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Pooja Pathak

pooji.mehta21@gmail.com

Dr. Vidhi. D. Mehta

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Mrs. Pooja V Pathak
Research Scholar, Department of English
Marwadi University, Rajkot, Gujarat 360003, India
Author: Mrs. Pooja V Pathak
Email: – pooji.mehta21@gmail.com
ORCID ID - https://orcid.org/0009-0008-6377-267X

Dr. Vidhi D Mehta
Assistant Professor, Department of English, Faculty of Arts,
Marwadi University, Rajkot, Gujarat 360003, India
Corresponding Author: Dr. Vidhi D Mehta
Email: drvidhimehta1@gmail.com
ORCID ID – https://orcid.org/0009-0002-6421-7754

Abstract

Incorporation of Artificial Intelligence (AI) into academic writing instruction has made a huge difference in instruction for English as a Second Language (ESL) students who often struggle with grammar, vocabulary, coherence, and academic organization. The present study investigated the effectiveness of using AI assisted learning platforms to improve academic writing of ESL students in higher education. The convergent mixed methods research design was used and a purposive sampling method was used to select 120 undergraduate and postgraduate ESL learners. A twelve-week academic writing intervention was developed that uses AI Tools such as ChatGPT, Grammarly, and QuillBot. Pre-test and post-test writing evaluation, and structured questionnaires were used to gather quantitative data and semi-structured interviews were conducted to get qualitative data. Results indicated that after the intervention, there was a great improvement in all aspects of academic writing performance. This improvement in overall writing was from a pre-test mean of 58.94 to a post-test mean of 83.67. Grammar accuracy, vocabulary use, coherence, organization and academic writing style were improved. The qualitative results also showed that the learners found AI-powered learning platforms user-friendly, interactive, and supportive, which boosted their confidence in writing, involvement in learning and revision process. But some participants also worried about the potential for too much reliance on AI-generated material and the ethical academic use of AI. The study concludes that AI-supported learning platforms have significant pedagogical potential in relation to the development of academic writing skills of ESL learners, provided they are used in relation to the academic writing process, considering responsible use in higher education settings.

Keywords: AI-assisted learning; academic writing; ESL learners; higher education; learner engagement; writing proficiency

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Declarations

Conflict of Interest. The authors declare that they have no conflict of interest regarding the publication of this paper.

Ethical Approval. The study was conducted in accordance with institutional ethical guidelines for research involving human participants. This study was approved by the Ethics Committee of Marwadi University, Gujarat, India.

Consent to Participate. Informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were explicitly informed about the research objectives, voluntary nature of participation, potential risks and benefits, confidentiality measures, and their right to withdraw from the study at any point without penalty.

Consent to Publish. Informed consent was obtained from all participants included in the study.

1 Introduction

The incorporation of Artificial Intelligence (AI) into the world of higher education has revolutionized modern education and training, especially in the field of language education and academic writing teaching. New developments in generative AI have delivered AI-powered tools to enhance the learning experience, such as automated feedback, language support, adaptive learning, and interactive academic guidance. Within universities, some applications (e.g., ChatGPT, Grammarly, QuillBot) are increasingly used to assist academic communication, learning and engagement process, and student writing development (Kim et al., 2024).

In Higher Education, one of the most crucial and yet difficult skills for English as a Second Language (ESL) students is academic writing. Academic writing should be grammatically correct, well-structured, and use academic language and conventions. Many ESL learners, however, struggle with the ability to organise ideas, have a lack of coherence and are unable to convey academic ideas well in writing (Tris & Yuan, 2025). These difficulties can have a negative impact

on participation in academic communication, confidence and academic performance.

In higher education, traditional writing teaching generally relies on feedback of teachers and minimal interaction in class. While feedback from the instructor is a key factor in the writing process, institutions may have problems providing feedback and extended writing practice, especially when class sizes are large and time for instruction is limited (Ferris, 2014). To overcome these challenges, AI writing tools have been developed as complementary tools to support writing during the learning process by providing instant feedback, customised instruction, and ongoing support (Fathi & Rahimi, 2024).

The benefits of AI writing tools for students include grammar checks, word usage suggestions, sentence restructuring, and feedback during the writing process. These may facilitate the development of the students' SRL strategies, reflective revision process, and autonomous learning outside the classroom (Song & Song, 2023). The recent studies have found that the grammar accuracy, coherence, vocabulary development, fluency of writing and learners' engagement is positively affected in the AI-supported learning environment for ESL/EFL students (Tseng & Lin, 2024; Chen and Gong, 2025).

While AI-assisted writing technologies offer these benefits, they also have raised significant pedagogical and ethical considerations. Over-reliance on AI-generated material, the limited scope of independent critical thinking, academic integrity/examining originality of student writing, are cited issues associated with the use of AI-generated content (Deep & Chen, 2025). The debate on responsible AI use, transparency and ethical academic practices remains to shape the discourse in higher education on AI-facilitated learning environments.

1.1 AI-Assisted Learning in Higher Education

AI-assisted learning is the use of AI technologies to facilitate instruction, learning, and student achievement. In the higher education space, AI is being used more and more to customize learning environments, to automate feedback, and to enable student-centered learning (Lode, 2024). AI writing tools can offer suggestions on grammar, word choices, paraphrasing, and give a conversational style of academic guidance as well as automated writing evaluation.

According to the previous studies, AI-supported learning environments could enhance the participation, motivation, and academic writing abilities of learners by providing customized feedback and engaging learning activities (Awaludin et al., 2025). Moreover, AI tools for writing can help alleviate writing anxiety by fostering experimental writing, self-correction, and multiple writing sessions (Selim, 2024).

1.2 Academic Writing Challenges among ESL Learners

Academic writing is a challenging task that requires a mastery of language and also requires higher intellectual skills. Higher education students learning English as a second (or other) language often struggle from a grammatical perspective, with vocabulary, coherence, organization and discipline-specific academic conventions being other areas of language difficulty (Hyland, 2019). Learners also have difficulties keeping a formal academic tone, building an argument based on evidence, and effectively synthesizing academic information.

In most classroom settings, access to individualized formative feedback is also limited, presenting another obstacle to the academic writing development of students. Learners also have difficulties keeping a formal academic tone, building an argument based on evidence, and effectively synthesizing academic information. Furthermore, language learners must not only focus on acquiring linguistic skills but also develop the capacity to critically evaluate content, understand cultural nuances, and recognize bias when engaging with digital environments (Mehta et al., 2025). Thus, students might not be able to pinpoint areas of recurring weaknesses in their writing and systematically improve their academic writing

Learners' writing anxiety, lack of confidence in writing, and psychological factors can also limit learners' involvement in academic writing activities. Such advantages can be achieved by AI-supported learning environments, which can provide assistance to learning in an interactive and non-threatening setting, resulting in active participation in writing tasks (Khan et al., 2024).

1.3 Significance of AI-Assisted Writing Platforms

With the ongoing digitalization of higher education, AI-powered writing tools have become more commonplace, mirroring the wider shift in the landscape of digital learning environments. The opportunities afforded to learners to engage in individualized and flexible learning processes, which is beyond the classroom environment, is provided by AI-powered writing systems. These technologies can be used to promote learner autonomy (Alangari, 2025) and might help learners develop academic writing more efficiently thanks to adaptive support and automated feedback.

AI-assisted writing platforms can also positively impact writers' motivation, engagement and confidence. Writing instruction can be made more responsive and accessible to learners of different language proficiency levels by implementing interactive feedback systems and conversational AI technologies (Deep et al., 2025). In particular, context-personalization infuses students' out-of-school interests into the academic content to support situational interest and increase overall engagement in digital learning spaces (Avalekar et al., 2025). In a multilingual and diverse higher education setting, AI-powered writing tools become even more pertinent due to their adaptability.

