

# Enhancing Secondary ESL Students' Writing Proficiency with AI-powered Writing Tools: An Empirical Study

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## ABSTRACT

The increasing presence of artificial intelligence (AI) in language education has accelerated the use of AI-powered writing tools to support English as a Second Language (ESL) learners. Despite their growing adoption, empirical evidence on their effectiveness at the secondary school level within Malaysian international school contexts remains limited. This study investigates the influence of AI-powered writing tools on the writing proficiency of 41 secondary ESL students enrolled in an international school in Kuala Lumpur. A quantitative research design was employed, involving pre-test and post-test writing tasks and a structured questionnaire. The questionnaire examined students' perceptions of grammar accuracy, vocabulary development, sentence restructuring, learner autonomy, and challenges associated with AI use. Data were analysed using descriptive and inferential statistics via SPSS. The findings revealed high mean scores for perceived improvement in grammar recognition and correction ( $M = 4.10$ ,  $SD = 1.11$ ), vocabulary variety ( $M = 3.95$ ,  $SD = 1.16$ ), and sentence restructuring ability ( $M = 3.90$ ,  $SD = 1.18$ ). Students also reported positive perceptions of AI feedback in promoting independent revision ( $M = 3.78$ ,  $SD = 1.11$ ) and critical evaluation of AI-generated suggestions ( $M = 4.00$ ,  $SD = 1.10$ ). However, a moderate level of dependence on AI-powered writing tools was identified ( $M = 3.73$ ,  $SD = 1.18$ ). Overall, the results indicate that AI-powered writing tools can effectively support multiple dimensions of ESL writing proficiency when integrated with appropriate instructional guidance. The study highlights the pedagogical value of AI-assisted writing while emphasising the need for balanced implementation to prevent excessive reliance.

**Keywords:** artificial intelligence; ESL writing; writing development; AI-assisted learning; learner perceptions

## INTRODUCTION

This chapter introduces the study by outlining its background, problem statement, research objectives, research questions, theoretical and conceptual frameworks, significance, and scope. It provides the foundation for examining how AI-powered writing tools influence ESL students' writing proficiency in a Malaysian secondary school context.

## RESEARCH BACKGROUND

The rapid advancement of artificial intelligence (AI) has significantly reshaped contemporary educational practices, particularly in the teaching and learning of English as a Second Language (ESL). One of the most impactful developments has been the introduction of AI-driven writing tools, which provide immediate and personalised feedback to learners on key components of writing, including grammatical accuracy, lexical choice, and sentence formulation (Aliyu et al., 2022; Muslimin et al., 2024).

This research was carried out in an international school situated in Kuala Lumpur, Malaysia. The institution adopts a globally recognized UK Cambridge curriculum and caters to a linguistically and culturally diverse student body. English functions as the main medium through which all subjects are taught, rendering a strong command of the language essential for learners' academic achievement. Consequently, the school places

considerable emphasis on building strong reading and writing skills from early education through to the secondary level.

Despite this emphasis, many students still struggle to develop competent writing skills. Common challenges include difficulties with grammar accuracy, constructing well-formed sentences, effective vocabulary usage, and maintaining coherence. Although teaching is guided by the Cambridge syllabus and supported by established instructional methods, practical constraints such as limited lesson time, differences in students' language proficiency, and large class sizes often restrict teachers' ability to provide timely and individualized feedback.

To tackle these issues and enhance language outcomes, the school has increasingly adopted digital tools to support instruction. In recent years, platforms such as Grammarly, QuillBot, and ChatGPT have been introduced into the ESL classroom. These AI tools provide automated guidance on grammar correction, sentence restructuring, vocabulary refinement, and content organization. They also encourage greater learner independence, enabling students to self-edit and refine their writing with minimal teacher intervention (Wang et al., 2023; Tan et al., 2023).

The integration of AI tools into ESL classrooms mirrors a wider international movement toward digitally supported and personalized learning approaches. Studies have found that such tools can boost learner motivation and confidence by offering instant, targeted feedback and reducing reliance on teachers for revision (Zhou et al., 2022). However, not all students benefit equally. Those with lower levels of digital literacy or limited English proficiency may find it challenging to use these tools effectively.

Moreover, while the global impact of AI in education is gaining attention, there is a noticeable gap in localized research, particularly within international schools in Malaysia. To respond to this research gap, the present study investigates how AI-powered writing tools contribute to the writing development of ESL learners. In addition, it explores students' views on the usability of these tools and examines the challenges encountered during their use. The outcomes of this study are intended to support more informed ESL instructional practices and to offer educators practical insights into the effective integration of AI in writing instruction within international school settings.

## **Problem Statement**

The use of artificial intelligence (AI) in language education has expanded significantly, particularly through AI-based writing applications that support learners of English as a Second Language (ESL). Tools such as Grammarly, QuillBot, and ChatGPT provide immediate feedback on grammar, vocabulary, and sentence structure, enabling students to independently revise their work and build confidence in their writing abilities (Aliyu et al., 2022; Muslimin et al., 2024; Zhou et al., 2022). These innovations align with the broader shift toward digital and learner-centered approaches, which are increasingly prevalent in both traditional and international educational environments (Rahim et al., 2024; Wang et al., 2023).

Despite these technological advancements, many secondary ESL learners continue to encounter fundamental difficulties in writing, including grammatical errors, incorrect word usage, limited sentence variety, and problems with cohesion and coherence (Kassim & Lim, 2023; Ismail et al., 2022). These challenges are often compounded by restricted opportunities for individualized teacher feedback due to large class sizes, limited instructional time, and teachers' heavy workloads (Wong et al., 2023; Lee & Idris, 2025). As a result, students may not receive the consistent support needed to improve their writing skills.

AI-powered writing tools are increasingly employed as supplementary aids to mitigate these instructional constraints. However, their impact on ESL writing outcomes has not been thoroughly investigated, particularly within Malaysian international school contexts, where students have diverse linguistic backgrounds and learn English as a second or additional language (Tan et al., 2023; Muslimin et al., 2024). While some studies indicate that AI tools can enhance writing performance and learner engagement (Zhou et al., 2022; Wang et al., 2023), other research notes that these technologies may not be equally accessible or effective for all learners, especially those with limited digital literacy or lower language proficiency (Rahim et al., 2024; Chong et al.,

2023). Furthermore, there is limited understanding of how ESL students perceive these tools, integrate them into writing tasks, and overcome challenges during use (Tan et al., 2023; Lee & Idris, 2025).

Addressing these gaps, the present study seeks to investigate the effects of AI-based writing tools on secondary ESL learners' writing proficiency, examine their perceptions of usability and effectiveness, and identify the challenges they experience when using such tools. The findings aim to contribute to the field of technology-enhanced language learning and provide practical guidance for ESL educators in digitally supported classrooms.

## Current Scenario and Research Background

In Malaysia, AI-powered tools have begun to penetrate the education system, but their implementation in ESL writing instruction is still in its infancy. Recent studies have highlighted the role of AI in enhancing student engagement and learning outcomes, yet empirical research specifically addressing AI-assisted ESL writing improvement remains limited (Marzuki et al., 2023). While some institutions have adopted AI-based feedback mechanisms, their effectiveness in enhancing writing proficiency among Malaysian ESL students has yet to be thoroughly investigated.

## Practical Gap

Although AI-powered writing tools are becoming more widely available, many Malaysian ESL students still experience significant difficulties in developing strong writing skills. Recent educational findings indicate that students at both secondary and tertiary levels often struggle with organizing their ideas clearly, using proper grammar, and applying a varied and accurate vocabulary (Marzuki et al., 2023). Traditional writing instruction methods tend to lack timely and specific feedback, which can delay students' progress and limit opportunities for immediate improvement. While AI-based writing tools offer a promising solution to address these limitations by providing instant guidance, their use in classrooms is not yet consistent. Moreover, some educators have raised valid concerns that frequent dependence on AI-generated suggestions might reduce students' ability to think critically and revise their work independently (Mohamed, 2023).

**Table 1.** Writing Proficiency Challenges Among Malaysian ESL Students (2021–2023) (Adapted from Marzuki et al., 2023)

Writing Challenge	Percentage of Affected Students
Grammar & Syntax Errors	65%
Lack of Vocabulary	58%
Coherence & Organization Issues	52%
Limited Access to Feedback	60%

## Solution Efforts Taken

In response to these ongoing challenges, various measures have been introduced. The Malaysian Ministry of Education has actively promoted digital learning initiatives, encouraging the incorporation of AI-based tools to support language development. Many schools and institutions have begun using AI-driven feedback systems as part of their writing assessments. Initial findings from pilot programs indicate that these tools can help improve students' writing accuracy (Marzuki et al., 2023). Nevertheless, there are still unanswered questions about how effective these tools truly are when it comes to nurturing more complex writing abilities and encouraging critical thinking in students.

## Theoretical Gap

While international research has increasingly recognized the advantages of artificial intelligence in writing instruction, there is still a significant lack of theoretical exploration within the Malaysian ESL context. Several studies conducted globally have examined AI applications such as automated grammar correction (Aliyu et al., 2022), AI-supported paraphrasing (Alamar & Amin, 2023), and vocabulary development through intelligent learning systems (Aladini, 2023). These findings indicate that AI can play a substantial role in enhancing different dimensions of student writing. However, a more comprehensive understanding is required. The existing body of work often examines isolated skills, such as grammar or vocabulary, without fully addressing how AI-powered writing tools influence students' overall writing proficiency, motivation, sustained engagement with writing tasks, and development of learner autonomy.

## Research Purpose

This study employs a quantitative approach to examine the impact of AI-powered writing tools on the writing performance of ESL learners. It investigates how feedback generated by AI contributes to improvements in grammar, coherence, and vocabulary usage. In addition, the research explores students' perceptions regarding the usability, effectiveness, and potential challenges of employing these tools to support their writing development. The findings of this study are expected to provide valuable insights for the field of ESL education, demonstrating how AI can be effectively incorporated into classroom practices to enhance learning and inform future teaching strategies.

## Research Objectives

- To investigate the influence of AI-powered writing tools on the writing skills of ESL students, particularly regarding grammar accuracy, coherence, and vocabulary development.
- To assess ESL students' perceptions of the usability and effectiveness of AI-powered writing tools using structured survey data.
- To identify the key challenges faced by ESL students when using AI-powered writing tools through statistical analysis of questionnaire responses.

## Research Questions

RQ1: To what extent do AI-powered writing tools improve ESL students' writing proficiency?

RQ2: What are the ESL students' perceptions of the usability and effectiveness of AI-powered writing tools?

RQ3: What challenges do ESL students face when using AI-powered writing tools for writing improvement?

## THEORETICAL FRAMEWORK

This study is anchored in two interrelated theoretical models: Puentedura's SAMR Model and Vygotsky's Sociocultural Theory. These frameworks provide a comprehensive lens to understand how AI-powered writing tools, such as ChatGPT, influence ESL students' writing proficiency in Malaysia.

