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Enhancing EFL Academic Writing through AI and Peer-assisted Learning

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ENHANCING ENGLISH AS A FOREIGN LANGUAGE ACADEMIC WRITING THROUGH AI AND PEER-ASSISTED LEARNING

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ABSTRACT

This study investigates the integration of artificial intelligence (AI), specifically ChatGPT, and peer-assisted learning (PAL) in enhancing academic writing skills among English as a Foreign Language (EFL) learners. Employing a participatory action research design, the study utilized a mixed-methods approach, combining quantitative and qualitative data collection. The research involved 143 EFL students in the experimental group participating in a 15-week academic writing course, with peer mentors actively engaging in the intervention process. Quantitative data were collected through pre- and post-tests assessing writing proficiency and questionnaires, while qualitative data were gathered via individual semi-structured interviews to explore participants' perceptions and experiences. Peer mentors in a PAL center used ChatGPT to provide personalized, immediate feedback on writing tasks. The results indicated substantial improvements in writing scores and increased student confidence and engagement. This research provides empirical evidence on the synergistic effects of AI and PAL in EFL pedagogy, offering practical insights for educators. Future recommendations include exploring diverse AI tools across various linguistic and cultural settings and conducting longitudinal studies on the enduring effects of these interventions.

Keywords: AI in Education, ChatGPT, EFL Writing Pedagogy, Peer-Assisted Learning, Academic Writing Skills

Introduction

In recent years, integrating artificial intelligence (AI) into educational settings has revolutionized teaching methodologies, particularly in English as a Foreign Language (EFL) instruction. Due to its complex nature and the limitations of traditional teaching methods, EFL learners often face significant challenges in mastering academic writing. As globalization continues to bridge cultural and linguistic gaps, the demand for proficient English communicators has surged. (Tsuneyoshi, 2013), propelling educational institutions to explore innovative approaches to language teaching. One promising approach is the combination of AI-driven tools and peer-assisted learning (PAL), which offer a powerful means of addressing these challenges and enhancing the writing proficiency of EFL learners.

The advent of AI technologies, particularly those involving natural language processing (NLP), has opened new avenues for language learning and teaching. AI-powered tools such as ChatGPT provide immediate, personalized feedback, allowing students to identify and correct grammar, coherence, and vocabulary errors in real time. (Dempere et al., 2023). These capabilities align well with data-driven learning (DDL) principles, which facilitate the discovery of linguistic patterns and promote adaptive language use. (Pérez-Paredes et al., 2019). However, AI's true potential is best realized when integrated with human-centered learning approaches, such as PAL, emphasizing student collaboration and mutual support.

PAL is a pedagogical approach where learners alternate between roles as teacher and learner, engaging in structured peer interactions that foster critical thinking and language development (Qiu & Lee, 2020). PAL's collaborative framework enhances academic writing by encouraging students to engage with their peers in meaningful discussions, provide constructive feedback, and develop writing strategies together. When combined with AI, PAL can be further enhanced, as AI-generated feedback can guide peer discussions and make the collaborative process more focused and productive. This integration supports an iterative learning cycle in which students draft, receive AI-supported insights, discuss improvements with peers, and revise their work, creating a dynamic and supportive environment for writing development.

In addition to quantitative measures of writing proficiency, this study also explores students' perceptions of the AI and PAL interventions, focusing on how these innovative approaches

impacted their academic writing experiences. The qualitative component is essential for understanding the learners' subjective experiences. (Denzin & Lincoln, 2005), particularly how they interacted with the AI-driven feedback and peer collaboration and how these interventions influenced their confidence, engagement, and development as academic writers. By integrating both quantitative and qualitative analyses, this research provides a comprehensive view of the impact of AI and PAL on EFL academic writing.

The synergy between AI and PAL creates a comprehensive approach to EFL writing instruction, merging the strengths of technology-driven precision with the benefits of peer collaboration. For example, while ChatGPT offers immediate feedback on writing tasks (Dever et al., 2020), identifying issues related to coherence or grammatical accuracy, peers can provide more nuanced suggestions regarding argumentation, style, or cultural appropriateness. This combination addresses surface-level writing concerns and higher-order skills, making it a holistic strategy for enhancing writing proficiency. The iterative nature of this integration aligns with process-oriented writing pedagogies, which emphasize the importance of feedback and revision in developing writing skills (Widodo, 2008).

Research Objectives

The objectives of this study are to investigate the impact of integrating AI, specifically ChatGPT, and PAL, on enhancing academic writing skills among EFL learners. To achieve this, the study aims to:

1. Evaluate the effectiveness of AI-supported PAL on writing proficiency among EFL learners, emphasizing improvements in coherence, cohesion, lexical resources, and grammatical accuracy. Additionally, the study aims to assess participants' experiences and perceptions using a 12-item questionnaire that explores support, resources, training preparedness, and personal development dimensions related to the interventions.
2. Identify the challenges and benefits of integrating AI and PAL in academic writing instruction, including insights gathered from participants' feedback through a structured questionnaire to understand the implementation comprehensively.
3. Examine students' and instructors' perceptions and attitudes toward using AI and PAL, specifically emphasizing the support, resources, training preparedness, and personal development aspects explored in the questionnaire.

4. Develop best practices for incorporating AI and PAL into EFL instruction, informed by quantitative improvements in writing skills and qualitative feedback from the questionnaire results. These best practices enhance writing pedagogy and support diverse learner needs in globalized educational contexts.

Research Questions

The study addresses the following research questions to guide the investigation into the effectiveness and impact of AI and PAL integration in EFL academic writing:

1. How effective is AI-supported peer-assisted learning (PAL) in improving writing proficiency among EFL learners?
2. What are the perceived challenges and benefits of integrating AI and PAL in academic writing instruction?
3. How do students and instructors perceive using AI and PAL to enhance academic writing skills?
4. What best practices can be developed for integrating AI and PAL into EFL instruction to optimize writing pedagogy and cater to the diverse needs of learners?

Literature Review

This literature review discusses five key constructs—writing proficiency, feedback effectiveness, student engagement, peer collaboration, and data-driven learning—that support the integration of AI and PAL in English as a Foreign Language (EFL) writing instruction. These constructs provide a comprehensive framework for understanding the theoretical and practical implications of combining AI tools and peer-assisted learning strategies in enhancing EFL writing skills.

The conceptual framework (Figure 1) illustrates the relationships between these key constructs and their combined impact on enhancing academic writing skills among EFL learners. This framework highlights the synergy between AI tools and PAL strategies as a guide for the research design, data collection, and analysis processes.

