

Integrating Artificial Intelligence into contemporary research and scientific writing: Ethical consideration and a methodological framework

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ABSTRACT: Artificial intelligence (AI), particularly generative AI and large language models (LLMs), is increasingly used to support literature discovery, research organization, data analysis, coding, and scientific writing. This narrative and conceptual review examines how AI can be integrated into postgraduate research and manuscript development, with particular attention to the Nigerian higher-education context and to agricultural, environmental, GIS, and health-related research. The synthesis identifies opportunities for improved efficiency and communication alongside risks involving inaccurate or fabricated information, algorithmic bias, authorship ambiguity, confidentiality, inappropriate reliance on generated text, and weaknesses in academic integrity. Five research questions guide the synthesis: the transition from conventional computational support to AI-assisted research; categories and applications of AI tools; academic-integrity, accuracy, authorship and ethical risks; principles for acceptable AI use; and the requirements of a practical integration framework. The review develops a five-pillar framework comprising (1) collaboration and human responsibility, (2) task-specific AI tool selection, (3) controlled AI use across the research workflow, (4) empirical cross-validation and verification, and (5) transparency, disclosure and academic integrity. The framework positions AI as a decision-support and language-assistance technology rather than an autonomous researcher. Responsible adoption therefore requires researchers to retain responsibility for research questions, evidence, interpretation, citations, methodological decisions, data protection and the final manuscript. The framework provides a practical basis for postgraduate researchers and Nigerian higher-education institutions seeking to integrate AI while preserving scientific rigour, research independence and academic integrity.

Keywords: Artificial intelligence; Generative AI; Large language models; Postgraduate research; Scientific writing; Research ethics; Academic integrity; Human-centered AI.

INTRODUCTION

Artificial intelligence (AI) has become increasingly relevant to higher education, particularly in literature searching, academic writing, data analysis, coding, summarization and research organisation. Generative AI (GenAI), including large language models (LLMs), can support researchers with brainstorming, idea organisation, language refinement, summarisation and manuscript development. These functions are most appropriate when they complement, rather than replace, independent scholarly thinking and human judgement. Dgebuadze and Kenkebashvili (2025), for example, emphasize responsible AI use in learning and research, with critical thinking and academic integrity remaining central Dgebuadze and Kenkebashvili (2025),

The Nigerian postgraduate context provides an important case for examining responsible AI integration and Postgraduate students are expected to search and evaluate extensive literature, formulate research problems, design studies, analyze evidence and communicate findings through thesis, dissertations and journal articles Granjeiro et al, (2025). These requirements

occur across agricultural, environmental, engineering, health and social-science disciplines, where researchers increasingly encounter large bodies of literature and complex datasets. AI-assisted tools can improve efficiency at several stages of this process, but they also introduce questions concerning accuracy, transparency, authorship, confidentiality, data protection and academic integrity Hani et al. (2026). Similarly, Muazu (2024) similarly highlights the importance of responsible AI use for research evaluation, quality assurance and academic integrity in higher education Muazu (2024).

A critical conceptual distinction is necessary between AI hallucination and plagiarism because Hallucination refers to inaccurate, fabricated, unsupported or misleading output generated by an AI system, including invented references or unsupported claims while Plagiarism, by contrast, concerns the presentation or use of another person's words, ideas, data or intellectual contribution without appropriate acknowledgement Joshi (2025). Meanwhile AI-generated text is therefore not automatically plagiarism. Nevertheless, AI-assisted work may contribute to academic-integrity violations when generated material is presented as independently verified scholarship, when sources are fabricated or misrepresented, or when institutional and journal requirements for disclosure are ignored Ifeanyichukwu, A., & Vina, V. (2025).

The evolution of AI-assisted research should also be distinguished from conventional computational support. Statistical packages, geographic information systems (GIS) and other specialized software remain important research technologies, while contemporary AI adds conversational systems, semantic search, machine-learning applications and LLM-based assistance Muazu (2024). Python is a general-purpose programming language rather than an advancement of natural language processing (NLP); its relevance arises from its extensive use for implementing machine-learning, NLP, statistical, visualization and data-analysis methods Oyelude (2024). This distinction is important because postgraduate researchers may use both specialised AI platforms and programmable environments to implement, evaluate or customize analytical approaches Oyelude (2024).