### SAMR Model (Substitution, Augmentation, Modification, Redefinition)

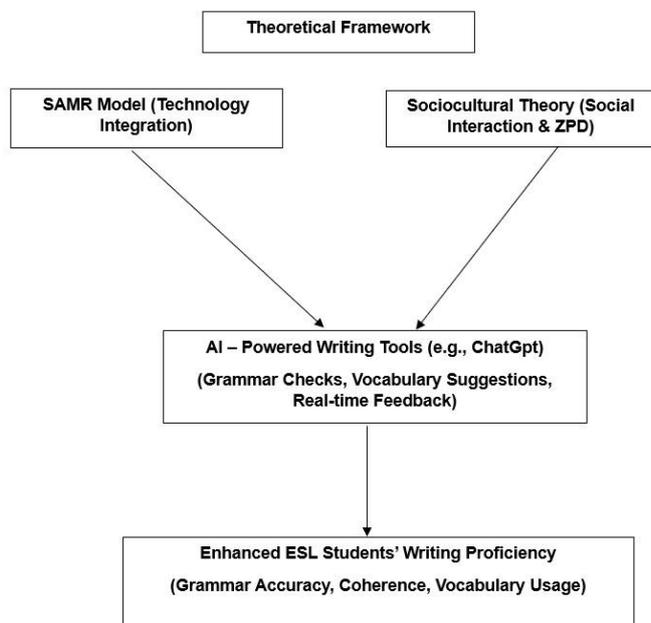
The SAMR model, introduced by Dr. Ruben Puentedura, outlines four stages of incorporating technology into educational practices. At the substitution level, technology simply replaces traditional tools without altering the function. For example, students typing assignments instead of writing them by hand. Augmentation involves slight improvements, such as using AI applications to check grammar and spelling. In the modification phase, technology reshapes the task itself, like when AI tools help students restructure sentences to improve clarity. Finally, redefinition refers to the creation of entirely new learning experiences, such as collaborative writing projects with real-time AI feedback, which would be difficult to achieve without digital tools.

Within Malaysia's ESL classrooms, the SAMR framework has been used to inform how educators introduce AI writing support into their lessons. Research by Tunjera and Chigona (2020) highlights the need for educators to

move beyond basic substitution and instead focus on deeper integration that transforms the learning experience and enhances student engagement.

### Vygotsky’s Sociocultural Theory

According to Vygotsky, the way individuals develop their thinking skills is largely influenced by their interactions with others and the tools provided by their culture. A key idea in his theory is the Zone of Proximal Development (ZPD), which refers to the gap between what a learner can accomplish on their own and what they can achieve with the help of a more knowledgeable person or resource. AI-powered writing tools serve as mediational means within the ZPD, providing scaffolding that enables ESL students to perform writing tasks beyond their current capabilities. Recent Malaysian studies have highlighted this dynamic. For example, Jeyabavani et al. (2024) found that Year 6 ESL pupils in Selangor perceived ChatGPT as enhancing their writing skills by offering immediate feedback and suggestions, thereby acting as a supportive scaffold in their learning process. Furthermore, collaborative writing practices facilitated by AI tools align with Vygotsky’s emphasis on social interaction in learning. A study conducted in a Malaysian university classroom demonstrated that students benefited from peer interactions and AI assistance, leading to improved writing outcomes.



**Figure 1. Theoretical framework.**

This framework underscores how the integration of AI tools, guided by the SAMR model and Sociocultural Theory, can enhance ESL students' writing skills by providing both technological support and social scaffolding.

### Conceptual Framework

This conceptual framework illustrates the expected relationship between the use of AI-powered writing tools and the writing proficiency of ESL students. In this framework, AI tools are considered the independent variable, while students’ writing outcomes serve as the dependent variable. The framework draws on two educational perspectives. The SAMR model explains how technology can be gradually integrated into learning environments, and Vygotsky’s Sociocultural Theory emphasizes the importance of guidance and social interaction in the learning process.

The independent variable, AI-powered writing tools, includes applications such as grammar and spelling checkers, real-time feedback systems, and vocabulary enhancement features. These tools support learners

throughout the writing process by functioning as both technological aids and cognitive supports. By providing guidance, they enable students to complete writing tasks that might be beyond their unaided abilities, promoting learning through scaffolded assistance.

The dependent variable is ESL students' writing proficiency, which will be measured through improvements in three areas: grammatical accuracy, paragraph coherence, and appropriate vocabulary use. These elements are recognized as key indicators of writing competence in academic and communicative contexts.

This conceptual framework provides a clear structure for the study, guiding the development of research questions, data collection tools, and analysis strategies. It emphasizes the potential effect of AI-powered writing tools on writing development and highlights how such technology can be thoughtfully implemented in Malaysian ESL classrooms to enhance students' writing performance.

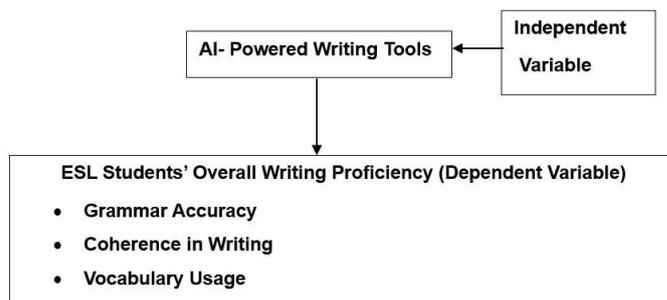
## Variables Overview

### Independent Variable:

Use of AI-powered writing tools  
(e.g., grammar feedback, vocabulary suggestions, real-time corrections)

### Dependent Variable:

- Writing proficiency (measured by improvements in grammar, coherence, and vocabulary usage)



### Figure 2. Conceptual Framework.

This diagram and explanation collectively show how the independent variable (AI-powered writing tools) is expected to directly influence the dependent variable (ESL students' writing proficiency), focusing on how the use of AI tools supports improvements in grammar accuracy, coherence, and vocabulary usage.

## Research Significance

This study is particularly relevant to those involved in English language education, especially within Malaysian secondary schools. As artificial intelligence becomes more embedded in teaching and learning practices, it is increasingly important to explore how these tools impact language instruction in practical ways. By examining the use of AI-powered writing tools, this research provides meaningful insights into how technology can aid ESL students in building stronger writing skills.

For teachers, the results of this study offer practical guidance on how AI tools can be integrated into lessons to complement existing teaching methods. These tools can support classroom instruction by offering immediate feedback and helping students strengthen their abilities in grammar, coherence, and vocabulary. The findings also shed light on some of the difficulties teachers may face, which can help them design more targeted strategies to support student learning.

From the student perspective, the study encourages more independent and reflective learning habits. As AI tools become more accessible, students can learn to use them as supportive resources rather than relying on

them passively. This can lead to greater engagement with the writing process and better self-revision skills over time.

For curriculum planners and education policymakers, the research provides data to support the thoughtful inclusion of AI in English language programs. This is timely, given Malaysia's ongoing efforts to promote digital learning and 21st-century competencies such as digital literacy and learner independence.

Finally, for academic researchers, the study addresses an important gap by offering localised, up-to-date findings on how AI affects ESL writing performance in real school settings. Although international interest in AI and education is rising, there has been limited focus on secondary-level ESL learners in Malaysia, particularly through a mixed-methods approach. This research adds valuable context to the growing conversation around the use of technology in language education.

In conclusion, this study contributes to a deeper understanding of how AI-powered writing tools can improve ESL instruction and student outcomes. It offers useful takeaways for enhancing both the quality and accessibility of language education in Malaysian classrooms.

### **Research Scope and Limitation**

This research explores the role of AI-powered writing tools in enhancing the writing proficiency of ESL students in Malaysian secondary education. It focuses on how these tools influence core components of writing, such as grammar accuracy, coherence, and vocabulary usage. Beyond assessing students' written performance, the study also examines their experiences with these tools and the challenges they may have encountered during use. The participants were 41 Form 3 ESL learners from an international school located in Kuala Lumpur. A quantitative research design was adopted, involving both pre-test and post-test writing assessments along with a structured questionnaire. Throughout the study, students had access to commonly used AI writing platforms, including Grammarly and QuillBot, to support their writing development.

While the study provides meaningful findings, several considerations should be taken into account when interpreting the results. The sample is drawn from a specific group of students within one international school, which may influence the generalizability of the outcomes to other contexts or education systems. The use of a quantitative approach offers measurable insights but does not capture the more nuanced, personal experiences students may have had while using AI tools. In addition, individual differences—such as familiarity with digital technology, baseline writing ability, and personal motivation—could have shaped how effectively students engaged with the tools. Variations in usage patterns may also have impacted the consistency of results.

Nonetheless, the study contributes important evidence on how AI-powered tools can support writing instruction in ESL settings. It offers a useful foundation for future research that may explore these tools across broader educational environments or incorporate more detailed qualitative perspectives.

## **OPERATIONAL DEFINITIONS**

### **AI-powered writing tools**

AI-powered writing tools in this study refer to digital applications and platforms that utilize artificial intelligence to provide real-time, automated feedback on various aspects of writing, including grammar, vocabulary, sentence structure, and coherence. Examples of such tools include Grammarly, QuillBot, and ChatGPT. These tools are designed to support the writing process by identifying linguistic errors, suggesting improvements, and offering paraphrasing or content generation support. In the context of this research, the use of AI-powered writing tools will be measured through the frequency of use and the perceived effectiveness as reported by students via a Likert scale questionnaire. The data will aim to determine whether regular interaction with these tools contributes to improved writing proficiency (Muslimin, Mukminatien, & Ivone, 2024).

## **ESL students**

ESL (English as a Second Language) students in this study refer to learners enrolled in secondary educational institutions where English is not the students' first language but is taught as an essential subject or used as the medium of instruction. The students selected for this study are from an international school in Kuala Lumpur that follows the UK Cambridge syllabus, where English is used in most academic subjects. These students actively engage in English writing tasks and are users of AI-powered writing tools as part of their learning process. Demographic data such as age, educational level, language background, and prior experience with AI tools will be collected to better understand the student profile and ensure relevance to the research objectives (Burkhard, 2022).

## **Writing proficiency**

Writing proficiency in this research refers to a student's ability to produce written texts that are clear, coherent, and grammatically accurate. This includes skills such as proper use of tenses, sentence structure, vocabulary choice, punctuation, paragraph organization, and logical flow of ideas. Writing proficiency is a critical component of academic success in ESL contexts, and the study aims to assess whether AI-powered tools can significantly enhance these writing abilities. To evaluate writing proficiency, a standardized writing rubric will be used in pre-test and post-test assessments, allowing for the comparison of students' writing performance before and after using AI tools (Muslimin et al., 2024).