1.4 Purpose of the Study

The aim of the present study is to investigate the effectiveness of AI-supported learning platform in improving academic writing competence of ESL learners in higher education. This study focuses on how AI-assisted writing technologies affect grammar accuracy, word choice, academic writing coherence and organization, and the attitudes to academic writing instruction.

Furthermore, the study examines the experiences of learners with AI writing platforms and delves into opportunities and challenges of using AI technologies in academic writing teaching. The study explores the pedagogical implications of AI-assisted learning environments, offering insights into technology-enhanced language learning in higher education.

1.5 Research Questions

The study seeks to answer the following research questions:

1. What impact do learning platforms with AI have on academic writing in higher education ESL learners?
2. How effective are AI-based feedback systems for enhancing the accuracy of grammar, usage of words, coherence, and organization in academic writing?
3. What are ESL learners' perceptions regarding the use of AI-assisted learning platforms for academic writing development?
4. What are the obstacles and concerns associated with the integration of AI writing tools in higher education?

2 Literature Review

As the technology of Artificial Intelligence (AI) has been introduced into the educational setting, more and more research has focused on this subject, especially in the area of language learning and academic writing teaching. AI's role in academic writing has revolutionized the way students carry out writing tasks, offering intelligent support at every stage of the writing process. The literature indicates that the use of AI learning environment holds a great potential to enhance the writing skills, learner engagement and writing revision of ESL/EFL learners. Meanwhile, researchers are continuing to draw attention to some pedagogical and ethical issues of academic integrity, overdependence and critical thinking.

2.1 AI in ESL and EFL Education

In the field of ESL/EFL, AI technologies have become rapidly integrated and developed with advancements in natural language processing and generative AI systems. Personalized learning, automated feedback, and learner-centered learning are being supported by AI-driven learning platforms (Godwin-Jones, 2022). Additionally, the implementation of AI-enhanced personalized learning systems provides structured algorithmic support that tailors educational content to individual learner requirements across higher education disciplines (Manoj et al., 2027)

AI has been shown to have a positive impact in language learning in several studies. Song and Song (2023) discovered that the writing activities carried out through ChatGPT not only enhanced EFL learners' writing skills but also their motivation. Likewise, Tseng and Lin (2024) found that university students' writing fluency, idea generation and revision practices improved when using AI-assisted writing tools. AI-supported learning environments were also found to improve academic writing and learner engagement with the help of real-time language support and interactivity in revision practices (Deep et al., 2025).

Collaborative and scaffolding aspects of AI technologies in language learning have also been highlighted in research. Guan and Bahari (2026) found that AI mediated interaction fostered reflective learning and dialogic interaction among learners, and Li and Bahari (2026) emphasized that AI assisted scaffolding had a positive impact on the development of basic academic writing skills among postgraduate EFL students.

While the research offers promising results, it is important to note that AI tools are meant to be used alongside human teachers, not in place of them. Even with these positive outcomes, researchers have repeatedly pointed out that AI technologies must be used as a complement to human teachers, not a replacement for them.

2.2 AI-Assisted Academic Writing Platforms

The use of AI-powered writing tools is growing in popularity within higher education due to their capacity to aid in various aspects of academic writing. These systems offer grammar correction, paraphrasing support, vocabulary suggestions, organisation suggestions, and feedback on the fly, during the process of writing.

Fathi and Rahimi (2024) concluded that AI-supported feedback contributed to reflective revision and enhancement of scholarly writing by learners. In a similar study, Chen and Gong (2025) noted that students who received instruction with AI showed great improvement in coherence, organization and grammatical competence. Additionally, Begmatova and Saydazimova (2025) found that the students who used AI support had a higher score in writing performance than the students who did not use AI support.

Other research has highlighted the contribution of AI-enabled platforms to the enhancement of learner autonomy and SLL. As part of their study, Pan and Xia (2025) discovered that university students were more dependent on AI technologies in writing, revising, and polishing their academic papers on their own. Similarly, Butarbutar and Vallejo (2025) found that students believed AI tools for writing to be useful for enhancing the structuring of academic writing and diminishing cognitive load during the execution of more complex writing assignments.

Overall, current research shows that AI writing tools can have a positive impact on the quality of academic writing, learners' autonomy, and the efficiency of writing in higher education settings.

2.3 AI-Based Feedback and Academic Writing Development

The role of feedback in academic writing development is widely acknowledged and is considered as a key part of the writing process, as it helps the learners detect the errors, make corrections and enhance their linguistic accuracy. AI-driven feedback systems have become another tool that can offer in-the-moment and individualized feedback along the writing process.

According to Jamshed et al. (2025), the incorporation of AI-generated corrective feedback in learning was one of the key variables that significantly influenced the Grammar accuracy and writing output of ESL learners. Likewise, Mehmood and Aziz (2025) emphasized that AI-driven feedback systems are effective in facilitating revision processes and enhancing academic writing.

A systematic review of AI for feedback in higher education by Urzúa et al. (2025) found that generative AI positively impacted on writing fluency and coherence, as well as learner confidence. Mujeeb et al. (2026) also reported that frequent use of AI-supported revision systems led to better gains in the quality of writing and reflective revision skills than did only standard feedback.

AI-generated feedback has also been found to enhance student motivation and engagement, promoting ongoing revision and the ongoing process of learning. (Wang et al., 2025) But educators warn that relying too heavily on the feedback from the computer could mean making superficial changes without a complete grasp of larger linguistic and rhetorical issues. Several researchers suggest the use of both AI feedback and teacher feedback in order to facilitate the balanced development of academic writing.

2.4 Learner Engagement and Perceptions toward AI-Assisted Learning

The successful implementation of AI-assisted learning technologies in higher education relies heavily on the level of engagement and perceptions of the learners. Learner's positive attitudes to educational technologies also often lead to higher participation, motivation and commitment to independent learning activities.

Widyaningsih et al. (2024) revealed that the use of these writing tools is perceived positively by the EFL learners due to their accessibility, convenience, and instant feedback capabilities. Likewise, Khan et al. (2024) claimed that university students believed AI tools to be helpful in enhancing their vocabulary, grammar, and academic writing.

Further, Awaludin et al. (2025) noted that the use of AI in learning environments had a positive impact on the motivation and participation of learners. Robert et al. (2025), however, revealed both positive and critical attitudes toward the use of AI in writing technologies, with learners noting risks of relying too heavily on AI-generated written products and diminishing critical thinking. Similarly, Kim et al. (2024) highlighted the need for moral principles and responsible practices for AI adoption in academic settings.

The results underscore the significance of learner perceptions of AI-supported educational technologies, which are influenced by technological effectiveness as well as trust, ethical, authentic, and academic integrity issues.

2.5 Ethical Concerns and Challenges of AI-Assisted Academic Writing

While AI writing tools offer great educational value, the surge in their use has sparked a host of ethical and pedagogical issues. Academic honesty and originality, authorship, and critical thinking in using AI-generated content have been subject to research inquiries.

While AI tools can assist with tasks, excessive reliance on them could also decrease the critical engagement learners have with academic tasks, as noted by Deep and Chen (2025). Likewise, Tahir et al. (2025) noted that the use of AI support systems can either support or hinder critical thinking, depending on how the learners interact with the ideas generated by AI.

Other issues, such as plagiarism, uncertainty in authorship, and the improper use of AI technologies, have also been discussed in the literature (Kim et al., 2024; Selim, 2024). Furthermore, it is important to note that AI-generated answers can sometimes lead to suggestions that are inaccurate or inappropriate given the context, especially when taken without critical analysis.