The research gap addressed by this review is therefore not the absence of ethical guidance on AI. Rather, existing guidance and discussions are dispersed across general AI ethics, academic-integrity policies, publishing guidance and tool-specific literature. Less attention is given to a coherent, field-sensitive workflow that shows postgraduate researchers how to select AI tools, limit their roles, verify outputs, preserve human responsibility and document appropriate use across the research cycle. This need is especially relevant in Nigeria as institutions adapt to rapidly changing AI capabilities and expectations for responsible scholarly practice. Obasi et al. (2026). Accordingly, this study examines AI applications in postgraduate research and scientific manuscript development, identifies their benefits and limitations, analyses associated ethical and academic-integrity risks, and proposes a five-pillar methodological framework for responsible integration in the Nigerian postgraduate context. The framework is intended to support researchers in using AI without compromising scientific accuracy, research independence, academic integrity or established principles of authorship Obasi et al. (2026).

The study is therefore guided by the following research questions:

RESEARCH QUESTIONS

- 1.How does the transition from conventional computational approaches to AI-assisted research influence the postgraduate research process?
- 2.What categories of AI tools and applications can support literature searching, research design, data preparation, coding, technical writing and data analysis?
- 3.What academic-integrity, accuracy, authorship and ethical risks are associated with generative AI and LLMs in postgraduate academic writing and research?
- 4.What ethical and authorship principles should guide acceptable AI use in seminar papers, theses, dissertations and scientific manuscripts?

5.What methodological framework can guide postgraduate researchers in evaluating and responsibly integrating AI tools throughout the research and manuscript-development process.

OBJECTIVE OF THE STUDY

The general objective is to examine the responsible use of AI in postgraduate research and manuscript development in Nigeria and to propose a structured framework for its effective and ethical integration.

- 1.Examine the transition from conventional computational approaches to AI-assisted and AI-collaborative research.
- 2.Identify categories and applications of AI tools that can support literature searching, research design, data preparation, coding, technical writing and data analysis.
- 3.Examine accuracy, academic-integrity, authorship and ethical risks associated with generative AI and LLMs in postgraduate research and academic writing.
- 4.Identify ethical and authorship principles for responsible AI use in seminar papers, theses, dissertations and scientific manuscripts.
- 5.Develop a five-pillar methodological framework incorporating human responsibility, task-specific tool selection, controlled AI use, cross-validation and transparent disclosure.

MATERIALS AND METHOD

This study employed a narrative and conceptual literature review to examine the applications, benefits, limitations and ethical implications of AI in postgraduate research and scientific manuscript development. The review was designed to support conceptual synthesis rather than statistical aggregation or systematic-review estimation.

Relevant literature was searched primarily through Scopus, Web of Science and PubMed. MDPI was consulted separately as a publisher platform rather than treated as a bibliographic index. Open-access availability was used to facilitate access to eligible material, while CrossMark was used where appropriate for publication-status or document-version verification. Search concepts included combinations of artificial intelligence, generative AI, large language models, academic writing, postgraduate research, research ethics, academic integrity, authorship, hallucination, literature review, scientific writing, agriculture, environmental research, GIS and data analysis. The literature focused mainly on publications from 2020 to 2026, with greater attention to recent work from 2023 to 2026 because of the rapid development of generative AI. Sources were selected for relevance to the research questions and objectives, with emphasis on peer-reviewed studies, scholarly discussions and authoritative publishing or authorship guidance. The selected material was thematically analyzed around AI applications, workflow integration, risks, ethical principles, human oversight and responsible disclosure. The framework was derived from recurring themes rather than from a formal systematic-review protocol.

AI tools used during manuscript preparation were limited to language editing, grammar correction, sentence restructuring, organization of researcher-generated ideas and paraphrasing. AI-generated outputs were critically reviewed by the authors, while factual claims and citations were checked against the original scholarly sources. Unsupported statements, fabricated references and other inaccurate outputs were corrected or removed. The study did not apply a PRISMA protocol, conduct quantitative meta-analysis or empirically test the proposed framework; consequently, the framework should be understood as a conceptual model requiring future empirical evaluation.

RESULTS AND THEMATIC SYNTHESIS

The thematic synthesis produced five connected findings corresponding directly to the five research questions. The first finding concerns a shift from conventional computational support

towards AI-assisted and AI-collaborative research. The second concerns task-specific applications across the research workflow. The third identifies risks associated with accuracy, integrity, authorship and over-reliance. The fourth establishes ethical principles for acceptable use. The fifth integrates these findings into a five-pillar framework for responsible postgraduate research.

Table 1. Comparative thematic synthesis of the reviewed literature. Source: Authors' compilation based on the sources cited within the table.

