirre-Aguilar et al., 2024; Dai et al., 2023; Darwin et al., 2024; Ou et al., 2024; Picciano, 2024).

Certain summarization features in AI, such as Scholarcy, offer additional features that allow students to customize the summary by specifying the word count, setting how the summary should be written, generating tables and figures from the literature, and creating summary flashcards that can be exported into Microsoft Excel (Kumar & Gunn, 2024). AI-generated summary allows students to compare and examine their own summaries and how they organize the main ideas (Kumar & Gunn, 2024). Moreover, translation utility in AI facilitates postgraduates in addressing language barrier when accessing academic articles by translating literature in other languages, especially when the articles are written in advanced English (Darwin et al., 2024; Hegazy et al., 2024; Mohammed et al., 2023).

3.2.2 Academic Writing Process

In academic writing, AI helps students structure their work, such as refining thesis or dissertation organization, ensuring conformity to specific writing formats, and developing outlines and writing drafts (Essien et al., 2024; Nemt-allah et al., 2024; Ou et al., 2024; Werdiningsih et al., 2024; Zou & Huang, 2024). AI also contributes to students' understanding of technical components in academic works (Alshwiah, 2024; Chauke et al., 2024). For example, students can understand the central ideas of various research sections, their importance in academic writing, methods for writing them, and their arrangements in research papers (Alshwiah, 2024).

AI can supply examples of intended parts, such as introduction, research titles, objectives, and methodology that allow students to reflect and compare with their existing works (Alshwiah, 2024; Zou & Huang, 2024). The incorporation of AI in structuring academic work is important for postgraduates, as it can guide them to present compelling arguments, compose more structured writing, and enhance the quality, readability and coherence of their writing (Elkatmış, 2024; Mohammed et al., 2023; Nemt-allah et al., 2024; Ou et al., 2024; Picciano, 2024; Rababah et al., 2024; Roman-Acosta et al., 2024; Werdiningsih et al., 2024; Zou & Huang, 2024).

In the context of a literature review, AI can be employed in formulating topics, providing guidelines for the review, retrieving credible articles, summarizing their contents, and synthesizing findings across the literature (Abdulah et al., 2024; Alshwiah, 2024; Dai et al., 2023; Essien et al., 2024; Hegazy et al., 2024; Mohammed et al., 2023; Nemt-allah et al., 2024; Ou et al., 2024; Picciano, 2024; Rababah et al., 2024; Suglo et al., 2024; Werdiningsih et al., 2024). Chauke et al. (2024) reported that students use ChatGPT for tailored guidance in identifying articles, while tools such as ChatPDF, support automated reading to help students synthesize significant ideas.

In addition, more advanced platforms, such as Litmap, Scholarcy, and Scite extend these functions through visualization features (Kumar & Gunn, 2024). These platforms offer literature mapping, structured summaries, and citation analysis, which help students initiate literature reviews, explore relevant sources and their connection, structure and summarize extracted information, and analyze citations and the impacts of the literature. Accordingly, these functionalities broaden students' perspectives on topics through the identification of gaps, supporting and contradictory findings, citation contexts, corrections and retractions within literature.

AI has also been found to be useful in supporting data analysis (Chia et al., 2024; Darwin et al., 2024; Hegazy et al., 2024; Suglo et al., 2024). The data analysis function provided by AI can perform statistical analyses and complex calculations, which enhances students' abilities to interpret collected data (Darwin et al., 2024; Hegazy et al., 2024). This function also helps students to foresee the outcome of analyses on different variables that help improve research design, such as refining research questions, methodology, and investigating existing

theories (Darwin et al., 2024). Besides numerical data, this utility can be employed to analyze non-numerical data, such as literary text and data in social media platforms. The tools can identify repeated themes in text and language usage patterns across diverse communities. Furthermore, the included studies also revealed AI's role in assisting with referencing (Hegazy et al., 2024; Rababah et al., 2024; Werdiningsih et al., 2024). ChatGPT, for instance, can provide guidance in performing proper citation and adhering to a specific citation format, such as APA 7th edition (Hegazy et al., 2024; Werdiningsih et al., 2024). Certain AI platforms have also been reported to support integration with citation managers (Kumar & Gunn, 2024).

