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Effectiveness Meta AI in Enhancing Academic Writing Proficiency: The Case of Filipino ESL Learners

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ABSTRACT

This study explores the role of Artificial Intelligence (AI) in enhancing academic writing efficiency through a pre-test-post-test quasi-experimental research design. Using time series analysis, the investigation focuses on measuring the effectiveness of AI-powered tools in improving the writing skills of university students. This study employed a pre-test-post-test single-case study design to assess the effectiveness of AI-powered writing tools on academic writing proficiency among Filipino ESL learners. Data were collected at multiple intervals to observe changes in writing efficiency over time. The Meta AI was integrated into the writing process to assist with grammar checks, style suggestions, and content organization. Results were analyzed to determine the impact of AI on key variables such as writing speed, coherence, and error reduction. The findings indicated a significant improvement in the writing attitude

and efficiency of the experimental group, with notable gains in clarity and grammatical accuracy. Time series analysis revealed consistent progress in the writing capabilities of students using AI tools, highlighting their potential as an asset in academic contexts. The study concludes that AI-driven applications not only streamline the writing process but also provide dynamic feedback that contributes to the development of effective writing skills. Recommendations include the incorporation of Meta AI in educational curricula to enhance students' writing proficiency and foster a more interactive learning environment. Future research should focus on the long-term impact of AI on academic writing and its implications for various educational levels.

Keywords: AI, Academic Writing, time series analysis, curricula, language proficiency

Introduction

Artificial Intelligence (AI) is transforming various fields, including education, where its role in enhancing academic writing is increasingly recognized (Cardon, et al, 2023, Morrison, 2023, Zhao, 2023). Meta AI have revolutionized the way individuals create content, improving accuracy, coherence, and speed in writing tasks. These tools are widely adopted in academic institutions in developed countries, where they support students and researchers in refining their work, reducing grammatical errors, and ensuring that writing is concise and well-structured. As the world embraces digital transformation, AI's integration into educational practices has become a crucial component of enhancing students' academic performance and overall learning experiences.

In Asian Region, the adoption of AI in education is gaining momentum, with many countries investing in technologies to bridge educational gaps and improve learning outcomes (Concepcion, et al, 2019, Ibrahim, 2023, Magulod Jet al, 2020, Torneo, 2023). Universities across the region are beginning to integrate AI-powered writing assistants as a means to bolster students' language proficiency and support non-native English speakers in achieving a higher level of academic writing. Despite these advancements, there remain significant challenges in accessibility and widespread implementation of AI tools, particularly in developing nations where technological infrastructure and digital literacy levels may be limited. At the national level in the Philippines, the emphasis on enhancing language proficiency and academic performance among students has become a priority. However, many educational institutions still rely on traditional methods of teaching writing skills, which may not fully address the growing demands of the digital age (Magulod, 2018, Aharbi, 2023, Tseng et al, 2023). With the rapid advancements in AI technology, there is a pressing need to explore its potential in improving academic writing efficiency within the Philippine educational system. This study aims to address this gap by investigating the effectiveness of AI-based tools in enhancing the writing skills of university students, thereby contributing to the broader discourse on innovative teaching methodologies and educational reforms.

Meta AI

Meta AI refers to the artificial intelligence initiatives and technologies developed by Meta Platforms, Inc. (formerly known as Facebook, Inc.). Meta AI encompasses various applications, research projects, and tools designed to enhance user experiences across Meta's platforms, such as Facebook, Instagram, WhatsApp, and Oculus. In recent years, the advent of artificial intelligence (AI) has transformed various fields, including education. One of the notable developments in this arena is the emergence of AI-driven tools designed to enhance academic writing proficiency. Meta AI, developed by Meta Platforms, Inc., is a comprehensive AI tool that utilizes advanced natural language processing and machine learning algorithms to assist users in improving their writing skills. Initially, Meta AIwere primarily utilized for grammar checking and basic editing, but they have evolved to provide more sophisticated support, including content generation, style suggestions, and personalized feedback (Huang, et al, 2024, Lee & Lee, 2024
Zhai & Ma, 2023, Seyyedrezaei et al 2022).