While previous research has largely indicated positive results with the use of AI-supported writing tools, there has been mixed and inconsistent educational results. While various studies address the improvement of grammar and revision speed, there are relatively few that emphasize the higher order academic sense-making, innovation and disciplinary argumentation. Moreover,

there are ongoing debates about the degree to which AI-enabled spaces enable students to become autonomous learners or dependent on technology. The inconsistencies indicate that the implementation of AI in the context of academic writing could be significantly influenced by instructional design and learner digital literacy and pedagogical support.

2.6 Research Gap

The previous studies have shown that there is a significant potential of AI-supported learning platforms to assist academic writing development of ESL/EFL learners. But there are some gaps that must still be emphasized that are not dealt with adequately.

First, there have been few studies that have concentrated on ESL students in higher education settings, as compared to EFL students. Second, many studies focus on specific aspects of writing development, e.g., grammar correction or vocabulary building, while neglecting to provide a comprehensive study on other aspects of writing competence in academic writing, such as coherence, organization, involvement and autonomy.

Moreover, many studies focus mainly on qualitative perceptions or interventions that last only a few weeks or months, which does not allow for a more in-depth understanding of the long-term pedagogical effects of AI-supported writing tools. There has been only limited research that has used mixed methods to combine quantitative evidence of writing improvement with qualitative research of learners' experience.

Further, while there are growing concerns about ethics surrounding the use of AI in writing, there is a dearth of research that specifically investigates how learners approach decisions concerning academic integrity, reliance on technology, and responsible AI use in academic writing tasks.

In order to address these gaps, the present study looks at the effect of the AI assisted learning platforms on ESL learners' academic writing development from a convergent mixed-methods perspective on multiple aspects of academic writing. The study differs from some of the previous studies by examining the writing skills, learner engagement, perceptions, and ethical issues, along with the pedagogical use of various AI-supported writing tools, such as ChatGPT, Grammarly, and QuillBot.

3 Theoretical Framework and Conceptual Model

The approach of this study is based on the Technology Acceptance Model (TAM) and Sociocultural Theory, where they offer a theoretical basis for the study of the impact of AI-based learning platforms on academic writing development among ESL learners in higher education. It is appropriate to integrate these perspectives because AI writing assistance comes with both technological incorporation and involvement, scaffolding, engagement, and reflective learning practices.

3.1 Technology Acceptance Model (TAM)

Davis (1989) has developed a model named the Technology Acceptance Model (TAM) that is able to explain users' acceptance of technological systems under two main constructs: perceived usefulness and perceived ease of use. Perceived usefulness is defined as the beliefs that AI tools

will enhance the quality of writing and learning for the learner, while perceived ease of use is characterized by how accessible and easy to use AI-assisted platforms are for the learner when using AI for writing.

Based on the previous studies, learners tend to be more accepting of using AI writing support tools when the tools give timely feedback, offer user-friendly interaction, and provide effective writing support (Kim et al., 2024). The present study facilitates the analysis of the relationship between learners' perception and engagement, motivation and academic writing development in relation to the AI-assisted platforms.

3.2 Sociocultural Theory

The study is also supported by the Vygotsky's Sociocultural Theory (1978), in which guided interaction, scaffolding and mediated support are considered to be important in the learning process. In the context of environments where writing is facilitated by artificial intelligence, intelligent writing platforms serve as tools that assist learners with writing by providing them with automatic feedback, language suggestions, and interactive writing revision practices.

Reflective learning, self-regulated revision and ongoing interaction with academic writing tasks might be supported by the AI system. More recent studies also reveal that AI-mediated interaction is able to provoke and enhance learners' critical thinking and self-editing in the writing process (Li & Bahari, 2026). Therefore, a framework of Sociocultural Theory is suitable for explaining the role of AI-assisted interaction on the improvement of academic writing skills for ESL learners.Hence, Sociocultural Theory is the suitable framework for understanding how the use of AI-assisted interaction helps the academic writing improvement of ESL learners.

3.3 Integration of Theoretical Perspectives

By combining TAM and the Sociocultural Theory, it becomes possible to develop an overall picture of technological acceptance and pedagogical interaction in AI-supported learning environments. The TAM framework can explain why learners are willing to use the AI-assisted writing platforms, while the Sociocultural Theory can explain the mechanism of AI-generated scaffolding and guided interaction on writing development.

These theoretical perspectives concur that the success of AI-based learning environments involves not only technologically functional aspects but also the meaningful involvement of learners, the reflective interaction and pedagogically guided practices.

3.4 Conceptual Framework of the Study

The study draws on the theoretical foundations selected and literature review conducted to conceptualize the link between AI-based learning platforms and academic writing development of ESL learners in higher education.

The proposed framework has AI-assisted learning platforms as the independent variable that affects the academic writing ability. Academic writing skills are considered from several angles, such as: grammar accuracy, word choice, coherence, organization, and academic writing style. Presented here are the supporting factors that influence the outcomes of the writing development, namely learner engagement, writing motivation, and perceived usefulness. The major conceptual

elements of the proposed study framework (independent variables, dependent variables, supporting factors, and education context) are summarized in Table 1.

Table 1. Conceptual Components of the Study

Variables	Dimensions
Independent Variable	AI-Assisted Learning Platforms
AI Tools Used	ChatGPT, Grammarly, QuillBot
Dependent Variable	Academic Writing Skills
Writing Dimensions	Grammar Accuracy, Vocabulary Usage, Coherence, Organization, Academic Style
Supporting Factors	Learner Engagement, Writing Motivation, Perceived Usefulness
Educational Context	ESL Learners in Higher Education

The conceptual framework also assumes that AI feedback and adaptive writing support, as well as interactive revision practices, are conducive to the academic writing development, enabling ongoing reflection and self-regulated learning. The conceptual relationships in this case between AI-assisted learning platforms, learner engagement, AI-generated feedback and academic writing development are demonstrated in Figure 1.

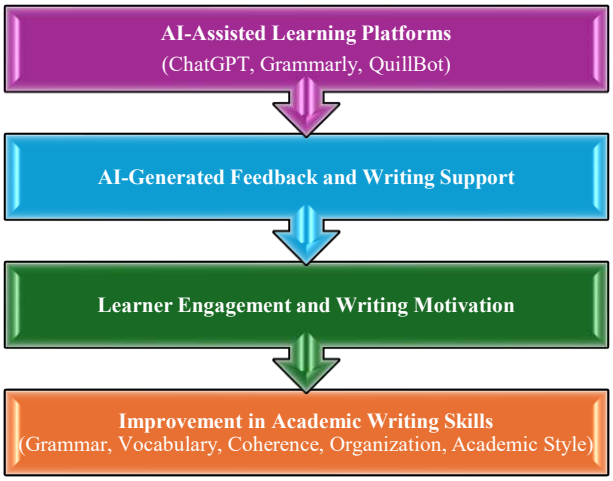


Figure 1: Conceptual Framework of AI-Assisted Academic Writing Development among ESL Learners

The conceptual framework in Figure 1 illustrates the interconnectedness between the elements of AI-assisted learning platforms, AI-generated feedback, learner engagement, and academic writing improvement for ESL learners in the higher education setting.

3.5 Hypotheses of the Study

Given the above theoretical framework and literature, the following hypotheses were developed:

- H1: AI-assisted learning platforms significantly improve ESL learners' academic writing proficiency.
- H2: AI-assisted feedback systems significantly improve grammar accuracy in academic writing.
- H3: AI-assisted learning platforms significantly enhance vocabulary usage and coherence among ESL learners.
- H4: Learner engagement positively influences the effectiveness of AI-assisted academic writing instruction.
- H5: ESL learners demonstrate positive perceptions toward AI-assisted learning platforms for academic writing development.

These hypotheses serve as the analytical framework to explore the effectiveness of using the AI-assisted learning platform to improve academic writing skills of the ESL learners in higher education.