## **Usability**

Usability in this study refers to the degree to which ESL students find AI-powered writing tools accessible, functional, and user-friendly when used for writing enhancement tasks. It encompasses factors such as ease of navigation, responsiveness of the interface, relevance of feedback, and the overall experience of using the tool to support the writing process. Understanding usability is crucial because even effective tools can be underutilized if students encounter difficulties during use. Usability will be assessed using a structured Likert scale questionnaire, capturing students' experiences with the design, accessibility, and overall satisfaction of AI tool interaction (Burkhard, 2022).

## **Writing challenges**

In this study, writing challenges refer to the particular difficulties ESL students face while using AI-powered writing tools. These challenges can range from technical issues and trouble understanding or applying the feedback provided by the tools, to becoming overly dependent on automated suggestions. Some students may also experience reduced engagement in critical thinking or find that the feedback offered does not always align with academic writing expectations. Understanding these challenges is important in evaluating whether AI tools are genuinely helping students improve their writing or creating new obstacles. To explore this aspect thoroughly, the study gathers data through both structured survey responses and open-ended feedback from students, allowing for a well-rounded view of their experiences (Burkhard, 2022; Muslimin et al., 2024).

## **SUMMARY**

This chapter has provided an overview of the study by outlining its purpose, key objectives, research questions, and the theoretical and conceptual frameworks guiding the investigation. It also highlighted the relevance of the research and the factors that could influence its outcomes. Through a quantitative approach, the study explores how AI-powered writing tools affect ESL students' writing proficiency, while also examining their perceptions and the difficulties they may face when using such tools. The insights gained are expected to offer practical recommendations for educators, curriculum developers, and researchers looking to make informed decisions about incorporating AI into writing instruction for ESL learners.

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## LITERATURE REVIEW

### Introduction

This chapter reviews the literature relevant to this study. It begins by clarifying the key concepts and variables, then examines the development and application of AI-supported feedback in ESL writing instruction. It also considers educational policies that influence the adoption of AI technologies in classrooms. Additionally, the chapter presents theoretical frameworks guiding this research and synthesizes findings from previous studies. Overall, the review aims to provide a clear understanding of the role AI-driven feedback plays in ESL writing development and its connection to the objectives of this study.

### Underpinning Theories

This study is grounded in multiple established theories that help explain how AI-powered writing tools affect ESL learners' writing skills. These theories support the design, implementation, and assessment of AI integration in ESL classrooms.

#### Cognitive Load Theory

Cognitive Load Theory (Sweller, 1988) suggests that learning is more effective when unnecessary mental effort is reduced. AI writing tools assist by managing lower-level tasks, such as grammar and spelling corrections, freeing learners to focus on higher-order writing skills like organization and argument development (Dawadi et al., 2021).

#### Sociocultural Theory

According to Vygotsky's Sociocultural Theory (1978), learning occurs through social interaction, cultural tools, and scaffolding. The Zone of Proximal Development (ZPD) identifies tasks learners can accomplish with guidance but not alone. AI tools act as digital scaffolds, offering personalized feedback and guidance that help students reach higher writing proficiency. They also support collaborative learning through peer review and shared writing activities, promoting socially constructed knowledge (Coffin, 2020; Jeyabavani et al., 2024).

#### Technology Acceptance Model (TAM)

Davis's Technology Acceptance Model (1989) explains technology adoption based on perceived usefulness and ease of use. ESL learners who view AI tools as helpful and user-friendly are more likely to use them in their writing practice. TAM provides insight into variations in student engagement and satisfaction with AI applications (Teo, 2022; Burkhard, 2022).

#### Constructivist Learning Theory

Constructivist Learning Theory (Piaget, 1973; Bruner, 1966) emphasizes that learners actively construct knowledge through interaction with their environment. AI writing tools support this approach by encouraging active participation, reflection, and iterative practice. Immediate feedback allows students to experiment, learn from mistakes, and gradually improve their writing skills (Alamar & Amin, 2023).

#### Self-Regulated Learning Theory

Zimmerman's Self-Regulated Learning Theory (2000) highlights learners' ability to plan, monitor, and evaluate their learning. AI tools facilitate self-regulation by allowing students to revise independently, track errors, and set learning goals. Instant feedback encourages reflection and metacognitive awareness, essential for effective writing development (Rahim et al., 2024; Muslimin et al., 2024).

While other frameworks, such as TPACK and Bloom's Digital Taxonomy, are also relevant for technology integration, the SAMR model is particularly suitable for ESL writing. It emphasizes progressive engagement with technology, making it useful for understanding how AI tools can be gradually incorporated into ESL instruction (Cherner & Mitchell, 2020).

## **Policy Related**

The integration of AI-powered writing tools in ESL education is influenced by several institutional and ethical policies. One of the key concerns is academic integrity, as AI-generated suggestions can lead to unintentional plagiarism if students overly depend on automated outputs without understanding or paraphrasing them properly (Prentice & Kinden, 2018). Additionally, there is a growing need for teacher training to ensure that educators are well-equipped to integrate AI tools meaningfully into their writing instruction, balancing automation with human feedback (Hamilton et al., 2016). Accessibility is another crucial policy issue, as many AI writing platforms offer limited functionality in free versions, potentially excluding students from less privileged backgrounds (Alamar & Amin, 2023). Schools must also address data privacy and ensure that the digital tools used comply with legal and ethical standards for student information protection. Overall, effective policy implementation requires a balanced approach that promotes innovation while safeguarding student learning, equity, and academic honesty.

## **Model Related**

### **SAMR Model**

The use of AI-powered writing tools in ESL instruction is supported by several educational theories and models that justify their effectiveness in enhancing writing proficiency. One key model is the SAMR Model (Substitution, Augmentation, Modification, Redefinition), which illustrates the stages of technology integration in learning. At the Substitution level, AI tools simply replace traditional writing aids, such as using Grammarly instead of a dictionary or grammar book. In the Augmentation phase, AI improves the task by offering real-time feedback and vocabulary suggestions. With Modification, writing tasks are redesigned through interactive writing platforms and adaptive learning paths. At the Redefinition level, AI enables entirely new writing experiences such as collaborative online editing and AI-assisted peer reviews, which were not possible before (Puentedura, 2014; Cherner & Mitchell, 2020). The SAMR model (Substitution, Augmentation, Modification, Redefinition) is highly relevant to this quantitative research study as it provides a structured framework to measure the extent and impact of AI integration in ESL writing instruction. Since the study aims to assess the effectiveness of AI-powered writing tools such as Grammarly, Cami AI, or QuillBot on students' writing performance, SAMR helps categorize how these tools are being utilized in practice, from basic substitution of traditional methods to complete redefinition of the writing process. Using SAMR, the study can quantitatively examine how different levels of technology integration, for example grammar correction versus collaborative AI enhanced writing tasks, correspond to measurable improvements in sub-skills like grammar accuracy, coherence, and vocabulary use. This alignment allows for clear operationalization of variables and comparison across levels of AI usage. For instance, data can be collected on student performance before and after using AI tools at different SAMR stages, enabling statistical analysis of their effectiveness. In summary, the SAMR model offers a practical and measurable framework that aligns well with the objectives of this quantitative study, supporting the analysis of how AI-powered writing tools influence specific aspects of ESL students' writing proficiency at varying levels of technological application.

## **Previous Studies**

### **Research on AI-Powered Writing Tools in ESL Instruction**

Numerous studies have examined the impact of AI-powered writing tools on ESL students' writing proficiency. AI has been found to significantly improve grammar accuracy, coherence, and vocabulary usage (Aladini, 2023; Wang et al., 2023).

### **Grammar Accuracy**

AI-powered tools like Grammarly and Cami AI provide automated grammar correction, helping ESL students improve syntactic accuracy and error detection (Imamyartha et al., 2023). Research indicates that students who use AI-powered grammar checkers demonstrate greater grammatical proficiency and reduced writing errors compared to those relying solely on traditional instruction (Burkhard, 2022).

## **Text Coherence and Organization**

Coherence is a crucial component of writing proficiency. AI tools assist students by suggesting sentence restructuring, linking ideas, and improving paragraph transitions (Rizqullah et al., 2023). Studies show that ESL students using AI-powered feedback produce more logically structured essays than those who receive only human feedback (Alamar & Amin, 2023).

## **Vocabulary Expansion and Lexical Resource**

AI-powered tools enhance vocabulary usage by suggesting synonyms, improving word choice, and analyzing lexical diversity (Koenka & Anderman, 2019). AI-based recommendations help students incorporate contextually appropriate words, increasing lexical richness and fluency in writing (Muslimin et al., 2023).

## **Perceptions and Challenges in AI-Assisted Writing**

### **Positive Student Perceptions**

Most ESL students view AI-powered writing tools as effective and user-friendly, appreciating their ability to provide instant feedback and individualized learning (Kohnke et al., 2023). AI fosters learning autonomy, allowing students to refine their writing independently (Mou & Li, 2022).

### **Challenges and Ethical Considerations**

While AI tools provide many benefits, they also present challenges. Some students exhibit overreliance on AI-generated suggestions, reducing their ability to critically analyze and edit their work (Burkhard, 2022). Ethical concerns include plagiarism risks, AI bias, and limitations in contextual understanding (Prentice & Kinden, 2018). Accessibility remains an issue, as many AI-powered tools require paid subscriptions for full functionality, limiting access for financially disadvantaged students (Muslimin et al., 2023).

### **Synthesis of Knowledge Trends**

Overall, research highlights the transformative impact of AI on ESL writing proficiency while acknowledging limitations related to ethical concerns, critical thinking, and accessibility. The integration of AI in writing instruction must be balanced with human guidance to ensure optimal learning outcomes (Bozkurt & Sharma, 2023). Future research should explore hybrid approaches combining AI feedback with teacher intervention to enhance writing development in ESL learners (Wang et al., 2023).

## **CONCLUSION**

This chapter reviewed the role of AI-powered writing tools in ESL instruction, covering definitions, theoretical frameworks, previous research, and key challenges. AI technology enhances grammar accuracy, coherence, and vocabulary usage, but ethical concerns and overreliance on AI remain significant challenges. The SAMR model was identified as the most suitable framework for integrating AI in ESL writing, providing a structured approach to technology adoption. While AI fosters writing proficiency and independent learning, responsible implementation and teacher-student collaboration are essential for maximizing its benefits while mitigating limitations. Future studies should focus on AI-human hybrid feedback systems to ensure sustainable writing development in ESL learners.

## **METHODOLOGY**

### **Introduction**

This chapter outlines the methodological procedures employed to investigate the influence of AI-powered writing tools on ESL students' writing proficiency. It details the research design, sampling strategy, instruments, and processes used to ensure the rigour, validity, and reliability of the study. Procedures for data collection and analysis are also described to demonstrate how the methodological decisions align with the research questions and enable systematic interpretation of findings in subsequent chapters. The structure of this chapter ensures a clear linkage between the methodological framework established here and the analyses presented in Chapter 4, thereby strengthening internal coherence across the study.