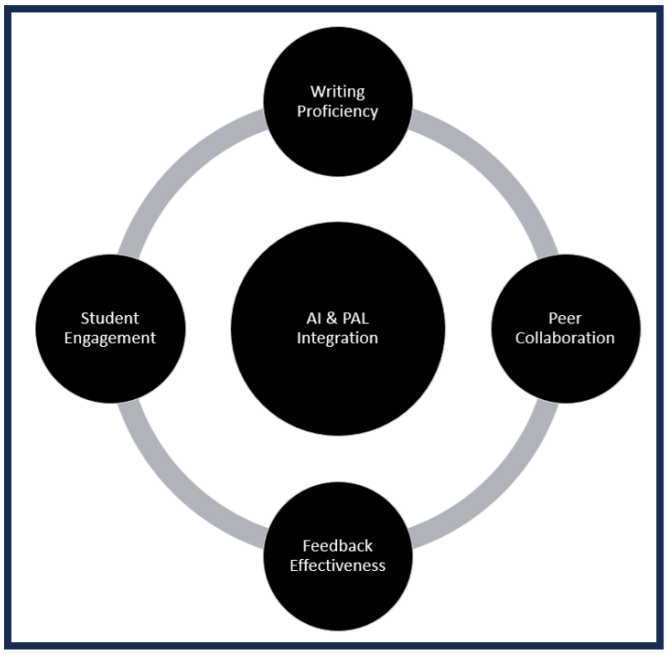

Figure 1: Research Model Framework

Writing Proficiency

Writing is a multifaceted and cyclical activity incorporating cognitive awareness, emotional engagement, and strategic actions. (Sun & Zhang, 2023). Among the four fundamental English skills—listening, speaking, reading, and writing—writing is regarded as the most challenging for learners, influenced by a variety of both objective and subjective factors (Anh, 2019). Writing proficiency is typically assessed through grammatical accuracy, lexical range, coherence, and task response, reflecting a learner's ability to produce clear and persuasive writing. (Ngubane et al., 2020).

Interventions such as iterative writing processes and targeted feedback have shown promise in improving EFL writing skills (Chen et al., 2022). AI tools like ChatGPT facilitate these improvements by providing real-time, personalized feedback that helps learners refine their drafts through multiple revisions (Dempere et al., 2023). Integrating AI with PAL allows students to engage in collaborative discussions about writing, leading to deeper understanding and incremental gains in writing proficiency. This approach aligns well with data-driven learning principles, discussed further in section 2.5, which support identifying and analyzing language patterns through repeated practice and feedback (Boulton & Cobb, 2017).

Feedback Effectiveness

Feedback is essential for improving writing skills, especially for EFL learners who may require detailed guidance to address language challenges. Traditional classroom feedback often suffers from delays, limiting its effectiveness in facilitating timely learning. (Carless, 2016). AI-driven tools, such as ChatGPT, have transformed feedback processes by providing instant, tailored suggestions that enable learners to correct grammar, coherence, and content organization errors as they arise. (Ibrahim, 2024).

Research suggests that AI-enhanced feedback identifies surface-level issues and offers deeper insights by explaining suggested changes and providing alternative phrasings. Thus, it supports learners in understanding the rationale behind each suggestion. (Schillings et al., 2023). When combined with PAL, AI-generated insights guide peer discussions on higher-order writing concerns, such as argumentation and style, enhancing the overall effectiveness of the feedback process. This aligns with DDL principles, emphasizing the importance of immediate feedback and pattern recognition in improving language skills. (Pérez-Paredes et al., 2019).

Student Engagement

Student engagement significantly influences learning outcomes in EFL settings, where learners may face motivational challenges due to language barriers. Engaging students in writing tasks can be difficult, as they may lack confidence or feel discouraged by language limitations. (Fredricks et al., 2004). Integrating AI tools and PAL strategies helps increase engagement by creating an interactive and supportive learning environment.

AI-powered tools like ChatGPT foster engagement by providing instant feedback, allowing students to see the immediate impact of their revisions, which motivates them to stay actively involved in the writing process. (Achour et al., 2024). The dynamic nature of AI-enhanced feedback encourages iterative revision, where students can explore different writing strategies and receive continuous input. Moreover, PAL promotes social interaction and collaborative learning, which are crucial for sustaining engagement. Peer discussions centered on AI-generated insights create a more reflective learning experience, improving writing quality. (Comer et al., 2014).

Peer Collaboration

Peer collaboration is pivotal in language learning by promoting structured interactions where students alternate roles as learners and peer mentors. PAL has been found to support the development of critical thinking, self-regulation, and writing skills through collaborative activities (Qiu & Lee, 2020). Integrating AI with PAL extends these benefits by providing AI-generated insights during peer review sessions, which can guide discussions and make the collaborative process more focused and productive.

Vygotsky's social constructivism, which emphasizes cognitive development through social interaction within a zone of proximal development (ZPD), supports the combined use of AI and PAL. (McCarthy & Armstrong, 2019). In this context, AI tools like ChatGPT act as more capable peers, offering scaffolded feedback that enables students to undertake challenging writing tasks. The feedback from AI can serve as a springboard for deeper exploration during PAL sessions, where peers engage in discussions that address both linguistic accuracy and higher-order writing skills, such as argumentation and cultural appropriateness.

Data-Driven Learning (DDL)

Data-driven learning (DDL) involves using authentic language data to uncover patterns and promote language awareness. Traditionally, DDL approaches have been associated with corpus-based instruction, which requires specialized tools and resources. (Godwin-Jones, 2021). However, advancements in AI, particularly in natural language processing, have made DDL principles more accessible to learners by enabling them to engage dynamically with language data.

ChatGPT's integration with DDL goes beyond conventional tools by allowing students to interact with language patterns in real time. Rather than merely checking for errors or paraphrasing text, ChatGPT helps learners explore various writing styles and linguistic structures by providing contextually relevant examples and suggestions. This aligns with DDL's inductive learning principles, where students experiment with language use and observe the effects on clarity, coherence, and tone. (Boulton & Cobb, 2017). The tool’s ability to facilitate real-time analysis of language choices enables learners to internalize writing strategies and develop a more nuanced understanding of language use.

Integrating DDL with PAL and AI tools such as ChatGPT offers a multifaceted approach to EFL writing instruction. Data-driven exploration of language patterns complements peer feedback and AI-generated insights. This combination supports learners in developing a more comprehensive skill set that addresses surface-level accuracy and deeper cognitive engagement with writing tasks.

Purpose and Scope of the Study

This study addresses the significant challenge that EFL learners face in mastering academic writing, given its complex nature and the limitations of traditional teaching methods. Although AI and PAL have shown potential in enhancing education, their combined impact on EFL academic writing proficiency is under-explored. This study specifically focuses on the unique contributions of ChatGPT, an AI-powered tool, in improving writing skills beyond conventional grammar-checking and paraphrasing.