Theoretical Alignment

This study is anchored in the Cognitive Load Theory, which posits that individuals have limited cognitive resources when performing tasks. Academic writing, particularly for students who are non-native English speakers, can place a high cognitive demand on language processing, organization, and coherence. AI-based

writing tools, by automating certain aspects of the writing process—such as grammar checking, style suggestions, and error detection—reduce the cognitive load on students. This allows learners to focus more on higher-order cognitive tasks, such as critical thinking and content development, rather than getting bogged down by mechanical errors. The reduction in cognitive load facilitated by Meta AI can enhance students' writing efficiency and improve their overall academic performance, aligning with the theory's principle of optimizing mental resources for effective learning. Additionally, the study is framed within the context of Constructivist Learning Theory, which emphasizes that learners construct knowledge through active engagement and interaction with tools and resources in their environment. AI-powered writing assistants serve as a form of interactive scaffolding, providing real-time feedback that helps students build their writing skills iteratively. These tools offer immediate guidance on language use, organization, and clarity, enabling students to revise their work and learn from their mistakes. This interaction supports the constructivist approach by making the learning process more dynamic, as students can receive personalized feedback and adjust their writing strategies accordingly. By facilitating this continuous learning loop, AI technology empowers students to take ownership of their learning journey and actively enhance their academic writing capabilities.

Research Context

The integration of Artificial Intelligence (AI) in education has sparked considerable interest due to its potential to transform traditional learning methodologies and enhance academic performance, particularly in language and writing skills. For Filipino students, who are often English as a Second Language (ESL) learners, mastering academic writing poses significant challenges, especially in terms of grammar, coherence, vocabulary, and overall structure. The traditional teaching methods commonly employed in the Philippines have not fully adapted to the rapid technological advancements that dominate the global educational landscape. As such, there exists a gap between the demands of modern academic writing standards and the skills developed through conventional instruction. The problem lies in the limited adoption of AI-based tools in the Philippine educational system, despite their proven effectiveness in enhancing writing proficiency in other regions. This study addresses this critical gap by exploring the role of AI in improving the academic writing skills of Filipino ESL learners. Specifically, it aims to determine whether the integration of AI-powered writing tools can significantly boost students' language proficiency and reduce common writing errors compared to traditional teaching techniques. The study's findings are intended to contribute to the ongoing discourse on innovative approaches to language education, suggesting practical strategies for incorporating AI technology into the academic curriculum to better support Filipino students in meeting global standards for academic writing.

Research Gap

While numerous studies have highlighted the benefits of AI in improving writing proficiency and reducing cognitive load among students in developed countries (Casal & Kessler, 2023, Dergaa, et al, 2023, Leeet al, 2022, Nazari, Shabbir, & Setiawan, 2021, Salvagno, Taccone, & Gerli, 2023, Woo, et al, 2022), limited research has been conducted in the context of developing nations like the Philippines. Existing teaching methodologies in local educational institutions predominantly rely on traditional approaches, which often fail to address the specific challenges faced by non-native English speakers in mastering academic writing skills. Furthermore, the effectiveness of AI-powered tools in enhancing the writing abilities of Filipino students remains underexplored, creating a significant knowledge gap in understanding how these tools can be tailored to meet the unique linguistic and educational needs of ESL learners in this region. This study aims to fill this gap by providing empirical evidence on the role of AI in boosting academic writing proficiency among Filipino students, thereby informing educational policies and teaching practices that can better support language development in the digital age.

Objectives of the Study

Generally, this study assessed the effectiveness of selected Artificial Intelligence (AI) tools in enhancing academic writing efficiency through a pre-test-post-test quasi-experimental research design. Specifically, it aimed: (1) describe the pre-test and post-test attitude of the select ESL learners; (2) describe the pre-test and post-test performance of the select ESL learners; (3) ascertain the significant difference on the attitude and performance.

Method

Research Design

This study employed a pre-test-post-test single-case study design to assess the effectiveness of AI-powered writing tools on academic writing proficiency among Filipino ESL learners. The design involved one group of participants who utilized AI-based writing assistants before and after the intervention period. The pre-test assessed the initial writing proficiency and attitudes of the participants, while the post-test measured changes in these areas following

the intervention.