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## Research Design

A quantitative research design was adopted to examine the extent to which AI-powered writing tools influence writing proficiency and to explore students' perceptions and challenges associated with their use. The study employed a quasi-experimental pre-test/post-test structure combined with a survey approach, enabling the collection of both performance-based and perception-based quantitative data. This design was selected because it provides measurable evidence of changes in writing performance while simultaneously capturing patterns in learners' experiences and attitudes (Cohen et al., 2007). The use of a pre-test/post-test format allowed for within-subject comparison, enabling the researcher to observe individual improvement after exposure to AI-generated feedback. This design aligns with the study's aim of assessing the pedagogical value of AI tools, as it isolates the effect of the intervention at the learner level. The incorporation of a questionnaire complemented this structure by offering insights into learners' perceived usability, effectiveness, and challenges associated with the tools. The combined use of descriptive and correlational analyses provided a comprehensive perspective on how AI tools function within an ESL learning context, thereby ensuring robust alignment between method and research purpose.

## Rationale for Design Selection

Using both testing and survey data allows for a thorough evaluation of the impact of AI tools on writing proficiency. The pre- and post-test approach measures concrete improvements in grammar, coherence, and vocabulary, while the questionnaire provides insights into students' experiences and perceptions. Combining these methods strengthens the study's validity, objectivity, and generalizability (Gall & Gall, 2003; Creswell, 2014).

## Research Process Flow

The research followed a structured sequence of five key stages to thoroughly investigate the impact of AI-powered writing tools on ESL students' writing proficiency. Each stage contributed to ensuring the study's reliability, validity, and relevance.

## LITERATURE REVIEW

The first stage consisted of an extensive literature review to build a strong theoretical foundation. The researcher examined scholarly articles, books, conference proceedings, and reputable online sources focused on the use of artificial intelligence in education, with a particular emphasis on ESL contexts. This review helped identify relevant variables and constructs, refine the research questions, and inform the design of the research instruments. It also highlighted the potential benefits, challenges, and pedagogical implications of AI tools, thereby shaping the overall direction of the study.

## Instrument Development

In the second stage, two primary research instruments were created: a pre- and post-test writing task and a questionnaire. The writing tasks covered two genres: email writing and article writing. These tasks were reviewed and validated by the Head of Department to ensure they aligned with the students' curriculum and ESL writing standards. The questionnaire was designed to gather students' perceptions of AI tools regarding grammar improvement, vocabulary development, coherence, and usability. To ensure content validity, the questionnaire was evaluated by ESL educators and experts in AI.

- Pre-test and Post-test: Students were given structured writing tasks (email and article formats) before and after AI assistance. These writing prompts were reviewed and validated by the Head of Department.
- ChatGPT Integration: After completing the initial draft, students refined their writing using ChatGPT with the following prompt:
- "Can you give me feedback on this writing in terms of grammar, vocabulary, and coherence? Please include suggestions for improvement."

- **Questionnaire:** A questionnaire using a 5-point Likert scale was created to gather students' views on AI powered writing tools. The survey covered areas such as grammar, vocabulary, coherence, usability of the tools, and potential limitations.

The third stage involved conducting a pilot study with 30 ESL students of varying proficiency levels who were not included in the main study sample. The purpose of this stage was to evaluate the clarity and reliability of the research instruments. Participants completed the pre-test and questionnaire, and they provided both verbal and written feedback on any ambiguous or repetitive items. The instruments were subsequently revised based on this feedback. A reliability analysis using Cronbach's alpha yielded a score of 0.85, indicating strong internal consistency for the questionnaire.

### **Data Collection**

The fourth stage was the main data collection. It spanned two weeks and was conducted within regular school hours to minimize disruption. In the first phase, students completed the pre-test writing task without any assistance. Afterward, they were instructed to refine their writing using ChatGPT. A standardized AI prompt was given: "Can you give me feedback on this writing in terms of grammar, vocabulary, and coherence? Please include suggestions for improvement." Students used the suggestions provided by ChatGPT to revise their work, which constituted the post-test. In the second phase, students filled out the questionnaire to provide feedback on their experiences with the AI writing tool.

### **Data Analysis**

In the fifth stage, the collected data were systematically organized and examined. Responses from students' writing tasks and questionnaires were compiled for analysis. Pre-test and post-test scores were compared to assess improvements in grammar, coherence, and vocabulary. Questionnaire data were coded and analyzed using SPSS. Descriptive statistics, including means and standard deviations, were calculated, followed by inferential analyses such as correlation and regression to explore the relationship between students' use of AI tools and their writing performance.

## **FINDINGS & INTERPRETATION**

The sixth stage involved interpreting the findings from the data analysis. Quantitative results were examined in relation to the research questions and objectives. Mean scores were evaluated using the classification index by Oxford (1990), which categorizes results into low, moderate, and high levels of impact. Patterns and relationships in the data were then identified to determine the effectiveness and challenges of AI-powered tools in ESL writing instruction. These outcomes were compared with previous research to assess consistency or divergence from existing literature. Based on the findings, practical recommendations for educators were developed, and directions for future research were suggested.

### **Population And Sample**

This study was carried out at an international school in Cheras, targeting ESL learners in lower secondary levels. A total of 41 students participated, representing beginner, intermediate, and advanced language proficiency levels. This range allowed the study to examine differences in writing development and engagement with AI tools across proficiency levels.

A stratified random sampling method was used to ensure proportional representation of students in each proficiency category. This approach enhanced internal validity by reducing sampling bias and ensuring that the sample reflected the linguistic diversity of the broader student population (Krejcie & Morgan, 1970). Although the sample size was modest, it met the recommended thresholds for correlational and group-comparison analyses (Cohen et al., 2007), allowing the use of both descriptive and inferential statistical methods.

Participants completed two writing assessments followed by a structured questionnaire. Their contributions were essential for addressing the study's research questions, particularly in evaluating pre- and post-AI writing performance and understanding students' perceptions of AI-supported learning.

### **Population and Sample Selection**

The target population comprises ESL learners from an international school in Cheras. A sample of 41 students

across beginner, intermediate, and advanced proficiency levels was selected to represent diverse language backgrounds and experiences.

### **Sampling Technique and Procedure**

Stratified random sampling was used to ensure balanced representation from each proficiency group (Krejcie & Morgan, 1970). Students were randomly chosen within these strata.

### **Sample Size Justification**

A sample of 41 is sufficient for correlation and group comparison analyses, as supported by Cohen et al. (2007). It includes students who use AI tools frequently and occasionally, enabling comparison.

### **Experimental Design Consideration**

While no control group was assigned, the **pre-test/post-test structure** allowed for within-subject analysis. Proficiency groups were kept homogenous to minimize bias.

### **Qualitative Research Considerations**

Although qualitative data could have enhanced the study, this research remains strictly quantitative. If added, a purposive sample of 4–8 would be selected for qualitative insights (Creswell, 2014).

### **Role of Respondents**

Students completed two writing tasks and provided feedback through a questionnaire. Their responses contributed to understanding how AI tools influenced their grammar, coherence, vocabulary use, and writing confidence.

### **Instruments**

To achieve the research objectives, this study employed two primary quantitative instruments: (1) writing tasks administered as pre-test and post-test activities, and (2) a structured questionnaire survey. These instruments were designed to collect data on both the measurable improvements in writing proficiency and students' subjective experiences using AI-powered writing tools such as ChatGPT, Grammarly, QuillBot, and Deepseek.

### **Writing Tasks (Pre-test and Post-test)**

The writing component consisted of two tasks: a formal email and an article writing activity. These tasks were carefully selected based on the curriculum requirements of the international school in Cheras and validated by the Head of Department to ensure curriculum alignment and task appropriateness. The pretest required students to complete the writing task independently without any technological assistance. This served as a baseline for measuring students' initial writing proficiency in terms of grammar, vocabulary, and coherence.

After completing the pre-test, students were given access to ChatGPT and provided with a standardized AI prompt:

“Can you give me feedback on this writing in terms of grammar, vocabulary, and coherence? Please include suggestions for improvement.”

Students were then instructed to revise their writing based on ChatGPT's feedback. This AI-refined version was considered the post-test submission.

Both the pre- and post-test responses were evaluated using a standardized ESL writing rubric that focused on three main criteria: grammar accuracy, vocabulary use, and coherence and organization. These assessments allowed for a direct comparison of students' writing performance before and after the use of AI tools, highlighting the influence of AI assistance on measurable aspects of writing proficiency.

## Questionnaire Survey

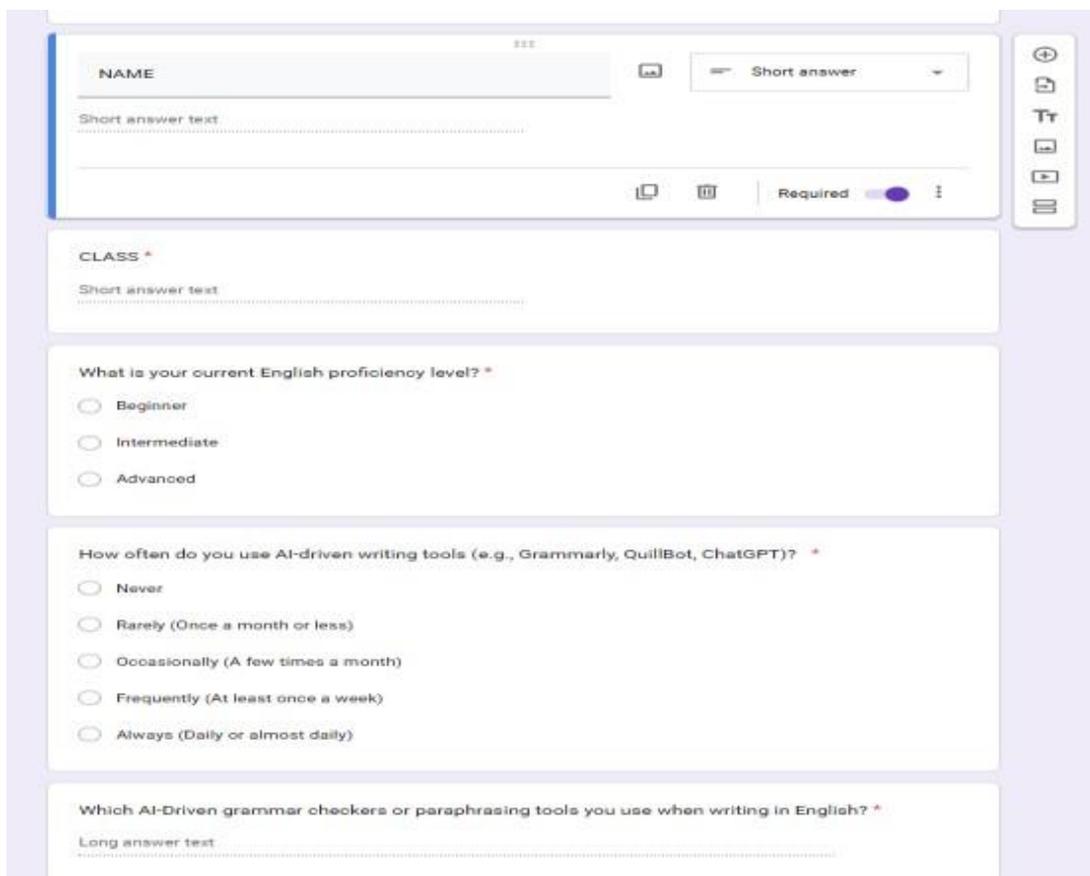
In addition to the writing tasks, a structured questionnaire was developed to collect students' perceptions of AI-powered writing tools and to explore usability, effectiveness, and encountered challenges. The survey was administered after the post-test and comprised five key sections aligned with the constructs of the study.