3.2.3 Cognitive and intellectual skills

Studies indicate that AI can overcome writer's block by suggesting new ideas that include those initially overlooked by students, engaging in brainstorming activities, elaborating concepts, gathering relevant materials and information, and offering suggestions from diverse perspectives (Abdulah et al., 2024; Alshwiah, 2024; Dai et al., 2023; Elkatmış, 2024; Essien et al., 2024; Mohammed et al., 2023; Nemt-allah et al., 2024; Ou et al., 2024; Picciano, 2024; Rababah et al., 2024; Suglo et al., 2024; Werdiningsih et al., 2024; Zou & Huang, 2024). Besides that, AI can also be used to organize ideas by recommending outlines, defining thesis statements, and structuring supporting ideas coherently in essays (Nemt-allah et al., 2024; Zou & Huang, 2024).

Furthermore, grounded in Bloom's Taxonomy, Essien et al. (2024) note that ChatGPT's support of lower-order tasks (i.e., Remember, Understand, and Apply) enables students to engage more deeply in tasks that require advanced cognitive skills (e.g., Analyze and Evaluate). This is due to its ability to automate mundane tasks that usually consume an extensive amount of time (Darwin et al., 2024; Essien et al., 2024; Zou & Huang, 2024). AI also promotes critical thinking among postgraduates through its diverse suggestions and generated examples. These outputs allow students to compare and reflect on their own works, thus helping them notice strengths and weaknesses (Alshwiah, 2024; Dai et al., 2023; Zou & Huang, 2024).

3.2.4 Research Engagement and Productivity

Findings indicate that AI can function as a consultative and supervisory tool by providing guidance and clarification on academic writings, supplying relevant information and examples, explaining complex concepts or theories, and offering feedback and suggestions to improve students' work (Abdulah et al., 2024; Alshwiah, 2024; Bouzar et al., 2024; Chauke et al., 2024; Dai et al., 2023; Darwin et al., 2024; Elkatmış, 2024; Mohammed et al., 2023; Nazari et al., 2021; Nemt-allah et al., 2024; Ou et al., 2024; Rababah et al., 2024; Roman-Acosta et al., 2024; Suglo et al., 2024; Werdiningsih et al., 2024; Zou & Huang, 2024).

In addition to that, Dai et al. (2023) also found that AI tools, such as ChatGPT, can be used to conduct mock presentations and rehearsals as preparation for meetings or research presentations by assigning certain roles and instructing it to respond accordingly. Through this approach, students can practice in risk-free

environments that simulate actual presentations, where they can predict possible questions or criticisms and respond to them.

Furthermore, due to AI's capacity to automate most tasks and provide feedback in a timely manner, students were able to expedite writing, optimize time, streamline research progress, and enhance writing quality as well as research productivity (Chauke et al., 2024; Chia et al., 2024; Dai et al., 2023; Darwin et al., 2024; Elkatmış, 2024; Essien et al., 2024; Kumar & Gunn, 2024; Mohammed et al., 2023; Picciano, 2024; Rababah et al., 2024; Suglo et al., 2024; Zou & Huang, 2024). Consequently, such capabilities allocate additional time for students to engage deeply in their research analysis and evaluation (Darwin et al., 2024; Essien et al., 2024; Picciano, 2024). Given that students became independently efficient in managing basic technical research tasks through this technology, supervisors can concentrate on higher-level discussions, including theoretical exploration and strategic research planning (Dai et al., 2023).

Moreover, findings suggest that AI tools enhance students' motivation, confidence, and self-efficacy in writing academic work, make the research process less daunting, and stimulate their enjoyment and interest in writing (Alshwiah, 2024; Bouzar et al., 2024; Dai et al., 2023; Elkatmış, 2024; Kumar & Gunn, 2024; Nazari et al., 2021; Zou & Huang, 2024); however, one study found a neutral perception of AI's motivational impact in academic writing (Chia et al., 2024). Notably, across the included studies, AI improves students' motivation by fostering autonomy, competence, and relatedness. Useful examples and explanations, opportunities to practice iteratively, and feedback delivered in private and responsive environments instill a greater sense of control and familiarity, capability, and support in their academic work (Alshwiah, 2024; Dai et al., 2023; Nazari et al., 2021).

4. Discussion

In this review, multiple potentials of AI have been identified as helping postgraduates develop their research skills. To illustrate how these potentials sustainably enhance postgraduate research skills, the findings are discussed through the lens of the SDGs. Generally, discussion of AI in education aligns closely with Goal 4: Quality Education (SDG 4). Nevertheless, from a broader perspective, the goals and targets of SDGs, in reality, are "integrated and indivisible, global in nature and universally applicable" (United Nations General Assembly, 2015, para. 55), which suggests inherent interrelationships among the goals (Pradhan et al., 2017). Considering this perspective, although SDG 4 constitutes the primary focus of the review, the discussion on progress toward the goal is influenced by the attainment of other interrelated goals and targets. Figure 3 presents a conceptual illustration of AI's potential through the lens of SDGs.