Research focus	Synthesis finding	Principal sources	Framework implication
Transition to AI-assisted research	AI extends conventional statistical, GIS and computational workflows through semantic search, conversational assistance, coding support and language generation; human judgement remains necessary.	Dgebuadze & Kenkebashvili (2025); Muazu (2024); Obasi et al. (2026)	Collaboration and human responsibility
Tool categories and applications	Semantic-search and research-discovery tools can assist literature filtering and gap identification, while conversational LLMs and coding environments support drafting, organisation and analysis.	Oyelude (2024); Pessin et al. (2025); Mtotywa et al. (2026)	Task-specific AI tool selection; controlled AI use
Accuracy and integrity risks	AI systems can generate fabricated citations, unsupported claims, biased or superficial outputs and contextually inappropriate interpretations.	Joshi (2025); Sontake (2025); Ifeanyichukwu & Vina (2025)	Empirical cross-validation and verification
Ethical and authorship principles	AI tools do not assume the accountability expected of human authors; responsible use requires disclosure, source verification, confidentiality and compliance with institutional and journal requirements.	COPE Council (2024); ICMJE (2023); Scott-Kennel et al. (2025)	Transparency, disclosure and academic integrity
Integrated responsible-use framework	AI is most defensible as decision support when researchers define the task, select appropriate tools, verify outputs and retain responsibility for the final scholarly product.	Hani et al. (2026); Mtotywa et al. (2026); Muazu (2024)	Five-pillar framework

TRANSITION FROM CONVENTIONAL COMPUTATION TO AI-ASSISTED

RESEARCH

The literature indicates a shift from research workflows dominated by statistical packages, GIS and manually managed literature searches towards workflows in which AI can provide interactive support as outline in the work of Muazu (2024); Obasi et al. (2026). This does not make conventional computational methods obsolete but instead AI can operate as an additional layer for literature discovery, coding assistance, thematic organization, semantic retrieval and communication which is apparent in the work of Sontake, (2025). In agricultural and environmental research, for example, AI can complement GIS and remote-sensing workflows by aiding spatial-data interpretation, classification and modelling (Obasi et al., (2024); Obasi et al., (2026). The key change is therefore organizational: mandating researchers increasingly interaction with computational systems through natural-language interfaces while retaining responsibility for the underlying research design and analytical decisions.

CATEGORIES AND APPLICATIONS OF AI TOOLS

AI applications can be organized according to the task rather than by brand name. Literature-discovery and semantic-search tools such as Elicit, Consensus, Semantic Scholar and related systems can assist with locating, filtering and organizing literature. Gap-identification approaches can support the extraction of themes and possible research gaps from large collections of documents by Pessin et al., (2025). Conversational LLMs such as ChatGPT and comparable systems can assist with brainstorming, outlining, language refinement, summarization and code generation, while statistical and programming environments such as R and Python remain responsible for executing reproducible analyses. Domain-specific AI applications can also support GIS, remote sensing, spatial modelling and agricultural data interpretation (Oyelude, 2024; Obasi et al., 2026). The appropriate principle is task-specific selection: the researcher should choose a tool according to the purpose, evidence requirements, privacy implications and acceptable level of automation.

Figure 1. Sequential integration of AI across the postgraduate research workflow.

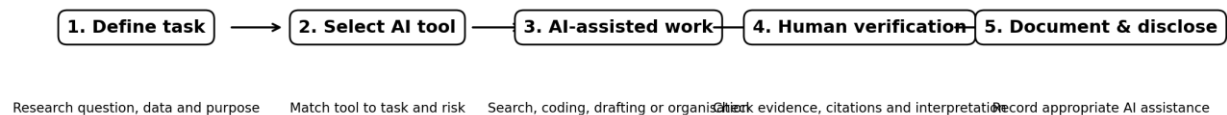


Figure 1. Sequential integration of AI across the postgraduate research workflow.

ACCURACY, INTEGRITY, AUTHORSHIP AND ETHICAL RISKS

The synthesis identifies five closely related risks associated with ai usage without following the order or protocol of disclosure as it concerns accuracy, integrity and authorship models. First, AI systems may generate hallucinations, including fabricated citations, unsupported claims and incorrect interpretations. Second, outputs may reproduce or amplify bias contained in data or model training. Third, over-reliance on generated prose can weaken critical engagement with the literature and obscure the researcher's own reasoning. Fourth, authorship and accountability become unclear if AI-generated material is treated as an independent contributor rather than a tool. Fifth, confidential or sensitive research information may be exposed if it is entered into inappropriate external systems. These risks make human verification essential (Joshi, 2025; Sontake, 2025; Scott-Kennel et al., 2025).