The first section collected demographic information, including the students' names, class identifiers, and self-assessed English proficiency levels (beginner, intermediate, or advanced). The second section addressed grammar improvement, containing items that assessed whether AI tools helped students recognize and correct grammatical errors. The third section focused on vocabulary development, examining how paraphrasing tools influenced word choice and lexical variety. The fourth section targeted writing coherence and organization, including how AI-generated suggestions helped students structure ideas more logically. The final section explored tool usability and limitations, probing students' experiences related to over-reliance on suggestions, contextual misunderstandings, and challenges in interpreting AI feedback.

Each item in the questionnaire was measured using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." This format enabled nuanced quantitative analysis of the data and facilitated the identification of patterns in students' engagement with AI tools.

Additionally, the survey included open-ended items where students shared their main reasons for using AI writing tools. The most frequently cited reasons included enhancing vocabulary usage, simplifying complex ideas, avoiding plagiarism, and improving sentence structure. Students also identified advantages such as faster writing, improved grammar accuracy, and increased confidence. However, common limitations reported included over-reliance on AI, lack of contextual understanding, unnatural paraphrases, and limited creativity.

The combination of structured response items and open-ended reflections provided both breadth and depth to the data, allowing the study to analyze AI's impact not just in terms of performance gains but also in relation to student attitudes and learning behaviors. This dual-instrument approach supported a comprehensive evaluation of the research questions and strengthened the overall validity of the findings.



The image shows a digital questionnaire form with the following sections:

- NAME**: A text input field with a "Short answer" dropdown menu.
- CLASS**: A text input field with a "Short answer" dropdown menu.
- What is your current English proficiency level? \***: A radio button selection with three options: "Beginner", "Intermediate", and "Advanced".
- How often do you use AI-driven writing tools (e.g., Grammarly, QuillBot, ChatGPT)? \***: A radio button selection with five frequency options: "Never", "Rarely (Once a month or less)", "Occasionally (A few times a month)", "Frequently (At least once a week)", and "Always (Daily or almost daily)".
- Which AI-Driven grammar checkers or paraphrasing tools you use when writing in English? \***: A text input field with a "Long answer" dropdown menu.

**Figure 3. Demographic Information of the Respondents'**

**Section 2 of 6**

**Impact of AI Grammar Checkers on Writing Accuracy**

In this section, we assess how AI grammar checkers influence your ability to recognize and correct errors. Your feedback will help determine whether these tools enhance grammatical proficiency.

Using AI grammar checkers has improved my ability to recognize and correct grammar mistakes. \*

1 2 3 4 5

Strongly disagree      Strongly agree

I usually rely more on the AI grammar checkers when writing in English. \*

1 2 3 4 5

Strongly disagree      Strongly agree

Since using AI grammar checkers, my grammatical accuracy in writing has improved a lot. \*

1 2 3 4 5

Strongly disagree      Strongly agree

AI grammar checkers help me understand grammatical rules better. \*

1 2 3 4 5

Strongly disagree      Strongly agree

After section 2 Continue to next section

**Figure 4. Impact of AI Grammar Checkers on Writing Accuracy**

**Section 3 of 6**

**Impact of AI Paraphrasing Tools on Lexical Diversity & Sentence Structure**

This section explores how AI paraphrasing tools affect vocabulary use and sentence restructuring. Your responses will help evaluate whether these tools support or hinder ESL writing development.

AI paraphrasing tools help me use a wider variety of vocabulary. \*

1 2 3 4 5

Strongly disagree      Strongly agree

Since using AI paraphrasing tools, my ability to restructure sentences in English has improved a lot. \*

1 2 3 4 5

Strongly disagree      Strongly agree

I often use AI-generated paraphrases to ensure they sound natural and good. \*

1 2 3 4 5

Strongly disagree      Strongly agree

Which of the following best describes your primary reason for using AI paraphrasing tools? \*

To improve sentence structure.

To enhance vocabulary usage.

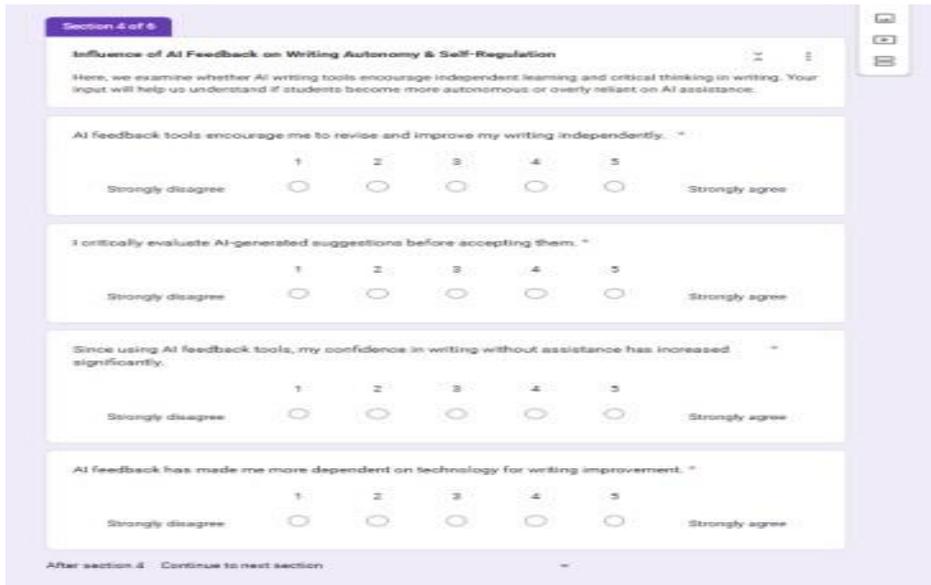
To avoid plagiarism.

To simplify complex ideas.

Other...

After section 3 Continue to next section

**Figure 5. Impact of AI Paraphrasing Tools in Lexical Diversity & Sentence Structure**



**Section 4 of 6**

**Influence of AI Feedback on Writing Autonomy & Self-Regulation**

Here, we examine whether AI writing tools encourage independent learning and critical thinking in writing. Your input will help us understand if students become more autonomous or overly reliant on AI assistance.

AI feedback tools encourage me to revise and improve my writing independently. \*

Strongly disagree 1 2 3 4 5 Strongly agree

I critically evaluate AI-generated suggestions before accepting them. \*

Strongly disagree 1 2 3 4 5 Strongly agree

Since using AI feedback tools, my confidence in writing without assistance has increased significantly. \*

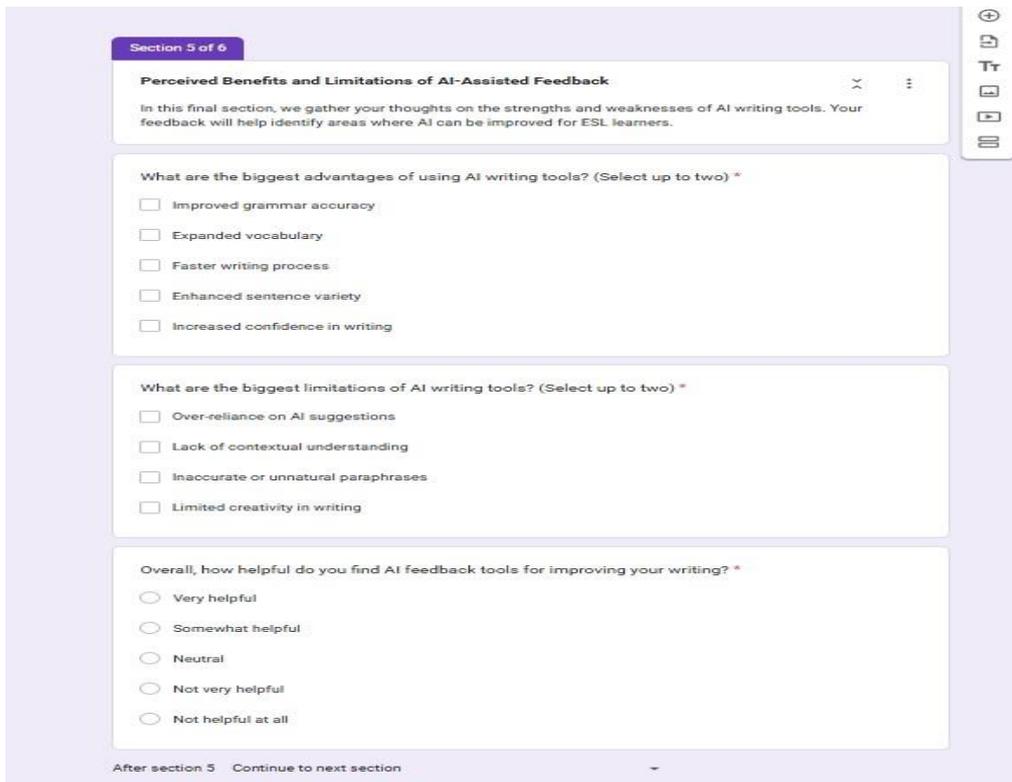
Strongly disagree 1 2 3 4 5 Strongly agree

AI feedback has made me more dependent on technology for writing improvement. \*

Strongly disagree 1 2 3 4 5 Strongly agree

After section 4 Continue to next section

**Figure 6. Influence of AI Feedback on Writing Autonomy and Self-Regulation**



**Section 5 of 6**

**Perceived Benefits and Limitations of AI-Assisted Feedback**

In this final section, we gather your thoughts on the strengths and weaknesses of AI writing tools. Your feedback will help identify areas where AI can be improved for ESL learners.

What are the biggest advantages of using AI writing tools? (Select up to two) \*

- Improved grammar accuracy
- Expanded vocabulary
- Faster writing process
- Enhanced sentence variety
- Increased confidence in writing

What are the biggest limitations of AI writing tools? (Select up to two) \*

- Over-reliance on AI suggestions
- Lack of contextual understanding
- Inaccurate or unnatural paraphrases
- Limited creativity in writing

Overall, how helpful do you find AI feedback tools for improving your writing? \*

- Very helpful
- Somewhat helpful
- Neutral
- Not very helpful
- Not helpful at all

After section 5 Continue to next section

**Figure 7. Perceived Benefits and Limitations of AI-Assisted Feedback**

### Adaptation from Previous Research

To ensure the relevance and academic robustness of the instrument, the questionnaire items were adapted from previous research data and validated sources. Some of the items were informed by real student feedback collected in earlier phases of study. In addition, the work of Gall & Gall (2003) and Cohen et al. (2007) was referenced to guide the formulation and structure of the questionnaire items. These sources provided theoretical and methodological frameworks for developing questions that would align with key constructs such as writing proficiency, grammar usage, vocabulary, and writing organization. The adaptation process ensured that the instrument was rooted in real-world applications while meeting established academic standards. This contributed to creating a balanced, practical, and academically sound tool for data collection.