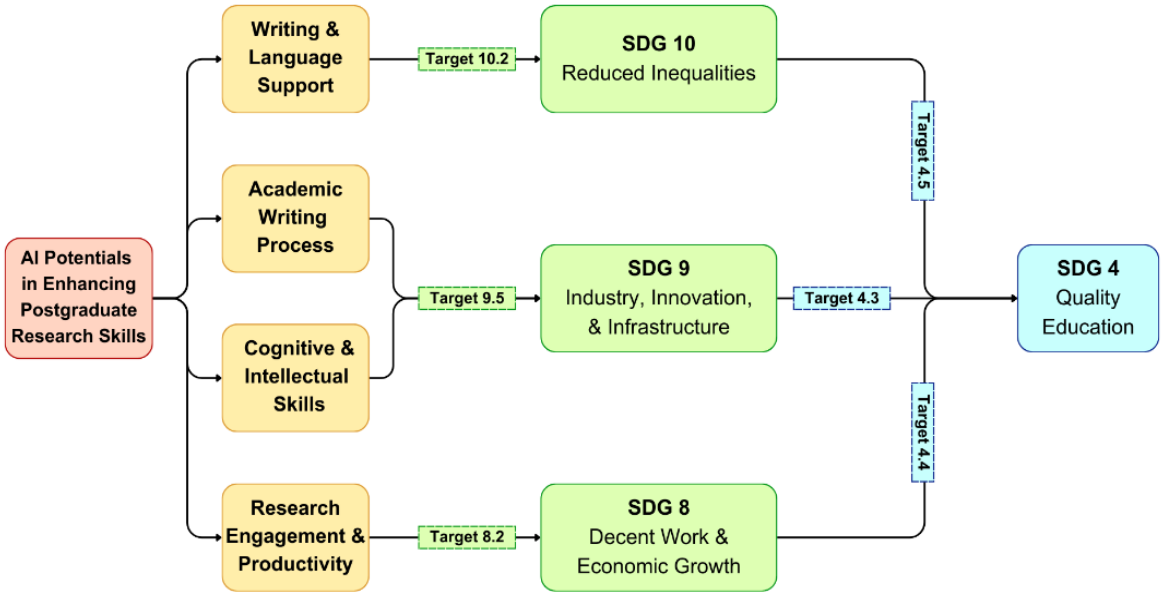


Figure 3: Conceptual illustration of AI potentials in the SDGs

Writing and language support offered by AI can potentially improve the quality of academic writing. To illustrate this context, AI can simplify and minimize ambiguity in text by reconstructing wordy sentences and replacing vague terminologies through its suggestions. Such support helps to narrow proficiency gaps among non-native speakers (Sarıca & Deneme Gençoğlu, 2025). Furthermore, AI-assisted paraphrasing utilities assist students in minimizing the risk of plagiarism (Pratami et al., 2025). AI-powered translation features facilitate students in identifying more accurate terminologies and expressions that convey the intended meaning of a particular context (Lee, 2020).

Although AI enhances writing and language, it also has a tendency to misinterpret words and phrases tailored to a specific culture, genre, and style, which can result in contextually inappropriate text in its suggestion (Nguyen et al., 2025; Sytnyk et al., 2025). AI-generated summaries also often lack depth and contextual details, which results in superficial understanding of the original text compared to human-generated summaries (Koraishi & Karatepe, 2025).

Despite several concerns, when viewed together, AI has the potential to diminish disparities and language barriers in accessing information and expressing students' ideas in accordance with academic rigor. By providing this support, AI tools help level the playing field between native English-speaking researchers and second-language researchers with diverse linguistic backgrounds. Such support aligns with Goal 10: Reduced Inequalities (SDG 10), particularly Target 10.2, which promotes inclusion for all regardless of individuals' background. It thereby helps to reduce discrimination in education as outlined in Target 4.5 of SDG 4.

Besides writing and language support, AI tools can benefit postgraduates when they are integrated into various stages of research writing. For instance, they can help students initiate writing and break down the task into manageable units when structuring academic works (Kim et al., 2025; Utami et al., 2023).

Additionally, the tools can help identify missing papers during traditional searching methods and potential studies that use unconventional terminologies (van de Schoot et al., 2025).

Despite having a substantial capacity to enhance multiple phases in academic writing, the tool remains limited in certain aspects. For example, AI tools used in identifying literature, such as Elicit, are associated with issues in repeatability, reliability, and accuracy when retrieving articles (Bernard et al., 2025), which indicates the necessity of human supervision and evaluation in the process. In data analysis, AI also faces challenges in computing complex or specific data analysis, and this issue requires user expertise to correct and validate the output of the analysis (Prandner et al., 2025). AI also tends to analyse qualitative data descriptively, possibly risk missing details and subtle meaning contained in the data (Morgan, 2023).