4 Research Methodology

The convergent mixed method research design was used to explore the effectiveness of AI learning platforms to improve academic writing skills for ESL students in higher education. The mixed methods approach was deemed suitable for the study as it would allow for the investigation of both measurable improvement in academic writing performance and learners' perceptions, experiences and engagement with the use of AI-assisted writing technologies.

The methodical framework was aimed at the overall assessment of various aspects of academic writing such as grammar accuracy, word choice, coherence, organization and academic writing style. The use of quantitative and qualitative approaches allowed triangulation of the findings as well as interpretative depth of the investigation.

4.1 Research Design

The study adopted a convergent mixed-methods design in which quantitative and qualitative data were collected during the same phase of investigation and integrated during interpretation. The quantitative component examined improvement in academic writing performance following exposure to AI-assisted learning platforms, whereas the qualitative component explored learners' experiences, perceptions, and challenges associated with AI-assisted writing instruction. Table 2 shows the overall design of this study, which applied the research approach, sampling technique, and analysis technique.

Table 2. Research Design Structure

Component	Description
Research Approach	Mixed-Methods
Research Design	Convergent Design
Quantitative Method	Pre-test and Post-test Assessment

Qualitative Method	Semi-Structured Interviews
Population	ESL Learners in Higher Education
Sampling Technique	Purposive Sampling
Data Analysis	Statistical and Thematic Analysis

4.2 Population and Sample

The target population were the ESL learners who were studying in a university at an undergraduate and postgraduate level. The study was carried out in two private universities that have English-medium courses in social sciences, management and information technology courses.

To select the participants who regularly used academic writing activities, and had a minimal knowledge of digital learning technologies, Purposive sampling was used. Participants were recruited via departmental announcements and by instructors.

The final sample consisted of 120 ESL students from different program areas. The participants had a wide range of education backgrounds and proficiency in their native language and English, which allowed for a more comprehensive analysis of the learners' engagement with AI-related writing technologies.

Furthermore, 20 participants were chosen in a purposive manner from the total sample to participate in semi-structured interviews based on the differences in academic achievement, involvement, and usage of AI tools. The qualitative sample encompassed undergraduates and postgraduates (to allow for diversity of viewpoints) The demographic characteristics of the participants in the study are given in table 3.

Table 3. Demographic Profile of Participants

Demographic Variable	Category	Frequency	Percentage
Gender	Male	54	45.0%
	Female	66	55.0%
Level of Study	Undergraduate	78	65.0%
	Postgraduate	42	35.0%
Prior Use of AI Tools	Yes	89	74.2%
	No	31	25.8%

4.3 AI-Assisted Learning Platforms Used in the Study

The study employed widely-used AI writing tools in higher education applications. Idea generation, drafting assistance, paraphrasing, and academic structuring were done with the help of ChatGPT. Grammarly provided grammar checking, clarity improvement, and punctuation analysis while QuillBot was mainly used for paraphrasing and restructuring sentences.

The intervention phase began with the participants being oriented to the ethical and responsible use of AI technologies. The orientation sessions also familiarized students with citation guidelines, plagiarism policies, and tips for critically assessing AI-generated answers. Table 4 provides an overview of the AI-assisted learning platforms implemented during the intervention and their most important learning functions.

Table 4. Functions of AI-Assisted Learning Platforms

AI Platform	Primary Functions
ChatGPT	Idea generation, drafting assistance, academic structuring
Grammarly	Grammar correction, clarity enhancement, punctuation review
QuillBot	Paraphrasing, sentence restructuring, vocabulary variation

4.4 Research Instruments

Multiple instruments were employed to ensure comprehensive data collection and methodological rigor.

4.4.1 Academic Writing Assessment

The pre- and post- standardized academic writing test was used to assess the learners' writing proficiency changes after the intervention. The participants were engaged in argumentative and analytical writing exercises for the higher education context. Participants were asked to write academic essays of 600–800 words in a controlled assessment setting for each writing task.

The scoring rubric was taken and modified from existing academic writing assessment tools in ESL developed by Hyland (2003) and Ferris (2013). Learners were assessed in the five broad areas of the rubric:

- Grammar Accuracy
- Vocabulary Usage
- Coherence
- Organization
- Academic Writing Style

All dimensions were rated on a 5-point scale and a total of 100 points could be achieved. Assessments were independently judged by two ESL writing experts to ensure consistency of scores. The agreement of evaluators was calculated by inter-rater reliability using Cohen's Kappa, which resulted in a value of 0.84.

Table 5 shows the assessment dimensions and the criteria for each.

Table 5. Assessment Dimensions and Scoring Criteria

Writing Dimension	Maximum Score
Grammar Accuracy	20
Vocabulary Usage	20
Coherence	20
Organization	20
Academic Style	20
Total Score	100

4.4.2 Questionnaire

To explore learners' perception about AI-assisted learning platforms, a structured questionnaire with a Likert scale ranging from 1 to 5 was created. The instrument evaluated:

- Perceived usefulness
- Ease of use
- Learner engagement
- Writing confidence
- Writing motivation
- Ethical concerns regarding AI usage

The items from the questionnaire were adapted from the previous studies related to educational technology and AI-assisted learning, especially those based on the Technology Acceptance Model (TAM) framework (Davis, 1989; Kim et al., 2024; Widyaningsih et al., 2024). Some minor adaptations were done to make the instrument more relevant to ESL academic writing setting of higher education.

The initial draft of the questionnaire was piloted with three experts in educational technology and applied linguistics to pretest the questionnaire for clarity, relevance and content relevance.

4.4.3 Semi-Structured Interviews

Semi-structured interviews were used to provide more in-depth qualitative data on the experiences of the learners using the AI assisted writing technologies. After completion of the intervention phase, the total number of the participants interviewed is 20.

The interviews centered on how learners interact with the AI tools, their perceived value of using the tools, difficulties with writing, an academic integrity perspective, and the impact of AI-assisted writing on student confidence in their own writing and engagement. The interviews were conducted online, with audio recording, for about 25-35 minutes with the consent of the participant, in English.

4.5 Procedure of Data Collection

The study was undertaken during the course of a 12-week intervention. The participants took a pre-test academic writing test to establish their baseline writing skills. Followed by this, orientation sessions were conducted to introduce the learners to the AI-assisted learning platforms and ethical practices for responsible use of AI.

The intervention involved two, approximately 90 minutes, writing sessions per week, which were structured. In the intervention period, the students participated in academic writing tasks using AI-equipped platforms. The students were involved in academic writing tasks with the support of AI-equipped platforms during the intervention period. The activities consisted of writing of argumentative essays, summarization of literature, reflective writing and preparing analytical reports.

Students used AI tools to draft, revise, correct grammar, paraphrase and organize their academic text; they maintained their independence in the critical interpretation of the text they are communicating. Teachers also supervised students' use of AI-powered platforms to promote fair and equitable participation and learning.

Participants were assessed with a post-test writing task and questionnaires and interviewed three semi-structured interviews at the end of the intervention period.

Figure 2 presents the overall flow of procedures involved in the recruitment, intervention, assessment and analysis of data for participants used in the present study.

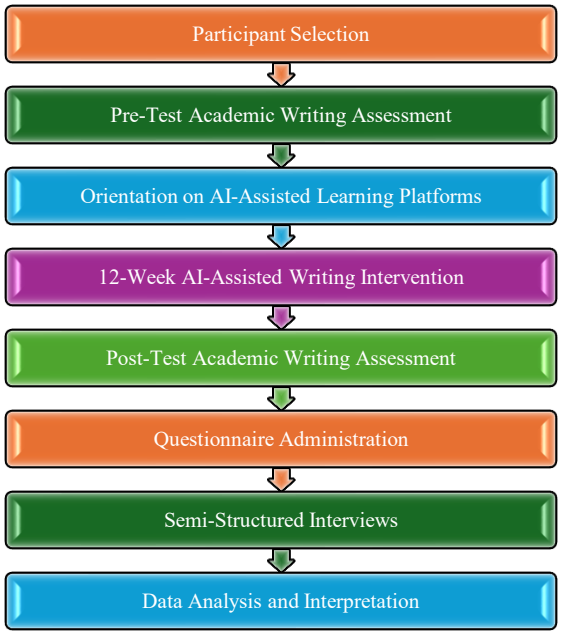


Figure 2. Research Procedure of the Study

The study adopted sequential process as presented in Figure 2, starting from selection of participants and culminating in data analysis and interpretation.