## Validity And Reliability Of Instruments

To ensure the validity and reliability of the instruments used in this study, multiple procedures were implemented. The two main instruments, the pre-test and post-test writing tasks and the structured questionnaire, were carefully reviewed, validated, and refined before full deployment. The pre-test and posttest writing tasks, which consisted of a formal email and an article, were validated by the Head of Department at an international school in Kuala Lumpur. The Head of Department has more than 20 years of experience in ESL instruction and curriculum planning. This expert validation ensured that the writing tasks were aligned with the academic expectations of the UK Cambridge syllabus and were suitable for assessing writing proficiency across grammar accuracy, vocabulary use, and coherence. The feedback provided by the Head of ESL Department confirmed that the writing tasks were appropriate in terms of language level, relevance to the ESL context, and content validity. This process also helped establish face validity by confirming that the tasks appeared suitable and comprehensive to both students and teachers. The questionnaire, which aimed to assess students' perceptions of AI-powered writing tools, was reviewed by a panel of ESL educators and AI-integration specialists. Their evaluation ensured that each item accurately addressed the key constructs of the study, including grammar improvement, vocabulary development, coherence, tool usability, and writing-related challenges. Based on their suggestions, modifications were made to improve item clarity and alignment with the research objectives. This step established the content and construct validity of the questionnaire.

To assess the reliability and practicality of the instrument, a pilot study was conducted.

### Pilot Study

A pilot study was conducted prior to the full-scale administration of the instrument to ensure the clarity, reliability, and validity of the items. The pilot respondents were selected from the same population as the main study. The procedure involved administering the draft questionnaire and collecting feedback on item clarity, comprehensibility, and response format. Reliability analysis of the eleven-item writing proficiency scale produced a Cronbach's alpha of .78 (standardized  $\alpha = .91$ ). Inter-item correlations ranged from  $-.11$  to  $.84$ , with most items demonstrating acceptable relationships. One problematic item was identified as it yielded a low corrected item-total correlation and negatively affected the internal consistency of the scale. Based on the findings, the item was revised and relocated, while the wording of several other items was improved to enhance clarity. The pilot study findings confirmed that the instrument was suitable for full administration after the revisions were incorporated.

### Pilot Study Participants

Thirty ESL students from an international school in Cheras participated in the pilot. The participants represented beginner, intermediate, and advanced proficiency levels and were selected using stratified random sampling to ensure diversity. None of these students were included in the main study sample.

### Pilot Study Procedure

The procedure involved administering both the pre-test and post-test writing tasks and the structured questionnaire. Students first completed the pre-test writing task independently, then revised their drafts using ChatGPT feedback. The post-test versions were submitted afterwards. The questionnaire was administered in either Google Forms or paper format, depending on student preference. The survey session lasted approximately 20–30 minutes. Additional feedback on clarity and item flow was gathered from students, while expert feedback was sought from the Head of Department and ESL educators to ensure item suitability across different proficiency levels.

### Key Findings and Improvements

The pilot study highlighted several areas for refinement. Certain questionnaire items were reworded for clarity, redundant items were removed to reduce length, and Likert scale labels were standardized for better interpretability. Reliability analysis was conducted using Cronbach's Alpha, yielding a coefficient of 0.85, which indicates high internal consistency. This confirmed that the questionnaire reliably measured students' perceptions of AI-powered writing tools. The refinements improved instrument clarity, enhanced data precision, and ensured that the tasks and questionnaire were appropriate for the main study.

## **Data Collection**

Data collection was carried out using the refined version of the questionnaire. Prior to administration, permission was obtained from the school authorities and informed consent was sought from participants. Ethical considerations, including confidentiality and voluntary participation, were strictly observed. The instrument was distributed to the selected sample during the agreed data collection period. The respondents completed the questionnaire within the classroom setting under the supervision of the researcher. To minimize the Hawthorne effect and other forms of response bias, the presence of the researcher was kept non-intrusive and no recording devices were used. Participants were assured that their responses would remain anonymous and would only be used for research purposes.

## **Data Collection Process**

The study employed two phases of data collection: (i) administration of the pre-test and post-test writing tasks, and (ii) distribution of the questionnaire. The process was designed to minimize bias and ensure accuracy.

## **Procedures for Data Collection**

### **Timeframe**

Data collection was carried out over a two-week period. This timeframe allowed adequate time for all students to complete the tasks without feeling pressured. It also ensured that each student, regardless of proficiency level, received equal opportunity to participate fully in the research activities.

### **Distribution of Instruments to Sample**

The pre-test was administered during English lessons, where students were given a writing prompt and asked to complete their responses independently. After completing the initial drafts, students were guided to use ChatGPT by entering prompt requesting feedback on grammar, vocabulary, and coherence. Using this AI-generated feedback, students revised their work, which was submitted as the post-test. The questionnaire was then distributed in both digital (Google Forms) and printed formats to accommodate varying student preferences and technological access. The instruments were administered during class time to encourage full participation.

### **Location of Data Collection**

All data collection activities took place within the classrooms of the international school in Cheras. This familiar environment helped reduce external distractions and promoted student focus, while also ensuring consistency across the research process.

### **Minimizing Bias and Addressing the Hawthorne Effect**

The researcher maintained a non-intrusive presence throughout the data collection process to avoid influencing student responses. All participation was anonymous and voluntary, and students were encouraged to respond honestly. Uniform instructions were provided to all classes to reduce bias and maintain fairness. Clarifications were only offered upon request, and no feedback was given that could influence responses.

### **Ethical Considerations**

Ethical standards were strictly observed throughout the study. Students were informed of the purpose of the research and were assured that participation was voluntary and anonymous. No identifying information was collected. Data were stored securely and only used for academic analysis. Digital responses were protected with restricted access, while physical responses were safely stored and digitized before analysis. The entire process adhered to institutional ethical guidelines.

## **Data Analysis**

Data were analysed using IBM SPSS Statistics Version 26.

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Descriptive statistics (frequencies, means, and standard deviations) were used to answer Research Questions 1, 2, and 3. Reliability was assessed using Cronbach’s alpha. Pearson correlations examined associations between AI use and writing proficiency indicators. Independent-samples t-tests and oneway ANOVA were conducted to compare differences across groups based on AI usage frequency and proficiency levels. Assumptions such as normality and homogeneity were tested prior to analysis; where relevant, alternative tests (e.g., Welch’s ANOVA) were employed.

The retention of detailed statistical procedures ensures transparency and supports the interpretive analyses presented in Chapter 4.

### Quantitative Data Analysis Approach

Quantitative methods were utilized to investigate the relationship between the use of AI-powered writing tools and ESL students’ writing proficiency. Both descriptive and inferential statistical analyses were performed.

### Measurement Scale and Data Coding

The questionnaire employed a five-point Likert scale, with 1 indicating Strongly Disagree and 5 indicating Strongly Agree. This scale enabled the analysis of students’ levels of agreement on areas such as grammar, coherence, vocabulary, and the usability of AI tools. Likert scales are widely adopted in educational research because they are straightforward and compatible with statistical analysis software (Likert, 1932; Boone & Boone, 2012).

### Statistical Tools for Data Analysis

Data analysis was conducted using IBM SPSS Statistics, Version 26.

- Descriptive statistics, including means, standard deviations, and frequencies, were calculated to summarise demographic characteristics and general patterns (Cohen et al., 2007).
- Reliability of the questionnaire was assessed using Cronbach’s alpha, with a value of 0.70 or higher considered acceptable, indicating satisfactory internal consistency (Nunnally, 1978; Tavakol & Dennick, 2011).
- Pearson correlation examined relationships between AI usage and writing proficiency indicators (Evans, 1996).
- Independent samples t-tests compared frequent and occasional AI users, while one-way ANOVA tested for differences among proficiency levels (Field, 2018).

**Table 3.1** Reliability Statistics for Writing Proficiency Scale

Scale	Cronbach’s Alpha	No. of Items	Standardised Alpha	Decision
Writing Proficiency	.78	11	.91	Acceptable

**Table 3.2** Case Processing Summary

Cases	N	Percentage (%)
Valid	38	92.7
Excluded (listwise)	3	7.3

Total	41	100.0
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**Table 3.3** Reliability Statistics for ESL Students' Overall Writing Proficiency Scale

Statistic	Value
Cronbach's Alpha	0.784
Cronbach's Alpha (Standardised Items)	0.911
Number of Items	11

**Table 3.4** Item Statistics for ESL Students' Overall Writing Proficiency Scale (N=38)

No.	Item	Mean	Std. Deviation
1	I usually rely more on the AI grammar checkers when writing in English.	3.71	1.27
2	Since using AI grammar checkers, my grammatical accuracy in writing has improved a lot.	3.61	1.15
3	AI grammar checkers help me understand grammatical rules better.	3.87	1.28
4	AI paraphrasing tools help me use a wider variety of vocabulary.	3.92	1.17
5	Since using AI paraphrasing tools, my ability to restructure sentences in English has improved a lot.	3.87	1.19
6	I often use AI-generated paraphrases to ensure they sound natural and good.	3.92	1.17
7	DV	7.00	4.48
8	AI feedback tools encourage me to revise and improve my writing independently.	3.74	1.11
9	I critically evaluate AI-generated suggestions before accepting them.	3.97	1.10
No.	Item	Mean	Std. Deviation
10	Since using AI feedback tools, my confidence in writing without assistance has increased significantly.	3.71	1.16
11	AI feedback has made me more dependent on technology for writing improvement.	3.68	1.19

**Table 3.5** Item–Total Statistics for ESL Students' Overall Writing Proficiency Scale

Item	Cronbach's Alpha if Item Deleted
AI grammar checker reliance	0.76
Improvement in grammatical accuracy	0.74
Understanding grammatical rules	0.75

Vocabulary improvement via paraphrasing	0.76
Sentence restructuring ability	0.75
Natural-sounding paraphrases	0.76
DV	0.93
Encouragement to revise independently	0.75
Critical evaluation of AI suggestions	0.77
Confidence without assistance	0.75
Dependence on AI for improvement	0.76

**Table 3.6** Scale Statistics for ESL Students’ Overall Writing Proficiency

Statistic	Value
Scale Mean	45.00
Variance	118.60
Standard Deviation	10.89
Number of Items	11

A reliability test was carried out to assess the internal consistency of the 11-item ESL Students’ Overall Writing Proficiency Scale. The analysis produced a Cronbach’s Alpha of 0.78, surpassing the generally accepted benchmark of 0.70 (Nunnally, 1978), which indicates that the instrument is reliably consistent. Additionally, the standardized Cronbach’s Alpha value of 0.91 demonstrates a high level of internal consistency, confirming that the items collectively measure the same underlying construct, namely students’ writing proficiency.