The research aims to evaluate how ChatGPT's interactive feedback and iterative revision support, when integrated with PAL strategies, can enhance academic writing skills among EFL learners. By leveraging ChatGPT's capabilities to provide real-time, context-aware feedback, the study investigates its role in addressing linguistic challenges and fostering deeper engagement with the writing process. This approach distinguishes ChatGPT from other AI tools and positions it as a novel solution for democratizing high-quality writing instruction in EFL contexts.

Methodology

Research Design

This study employed a participatory action research design to explore the integration of AI, specifically ChatGPT, and PAL, in enhancing EFL academic writing skills. The design facilitated a collaborative and iterative approach, where the researchers and participants worked together to refine the educational intervention. A mixed-methods approach was used, combining quantitative and qualitative data collection to understand the research problem comprehensively. The study measured writing proficiency improvements through pre- and post-tests while exploring participants' experiences and perceptions through questionnaires and individual semi-structured interviews.

Participants

The participants in this study were selected to align with the study's purpose of evaluating the integration of AI-powered tools and PAL strategies in enhancing academic writing skills among EFL learners. The total population consisted of 245 undergraduate students enrolled in various General Education English writing courses at an international college in Thailand. These courses were offered to students across different academic programs and years, primarily within their first and second years. The students' grades ranged from freshmen (Year 1) to sophomores (Year 2), ensuring representation of different levels of writing experience and familiarity with academic writing practices.

A stratified random sampling method was employed to ensure a representative sample, resulting in a total sample size of 143 participants, all of whom were part of the experimental group. There was no control group in this participatory action research study. All students participated in the intervention, which integrated ChatGPT and PAL. The sample was stratified according to English proficiency levels, as determined by scores on a standardized in-house English placement test. The participants selected for the study all had a CEFR proficiency level of B2 or higher, indicating an upper-intermediate to advanced level of English. This sampling approach allowed for the inclusion of a diverse group of students in terms of language proficiency and academic background.

Cultural diversity was a significant feature of the sample, with participants coming from various cultural and linguistic backgrounds. The cohort included students from Thailand, Myanmar, China, Vietnam, and Japan and fewer students from European and Middle Eastern countries. This cultural diversity added dimension to the study, allowing for the exploration of how AI and PAL strategies could cater to students with different linguistic and cultural experiences.

Research Model Framework

The research model framework for this study integrates AI-powered tools, specifically ChatGPT, with Peer-Assisted Learning (PAL) strategies to enhance EFL academic writing skills. The framework incorporates key constructs such as Writing Proficiency, Feedback Effectiveness, Student Engagement, and Peer Collaboration, which are essential for understanding the impact of AI and PAL on writing development. These constructs are

discussed in detail in the Literature Review, where their theoretical foundations and significance in language learning are elaborated. The framework guides the research design, data collection, and analysis processes, highlighting the interactions between AI tools and PAL strategies in improving students' writing.

Data Collection Procedures

This study employed a mixed-methods approach to collect quantitative and qualitative data, ensuring a thorough understanding of the integration of AI and PAL in EFL academic writing instruction.

Quantitative Data Collection

The qualitative part of this study is pre-and post-tests and questionnaires. They were designed to complement the quantitative analysis by exploring the participants' subjective experiences. Specifically, the qualitative study aimed to gain deeper insights into how EFL learners perceived and experienced the integration of AI, particularly ChatGPT and PAL, in their academic writing processes. This approach aimed to explore the impact of these interventions on writing proficiency and the challenges, perceptions, and benefits students encountered throughout the course.

Quantitative Data Collection

The qualitative data were collected through individual semi-structured interviews administered at the end of the intervention. The semi-structured interviews were conducted with 50 randomly selected participants from diverse cultural and linguistic backgrounds, ensuring representation across different writing proficiency levels and academic programs. These interviews allowed students to share their experiences, detailing how they interacted with AI-generated feedback and engaged in peer-assisted learning sessions. Key areas of focus included their perceptions of AI feedback, the role of peer collaboration, and the perceived value of these tools in developing their academic writing skills.

The qualitative study sought to provide a comprehensive understanding of the students' subjective experiences, particularly about their diverse cultural and linguistic contexts. This was critical for understanding how the combination of AI and PAL catered to students from

different backgrounds and how factors such as language proficiency, cultural expectations, and prior exposure to technology influenced their engagement with the interventions.

The interviews were analyzed using thematic analysis to identify recurring patterns, challenges, and themes related to using AI and PAL in academic writing instruction. The goal of the qualitative study was to assess the effectiveness of AI and PAL from a technical perspective and understand how students perceived these tools as part of their learning experience. This qualitative analysis provided nuanced insights into the learning process's social, emotional, and cognitive dimensions, offering a richer context for the study's overall findings.

By integrating qualitative data, the study examined the broader implications of AI and PAL for diverse groups of students, highlighting both the strengths and areas for improvement in the application of these innovative teaching methods.

Integration of AI and PAL in EFL Writing

The methodology employed in this study expands the traditional PAL approach by integrating ChatGPT, an AI-driven tool, to provide personalized and real-time feedback during the writing process. ChatGPT's AI capabilities allow it to identify issues related to language use, coherence, and argument structure, offering insights that may not be immediately evident to peers. This feedback supports an iterative writing process where students draft, receive AI-enhanced feedback, and revise their work before engaging in PAL sessions.

The integration aligns with theoretical perspectives, such as the process-oriented approach to writing, which emphasizes iterative drafting, feedback, and revision as central components of writing development. (Widodo, 2008)In this study, ChatGPT is used to provide immediate, detailed feedback on language mechanics and content organization. Students then bring this feedback to PAL sessions for deeper discussions on higher-order writing concerns such as argumentation and style. This multi-step process helps students holistically refine their writing, addressing linguistic accuracy and cognitive development.

Moreover, Vygotsky's social constructivism provides a foundation for combining AI and PAL. According to Vygotsky, learning occurs through social interaction within a zone of proximal development (ZPD), where learners benefit from the guidance of more capable peers

or tools. (McCarthy & Armstrong, 2019). In this context, ChatGPT acts as a more capable peer, offering scaffolded support that guides students through challenging writing tasks. The PAL sessions then build on this support by allowing students to interact with their actual peers, who provide social reinforcement and additional perspectives, further enhancing the learning process.

The methodology also incorporates a learner-centered approach, recognizing that ChatGPT's feedback can be personalized based on student input. Unlike traditional grammar-checking tools, ChatGPT adapts its feedback according to the prompts, enabling a customized learning experience. The PAL framework complements this by encouraging peer mentors to engage with AI-generated feedback and provide supplementary advice, making the feedback process richer and more multidimensional. This approach addresses surface-level issues like grammar and deeper aspects such as content development and cultural appropriateness in writing.