4.6 Data Analysis Techniques

The quantitative data from writing assessment and questionnaire were analyzed by using IBM SPSS Statistics Version 26. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used to present the results of the participants' responses and writing performance. The normality was tested with the Shapiro–Wilk test prior to the inferential analysis. The results met the normality assumptions ($p > 0.05$) and thus allowed for the use of parametric statistical methods. The pre-test and post-test writing scores were compared using paired sample t-tests. Pearson correlation analysis was also used to analyses relationships between learner perception variables and writing improvement and multiple regression analysis was used to identify predictive factors affecting the writing development.

The more assumptions of multicollinearity and homoscedasticity were also checked prior to regression analysis. There were no multicollinearity concerns as the variance inflation factor (VIF) values were within the range of 1.34 to 2.11.

Thematic analysis has been used to analyze the qualitative interview data, using the six phases of the coding procedure as outlined by Braun and Clarke. Thematic analysis was used to

systematically code all the interview transcripts for the themes that emerged from the data related to learner engagement, perceptions, benefits, challenges and ethical issues in relation to AI-assisted writing practices.

4.7 Reliability and Validity

To provide methodological rigour, the questionnaire instrument was piloted before it was administered to the final sample of ESL learners (25 ESL learners not part of the final study population). The internal consistency reliability was checked by Cronbach's alpha coefficient. The results of the reliability analysis of the research instruments used in the study are shown in Table 6.

Table 6. Reliability Analysis of Research Instruments

Research Instrument	Number of Items	Cronbach's Alpha
Learner Perception Questionnaire	24	0.89
Academic Writing Assessment Rubric	5	0.86
Overall Instrument Reliability	29	0.88

The acceptable threshold value was set at 0.70 and the reliability coefficients surpassed this value, indicating satisfactory internal consistency.

The content validity was ensured by language education and educational technology experts. Nestled in this, triangulation of the quantitative and qualitative results bolstered interpretative validity.

The exploratory Factor Analysis (EFA) was performed to explore construct validity of the learner perception questionnaire. The Kaiser–Meyer–Olkin (KMO) value was 0.87 and Bartlett's Test of Sphericity was statistically significant ($p < 0.001$), which indicated that the data were appropriate for factor analysis.

4.8 Ethical Considerations

The study followed the acceptable ethical guidelines of educational research using human subjects. The institutional research ethics committee gave ethical approval before data collection. The objectives and procedures of the study were explained to the participants, and they gave informed consent prior to participating in the study.

The concepts of voluntary participation, confidentiality and anonymity were adhered to for the research process. The participants were also provided with guidelines on the ethical and responsible use of AI technologies, such as plagiarism, hallucinated information, inaccuracies in citations, and over-reliance on AI-generated material. Students were urged to reflect on and assess AI-generated ideas, not to copy and paste AI-generated texts verbatim in their assignments.

5 Results and Analysis

In this study, the effect of using AI-based learning platforms to improve the academic writing skills of ESL learners in higher education was investigated. Pre-test and post-test writing assessment and structured questionnaires were used to collect quantitative data and semi structured interviews were used to gather qualitative data. This analysis was conducted in the

areas of academic writing improvement, engagement of learners, attitudes towards the use of AI in learning, and problems related to the use of AI in the writing environment.

5.1 Descriptive Analysis of Academic Writing Performance

Descriptive statistics were used to analyze learners' performance in academic writing pre and post the AI-assisted intervention. Table 7 shows the descriptive statistics of the participants' academic writing performance before and after the intervention.

Table 7. Descriptive Statistics of Pre-Test and Post-Test Writing Scores

Writing Dimension	Pre-Test Mean	Post-Test Mean	Mean Difference	Standard Deviation
Grammar Accuracy	11.42	16.87	5.45	2.14
Vocabulary Usage	12.18	17.04	4.86	2.06
Coherence	11.75	16.52	4.77	2.22
Organization	12.03	16.91	4.88	2.10
Academic Style	11.56	16.33	4.77	2.18
Overall Writing Score	58.94	83.67	24.73	6.42

The results show that there is significant improvement in all aspects of academic writing after the intervention. Grammar accuracy and organization showed the greatest means of gain followed by vocabulary. The results indicated that the overall scores of the writing test showed a significant improvement from the pre-test to the post-test, implying that the writing development of students was positively affected by the use of AI-assisted learning platforms.

But there was not a uniform improvement in all participants. Interviews showed that some students' higher-order writing skills (e.g., developing arguments and the style of disciplinary writing) were less developed. Some participants had also found it hard to critically assess AI generated suggestions in revision tasks, this is also a limitation of the tool.

Figure 3 illustrates the overall improvement in Academic Writing scores after the intervention.

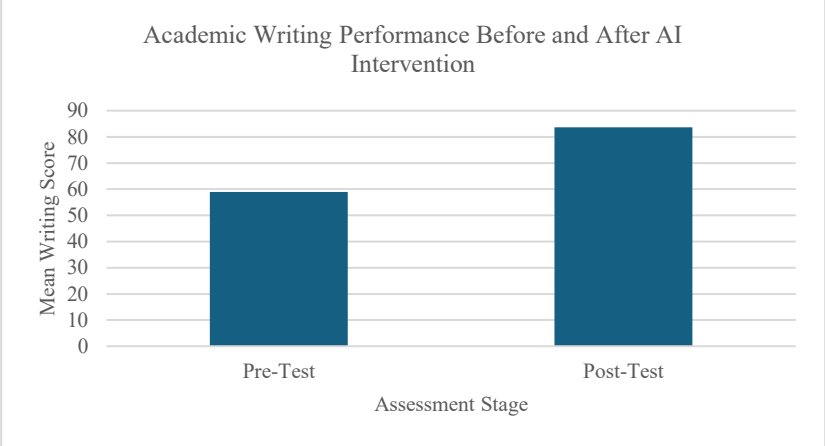


Figure 3. Comparison of Pre-Test and Post-Test Academic Writing Scores

Figure 3 shows the improvement in grades for academic writing after the intervention with AI.

5.2 Improvement in Grammar Accuracy

The study also explored the effectiveness of the use of AI-based feedback systems for improving the grammatical accuracy of the ESL students. Table 8 shows the changes in accuracy of grammar in the writing post-test after the AI supported writing intervention.

Table 8. Changes in Grammar Accuracy Following AI-Assisted Instruction

Grammar Components	Pre-Test Mean	Post-Test Mean	Improvement (%)
Sentence Structure	11.20	16.45	46.88%
Verb Usage	11.78	17.02	44.48%
Punctuation	12.04	16.91	40.45%
Subject–Verb Agreement	10.96	17.10	56.02%
Overall, Grammar Accuracy	11.42	16.87	47.72%

The results show significant improvements in all the grammar-related aspects. The percentage increase was the highest with subject-verb agreement, showing that the AI-assisted writing platforms proved to be helpful for learners to benefit from automated corrective feedback and continuous revision support.

The percentage improvement for each of the major grammar components is graphed in Figure 4.