The inter-item correlation coefficients varied between  $-0.11$  and  $0.84$ , indicating that the majority of items were moderately to strongly related. The single negative correlation, however, suggests that one item may not be fully consistent with the overall scale.

Item-total statistics revealed that most items had corrected item-total correlations above  $.30$ , which is considered satisfactory (Field, 2018). However, one item—“*Which of the following best describes your primary reason for using AI paraphrasing tools?*”—had a low corrected item-total correlation of  $.18$ , indicating that it did not correlate well with the overall scale.

If this item were removed, Cronbach’s Alpha would increase from  $.78$  to  $.93$ , showing that the internal reliability of the scale could be improved by deleting it. Therefore, it was concluded that the scale was reliable overall but could achieve even greater consistency with minor refinement.

### Determining Strength of Scores Based on Measurement Scale

Likert responses were interpreted according to Best and Kahn (2006):

- 1.00–1.80 = Very Low
- 1.81–2.60 = Low

- 2.61–3.40 = Moderate
- 3.41–4.20 = High
- 4.21–5.00 = Very High

### Justification for Statistical Methods Used

Descriptive statistics provided an overview of trends in AI use and perceptions. Cronbach’s Alpha confirmed scale reliability. Pearson correlation identified associations between tool use and proficiency. Group comparisons using t-tests and ANOVA offered insight into differences based on frequency and proficiency levels. These combined approaches ensured that findings were robust, valid, and directly addressed the research objectives.

### SUMMARY

This chapter has outlined the methodological framework used in the study, including the research design, sampling strategy, instruments, validation processes, pilot study outcomes, and analytical procedures. The alignment between the methodology and the research questions ensures that the findings presented in Chapter 4 are grounded in rigorous and systematically applied methods. The structured approach adopted in this chapter establishes a strong foundation for the interpretation and discussion of results in subsequent chapters.

## FINDINGS

### Introduction

This chapter presents the results of the study, which were obtained from 41 ESL students using a structured questionnaire. The collected data were analysed with IBM SPSS Statistics (Version 26). Descriptive statistics were applied to address Research Questions 1, 2, and 3, examining frequencies, percentages, mean scores, and standard deviations. Inferential statistics were used to determine whether there were significant differences in overall writing proficiency among groups based on their use of AI tools. The chapter is organised into sections covering participant demographics, findings for each research question, inferential analysis, and a summary of the results.

### Demographic Data of Participants

A descriptive analysis was conducted to provide background information on the participants, including their English proficiency levels and the frequency with which they used AI-powered writing tools. The demographic characteristics of the respondents are summarised in Table 4.1, which shows the distribution of participants according to proficiency levels and patterns of AI tool usage.

**Table 4.1 Demographic Profile of Respondents (n = 41)**

Variable	Category	Frequency (n)	Percentage (%)
English proficiency level	Beginner	4	9.8
	Intermediate	20	48.8
Frequency of AI tool usage	Advanced	17	41.5
	Always (daily/almost daily)	18	43.9
	Frequently (at least once a week)	16	39.0
	Occasionally	5	12.2
	Rarely	2	4.9

Table 4.1 shows that the majority of respondents were intermediate (48.8%) and advanced (41.5%) ESL learners, indicating that most participants possessed moderate to high English proficiency. In terms of AI tool usage, a substantial proportion of students reported using AI-powered writing tools either daily or weekly (82.9%), suggesting that AI tools are frequently integrated into students' writing practices.

### To what extent do AI-powered writing tools improve ESL students' writing proficiency?

The first research question aimed to explore how AI-powered writing tools influence the writing proficiency of ESL students. To answer this question, students' perceptions regarding the effects of AI grammar checkers and paraphrasing tools on different aspects of their writing skills were examined. The descriptive statistics summarising these perceptions, including frequencies, percentages, mean scores, and standard deviations, are presented in Table 4.2.

**Table 4.2** Perceived Impact of AI Grammar Checkers and Paraphrasing Tools on Writing Proficiency

Item	Disagree (1–2) n (%)	Neutral (3) n (%)	Agree (4–5) n (%)	Mean (M)	SD
Improved ability to recognise and correct grammar mistakes	4 (9.7)	8 (19.5)	29 (70.7)	4.10	1.11
Reliance on AI grammar checkers when writing	8 (19.6)	7 (17.1)	26 (63.4)	3.68	1.31
Improved grammatical accuracy in writing	7 (17.1)	8 (19.5)	26 (63.4)	3.63	1.18
Better understanding of grammatical rules	7 (17.1)	4 (9.8)	30 (73.2)	3.88	1.25
Wider variety of vocabulary use	5 (12.2)	7 (17.1)	29 (70.7)	3.95	1.16
Improved ability to restructure sentences	5 (12.2)	9 (22.0)	27 (65.9)	3.90	1.18
AI-generated paraphrases sound natural	6 (14.6)	6 (14.6)	29 (70.7)	3.90	1.24

Table 4.2 presents ESL students' perceptions of the extent to which AI-powered grammar checkers and paraphrasing tools improve their writing proficiency. To interpret the mean scores, this study adopts the classification index proposed by Oxford (1990) and widely used in ESL and educational research, where mean scores of 1.00–2.49 indicate a low level, 2.50–3.49 indicate a moderate level, and 3.50–5.00 indicate a high level of impact.

Based on this classification index, the overall mean score for the seven items was  $M = 3.86$ , which falls within the high-level category. This finding indicates that, overall, ESL students perceived AI-powered writing tools as improving their writing proficiency to a high extent, thereby directly addressing the first research question.

At the item level, the highest mean score was recorded for *improved ability to recognise and correct grammar mistakes* ( $M = 4.10$ ,  $SD = 1.11$ ). With 70.7% of respondents agreeing or strongly agreeing, this item reflects a high perceived impact, suggesting that AI grammar checkers are particularly effective in enhancing students' grammatical awareness. Similarly, *better understanding of grammatical rules* ( $M = 3.88$ ,  $SD = 1.25$ ) also fell within the high classification range, indicating that AI feedback supports learners' understanding of grammar beyond surface-level correction.

High mean scores were likewise observed for vocabulary and sentence-level improvements. Items related to *wider variety of vocabulary use* ( $M = 3.95$ ,  $SD = 1.16$ ), *improved ability to restructure sentences* ( $M = 3.90$ ,  $SD = 1.18$ ), and *AI-generated paraphrases sounding natural* ( $M = 3.90$ ,  $SD = 1.24$ ) all fall within the high-

impact category, with more than 65% of students expressing agreement. These findings suggest that AI paraphrasing tools contribute positively to lexical diversity and syntactic flexibility in ESL writing.

Although *improved grammatical accuracy in writing* recorded the lowest mean score ( $M = 3.63$ ,  $SD = 1.18$ ), it remains within the high classification range according to the index. This indicates that while students perceive noticeable improvements in accuracy, the gains may be less pronounced compared to grammatical awareness and vocabulary-related outcomes. Additionally, the item on *reliance on AI grammar checkers when writing* ( $M = 3.68$ ,  $SD = 1.31$ ) suggests a high level of dependence, highlighting both the supportive role of AI tools and the potential risk of overreliance.

In conclusion, guided by the classification index and supported by the overall mean score, the findings demonstrate that AI-powered writing tools improve ESL students' writing proficiency to a high extent, particularly in enhancing grammatical awareness, vocabulary use, and sentence restructuring.

### What are ESL students' perceptions of AI-powered writing feedback and independent learning?

The second research question aimed to explore ESL students' perceptions of AI-powered writing feedback and its role in supporting independent learning. To answer this question, students' responses regarding their engagement with AI feedback, revision practices, and confidence in writing independently were examined. The results of this analysis are presented in Table 4.3 below.

**Table 4.3** Students' Perceptions of AI Feedback and Independent Writing Development

Item	Disagree (1–2) n (%)	Neutral (3) n (%)	Agree (4–5) n (%)	Mean (M)	SD
AI feedback encourages independent revision	5 (12.2)	12 (29.3)	24 (58.5)	3.78	1.11
Critically evaluate AI-generated suggestions	5 (12.2)	6 (14.6)	30 (73.2)	4.00	1.10
Increased confidence in writing without assistance	6 (14.7)	9 (22.0)	26 (63.4)	3.76	1.16

Table 4.3 presents ESL students' perceptions of AI-powered writing feedback and its role in supporting independent learning. To interpret the mean scores, this study adopts the classification index proposed by Oxford (1990), in which mean scores of 1.00–2.49 indicate a low level, 2.50–3.49 indicate a moderate level, and 3.50–5.00 indicate a high level of perception.

Based on this classification index, the overall mean score for the three items was  $M = 3.85$ , which falls within the high-level category. This indicates that ESL students generally hold positive perceptions of AI-powered writing feedback, suggesting that such feedback supports independent learning to a high extent, thereby directly addressing the second research question.

At the item level, the highest mean score was recorded for *critically evaluating AI-generated suggestions* ( $M = 4.00$ ,  $SD = 1.10$ ), with 73.2% of respondents agreeing or strongly agreeing. This high mean score indicates that most students did not accept AI feedback passively but instead engaged critically with the suggestions provided, reflecting the development of reflective and self-regulated learning behaviours.

Similarly, the item *AI feedback encourages independent revision* recorded a high mean score ( $M = 3.78$ ,  $SD = 1.11$ ), with more than half of the respondents (58.5%) expressing agreement. This suggests that AI-powered feedback plays a supportive role in promoting autonomous revision practices, enabling students to take greater responsibility for improving their writing.

The item *increased confidence in writing without assistance* also fell within the high classification range ( $M = 3.76$ ,  $SD = 1.16$ ), with 63.4% of students agreeing or strongly agreeing. This finding indicates that regular

exposure to AI feedback may enhance learners' confidence to write independently, even in the absence of immediate technological support.

In summary, guided by the classification index and supported by the overall mean score, the findings demonstrate that ESL students perceive AI-powered writing feedback as highly supportive of independent learning, particularly in fostering critical engagement with feedback, encouraging independent revision, and increasing confidence in writing autonomously.

### What challenges do ESL students face when using AI-powered writing tools?

The third research question intended to identify the challenges ESL students face when using AI-powered writing tools. To address this research question, students' perceptions of potential limitations and difficulties associated with AI tool usage were analysed. These challenges include issues related to technological dependence, cognitive autonomy, and clarity of AI-generated feedback. The descriptive statistics for these challenges are presented in Table 4.4 below.