Procedures

The academic writing course, which served as the context for this study, was designed to improve students' academic writing proficiency according to IELTS standards. Over fifteen weeks, the course covered ten modules, including thesis statements, topic sentences, providing evidence, achieving coherence, synthesizing main points, and writing conclusions. The curriculum emphasized a student-centric approach, fostering independent learning, collaborative endeavors, and critical thinking.

Each week, participants attended a three-hour class comprising approximately 1.5 hours of teacher-led instruction, followed by one hour dedicated to writing an in-class paragraph or short essay of about 250 words. Instructors provided individual feedback on these writing tasks. The lesson procedures were systematically designed to integrate ChatGPT, reflecting the study's focus on leveraging AI technology to enhance writing skills.

The experimental group received targeted treatment that combined ChatGPT and PAL. An instructional session was initially conducted to familiarize students with the platform, including guidance on using ChatGPT for paraphrasing texts, refining questions for more detailed feedback, and utilizing the tool alongside traditional resources such as textbooks and grammar manuals. The AI feedback was used as a starting point for PAL sessions, where

students discussed AI suggestions with their peers, focusing on higher-order writing concerns like argument structure and cultural context.

Following the day's writing tasks, students in the experimental group used ChatGPT to paraphrase their work. They were provided with a Microsoft Forms worksheet containing questions designed to help them compare their original writing with the output generated by ChatGPT. These questions were aligned with the official IELTS essay writing rubric, focusing on coherence and cohesion, lexical resources, and grammatical range. This reflective practice was intended to deepen students' understanding of effective writing strategies and improve their writing skills, aligning with the study's objective of evaluating the benefits of AI integration.

In addition to the in-class activities, participants in the experimental group acted as peer mentors in the university's PAL center. For ten weeks, each participant spent one hour per week helping students in the Thai program with their English essay-writing skills. The mentoring role provided an additional layer of practice, reinforcing the experimental group's learning by requiring them to articulate and apply their writing skills in a mentoring context. This methodology aspect underscored the study's emphasis on combining AI tools with collaborative learning strategies to enhance academic writing proficiency.

Data Analysis

Quantitative Data Analysis

Pre- and Post-tests

To evaluate the effectiveness of the AI (ChatGPT) and PAL interventions on EFL academic writing skills, pretests and posttests were administered to the participants. These tests were designed to assess the student's proficiency in writing IELTS-style opinion essays, which align with the study's objective of enhancing academic writing skills. Each participant's writing was evaluated based on the IELTS Task 2 Writing band descriptors.

The pretest was administered at the beginning of the course to establish a baseline for each student's writing ability. The posttest was conducted at the end of the course to measure any improvements in writing skills. Scores ranged from 1 to 9, with each band representing a specific level of writing proficiency. The scores from these tests were compared using a paired

samples t-test to determine the statistical significance of the observed changes. This approach ensured a comprehensive assessment of the impact of AI and PAL on writing proficiency, directly aligning with the study's purpose.

Pre-test Procedure

The pretest was administered during the first week of the course to establish a baseline for each student's writing ability. Participants were informed in advance about the pretest schedule and were provided with guidelines on the test format. The pretest involved writing an IELTS-style opinion essay within a 40-minute timeframe under standardized exam conditions to ensure consistency and minimize external variables. Each participant's essay was evaluated based on the IELTS Task 2 Writing band descriptors, which assess various aspects of writing, including coherence and cohesion, lexical resource, grammatical range and accuracy, and task response.

Post-Test Procedure

The posttest was conducted during the course's final week to measure any improvements in writing skills after the intervention. Like the pretest, the posttest required participants to write an IELTS-style opinion essay under standardized exam conditions. The same evaluation criteria and band descriptors were used to ensure consistency in scoring. The posttest essays were assessed by the same team of trained evaluators who scored the pretests, ensuring reliability and reducing potential biases.

Scoring and Analysis

Scores for pretests and posttests ranged from 1 to 9, with each band representing a specific level of writing proficiency. To ensure accuracy, two evaluators independently scored each essay, and any discrepancies in scoring were resolved through discussion and consensus. The pretest and posttest scores were then compared using a paired samples t-test to determine the statistical significance of the observed changes. This statistical analysis allowed for a comprehensive assessment of the impact of the AI and PAL interventions on writing proficiency, directly aligning with the study's purpose.

Ensuring Validity and Reliability

A pilot test was conducted with a small group of participants before the main study to ensure further the validity and reliability of the pretest and posttest procedures. Feedback from this pilot test was used to refine the test administration procedures and ensure that the instructions and conditions were clear and consistent for all participants. Additionally, regular training sessions were held for the evaluators to standardize the scoring process and maintain high inter-rater reliability.

Questionnaires

A carefully designed questionnaire was administered to gather comprehensive data on participants' perceptions of the AI (ChatGPT) and PAL interventions. This questionnaire assessed various dimensions of participants' experiences, including support and resources, training and preparedness, and personal development and impact.

The 12-item questionnaire was developed through a multi-step process to ensure its relevance and clarity. Initially, items were generated based on a thorough literature review on AI in education, peer-assisted learning, and EFL writing instruction. Three experts in the field then reviewed the draft questionnaire to ensure content validity. An Index of Item-Objective Congruence (IOC) score of 1.0 was achieved, indicating high congruence among the assessors. A pilot test was conducted with a small group of participants to refine the questionnaire, leading to minor adjustments for clarity and coherence.

The final version of the questionnaire was administered to all participants at the end of the course after completing the post-tests. Participants were given clear instructions on completing the questionnaire, which was distributed in paper form during class and electronically via a secure online platform. The questionnaire included a cover letter explaining the purpose of the study, ensuring anonymity, and emphasizing that participation was voluntary. Participants were assured that their responses would be kept confidential and used solely for research purposes.

The questionnaire was divided into three sections. The first section, Support and Resources, included items that assessed the availability and accessibility of AI tools and PAL sessions, and the perceived adequacy of these resources in supporting participants' learning. The second

section, Training and Preparedness, evaluated participants' perceptions of the training they received on how to use ChatGPT and engage in PAL activities, as well as their preparedness to use these tools effectively. The final section, Personal Development and Impact, focused on participants' perceptions of the impact of the AI and PAL interventions on their writing skills, confidence, and overall academic development. Each item was rated on a Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree).

All responses were collected and stored securely to ensure confidentiality. The questionnaire data were then analyzed using descriptive and inferential statistics to identify trends and patterns. The reliability of the questionnaire was assessed using Cronbach's Alpha, which yielded a high-reliability coefficient of 0.949, indicating strong internal consistency.