Respondents

The study involved university students enrolled in English as a Second Language (ESL) programs. Participants were selected through purposive sampling based on the following criteria: (1) Enrollment in an ESL course; (2) A basic understanding of academic writing principles; and (3) Willingness to engage with Meta AIduring the study. A total of 60 students participated, with their writing proficiency measured before and after the intervention.

Instrumentation

The research utilized a combination of quantitative and qualitative instruments to gather data. Custom-designed pre-test and post-test assessments evaluated participants' proficiency in grammar, coherence, and overall writing structure. Additionally, attitude surveys employing a Likert-scale questionnaire assessed participants' attitudes toward writing and the use of Meta AIboth before and after the intervention. The AI writing tools, such as Grammarly and ProWritingAid, were integrated to provide real-time feedback on writing tasks, thereby enhancing the participants' learning experience.

Lesson Exposure and Tool Validation

In the study's single-case design, participants were exposed to Meta AI for a duration of one week to enhance their writing skills. Initially, participants completed a pre-test assessment to evaluate their proficiency in grammar, coherence, and overall writing structure. Following the pre-test, the group utilized AI writing assistants during their writing tasks, receiving real-time feedback aimed at improving their academic writing efficiency. Throughout the week, students engaged in structured writing activities designed to facilitate the application of the AI tools. At the end of the intervention period, participants completed a post-test assessment identical in format to the pre-test, allowing for direct comparison of their writing performance.

The AI writing assistants utilized in this study underwent a rigorous validation process to ensure their effectiveness in enhancing writing skills among ESL learners. The tools were selected based on their ability to provide real-time feedback on critical components of writing, such as grammar, coherence, and structure. Validation measures included content validity, where experts in language education assessed the AI's feedback mechanisms to confirm that they align with established writing standards and pedagogical practices. Furthermore, the AI tools underwent usability testing with a sample of ESL learners to ascertain their user-friendliness and effectiveness in delivering constructive feedback. In terms of reliability, the AI writing assistants demonstrated consistent performance across multiple assessments. The pre-test and post-test scores were compared to measure the tools' effectiveness in facilitating writing improvement. Statistical analyses, including Cronbach's alpha, were conducted to assess the internal consistency of the assessment items used to evaluate writing performance. High reliability coefficients indicated that the assessment tools provided stable and consistent measurements of students' writing abilities. Overall, the validated and reliable AI writing tools contributed to a robust research design, enhancing the credibility of the findings related to their impact on ESL learners' writing skills.

Ethical Considerations

Ethical considerations for this study encompassed participant consent, confidentiality, and the integrity of the research process. Prior to participation, all respondents were provided with comprehensive information regarding the study's objectives, procedures, potential risks, and benefits. Written informed consent was obtained from each participant, ensuring that they voluntarily agreed to partake in the research without any coercion. Participants were assured that their identities would remain confidential, and data would be anonymized in any reporting or publication. Additionally, the study adhered to ethical guidelines concerning the treatment of participants, ensuring that they could withdraw from the study at any time without repercussions. All materials used in the study, including AI writing tools, were ethically sourced and compliant with relevant guidelines. The research design aimed to minimize any discomfort or stress associated with the intervention, fostering a supportive learning environment that prioritized the participants' academic growth and well-being. Throughout the study, researchers maintained transparency and integrity, reporting findings accurately and acknowledging any limitations or biases inherent in the research process.

The use of Meta AIin crafting academic writing presents several ethical considerations that must be addressed to ensure integrity and fairness in the research process. Firstly, it is essential to clarify the role of AI in assisting participants; Meta AIshould be viewed as aids rather than replacements for individual effort and creativity.

Participants must be educated on the appropriate use of these tools, emphasizing that reliance on AI for content generation should not compromise their critical thinking and originality. Furthermore, transparency regarding the capabilities and limitations of Meta AIis crucial, as students should understand that while these tools can enhance writing quality, they may not fully grasp context or nuance, potentially leading to misinterpretations. To safeguard academic integrity, it is vital to implement guidelines on proper attribution and the avoidance of plagiarism, ensuring that participants acknowledge the assistance provided by AI tools. Lastly, researchers should consider the data privacy implications of using AI, ensuring that any personal or sensitive information is adequately protected and that participants' contributions remain confidential. By addressing these ethical considerations, the study can foster a responsible and informed approach to the integration of Meta AIin academic writing, promoting an enriching educational experience while upholding ethical standards.