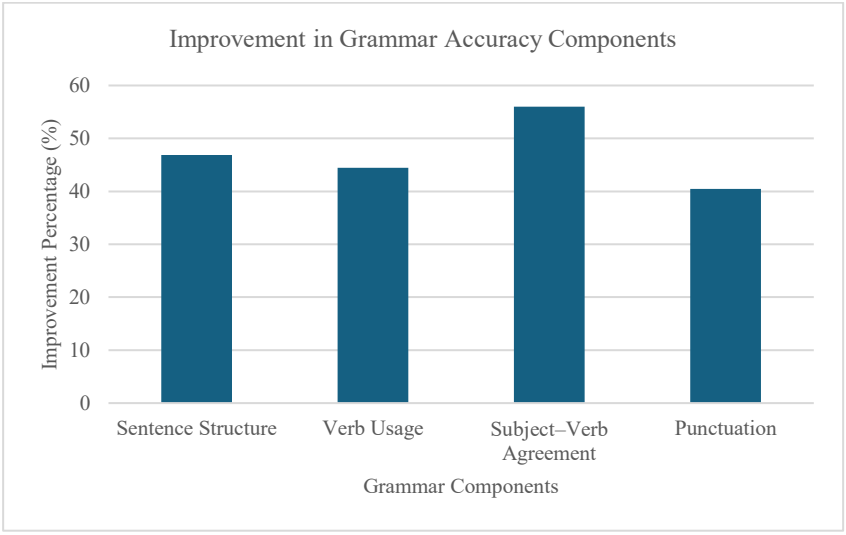


Figure 4. Improvement in Grammar Accuracy Components after AI-Assisted Intervention

Figure 4 shows the percentage of improvement in the key grammar components after the intervention.

5.3 Improvement in Vocabulary Usage and Coherence

The study also investigated if the use of AI tools in learning platforms helped to enhance vocabulary acquisition and improved writing coherence. Table 9 highlights the vocabulary and coherence improvements following the use of AI learning platforms:

Table 9. Improvement in Vocabulary Usage and Coherence

Writing Aspect	Pre-Test Mean	Post-Test Mean	Mean Gain
Academic Vocabulary	12.06	17.31	5.25
Lexical Diversity	11.84	16.95	5.11
Paragraph Coherence	11.52	16.48	4.96
Logical Organization	12.03	16.91	4.88
Transition Usage	11.29	16.36	5.07

The results indicate that there is a consistent improvement in the dimensions related to vocabulary and coherence. The vocabulary suggestion and paraphrasing tools that are performed by AI seemed to facilitate learners' academic expression and organization.

The results of the improvements in the vocabulary and coherence dimensions are shown in Figure 5.

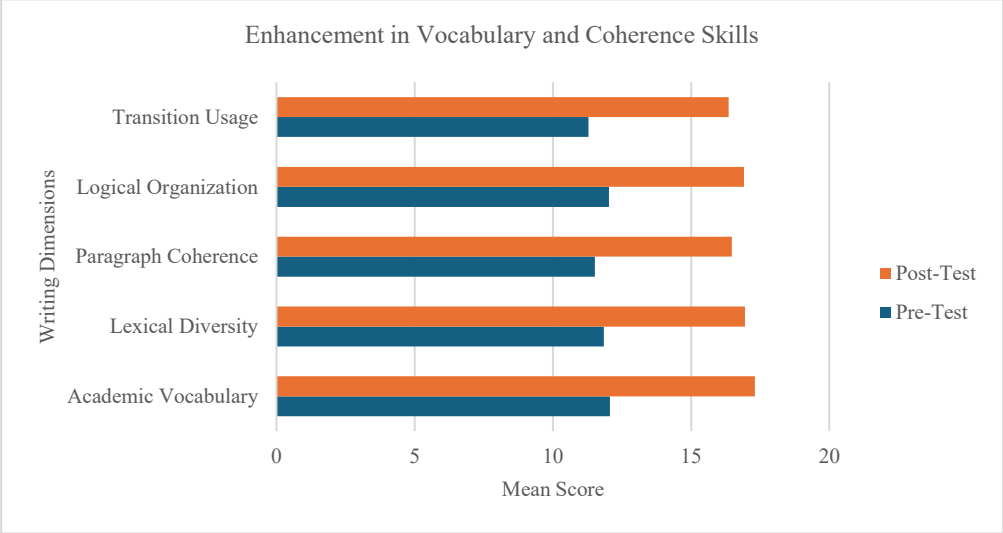


Figure 5. Improvement in Vocabulary and Coherence Dimensions

Figure 5 shows that after exposure to AI enhanced writing environments, there was an improvement in vocabulary use, coherence, and organizational features of writing.

5.4 Paired Sample t-Test Analysis

Paired sample t-tests were performed to establish whether the observed improvement in

academic writing was statistically significant. Paired-sample t-test was used to evaluate the statistical significance of the observed improvement in academic writing performance, and the findings are presented in Table 10.

Table 10. Paired Sample t-Test Results for Academic Writing Scores

Variable	Mean Difference	t-value	p-value	Result
Grammar Accuracy	5.45	11.82	< 0.001	Significant
Vocabulary Usage	4.86	10.97	0.002	Significant
Coherence	4.77	10.54	0.004	Significant
Organization	4.88	10.73	0.006	Significant
Academic Style	4.77	10.11	0.011	Significant
Overall Writing Score	24.73	15.48	< 0.001	Significant

The results showed statistically significant improvements in all aspects of academic writing after the intervention with the AI tools.

Cohen's d effect size analysis was used to explore the magnitude of the intervention effect and is shown in Table 11.

Table 11. Effect Size Analysis for Academic Writing Improvement

Writing Dimension	Cohen's d	Interpretation
Grammar Accuracy	0.71	Large Effect
Vocabulary Usage	0.58	Moderate to Large Effect
Coherence	0.49	Moderate Effect
Organization	0.55	Moderate to Large Effect
Academic Style	0.43	Moderate Effect
Overall Writing Score	0.76	Large Effect

The observed improvements were also found to be educationally significant through the results of the effect size analysis, in which the results were moderate to large for the writing dimensions investigated.

5.5 Learners' Perceptions toward AI-Assisted Learning Platforms

The findings of the questionnaires, however, confirmed some positive overall attitudes of learners towards the use of the AI-assisted writing tools, highlighting the following aspects of writing accuracy, revision support, enhancement of vocabulary, and the ease of use of the tools. Table 12 presents the results from participants' perceptions of the effectiveness and usability of AI writing platforms.

Table 12. Learner Perceptions of AI-Assisted Writing Platforms

Questionnaire Statement	Mean Score	Interpretation
AI tools improved my writing accuracy	4.18	Agree
AI feedback helped me revise effectively	4.11	Agree
AI-assisted learning increased my writing confidence	3.96	Agree
AI tools improved vocabulary usage	4.07	Agree
AI-assisted learning increased engagement	3.88	Agree
AI platforms were easy to use	4.15	Agree
AI tools reduced writing anxiety	3.74	Moderately Agree

AI-generated suggestions sometimes caused confusion	3.21	Neutral
I became overly dependent on AI assistance at times	3.36	Neutral

Overall, the participants found AI-powered platforms to be user-friendly, supportive learning tools that helped them improve their writing. However, a few students expressed some difficulty understanding the AI-generated suggestions and moderate reliance on AI feedback systems, highlighting the need for careful and judicious use of AI in learning.

The graph in Figure 6 illustrates the graphical representation of learners' perceptions regarding the writing technologies associated with AI.