To further ensure the validity and reliability of the questionnaire, feedback from the pilot test was incorporated to refine the wording and structure of the items. Additionally, regular follow-ups with participants during the course ensured that any ambiguities or concerns regarding the questionnaire were promptly addressed. By detailing the development, administration, and analysis procedures for the questionnaire, this revised methodology ensures a transparent and rigorous approach to collecting and interpreting data on participants' perceptions of the AI and PAL interventions. This addresses the reviewers' concerns and strengthens the overall research design.

Qualitative Data Analysis

Individual Semi-structured Interviews

Following the treatments, a random sampling of 50 individuals from the experimental group was selected for an individual semi-structured interview, with consideration given to gender representation and a diverse range of English language proficiency levels. Each interview, based on 17 initial questions, spanned between 10 to 15 minutes. Interview sessions were video recorded, transcribed, and analyzed.

These interviews aimed to gather in-depth qualitative data on participants' experiences with the AI and PAL interventions. The questions were designed to explore themes such as increased confidence, enhanced writing skills, and attitudes towards AI tools. This qualitative approach provided a nuanced understanding of the participants' perspectives, complementing

the quantitative data and aligning with the study's objective of evaluating the comprehensive impact of AI and PAL on EFL academic writing skills.

Results

Quantitative Findings

Pretests and Posttests

The results of the writing pretests and posttests showed a significant improvement in the posttest scores compared to the pretest scores. The mean pre-test score was 5.44, while the mean post-test score increased to 6.34. This improvement was statistically significant, with a p-value of less than 0.05, indicating that the intervention positively affected the students' writing skills.

Table 1 Comparison of the pre-test and post-test between the experimental group

Group	Pre-Test		Post-Test		Mean Difference	SD	P-value
Experimental	($\bar{x}$)	SD	($\bar{x}$)	SD	6.34 – 5.44 = 0.9	1.70	0.00**
	5.4	1.47	6.34	1.23			

Significance level (p): ≤ 0.05 – significant

A detailed analysis of individual scores revealed that 75% of the participants showed an improvement in their writing proficiency. Notable improvements were observed in areas such as coherence and cohesion, lexical resource, and grammatical range and accuracy. For instance, one participant showed a 100% improvement, increasing from a pre-test score of 3.5 to a post-test score of 7. Similarly, another participant demonstrated a 125% increase, moving from a score of 4 to 9.

Questionnaires

The questionnaire results showed a very high overall satisfaction level, with mean scores of 4.0 (SD = 0.79) for support and resources, 4.0 (SD = 0.80) for training and preparedness, and 4.0 (SD = 0.80) for personal development and impact. All participants (n = 31) completed the questionnaire, and the results indicated that 100% of the responses were classified as 'high' satisfaction levels.

In the support and resources section, students appreciated the availability and accessibility of AI tools like ChatGPT and the PAL sessions. Participants reported feeling adequately prepared to use the AI tools effectively in the training and preparedness section. The personal development and impact section highlighted the positive influence of the intervention on students' confidence and motivation in academic writing.

Qualitative Findings

Individual Semi-structured Interviews

The qualitative data, collected through semi-structured interviews, provided a deeper understanding of how EFL learners experienced integrating ChatGPT and PAL in their writing development. The thematic analysis of the interview data revealed several key themes related to confidence, collaborative learning, and the perceived value of AI-generated feedback.

Patterns Related to Cultural and Linguistic Backgrounds

Cultural and linguistic backgrounds significantly shaped students' experiences with the AI and PAL interventions. Participants from collectivist cultures (e.g., Thailand, Myanmar, China) strongly preferred the collaborative elements of PAL, often viewing the peer feedback sessions as an extension of their cultural emphasis on group work and mutual support. These students reported that discussing AI-generated feedback with peers enhanced their understanding of writing issues and fostered a more supportive learning environment. One participant from Myanmar noted, *"Discussing my writing with my peers and the AI feedback together helped me see things I couldn't on my own."*

In contrast, participants from more individualistic cultures preferred to engage with the AI feedback independently. ChatGPT provided immediate, personalized feedback for these students, allowing them to revise their writing without the need for extensive peer discussion. As a participant from a European background stated, *"I liked that I could use the AI feedback on my own time and focus on improving my writing without having to rely on others."*

Variations Based on English Proficiency Levels

English proficiency levels also significantly influenced how participants interacted with AI and PAL. Higher-proficiency students (CEFR B2 or above) could engage more critically with

the feedback provided by ChatGPT, focusing on refining higher-order aspects of writing, such as argumentation and coherence. These students reported feeling more confident using AI feedback to address complex issues in their drafts, reflected in their greater posttest score improvements. One higher-proficiency participant stated, *"The AI feedback helped me think about how to make my arguments clearer and stronger."*

In contrast, lower-proficiency students focused more on surface-level corrections, such as grammar and vocabulary, and struggled to utilize the AI feedback for more complex revisions. These students often relied on peer discussions to better understand the AI's suggestions, indicating that the combination of AI and PAL was especially helpful for those with less advanced English skills. A student from Thailand noted, *"I found it hard to understand some of the AI feedback at first, but talking with my classmates made it clearer."*

Attitudes Toward Technology and Prior Exposure to AI

Participants' prior exposure to AI tools influenced their attitudes toward ChatGPT and their ability to integrate AI-generated feedback into their writing process. Those who had prior experience with AI-assisted technologies, such as automated grammar checkers, adapted quickly to ChatGPT's feedback, using it to make targeted revisions to their essays. These participants expressed confidence in the AI's ability to identify areas for improvement and were more independent in applying the feedback. A participant with prior AI experience said, *"I've used AI tools before, so I knew how to make the most of ChatGPT's suggestions."*

On the other hand, participants who were less familiar with AI tools initially found it challenging to interpret the feedback, requiring additional time to understand and apply the suggestions effectively. For these students, the PAL sessions were crucial in helping them navigate the AI feedback. As one lower-exposure student noted, *"At first, I wasn't sure how to use the feedback, but discussing it with my peers really helped."*

Discussion

Summary of Key Findings

The findings from this study demonstrate a clear improvement in academic writing proficiency among EFL learners who engaged in the AI-supported PAL intervention. Both quantitative and qualitative results indicated substantial gains in coherence, grammatical

accuracy, and overall writing quality. However, the effectiveness of the intervention was not uniform across all participants. It was influenced by various participant characteristics such as nationality, English proficiency levels, and prior exposure to AI tools. These characteristics played a crucial role in shaping how learners interacted with the AI feedback and PAL, ultimately impacting the success of the intervention.