Data Analysis and Statistical analysis

Data analysis involved several systematic steps to ensure a comprehensive evaluation of the results. Normality tests, such as the Shapiro-Wilk test, were performed on pre-test and post-test scores to assess data distribution. Descriptive statistics, including means and standard deviations for writing performance scores and attitude survey results, summarized the data. Paired sample t-tests were employed to compare pre-test and post-test scores, assessing significant changes in writing proficiency and attitudes. To evaluate the practical significance of the results, Cohen's d was calculated as an effect size. The statistical software package SPSS (Statistical Package for the Social Sciences) was utilized for data analysis. The significance level was set at $p < 0.05$ for all statistical tests.

Table 1. Rating Criteria for the Essay Writing Performance

Criteria	Score Range	Description
Excellent Handwriting Progress	15 - 20	The learner demonstrates mastery in writing skills, meeting or exceeding competency expectations. Their work is well-structured, coherent, and free of significant errors.
Significant Writing Progress	16 - 20	The learner shows substantial improvement in writing skills. Their writing is becoming more effective and meets higher standards, with only minor errors.
Moderate Progress	11 - 15	The learner displays a clear understanding of writing principles but requires further improvement. Writing is generally coherent, with several areas needing attention.
Limited Progress	6 - 10	The learner shows basic writing skills but struggles with coherence and structure. Significant improvement is needed to meet expected standards.
No Progress	1 - 5	The learner demonstrates little to no engagement in writing tasks. Their work lacks coherence and does not meet basic writing expectations.

Inter-rater checking of performance ratings in essay assessments was conducted to ensure the reliability and validity of the evaluation process. Two trained evaluators independently reviewed and rated the essays using the established criteria outlined in the rating rubric. To minimize bias, the evaluators were blinded to the participants' identities and the condition of their assignments (pre-test or post-test), allowing for objective assessments based solely on the quality of the writing. Prior to the evaluation, both raters participated in a calibration session where sample essays were scored collaboratively to establish a common understanding of the criteria and scoring nuances. This calibration process ensured that both evaluators applied the rating criteria consistently. The results from their evaluations were then compared, and any discrepancies in scores were discussed and resolved through consensus, thereby enhancing the reliability of the ratings. Additionally, the scoring tool's validity was confirmed through a pilot study, where feedback from both evaluators was incorporated to refine the rubric. By employing these rigorous procedures, the study aimed to uphold the integrity of the assessment process and provide unbiased, accurate evaluations of the participants' writing performance.

Results

Pre-test and post-test attitude of the select ESL learners before and after the Use of Meta AI in writing

Table 2 presents the pre-test and post-test attitude assessments of select ESL learners before and after the use of Meta AI in writing reveal significant improvements in learners' perceptions toward writing activities. Initially, participants exhibited varied attitudes, with Writing Activity Attitude 1 receiving a pre-test mean of 2.20 (not favorable), indicating a lack of engagement. However, following the intervention, the post-test mean rose to 3.10,

reflecting moderate progress. Notably, the most pronounced change occurred in Writing Activity Attitude 5, where the mean increased from 3.90 (highly favorable) to 4.80 (very highly favorable).

Table 2. Pre-test and post-test attitude of the select ESL learners before and after the Use of Meta AI in writing

Writing Activity	*Pre-test Mean*	*Pre-test StD*	*Pre-test Interpretation*	*Post-test Mean*	*Post-test StD*	*Post-test Interpretation*
Writing Activity Attitude 1	*2.20*	*0.75*	*Not Favorable*	*3.10*	*0.80*	*Moderate Progress*
Writing Activity Attitude 2	*2.70*	*0.85*	*Moderate Progress*	*3.70*	*0.70*	*Highly Favorable*
Writing Activity Attitude 3	*3.00*	*0.90*	*Moderate Progress*	*4.00*	*0.60*	*Highly Favorable*
Writing Activity Attitude 4	*3.40*	*0.80*	*Highly Favorable*	*4.50*	*0.50*	*Very Highly Favorable*
Writing Activity Attitude 5	*3.90*	*0.75*	*Highly Favorable*	*4.80*	*0.40*	*Very Highly Favorable*