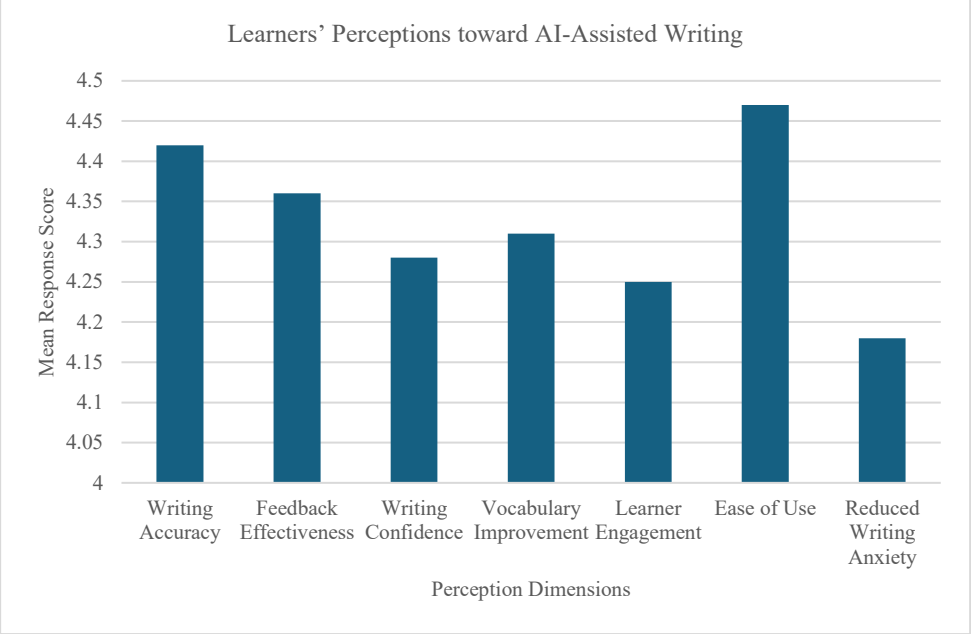


Figure 6. Learners' Perceptions toward AI-Assisted Writing Technologies

Figure 6 shows the general attitudes of learners towards the use of AI tools for writing and their learning experiences.

5.5.1 Correlation Analysis

Pearson correlation analysis was used to investigate the relationship among the variables of the learners' perception and academic writing improvement. The relationships among the learner perception variables and academic writing improvement are shown in Table 13.

Table 13. Correlation Analysis between Learner Perception Variables and Writing Improvement

Variable	Writing Improvement
Perceived Usefulness	.62**
Learner Engagement	.58**
Ease of Use	.49*
Writing Confidence	.53**

- $p < 0.05$; ** $p < 0.01$

The results show that those who found AI tools useful, entertaining and accessible showed relatively higher academic writing performance improvements.

5.5.2 Multiple Regression Analysis

Multiple regression analysis was used to discover all the factors influencing learner's writing improvement which are writing confidence, perceived usefulness and learner engagement. Table 14 shows the results of multiple regression analysis to determine the most important variables affecting the improvement in academic writing.

Table 14. Multiple Regression Analysis Predicting Academic Writing Improvement

Predictor Variable	Standardized Beta (β)	t-value	p-value	Result
Learner Engagement	0.41	4.87	< 0.001	Significant
Perceived Usefulness	0.36	4.12	0.002	Significant
Writing Confidence	0.24	3.46	0.005	Significant

Model Summary:

$R = 0.64$

$R^2 = 0.41$

Adjusted $R^2 = 0.39$

F-value = 26.84

Significance Level = < 0.001

The results of the regression show that the variables of learner engagement, perceived usefulness and writing confidence have significant influences on the academic writing improvement. The writing development variables that best predicted the intervention were the learner's engagement

5.6 Qualitative Findings from Semi-Structured Interviews

The results of the thematic analysis of learners' experiences in the AI aided academic writing environments revealed four main themes. A summary of the thematic analysis of the participant interviews is provided in Table 15 below.

Table 15. Major Themes Identified from Interview Analysis

Theme	Participant Response Focus
Improved Writing Confidence	Reduced fear of writing errors
Immediate Feedback	Faster revision and correction
Learner Autonomy	Independent writing improvement
Ethical Concerns	Dependence on AI-generated content

Participants shared that the platforms with AI enhanced their writing confidence when writing, make quick revisions and have more control over their learning. But some students also

voiced some concerns about excessive reliance on AI-suggested ideas and challenges with being able to independently assess higher order aspects of academic writing.

A single post-graduate participant (P12) reported that relying on AI suggestions for writing every day sometimes led to a loss of trust in his/her own academic writing. Other participants (P19) commented that paraphrasing, a process often performed by AI, resulted in a change of the intended discipline meaning in academic arguments.

5.7 Hypothesis Testing Summary

The statistical results from quantitative analysis were used to test the proposed hypothesis for the study. The findings presented in table 16 are whether the formulated hypotheses have been accepted based on the empirical evidence found in the investigation. The quantitative findings of this study are summarized in the results of the hypothesis tests in Table 16 below.

Table 16. Summary of Hypothesis Testing

Hypothesis	Result
H1: AI-assisted learning platforms significantly improve academic writing proficiency	Supported
H2: AI-assisted feedback systems improve grammar accuracy	Supported
H3: AI-assisted platforms enhance vocabulary usage and coherence	Supported
H4: Learner engagement positively influences AI-assisted writing effectiveness	Supported
H5: ESL learners demonstrate positive perceptions toward AI-assisted learning platforms	Supported

All proposed hypotheses were backed up by the statistical results, with the qualitative results also indicating issues around ethical use of AI and technological dependence.

5.8 Summary of Major Findings

These results suggest that the ESL higher education student's academic writing improvement was facilitated by using AI-supported learning platforms. There was a marked improvement post intervention on grammar accuracy, vocabulary use, coherence, organization, and writing overall.

The research also identified that AI-implemented feedback helped enhance learner writing confidence, revision practices, and engagement. Meanwhile, participants noted the need to use AI responsibly and critically engage with work during academic writing processes.

Overall, AI-supported learning platforms can serve as valuable supplementary learning tools in higher education settings to support academic writing, provided they are used properly.

6 Discussion

The present study aimed to investigate the effectiveness of the AI-assisted learning platforms on the academic writing skills of ESL students in higher education. The results showed that significant improvements in grammar accuracy, vocabulary usage, coherence, organization, and academic writing performance after the intervention with AI. In addition, the learners had generally favorable views on the usefulness, availability, and interactivity of AI tools for writing.

6.1 Improvement in Academic Writing Skills

The study revealed that providing access to AI-enabled learning platforms significantly enhanced participants' academic writing abilities. The key finding of the study was that there was significant improvement in the academic writing skills of the learners after being exposed to using platforms for AI assisted learning. The results of the post-test scores indicated that there was an improvement in the ability of learners to create academic texts with accuracy and organization by adding support with AI-generated feedback and revision.

An improvement in grammar and vocabulary use and in the coherence of writing could be linked to the instant and repeated feedback made available by AI-supported writing systems. Contrary to the delayed type of feedback, AI tools allowed students to see and correct their mistakes as they worked, promoting reflective feedback and ongoing participation in learning tasks concerning academic writing.

The results showed that there is a difference in learner improvement based on the digital literacy and critical engagement levels of the participants with the suggestions generated by AI. Those who actively considered feedback on AI revision seemed to experience more significant gains than those simply receiving automated revisions. This is an observation that confirms the sociocultural approach that highlights the importance of guided interaction and reflective mediation in educational processes.

This study results align with prior research that has found positive outcomes of AI writing tools on writing and revision behaviors (Song & Song, 2023; Chen & Gong, 2025). Likewise, Begmatova and Saydazimova (2025) found that using AI in writing instruction led to better writing results than conventional writing instruction.

Table 17 presents a comparison of the present study with some of the previous studies on AI-assisted academic writing.