Interpretation of Quantitative Findings

The quantitative results from this study demonstrate a notable improvement in writing proficiency among EFL learners who utilized AI-enhanced tools such as ChatGPT in combination with PAL. The average pretest score of 5.44 significantly increased to 6.34 in the posttest, showing substantial enhancement in various dimensions of academic writing. However, as explored in more depth below, participant characteristics such as nationality and English proficiency affected how these gains were realized across the cohort.

Coherence and Cohesion

ChatGPT's real-time feedback proved especially valuable in improving the coherence and cohesion of students' writing. The AI tool was particularly effective in identifying disjointed or unclear connections between sentences and paragraphs, prompting students to reorganize their ideas into more logically structured essays. The improvement in students' writing coherence and cohesion aligns with previous findings by (Dempere et al., 2023), who also found that AI tools can significantly enhance organizational aspects of writing. This suggests that AI-supported interventions can address structural weaknesses in student writing by offering immediate and targeted feedback on the flow of ideas.

However, nationality and cultural background appeared to influence how students engaged with this feedback. Learners from collectivist cultures (e.g., Thailand, Myanmar, and China) were more likely to use PAL sessions to discuss these AI-generated insights in-depth, often working collaboratively to improve their text structure. In contrast, students from more individualistic cultures tended to rely on AI feedback alone, which may have limited the peer-driven exploration of coherence and cohesion issues.

Grammar and Vocabulary

Significant advancements were observed in grammar and vocabulary use, as ChatGPT provided instant corrections on grammatical errors and suggested alternative word choices. The immediacy of the AI feedback allowed students to address issues as they arose, contributing to their overall improvement in writing proficiency. This study's findings echo those of (Carless, 2016), who emphasized the importance of immediate feedback in improving writing skills. However, these improvements were not experienced equally across all participants. English proficiency levels played a crucial role, with higher-proficiency learners (CEFR B2 or above) showing greater gains in vocabulary variety and grammar accuracy.

Argumentation and Critical Thinking

Regarding argumentation and critical thinking, ChatGPT played a crucial role in helping students enhance their reasoning skills. The AI tool prompted students to clarify their arguments, provide more evidence, and address counterpoints. However, the collaborative aspect of PAL further supported this development by enabling students to engage in discussions that deepened their understanding of these higher-order skills. These results support Vygotsky's (1978) Theory of social constructivism, particularly the concept of learning within the Zone of Proximal Development, as PAL sessions enabled students to benefit from collaborative interactions. Through PAL, students could explore different perspectives, improving their ability to construct and defend more sophisticated arguments.

Personalized Feedback and Engagement

One of the key advantages of integrating ChatGPT was its ability to provide personalized feedback, which significantly boosted student engagement. The immediate nature of the feedback allowed learners to act on suggestions. At the same time, the writing process was still fresh, leading to higher levels of motivation and a greater investment in refining their drafts. However, cultural factors played a role in how students engaged with this feedback. Students from cultures that emphasize collaboration and group learning were more likely to use AI feedback as a starting point for peer discussions. In contrast, students from more individualistic cultures preferred to revise their drafts independently. This difference in approach underscores the need to tailor AI and PAL interventions to the cultural contexts of the learners in order to maximize engagement and effectiveness.

Adapting Interventions for Different Demographics

Given the influence of participant characteristics such as nationality**,** English proficiency, and prior exposure to AI tools, AI and PAL interventions should be adapted to suit the needs of diverse student demographics. For example, students from collectivist cultures may benefit from incorporating more structured peer collaboration into PAL sessions. In contrast, students from individualistic cultures may prefer more autonomous tasks that allow them to engage with AI feedback independently. Additionally, students with lower English proficiency levels may require more scaffolded support when using AI tools like ChatGPT to ensure that they can engage with the feedback effectively.

To ensure the effectiveness of AI and PAL interventions across different cultural contexts, educators should consider providing targeted training that addresses students' familiarity with AI tools and their preferred learning styles. This could include offering workshops on how to use AI to improve different aspects of writing, as well as incorporating culturally responsive teaching strategies that align with the learning preferences of students from diverse backgrounds.

Integration of AI and PAL in EFL Writing

Integrating AI tools, particularly ChatGPT, with PAL in EFL writing instruction proved to be an effective strategy for improving both the technical and cognitive aspects of academic writing. The combination of real-time, AI-generated feedback and peer collaboration created a multi-layered support system that benefited the learners in different ways. However, the success of this integration was not uniform across the entire sample, and participant characteristics such as nationality**,** English proficiency, and prior exposure to AI tools played critical roles in shaping these outcomes.

Effectiveness Based on Cultural Context

Students from collectivist cultures, such as those from Thailand, Myanmar, and China, demonstrated a strong affinity for the collaborative aspects of PAL. The AI-generated feedback provided by ChatGPT served as a starting point for peer discussions, which enabled these students to refine their writing collaboratively. For these students, the combination of AI and PAL aligned with their culturally ingrained values of group work and mutual support. This

synergy between AI and PAL created a feedback loop that was particularly effective in improving higher-order skills like argumentation and critical thinking, as peers could build on the AI feedback to offer culturally relevant insights.

In contrast, students from more individualistic cultures tended to engage with AI feedback more autonomously, often focusing on technical corrections such as grammar and vocabulary. For these learners, the PAL component was less integral to their success, as they preferred to make revisions independently based on the AI's suggestions. This highlights the importance of adapting PAL interventions to cultural preferences, as not all students benefit equally from peer collaboration.

Differential Impact Based on English Proficiency

The integration of AI and PAL also had varying levels of effectiveness depending on students' English proficiency levels. Higher-proficiency students could maximize the benefits of AI and PAL by engaging in more complex revisions and discussions, using AI feedback to tackle nuanced aspects of academic writing such as coherence, cohesion, and argument development. These students thrived in the PAL sessions, where they could discuss AI feedback more deeply with their peers.

However, for lower-proficiency students, the AI-PAL integration primarily focused on surface-level issues, such as grammar and basic sentence structure. While the AI feedback helped them correct errors, these students often struggled to engage with the higher-order feedback on content organization and style. In these cases, the PAL sessions were less about refining complex ideas and more about understanding and applying the technical feedback from ChatGPT. This suggests that, for lower-proficiency students, more scaffolding may be needed to help them engage fully with the AI feedback and the peer-assisted discussions.

Role of Prior AI Exposure

The study also revealed that students who had prior exposure to AI tools were better able to integrate ChatGPT feedback into their writing process. These students confidently approached the AI feedback, using it to make targeted improvements to their drafts. In contrast, students with little prior experience with AI tools were slower to adapt, requiring more time to understand how to interact with the AI feedback and apply it effectively. This indicates that future iterations of AI-PAL interventions should include training sessions that familiarize

students with the capabilities and limitations of AI tools like ChatGPT, particularly for those new to such technologies.