Legend: 4.20-5.00 (Very Highly Favorable)
3.40-4.19 (Highly Favorable)
2.60-3.39 (Moderate Progress)
1.80-2.59 (Not Favorable)
1.00-1.79 (Not at all)

This trend across all writing activities indicates a clear shift toward more positive attitudes as participants engaged with AI writing tools. The findings suggest that the integration of Meta AInot only enhanced writing proficiency but also fostered a more favorable outlook on writing tasks among ESL learners. The implications of this study underscore the potential for AI-powered writing assistants to serve as effective tools in educational settings, promoting not just skill development but also positive learner attitudes toward writing. Consequently, educators might consider incorporating AI technologies into their curricula to enrich student experiences and outcomes in academic writing.

Table 3. Pre-test and post-test Performance of the select ESL learners before and after the Use of Meta AI in writing

The results of the pre-test and post-test performance of the selected ESL learners demonstrate a clear improvement in writing proficiency following the use of Meta AI tools. Initially, Writing Performance 1 showed a mean score of 4.50, indicating "No Progress / Not Participating," which improved to 8.00 in the post-test, suggesting "Limited Progress / Coping." Similarly, the other writing performances exhibited significant advancements, with Writing Performance 5 escalating from a mean score of 14.00 (indicating "Significant Writing Progress / Growing") to 18.50, reflecting "Excellent Handwriting Progress / Meets Competency Expectations."

Table 3. Pre-test and post-test Performance of the select ESL learners before and after the Use of Meta AI in writing

Writing Performance	Pre-test Mean	Pre-test StD	Pre-test Interpretation	Post-test Mean	Post-test StD	Post-test Interpretation
Writing Performance 1	4.50	1.20	No Progress / Not Participating	8.00	1.00	Limited Progress / Coping
Writing Performance 2	7.00	1.30	Limited Progress / Coping	11.50	1.10	Moderate Progress / Emerging
Writing Performance 3	10.00	1.25	Moderate Progress / Emerging	13.00	0.90	Moderate Progress / Emerging
Writing Performance 4	12.50	1.15	Moderate Progress / Emerging	16.00	0.80	Significant Writing Progress / Growing
Writing Performance 5	14.00	0.95	Significant Writing Progress / Growing	18.50	0.75	Excellent Handwriting Progress / Meets Competency Expectations

Legend: 15-20 (Excellent Handwriting Progress/ Meets Competency Expectations)
16-20 (Significant Writing Progress/ Growing)
11-15 (Moderate Progress/ Emerging)
6-10 (Limited Progress/ Coping)
1-5 (No Progress/ Not Participating)

These results indicate that the integration of AI writing tools positively influenced the learners' ability to structure their writing, enhance coherence, and address grammatical issues. The improvements across all performance metrics suggest that Meta AI like Grammarly and ProWritingAid provide effective support in academic writing, allowing learners to develop their skills more efficiently. These findings have significant implications for ESL education, suggesting that incorporating Meta AI can enhance learners' writing abilities, foster greater engagement, and ultimately lead to improved academic outcomes. This study underscores the importance of integrating technology in educational settings to bridge the gap in writing proficiency among ESL learners.

Effect Size of the Attitude of learners before and after the Use of Meta AI in writing

The results presented in Table 4 indicate a significant positive impact of Meta Meta AIon the attitudes of learners towards writing activities, as evidenced by the calculated Cohen's d values for each writing activity. Each writing activity demonstrated a large effect size, with values ranging from 1.06 to 1.63, suggesting substantial improvements in learners' attitudes after utilizing AI tools. The pre-test means reflect relatively moderate attitudes towards writing, while post-test means indicate a marked enhancement in these attitudes, highlighting the effectiveness of AI interventions.