Table 17. Comparison of Present Study with Existing Research

Study	Focus Area	Major Findings	Distinct Contribution of Present Study
Song & Song (2023)	ChatGPT and writing motivation	Improved writing performance	Included broader writing dimensions
Chen & Gong (2025)	AI-assisted academic writing	Enhanced grammar and coherence	Focused on ESL higher education learners
Begmatova & Saydazimova (2025)	Traditional vs AI-assisted learning	Better performance through AI support	Integrated qualitative learner experiences
Present Study	AI-assisted academic writing among ESL learners	Improvement across writing dimensions	Mixed-methods analysis with pedagogical and ethical interpretation

The findings given in comparison, indicate that the current study complements the previous studies by analyzing several dimensions of academic writing, along with the perception, engagement, and ethical issues of the learners in academic writing in a mixed-methods approach.

6.2 Effectiveness of AI-Generated Feedback

The results showed that the AI feedback system helped students achieve a higher level of grammatical accuracy and revision process. Participants indicated that the automated feedbacks helped them revise their sentence structure, punctuation, word choice and academic organization.

The results are in line with the previous studies, which focused on the importance of immediate feedback within the language learning context (Jamshed et al., 2025; Mehmood & Aziz, 2025). The present study also shows that AI-generated feedback not only helped to correct the surface-level grammar, but it also helped with the different aspects of academic writing such as coherence and logical organization.

The constant repetition of writing and reflection as a result of the continuous interaction with AI-assisted revision systems seemed to increase the awareness of the academic writing conventions and linguistic correctness at the part of the learners.

6.3 Learner Engagement and Writing Confidence

Positive learner perceptions of using AI-assisted learning platforms were also identified from the study. The participants found the AI writing tools to be available, helpful, and engaging learning tools. AI-generated suggestions helped students rewrite their papers with greater confidence, and promoted self-correction exercises for students, who said they felt more confident in their academic writing.

The results are consistent with previous research showing positive effects of AI-supported learning environments on learners' engagement and motivation in ESL learning (Awaludin et al., 2025; Khan et al., 2024).

The results of qualitative findings also showed that the students became more autonomous in academic writing process. As students interacted multiple times with AI supported platforms, they were able to better detect weaknesses in their writing and make revisions to their academic text on their own. AI-assisted environments can thus support SLL processes in a positive way because of their supportive and low-anxious attributes.

6.4 Ethical Concerns and Responsible AI Usage

Although the benefits seen in the intervention were noted, learners also voiced concerns about the potential for over-reliance on AI-generated content and a potential loss of critical thinking skills. Some of the participants noted a risk of AI-generated ideas impacting authenticity and originality of academic content if they are accepted without critical examination.

Some of the learners also mentioned that they sometimes get confused when trying to understand suggestions to paraphrase and restructure provided by AI. Some participants were also moderately dependent on the automated feedback systems. The results demonstrate that although AI-supported learning environments offer significant support in the teaching process, it is not always possible to increase the independent analytical engagement if such systems are overused.

These are similar to the issues highlighted in previous research that considers AI products as additional tools to aid students' critical thinking, rather than as a substitute (Deep & Chen, 2025; Tahir et al., 2025).

The results thus remind us of the need for the ethical use of AI-based technologies in higher education. School districts and schools must create clear guidelines and policies surrounding the use of AI tools, and promote the originality, critical thinking, and integrity of students. The study additionally implies that AI supported writing environments might be most successful within pedagogical contexts led by instructors, instead of the environment's use being completely autonomous.

6.5 Theoretical Implications

The results give empirical evidence for the Technology Acceptance Model (TAM) and Sociocultural Theory used in the conceptual model.

TAM's findings indicated that the AI-enhanced learning platforms were perceived as useful and easy to use by the learners, positively impacting their engagement and writing improvement results. At the same time, the results align with the basic premise of Sociocultural Theory by showing how AI-supported systems acted as a scaffolding device, enabling students to learn and interact with the system, and even revise their work during the learning process.

The combined application of these theoretical frameworks offers a relevant explanation for the correlation between the AI-assisted learning environments and academic writing development for ESL students.

6.6 Practical and Pedagogical Implications

The findings possess several important implications for higher education institutions, educators, and curriculum developers.

- AI-supported learning platforms can serve as an additional training support for academic writing and for engaging students in learning could be used as pedagogic tools for revision support.
- Academic institutions need to have guidelines on the responsible use of AI-assisted writing tools in academic settings.
- Trainings are needed for language teachers on how to effectively use AI in writing education.
- AI platforms can aid in delivering more inclusive and personalized writing instruction to students of diverse language proficiency.

The findings indicate that, in general, the use of AI-supported technologies in a balanced and pedagogically-appropriate manner can enhance the learning environment in academic writing within higher education.

6.7 Limitations of the Study

Although helpful and informative, there are some limitations to the study. The study was undertaken within a small-scale, high education context with a moderate number of ESL learners. The intervention time was limited to twelve weeks, and the long-term effects of AI for learning were not explored. Furthermore, the study has mainly centered on some of the most popular AI-powered platforms, like ChatGPT, Grammarly, and QuillBot.

Some of the results on learner perceptions and involvement were self-reported and could thus be interpreted subjectively. These restrictions do not detract from the value of the study, but suggest that future studies of the impact of AI on academic writing development among ESL learners could be expanded and more in-depth.

7 Conclusion and Future Scope

The present study compared the effectiveness of an AI based learning platform and academic writing skills development of ESL students in higher education. The results of the study showed that all facets of academic writing skills (grammar accuracy, vocabulary skills, coherence, organization, and academic writing style) improved as a result of the use of AI-assisted writing tools. Significant scores were obtained by the participants with AI-assisted platforms in post-test writing when compared with their pre-test scores.

The results also showed that the AI-generated feedback helped learners continuously revise their writing, promote engagement in the learning process, and enhance writing confidence. The use of AI tools like ChatGPT, Grammarly, and QuillBot provided learners with instant feedback, personalized support, and customizable learning experiences, enhancing their engagement with academic writing. The features helped the learners positively to develop their learner autonomy and self-regulated writing.

Qualitative results also showed that the students' experiences regarding the use of AI assisted learning environments were mostly positive, in terms of ease of access, interaction and support. There were also participants that voiced concerns about the potential for relying too heavily on AI-generated work, originality, and ethical academic use. The results highlight the need for the responsible and balanced use of AI in the educational environment, particularly in higher education.

Based on the findings of this study, it is concluded that AI based learning platforms have a significant pedagogical potential to facilitate the development of academic writing skills in ESL students, if used in a right way in guided learning situations. However, AI technologies should be used as an adjunct to learning, a tool to aid learning and not to replace independent critical thinking and academic creativity.

The study may serve as another contribution to the literature on language learning that is supported by technology, given that it offers empirical evidence on the effectiveness of the academic writing instruction in higher education with the aid of AI for ESL learners.

The results of the present research provide some exciting avenues for future research.

- Future research could explore long-term outcomes of the use of AI in academic writing, such as the impact on learner autonomy and academic writing skills.
- Cross-sector, cross-discipline and cross-proficiency comparative research can offer more general insights into the learning experience of using AI-enabled writing technologies.
- Existing or future generative AI tools other than ChatGPT, Grammarly and QuillBot can be tested for their effectiveness in academic writing courses.
- Further research could delve into the perspectives and preparedness of educators, as well as the integration strategies for AI-driven learning environments.
- Also, additional studies on ethical guidelines, academic honesty policies, and practices of responsible use of AI in educational institutions are needed.
- Experimental research that investigates the learning outcomes of critical thinking, creative thinking, and analytical writing in the learning context using AI technology can be used to gain deeper pedagogical insights.

Given the rapid pace of AI technology development, it's likely that AI-enhanced learning will shape the way academic writing is taught in the future. To address the pedagogical, ethical, and

academic implications of integrating AI into higher education, ongoing research is essential to guarantee that it remains a valuable instructional tool for all kinds of learners.

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