The distinction between hallucination and plagiarism must be preserved because hallucination concerns the reliability of generated content; plagiarism concerns attribution and ownership of intellectual work. They may interact in practice for example, an invented reference may lead to inaccurate scholarship but they are not synonymous. The term 'AI-giarism' is therefore not used in this manuscript because it obscures rather than clarifies the distinction Scott-Kennel et al., (2025).

ETHICAL AND AUTHORSHIP PRINCIPLES

Several principles and guidelines has mandated human researchers on a must to remain accountable for the accuracy and integrity of their work. AI systems should not be treated as authors because they cannot assume the responsibilities associated with authorship, accountability and disclosure (ICMJE, 2023; COPE Council, 2024). Researchers should verify citations and factual claims, protect confidential information, comply with institutional and journal policies, and disclose .AI assistance when required or when it materially affects manuscript preparation. AI use should be proportionate to the task and should not substitute for independent research design, interpretation or scholarly judgement in accord with the work of Hani et al. (2026). These principles also apply to postgraduate assessments. Seminar papers drafts, term papers, thesis and dissertations should demonstrate the student's own reasoning,

methodological understanding and interpretation. AI can assist with language and organization, but the student remains responsible for the intellectual content and for demonstrating that the evidence has been independently evaluated Dgebuadze, M., & Kenkebashvili, K. (2025).

METHODOLOGICAL FRAMEWORK FOR RESPONSIBLE INTEGRATION

These methodological framework is a synthesis that supports a single five-pillar framework. The five pillars are deliberately defined with fixed labels and are used consistently throughout the manuscript: viz (1) Collaboration and human responsibility; (2) Task-specific AI tool selection; (3) Controlled AI use across the research workflow; (4) Empirical cross-validation and verification; and (5) Transparency, disclosure and academic integrity. Together, the pillars define AI as a decision-support technology operating within a human-led research process Mtotywa et al. (2026).

Figure 3. Five-pillar methodological framework for responsible AI deployment in postgraduate research.

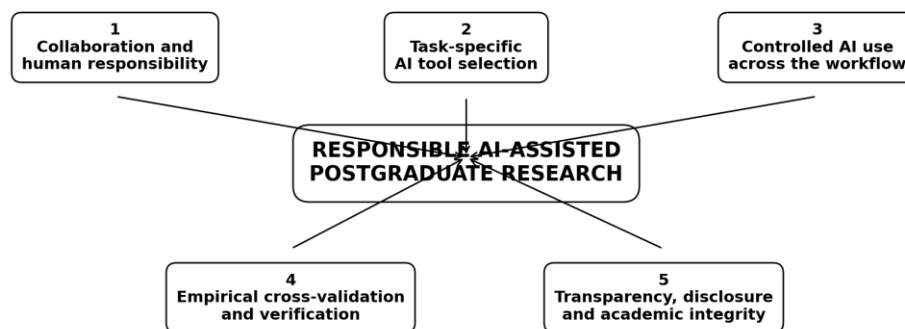


Figure 3. Five-pillar methodological framework for responsible AI deployment in postgraduate research.

METHODOLOGICAL AND ETHICAL CHALLENGES

The framework responds to several practical challenges. And one major challenge is the possibility of a closed loop in which AI is used to generate scholarly text and other automated systems are then used to evaluate or refine that text with adequate human judgement and consistent verifications. Such a process can reward a shallow readability while weakening attention to empirical evidence and disciplinary reasoning. Because LLMs generate outputs from learned statistical patterns, fluent language does not establish factual accuracy. Human researchers must therefore test important claims against appropriate evidence to refine a developed manuscript.

A second challenge is accountability which is a narrative whereby AI systems do not carry the scholarly, ethical or legal responsibility expected of researchers. Researchers must decide what evidence is relevant, whether an analytical approach is valid, whether a citation actually supports a claim, and whether the final manuscript accurately represents the study. AI literacy should therefore be understood not simply as the ability to operate a tool, but as the ability to judge when a tool is appropriate, recognize its limitations and verify its outputs.

A third challenge concerns confidentiality and responsible data handling processes like

collection, cleaning, analysis and the ability of using them for informed decisions. Researchers should not place confidential manuscripts, identifiable participant information, unpublished datasets, proprietary information or other protected material into AI systems unless the relevant institutional, legal and publisher requirements permit such use. Tool selection should therefore consider not only performance but also data governance and privacy.