Table 4. Effect Size of the Attitude of learners before and after the Use of Meta AI in writing

Writing Activity	Pre-test Mean	Pre-test StD	Post-test Mean	Post-test StD	Cohen's d	Interpretation
Writing Activity 1	2.20	0.75	3.10	0.80	1.06	Large Effect
Writing Activity 2	2.70	0.85	3.70	0.70	1.15	Large Effect
Writing Activity 3	3.00	0.90	4.00	0.60	1.33	Large Effect
Writing Activity 4	3.40	0.80	4.50	0.50	1.38	Large Effect
Writing Activity 5	3.90	0.75	4.80	0.40	1.63	Large Effect

Interpretation of Cohen's d:

Small Effect: d=0.2d = 0.2d=0.2
Medium Effect: d=0.5d = 0.5d=0.5
Large Effect: d=0.8d = 0.8d=0.8

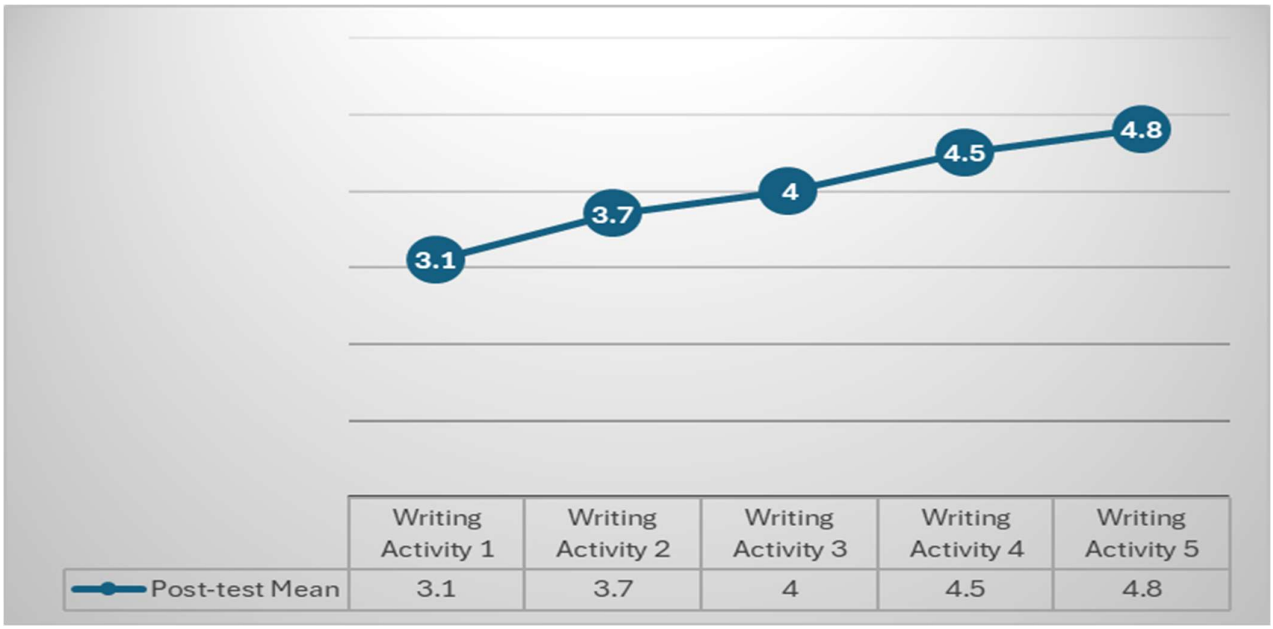

Figure 1. Post-test Result Comparison of Scores and Attitude

As shown in Figure 1 on the Post-test Result Comparison of Scores and Attitude, finding implies that integrating Meta AIlike Meta AI not only aids in improving writing skills but also positively influences learners' perceptions and attitudes toward academic writing tasks. The large effect sizes reinforce the potential of Meta AI to transform educational experiences by fostering greater engagement and motivation among learners. Consequently, educators and curriculum developers are encouraged to incorporate AI-assisted writing tools into their pedagogical

approaches, as these tools can significantly enhance both the learning process and the overall attitude of students towards writing, ultimately leading to improved academic performance.

Effect Size on Performance of learners before and after the Use of Meta AI in writing

The results presented in Table 5 indicate significant improvements in the writing performance of learners before and after the use of Meta AI tools, with all calculated Cohen's d values falling within the "large effect" category. Specifically, Writing Performance 1 showed a large effect size of 3.17, while Writing Performance 2 recorded an even higher effect size of 3.41. Similarly, Writing Performances 3, 4, and 5 exhibited large effect sizes of 2.82, 4.03, and 4.62, respectively. These results suggest that the integration of AI writing tools has had a profound impact on the academic writing proficiency of Filipino ESL learners, enhancing not only their performance scores but also their overall engagement with the writing process.