Another important role of AI in enhancing research skills among postgraduates is the capacity to improve cognitive and intellectual skills. This technology assists students in diversifying their perspectives and ideas (Kim et al., 2025). AI is also very useful for narrowing down topics and organizing them in a coherent and meaningful sequence (Kim et al., 2025; C. Wang, 2025). Even with this potential, students risk developing an over-reliance on AI to stimulate their cognitive and intellectual skills, which ultimately undermines their ability to think critically and make original evaluations (Pratiwi et al., 2025).

Collectively, the implementation of AI in these two contexts is substantially useful in strengthening research abilities among postgraduates with varying levels of research competency and reducing technical barriers in multiple phases of research procedures. These potentials resonate with Target 9.5 of Goal 9: Industry, Innovation, and Infrastructure (SDG 9), which emphasizes the improvement of scientific research and innovation promotion. The efforts to augment research ability among postgraduates also promote inclusive and high-quality education, which in turn contributes to advances Target 4.3 of SDG 4, which aims to ensure equal access to better quality higher education.

Besides its roles in cognitive and intellectual skills, the tool is able to enhance research engagement and productivity. For example, AI's role in providing consultative and supervisory support helps students reduce cognitive load, thereby permitting them to dedicate more time to advanced tasks (H. Hong et al., 2025). Although it holds this significant role, AI risks propagating a negative environment in academic practices that prioritize metric-driven and output-focused cultures, which can ultimately undermine research quality (Chubb et al., 2022).

AI's potential in improving research engagement and productivity suggests that the tools help provide continuity and accessibility of research guidance, which corresponds with Target 8.2 of Goal 8: Decent Work and Economic Growth (SDG 8), which aims to achieve higher productivity through innovation and technology. Therefore, by promoting greater productivity, AI also encourages the

development of professional research skills among postgraduates that are instrumental in academic institutions. Such efforts help contribute to Target 4.4 of SDG 4, which aims to maximize the number of adults with employable skills. In this context, the support specifically relates to postgraduates' skills in conducting proper research as researchers and novice academicians in educational institutions and through collaboration with other researchers.

5. Conclusion

In conclusion, the current review has identified the potential of AI in strengthening research skills development among postgraduates, which is reflected in four main areas: writing and language support, academic writing process, cognitive and intellectual skills, and research engagement and productivity.

These four roles of potential not only enhance research skills but also sustainably support postgraduates in obtaining higher-quality tertiary education by promoting equity among researchers from diverse backgrounds, reinforcing research abilities, minimizing technical barriers, and providing continuous and accessible guidance in conducting research and academic writing. The potential of AI, based on recent findings, is not only beneficial to postgraduates in their academic endeavors, but it can also contribute to the improvement of existing curricula and instruction. By integrating up-to-date research skills, this better prepares tertiary-level students for today's AI-integrated era.

Despite adhering to rigorous procedures, a limitation of this review is that the contextually specific research question and scope limited the initial literature coverage. The reason for this specific scope was the authors' interest in investigating promising AI's potential that not only reinforces research abilities among students but also provide inclusivity and long-term prospects in developing research skills. To address this issue, the author conducted the identification process twice, with the second attempt involving broader keywords, and utilized both manual and advanced search strategies to retrieve more potential literature.

In terms of recommendations, due to the nature of this review relying on qualitative synthesis, future research might extend the present findings and capture comprehensive overview of AI's impact on postgraduates' research skills by conducting meta-analyses to examine the strengths of these potentials in enhancing research skills and identify the contributing variables, such as the type of AI tools and the extent of human involvement in the AI-assisted process.

Conflict of Interest

The authors declared no competing interests.

6. Funding

This study was supported by the Ministry of Higher Education of Malaysia under the Fundamental Research Grant Scheme (FRGS-EC/1/2024/SSI09/UIAM/02/05). The authors also acknowledge the use of

DeepSeek and ChatGPT in the writing of this paper to merely help improve the language, grammar, and readability of texts. All AI-generated outputs were carefully reviewed and verified by the authors, who take full responsibility for the published content.

7. Acknowledgments

The authors acknowledge that AI tools, such as ChatGPT and DeepSeek, were used in the preparation of the review. The involvement of AI was intended to improve the language of the writing. The tools, however, were not used to generate research data or independently conduct data analysis and interpretation. The generated outputs were carefully reviewed and verified by the authors. The authors take full responsibility for the content of the published work.

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