THE FIVE-PILLAR METHODOLOGICAL FRAMEWORK

The framework is intended as a practical guide for postgraduate researchers. It does not prescribe one software package. Instead, it establishes a sequence of responsibilities that can be applied across disciplines and research stages.

COLLABORATION AND HUMAN RESPONSIBILITY

The researcher defines the research problem, determines the scope of AI assistance, sets constraints and evaluates outputs. AI functions as an interactive assistant rather than as an autonomous research authority. Human responsibility begins before a prompt is entered and continues through final manuscript approval Hani et al. (2026).

TASK-SPECIFIC AI TOOL SELECTION

Tool choice should follow the research task. A semantic-search system may be suitable for literature discovery, an LLM may assist with language refinement or code explanation, and statistical or GIS software may remain the appropriate environment for formal analysis. Researchers should consider accuracy, reproducibility, privacy, disciplinary suitability and institutional policy before using a tool Mtotywa et al. (2026).

CONTROLLED AI USE ACROSS THE RESEARCH WORKFLOWS

AI use should be limited to clearly defined functions such as brainstorming, literature organization, language editing, coding assistance, summarization or restructuring of researcher-generated drafts. Generated material should be treated as provisional. AI should not independently determine the research question, fabricate evidence, create unsupported results or replace the researcher's interpretation of empirical findings Scott-Kennel et al., (2025).

EMPIRICAL CROSS-VALIDATION AND VERIFICATION

Every substantive AI-generated claim, reference, numerical statement, methodological recommendation or interpretation should be checked against appropriate primary literature, verified datasets, institutional resources or data analysis. Citation checking is particularly important because a fluent response can contain references that do not exist or do not support the associated claim. Figure 2 summarizes the human-in-the-loop verification sequence.

Figure 2. Human-in-the-loop verification workflow for responsible AI use.

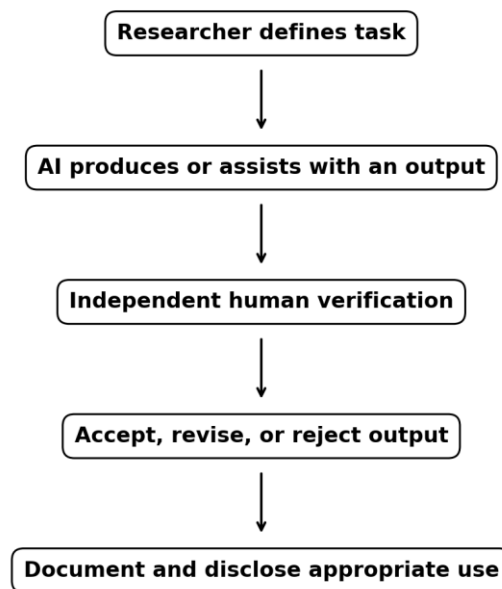


Figure 2. Human-in-the-loop verification workflow for responsible AI use.

TRANSPARENCY, DISCLOSURE AND ACADEMIC INTEGRITY

Researchers should document and disclose AI assistance in accordance with institutional and journal requirements. Disclosure should be sufficiently clear to indicate the tools used and the general purpose of their use when such information is requested or materially relevant. AI assistance does not transfer authorship responsibility from the researcher to the tool. Compliance with authorship guidance, citation rules, confidentiality requirements and research-integrity standards remains essential (ICMJE, 2023; COPE Council, 2024).

DISCUSSION

The findings indicate that responsible AI integration is best understood as a governance problem within the research workflow rather than simply a question of whether AI is beneficial or harmful. The first research question is answered by the observed transition from conventional computational support to interactive AI-assisted workflows, while the second is addressed by organizing applications according to research tasks. The third question is answered by the identified risks of hallucination, bias, over-reliance, authorship ambiguity and confidentiality. The fourth is addressed by principles of human accountability, verification, appropriate disclosure and compliance with authorship guidance. The fifth is addressed by the five-pillar framework, which integrates these findings into a coherent workflow.

The framework also clarifies why AI should not be positioned as a substitute for research competence. Efficiency gains in searching, drafting or coding are valuable only when the researcher can evaluate the quality of the resulting output. In agricultural and environmental research, for example, an AI-assisted interpretation of soil, GIS or remote-sensing information still requires disciplinary knowledge and validation. Similarly, a generated statistical script must be checked for the correctness of the model, assumptions, variables and interpretation before results are reported.