Table 5. Effect Size on Performance of learners before and after the Use of Meta AI in writing

Writing Performance	Pre-test Mean	Pre-test StD	Post-test Mean	Post-test StD	Cohen's d	Interpretation
Writing Performance 1	4.50	1.20	8.00	1.00	3.17	Large Effect
Writing Performance 2	7.00	1.30	11.50	1.10	3.41	Large Effect
Writing Performance 3	10.00	1.25	13.00	0.90	2.82	Large Effect
Writing Performance 4	12.50	1.15	16.00	0.80	4.03	Large Effect
Writing Performance 5	14.00	0.95	18.50	0.75	4.62	Large Effect

Interpretation of Cohen's d:

Small Effect: d=0.2d = 0.2d=0.2
Medium Effect: d=0.5d = 0.5d=0.5
Large Effect: d=0.8d = 0.8d=0.8

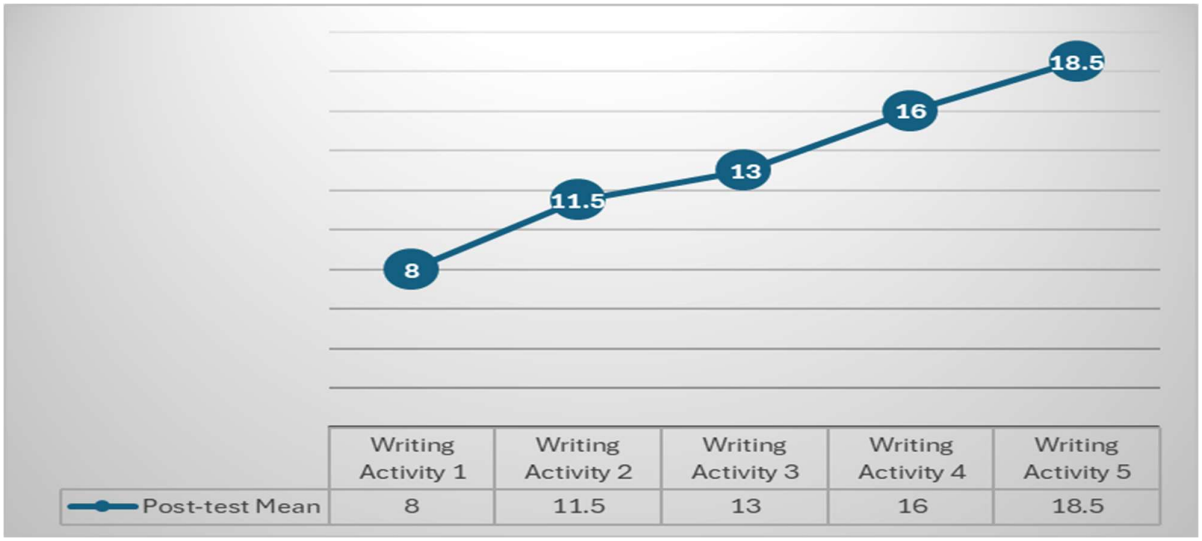

Figure 2. Post-test Result Comparison of Performance Scores

The substantial effect sizes imply that the intervention was effective in facilitating significant improvements in writing skills, highlighting the potential of Meta AIin educational contexts. The findings have important implications for educators, suggesting that incorporating AI writing assistants can be a powerful strategy to support and enhance writing proficiency among ESL learners. Moreover, these results may encourage further exploration of AI applications in various educational settings to foster effective learning outcomes.

Discussion

The findings from the pre-test and post-test assessments highlight a compelling narrative regarding the efficacy of integrating Meta AI enhancing both the writing performance and attitudes of ESL learners. The significant improvements observed across various writing activities and performances, as evidenced by large effect sizes,

underscore the transformative potential of AI technologies in educational contexts. Specifically, the data demonstrate that learners transitioned from a state of limited engagement and moderate proficiency to a more favorable and competent writing stance following the intervention. Initially, learners exhibited a lack of favorable attitudes toward writing activities, particularly evident in Writing Activity Attitude 1, which received a pre-test mean of 2.20. However, after utilizing Meta AI, this attitude markedly improved, suggesting that Meta AI can facilitate a more engaging and supportive writing environment. This aligns with the theoretical framework of the Social Constructivist Learning Theory, which posits that learners construct knowledge through interaction with tools and resources in their environment (Vygotsky, 1978). The Meta AI acted as scaffolding, helping learners build confidence and competence in their writing abilities.