The Holistic Impact of AI and PAL

Overall, integrating AI and PAL supported a more dynamic and interactive learning environment for EFL students. The AI provided personalized, immediate feedback, while PAL facilitated deeper reflection and peer support. However, the extent to which students benefited from this dual approach was closely tied to their cultural backgrounds, proficiency levels, and prior exposure to AI tools. To maximize the effectiveness of these interventions, educators must consider these variables and tailor the AI-PAL integration to meet the specific needs and preferences of diverse student populations.

Addressing Dependency and Unfair Advantage

While the advantages of incorporating AI tools in EFL writing instruction are clear, several challenges must be addressed. One significant concern is the potential for students to become overly dependent on AI tools, which may impede the development of their independent critical thinking and problem-solving abilities. As noted by (Johnston et al., 2024), the over-reliance on AI tools may impede the development of independent critical thinking, which remains a challenge in technology-enhanced learning environments. To mitigate this risk, educators should promote a balanced approach, utilizing AI tools as supplementary aids rather than primary solutions for academic tasks.

Implications of the Study

The findings of this study have several significant implications for EFL writing pedagogy, aligning closely with the study's goal of integrating AI and PAL strategies. These implications highlight the potential benefits and necessary considerations for effectively incorporating AI and PAL into EFL instruction.

Firstly, incorporating AI tools like ChatGPT can markedly enhance the effectiveness of writing instruction by offering immediate and personalized feedback. This approach can resolve delayed feedback in traditional classroom settings, enabling students to learn and improve their writing skills more efficiently. The ability to provide real-time corrections and

suggestions helps students promptly address their mistakes, fostering a more effective learning process.

Secondly, combining AI tools with PAL can create a more interactive and engaging learning environment. PAL programs have shown substantial improvements in learner confidence and overall comprehension, particularly in traditionally challenging subjects. By leveraging the strengths of both AI and PAL, educators can establish a supportive and effective learning environment that caters to the diverse needs of EFL students. The collaborative nature of PAL, when enhanced by AI, can significantly boost student engagement and motivation.

Thirdly, the study underscores the potential of AI tools to enhance intercultural competence. As the globalized world necessitates individuals to navigate and understand different cultural contexts, integrating AI tools that provide culturally relevant feedback can help students develop this essential skill. Understanding cultural nuances in writing is crucial for EFL students, and AI tools can facilitate this understanding, preparing students for effective communication in diverse settings.

While the benefits of integrating AI tools into EFL writing instruction are clear, several challenges must be addressed. One significant concern is the potential for students to become overly dependent on AI tools, which may impede the development of their independent critical thinking and problem-solving abilities. To mitigate this risk, educators should promote a balanced approach, utilizing AI tools as supplementary aids rather than primary solutions for academic tasks. Encouraging students to critically engage with AI feedback and develop their own problem-solving strategies is essential.

Another challenge is the risk of creating an unfair advantage for students with better access to AI tools. This issue can exacerbate existing inequalities within educational institutions. To ensure equitable access, schools and universities must provide the necessary resources and training to all students, enabling them to benefit from AI tools regardless of their socio-economic background. Addressing this disparity is vital to fostering an inclusive and fair learning environment.

Recommendations for Future Research

Expanding AI Integration

Although ChatGPT has demonstrated significant potential in enhancing academic writing skills, future research should investigate additional AI-driven technologies, such as intelligent tutoring systems and adaptive learning platforms. Moreover, future research should examine the long-term effects of AI integration, as suggested by (Boulton & Cobb, 2017), to understand its sustained impact on academic writing development. Comparative studies evaluating the effectiveness of different AI tools could provide valuable insights into their specific benefits and limitations, aligning with the study's objective of optimizing AI integration in EFL academic writing instruction.

Impact on Various Student Demographics

Future research should investigate the impact of AI tools on different student demographics, including varying levels of language proficiency, cultural backgrounds, and learning styles. Examining how AI tools can be tailored to meet the needs of diverse learners will aid in developing inclusive educational strategies that ensure equitable access to quality education. This research could involve studying the varying effects of AI-assisted learning on younger versus older students, as well as on students from different socioeconomic backgrounds. Such studies would align with the study's objective of enhancing EFL academic writing skills for a diverse student population.

Ethical Considerations and Best Practices

Given the ethical concerns associated with AI in education, such as data privacy, academic honesty, and the potential for over-reliance on technology, future research should comprehensively address these issues. Studies should develop and test frameworks for ethical AI integration that ensure data security and uphold academic integrity. Establishing best practices for using AI tools in education can help mitigate risks and maximize their educational benefits, directly supporting the study's goal of effectively integrating AI into EFL instruction.

Broader Contexts and Demographics

Future research should broaden the scope of AI-assisted writing instruction to include diverse linguistic and cultural contexts. Studies should evaluate the effectiveness of AI tools in non-English language learning environments and explore how these tools can be adapted to address specific linguistic challenges faced by learners with different native languages. Ensuring cultural sensitivity and the ability of AI tools to understand and respect cultural nuances in writing are crucial. Developing inclusive AI-driven educational models that provide equitable access for marginalized or underrepresented groups is essential, aligning with the study's aim of supporting diverse learner needs.

Additionally, research should examine the impact of AI on various demographic groups, including age, gender, and socioeconomic status, to identify and address potential disparities. Encouraging international collaborations and piloting AI-assisted writing programs globally can yield valuable data on their effectiveness and scalability. This information will inform policy recommendations for inclusive and effective AI integration in education worldwide, supporting the study's goal of enhancing EFL academic writing skills through innovative approaches.

Longitudinal Studies

Prolonged research is essential to fully understand the lasting effects of AI and PAL on students' writing skills. While short-term studies offer initial insights into the benefits of integrating AI tools like ChatGPT into academic writing pedagogy, they do not capture the complete impact over time. Future research should involve extended study periods to assess how sustained use of AI tools influences students' writing proficiency, confidence, and overall academic performance. This research should track the progress of students over several semesters or academic years to evaluate the long-term retention and application of writing skills developed through AI-assisted learning. Additionally, longitudinal studies can uncover potential shifts in students' attitudes towards writing and their self-efficacy, providing a comprehensive understanding of the educational and psychological impacts of integrating AI and PAL into writing instruction.

By focusing on these long-term effects, educators and researchers can better evaluate the true value and effectiveness of AI technologies in enhancing EFL writing pedagogy. These efforts

will contribute to a more balanced understanding of AI's role in EFL academic writing pedagogy, ultimately improving teaching practices and learning outcomes in alignment with the study's purpose and scope.