For Nigerian postgraduate education, the practical implication is that institutions should move

beyond either unrestricted adoption or blanket prohibition. Training should focus on AI literacy, critical evaluation, research integrity, responsible tool selection and appropriate disclosure. Institutional guidance can also clarify which forms of AI assistance are acceptable in theses, dissertations and journal manuscripts and which forms would undermine independent scholarly assessment. These measures are consistent with the broader objective of strengthening research quality while acknowledging the realities of rapidly evolving AI technologies.

IMPLICATIONS FOR NIGERIAN HIGHER EDUCATION AND RESEARCH PRACTICE

The Nigerian context requires practical institutional responses. Universities and polytechnics can develop clear guidance for postgraduate researchers on acceptable AI-assisted activities, verification responsibilities, confidentiality and disclosure. Research-methods training can incorporate practical exercises in evaluating generated references, checking factual claims, reviewing AI-assisted code and distinguishing language assistance from substantive generation of scholarly content. Academic libraries can support researchers by providing access to reliable scholarly databases and training in source evaluation. Institutions and research funders can incorporate responsible-AI expectations into research governance and quality-assurance procedures.

At the national level, agencies such as the National Universities Commission (NUC), National Board for Technical Education (NBTE) and Tertiary Education Trust Fund (TETFund) can support harmonized guidance for ethical AI use in postgraduate research. Such guidance should emphasize human accountability, evidence verification, data protection, transparent disclosure and research independence rather than prescribing dependence on particular commercial tools. The objective should be to strengthen scientific quality and equitable access to research-support technologies.

LIMITATIONS OF THE REVIEW

This study is a narrative and conceptual review rather than a systematic review. It does not estimate effect sizes, compare AI tools experimentally or empirically test the proposed five-pillar framework. The rapidly changing AI environment also means that specific tools and policies may evolve faster than the literature. In addition, the Nigerian context is used as the principal institutional setting while the evidence base includes international literature. Future research should therefore test the framework with postgraduate students, supervisors and research institutions across Nigerian disciplines and compare its implementation with institutional and journal requirements.

CONCLUSION

AI has significant potential to support postgraduate research and scientific writing through literature discovery, research organization, coding assistance, data analysis support and language refinement. The benefits, however, depend on the researcher's ability to evaluate and control AI-generated outputs. The review demonstrates that hallucination is distinct from plagiarism, that Python is a general-purpose programming language rather than an advancement of NLP, and that fluent AI output cannot substitute for empirical verification or scholarly judgement.

The study proposes a single, consistent five-pillar framework comprising collaboration and human responsibility; task-specific AI tool selection; controlled AI use across the research workflow; empirical cross-validation and verification; and transparency, disclosure and academic integrity. These pillars provide a practical structure for integrating AI into postgraduate research while preserving research independence, scientific rigour and accountability. In Nigeria, the framework can support institutional guidance and postgraduate

training as higher-education systems adapt to the opportunities and risks associated with generative AI.

RECOMMENDATION

Postgraduate programmes should provide practical training in responsible AI use, including source verification, citation auditing, critical evaluation and data-protection principles.

Institutions should establish clear guidance on acceptable and unacceptable AI-assisted activities in theses, dissertations, seminar papers and research publications.

Researchers should retain human responsibility for research design, evidence selection, analysis, interpretation, citations and final manuscript approval.

AI-assisted outputs should be independently verified before they are incorporated into scholarly work, particularly claims, references, numerical results, methodological recommendations and interpretations.

Researchers should disclose AI assistance in accordance with institutional and journal requirements and should avoid entering confidential or protected research information into inappropriate AI systems.

NUC, NBTE and TETFund should support coherent national and institutional guidance that promotes ethical AI adoption while protecting research integrity and independence.

Conflict of Interest

The authors declare that the research was conducted in the absence of commercial or financial relationships that could be construed as a potential conflict of interest. AI tools discussed in this review were considered as academic productivity and decision-support tools; the authors have no financial endorsement from the developers of the software platforms discussed.

Generative AI Statements

During preparation of this manuscript, generative AI and semantic-search tools, including ChatGPT, Google Gemini, Consensus and Elicit, were used as decision-support and language-assistance tools for preliminary organisation, language editing, syntax refinement and restructuring of researcher-generated text. The authors critically reviewed all AI-assisted outputs and independently verified factual claims and references against the cited scholarly sources. The authors retain full responsibility for the content, interpretation and final version of the manuscript.

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