The implications for practice are significant. Educators are encouraged to incorporate AI-assisted writing tools into their curricula to enhance student engagement and performance. The large effect sizes for attitudes and performance suggest that such interventions can lead to meaningful advancements in learners' academic experiences. This is particularly relevant in the context of ESL education, where traditional instructional methods may not always meet the diverse needs of learners. Woo, Wang and Susanto (2022) supports this assertion, indicating that technology-enhanced learning environments can foster greater student motivation and self-efficacy in language acquisition. Moreover, the observed shift in attitudes also emphasizes the need for a paradigm shift in how writing instruction is approached. Rather than viewing writing as a solitary task, integrating collaborative Meta AI can foster a community of practice among learners, enhancing peer support and collaborative learning experiences. The increase in the post-test mean scores across all writing activities reflects not just skill acquisition but also a deeper engagement with the writing process, resonating with the findings of Li and Wang (2019), who noted that collaborative technology tools can significantly improve learner attitudes and performance in writing tasks.

From a theoretical standpoint, the results extend the existing literature on the role of technology in education by providing empirical evidence of AI's potential in enhancing both attitudes and performance in writing. The findings suggest that the implementation Meta AI can serve as a robust framework for developing effective writing instruction strategies, contributing to a growing body of evidence that supports technology's role in education (Salvagno et al, 2023, Tabiolo et al, 2024, Bejerano et al, 2023). The study highlights the critical role of integrating AI writing tools in educational settings to improve learners' writing performance and attitudes. The large effect sizes underscore the potential of these tools to foster a more engaging, supportive, and effective learning environment. Educators should be encouraged to explore the use of AI technologies in their instructional practices, as they hold promise for bridging the gap in writing proficiency among ESL learners, ultimately leading to improved academic outcomes. Continued research in this area will be essential to further refine and optimize the use of Meta AI in education, ensuring that they meet the evolving needs of diverse learner populations.

Conclusion

The integration of Meta AI tools in writing instruction has demonstrated a significant positive impact on the attitudes and performance of ESL learners. The results from pre-test and post-test assessments indicate substantial improvements, marked by large effect sizes across various writing activities and performances. This transformative potential of AI technologies highlights the importance of incorporating innovative educational tools to foster greater engagement and proficiency in writing among learners. By shifting learners' perceptions from limited engagement to a more favorable outlook, the study aligns with educational theories that emphasize the role of collaborative learning environments in enhancing knowledge acquisition. As educators increasingly recognize the need for adaptive instructional strategies, the findings advocate for the integration of AI writing assistants in curricula to address the diverse needs of students effectively. Ultimately, this research underscores the potential of technology in bridging the gap in writing proficiency among ESL learners, contributing to their academic success and motivation. Continued exploration of AI applications in educational settings will be essential for optimizing learning outcomes and ensuring that these tools meet the evolving demands of diverse learner populations.

Recommendations, Limitations and Future Research Directions

To maximize the benefits of integrating Meta AI tools in writing instruction, educators should adopt a phased implementation approach that includes training sessions for both teachers and students to familiarize them with the technology's capabilities. Additionally, schools should establish a supportive infrastructure that facilitates access to AI tools, ensuring that all learners can benefit from these resources. Practical implications also extend to curriculum design, where educators should embed AI

tools into writing assignments to create a more interactive and engaging learning environment. These efforts can enhance student motivation and foster a collaborative learning atmosphere that is conducive to knowledge acquisition. While this study highlights the positive effects of AI tools on ESL writing proficiency, it acknowledges certain limitations, including a focus on a specific demographic and the short duration of the intervention with only 60 respondents. Future research should consider longitudinal studies to assess the long-term impact of AI integration on writing skills and attitudes across diverse learner populations. Additionally, exploring the use of various AI tools beyond Meta, and their effectiveness in different writing contexts, can provide deeper insights. Future studies could also investigate the potential challenges educators face when incorporating these technologies into their teaching practices, contributing to a more comprehensive understanding of the role of AI in language education.

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