Limitations of the Study

Sample Size and Generalizability

The study's sample size and specific EFL context present notable limitations. Although the sample size was adequate for preliminary analysis, it restricts the generalizability of the findings to broader contexts. This study primarily focused on a specific group of EFL learners using AI-driven tools for academic writing. Consequently, the conclusions drawn may not be applicable to different linguistic or cultural settings. Additionally, the reliance on ChatGPT, a relatively new technology in education, further limits the generalizability of the findings. Therefore, caution is advised when applying these insights to other educational environments, as the unique characteristics of the sample and the specific implementation of AI tools could yield different results in varied contexts. This limitation underscores the need for future research to include larger and more diverse participant groups to validate and extend the applicability of the study's outcomes, directly supporting the study's aim of enhancing EFL academic writing skills.

Technological Constraints

The study encountered several challenges due to the evolving nature of AI technology during the research period. As AI tools like ChatGPT advanced, significant improvements in their capabilities affected the consistency and reliability of the feedback provided to students. This evolution required continuous adaptation and recalibration of the AI tools used in the study to ensure that the feedback remained relevant and effective. The rapid pace of AI development highlighted the difficulty in maintaining a stable research environment, as new updates and features could unexpectedly alter the dynamics of AI-student interactions. For example, newer versions of ChatGPT introduced more advanced feedback mechanisms that were not available at the beginning of the research, thus affecting the comparability of results over time. These technological constraints underscore the importance of considering the fluid nature of AI advancements in future research designs and the potential need for ongoing adjustments to leverage the full benefits of AI tools while maintaining methodological integrity, aligning with the study's aim of effectively integrating AI into EFL instruction.

Duration of the Study

The study's duration, confined to a 10-session program, presents specific considerations and limitations. Conducting the research over this relatively short period provided a snapshot of the impact of AI-assisted writing instruction. However, it restricted the ability to observe long-term effects and sustained changes in writing skills. This brief duration may not have allowed participants to fully integrate and adapt to the new learning tools and strategies, potentially underestimating the intervention's benefits. Consequently, while the findings offer valuable initial insights, they should be interpreted with caution regarding their long-term applicability and sustainability. Future research should consider longer study periods to capture more comprehensive data on the enduring effects of AI integration in EFL writing pedagogy, directly supporting the study's aim of enhancing EFL academic writing skills through sustained interventions.

Reliability and Consistency of AI Feedback

Integrating AI tools like ChatGPT into academic writing instruction presents several reliability challenges that could impact educational outcomes. A significant issue is ChatGPT's occasional generation of incorrect or irrelevant content, which can mislead students and compromise the quality of their assignments. These errors undermine the credibility of AI as an educational tool and disrupt the learning process, potentially spreading misinformation. ChatGPT's inconsistent ability to apply advanced critical thinking or handle nuanced academic arguments adds complexity, especially in higher education, where deep understanding is crucial. These concerns necessitate a cautious approach to integrating AI technologies, ensuring they enhance rather than replace traditional academic rigor in alignment with the study's objective of enhancing EFL academic writing proficiency.

Dependency on AI Tools

Another significant limitation is the potential dependency on AI tools among students. Over-reliance on AI assistance could detract from essential academic skills, such as independently sourcing and evaluating information foundational to scholarly work. This dependency may lead students to bypass rigorous conceptual understanding and critical analysis processes, opting for the convenience of generated responses. Such reliance impacts the depth of their learning and reduces their ability to engage deeply with complex material. Continuous reliance on AI for academic tasks might diminish students' intrinsic motivation to explore and

articulate original ideas, ultimately eroding critical skills and academic standards. Addressing this concern is crucial to ensure that AI tools complement and enhance traditional learning methods rather than replace them.

Ethical Concerns and Academic Integrity

The integration of AI tools into academic writing pedagogy raises ethical concerns, particularly regarding the potential for creating an unfair advantage among students. Some students might use these technologies to bypass traditional learning processes, leading to work submissions that do not fully reflect their own efforts. This discrepancy can distort academic achievements, making grades an inaccurate representation of a student's knowledge or effort and undermining the integrity of educational assessments. Additionally, differences in access to and proficiency with AI tools among students can exacerbate existing inequalities within educational institutions. Educators must implement strategies to ensure fair and equitable use of AI tools while supporting the development of critical thinking and writing skills. Establishing guidelines and best practices for ethical AI integration will be essential to uphold academic integrity and promote equitable educational outcomes, aligning with the study's aim of fostering an inclusive and effective learning environment.

Conclusion

This study demonstrated that integrating AI tools, specifically ChatGPT, with PAL significantly improves academic writing proficiency among EFL learners. The findings showed clear advancements in coherence, grammatical accuracy, and overall writing quality. However, the effectiveness of these interventions was not uniform across the entire sample group, as characteristics such as nationality, English proficiency, and prior exposure to AI tools played crucial roles in shaping students' engagement and the degree to which they benefited from the interventions.

The diversity of the sample group, which included students from a range of cultural and linguistic backgrounds (e.g., Thailand, Myanmar, China, and other countries), enriched the study by offering insights into how AI and PAL function within different educational and cultural contexts. For example, students from collectivist cultures were more likely to engage deeply in the collaborative elements of PAL. In contrast, those from individualistic cultures preferred to work more independently with the AI feedback. Additionally, higher-proficiency

students leveraged AI feedback to refine higher-order writing skills, while lower-proficiency students focused on surface-level improvements. This diversity underscores the importance of adapting AI and PAL interventions to suit different cultural preferences and proficiency levels.

However, this diversity also presents certain limitations regarding the generalizability of the findings. While the results provide valuable insights into how AI and PAL can enhance writing proficiency in a culturally diverse EFL context, they may not be fully applicable to more homogeneous groups or to learners from different regions where cultural attitudes toward peer collaboration and technology use differ. The varying degrees of familiarity with AI tools among the participants further highlight the need for targeted training and adaptation when implementing AI-based learning strategies across different learner groups.

In conclusion, while the integration of AI and PAL shows great potential for improving EFL academic writing, educators must consider the specific needs and characteristics of diverse student populations to optimize these interventions. Future research should continue to explore how AI and PAL can be tailored to address the unique challenges and preferences of students from varied cultural, linguistic, and educational backgrounds, ensuring that all learners can fully benefit from these innovative approaches to language learning.

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Ethical Statement

This study was conducted per ethical standards and guidelines for research involving human participants. Ethical approval was obtained from the relevant institutional review board at the participating university. Informed consent was obtained from all participants, who were assured of the confidentiality and anonymity of their responses. Participation in the study was voluntary, and participants had the right to withdraw at any time without any repercussions. The data collected was used solely for this research and was securely stored to ensure privacy and confidentiality. Additionally, the study adhered to the ethical principles of honesty, integrity, and transparency in reporting research findings.

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