**Table 4.4** Challenges in Using AI-Powered Writing Tools

Item	Disagree (1–2) n (%)	Neutral (3) n (%)	Agree (4–5) n (%)	Mean (M)	SD
Increased dependence on technology	7 (17.0)	11 (26.8)	23 (56.1)	3.73	1.18
Over-reliance on AI reduces independent thinking	9 (22.0)	10 (24.4)	22 (53.6)	3.66	1.21
Difficulty deciding which AI feedback to accept	8 (19.5)	13 (31.7)	20 (48.8)	3.54	1.15
AI feedback is sometimes confusing or unclear	10 (24.4)	12 (29.3)	19 (46.3)	3.46	1.20
Limited understanding of AI-generated suggestions	11 (26.8)	11 (26.8)	19 (46.3)	3.44	1.24
Concern about accuracy of AI feedback	9 (22.0)	14 (34.1)	18 (43.9)	3.41	1.16
Reduced confidence in own writing ability	12 (29.3)	13 (31.7)	16 (39.0)	3.29	1.19

Table 4.4 presents ESL students' perceptions of the challenges they face when using AI-powered writing tools. To interpret the mean scores, this study adopts the classification index proposed by Oxford (1990), where mean scores of 1.00–2.49 indicate a low level, 2.50–3.49 indicate a moderate level, and 3.50–5.00 indicate a high level of challenge.

Based on this classification index, the overall mean score for the seven challenge-related items was  $M = 3.50$ , which lies at the borderline between the moderate and high categories, indicating that ESL students experience challenges when using AI-powered writing tools to a moderate extent. This directly addresses the third research question by suggesting that while challenges are present, they are not overwhelmingly severe.

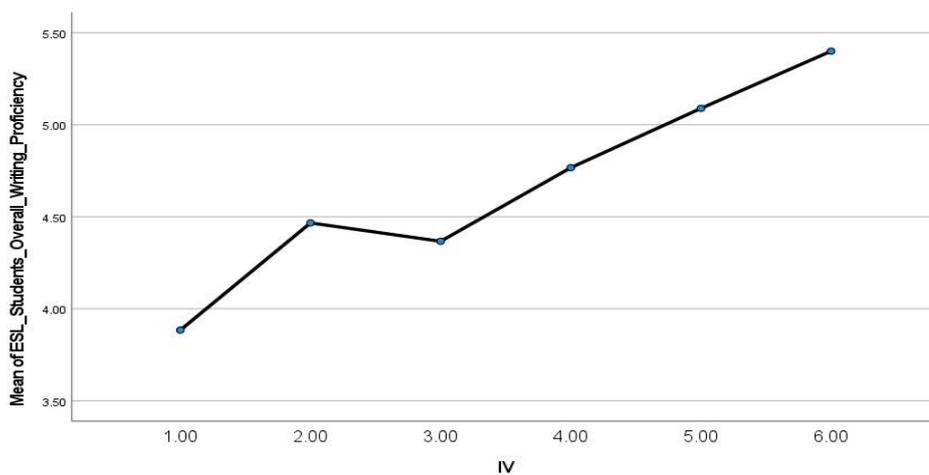
At the item level, the most prominent challenge identified was *increased dependence on technology* ( $M = 3.73$ ,  $SD = 1.18$ ), with 56.1% of respondents agreeing or strongly agreeing. According to the classification index, this reflects a high level of perceived challenge, suggesting that frequent use of AI tools may lead to reliance that potentially affects learner autonomy. Similarly, the item *over-reliance on AI reduces independent thinking* recorded a high mean score ( $M = 3.66$ ,  $SD = 1.21$ ), reinforcing concerns related to cognitive autonomy and self-regulated learning.

Several challenges fell within the moderate classification range, including *difficulty deciding which AI feedback to accept* ( $M = 3.54, SD = 1.15$ ) and *AI feedback is sometimes confusing or unclear* ( $M = 3.46, SD = 1.20$ ). These findings indicate that although AI tools provide extensive feedback, students may struggle to interpret, evaluate, and apply the suggestions effectively. Additionally, concerns regarding *limited understanding of AI-generated suggestions* ( $M = 3.44, SD = 1.24$ ) and *accuracy of AI feedback* ( $M = 3.41, SD = 1.16$ ) further suggest that trust and comprehension remain ongoing issues.

The lowest mean score was recorded for *reduced confidence in own writing ability* ( $M = 3.29, SD = 1.19$ ), which falls within the moderate level of challenge. This suggests that although some students experienced confidence-related issues, this challenge was comparatively less pronounced than concerns related to dependence and feedback interpretation.

In summary, guided by the classification index and supported by the overall mean score, the findings indicate that ESL students face moderate challenges when using AI-powered writing tools, particularly in terms of technological dependence, reduced independent thinking, and difficulties interpreting AI-generated feedback. However, when considered alongside the stronger positive perceptions reported for writing improvement and independent learning, these challenges appear present but not dominant, highlighting the need for guided and pedagogically informed use of AI tools in ESL writing instruction.

To provide a consolidated overview of ESL students' overall perceptions of AI-powered writing tools across different functional categories, a summary analysis was conducted. The combined results reflecting students' experiences with grammar checkers, paraphrasing tools, and feedback systems are presented in Figure 8 below.



**Figure 8. Mean of ESL Students' Overall Writing Proficiency**

### **Inferential Statistics: Differences in Writing Proficiency Based on AI Tool Usage**

To further address Research Question 1, a one-way Analysis of Variance (ANOVA) was conducted to determine whether there were statistically significant differences in overall writing proficiency among students based on their AI-powered writing tool usage patterns.

Preliminary assumption testing indicated that Levene's Test for homogeneity of variances was significant ( $p = .025$ ), suggesting unequal variances across groups. However, given the robustness of ANOVA with relatively balanced group sizes, the analysis was deemed appropriate for exploratory comparison.

The ANOVA results revealed no statistically significant difference in overall writing proficiency across AI tool usage groups,  $F(5, 35) = 1.414, p = .243$ . Although descriptive statistics showed variation in mean scores between groups, these differences were not large enough to be considered statistically meaningful.

This finding suggests that differences in AI tool usage frequency or type did not result in significantly different levels of perceived writing proficiency within this sample. One possible explanation is that AI-powered writing tools provide similar baseline support regardless of usage frequency, particularly in areas such as grammar

correction and vocabulary enhancement. Another plausible explanation is that writing proficiency development may depend more strongly on learners' prior language ability, instructional support, and metacognitive engagement than on frequency of AI tool use alone.

Importantly, the absence of statistically significant differences does not negate the positive descriptive findings reported earlier. Instead, it indicates that while students generally perceive AI tools as beneficial, increased usage does not necessarily translate into proportionally higher perceived writing proficiency. This finding reinforces the view that the quality and pedagogical integration of AI tools may be more important than frequency of use, aligning with previous research emphasising guided and purposeful AI adoption (Tan et al., 2023; Wang et al., 2023).

## SUMMARY

This chapter presented the findings of the study based on descriptive and inferential analyses. The results indicated that AI-powered grammar checkers and paraphrasing tools were generally perceived as effective in improving ESL students' writing proficiency, particularly in grammar recognition, vocabulary use, and sentence restructuring. Students also demonstrated positive perceptions of AI feedback in promoting independent revision and critical engagement, although moderate concerns regarding technological dependence were identified. The inferential analysis further revealed no statistically significant differences in overall writing proficiency across different AI tool usage groups. While descriptive statistics demonstrated high perceived benefits of AI-powered writing tools, inferential analysis indicated that differences in overall writing proficiency across AI usage groups were not statistically significant, suggesting that perceived effectiveness may be consistent across varying usage patterns. The next chapter discusses these findings in relation to existing literature and theoretical perspectives.

## DISCUSSION & CONCLUSION

### INTRODUCTION

This chapter provides a critical discussion of the study's findings in relation to the research questions, theoretical frameworks, and prior literature. Instead of simply restating the results from Chapter 4, this discussion interprets the outcomes, exploring the reasons behind them and examining how they align with or differ from existing research. The chapter also considers alternative explanations, evaluates the study's limitations, and presents pedagogical implications and recommendations for future research. Overall, it highlights how AI-powered writing tools can support ESL writing development while identifying the conditions required for their effective and responsible use.

### Summary of Research Findings

The study investigated ESL learners' perceptions of AI-based writing tools—including grammar checkers, paraphrasing software, and AI-generated feedback—and examined how these tools are perceived to impact writing development. The findings indicate that students generally hold positive attitudes toward AI-assisted writing. Most participants reported that grammar checkers helped them identify and correct errors, improve grammatical accuracy, and better understand grammatical rules. Likewise, AI paraphrasing tools were seen as useful for enhancing vocabulary range and improving sentence restructuring skills.

The results also show that AI feedback tools encouraged learners to revise their work independently and critically evaluate suggestions, while contributing to greater confidence in their writing. However, some students expressed moderate concern about potential over-reliance on AI, suggesting awareness of the risks associated with depending too heavily on technological support. Inferential analysis revealed no significant differences in overall perceptions of writing proficiency across subgroups, indicating that participants' views of AI tools were relatively consistent.

## DISCUSSION OF FINDINGS

### **To what extent do AI-powered writing tools improve ESL students' writing proficiency?**

The findings of this study suggest that AI-powered writing tools improve ESL students' writing proficiency to a moderate to high degree, particularly in areas related to grammatical awareness, vocabulary development, and sentence restructuring. The descriptive results indicated relatively high mean scores for grammar-related items, demonstrating that students perceived AI tools as effective in helping them identify and correct language errors during the writing process.

This outcome can be interpreted through Cognitive Load Theory, which proposes that learning is enhanced when unnecessary mental effort is reduced. By automatically highlighting grammatical and lexical issues, AI-powered writing tools reduce learners' extraneous cognitive load, allowing greater focus on idea development and text organisation. This finding is consistent with previous research which reported that automated feedback supports language accuracy and writing fluency among ESL learners (Dawadi et al., 2021; Wang et al., 2023).

However, despite high levels of grammatical awareness, perceived improvement in grammatical accuracy was comparatively lower. This indicates that the ability to recognise errors does not always result in sustained accuracy gains. Writing proficiency develops gradually and requires continuous practice, teacher guidance, and meaningful feedback. Therefore, AI-powered writing tools appear to be most effective when used as supportive instructional aids rather than as independent teaching tools.

Furthermore, inferential analysis revealed no statistically significant differences in overall writing proficiency across different AI tool usage groups. This suggests that variations in AI tool usage did not lead to significantly different proficiency outcomes. One possible explanation is that AI tools provide a similar level of assistance regardless of usage frequency. Additionally, factors such as learners' prior language proficiency, motivation, and classroom instruction may have exerted a stronger influence on writing development than AI usage alone.

Overall, the findings indicate that AI-powered writing tools contribute positively to ESL students' writing proficiency, particularly in enhancing revision and language awareness, although their impact may be limited without sustained pedagogical support.

### **What are ESL students' perceptions of AI-powered writing feedback and independent learning?**

The findings reveal that ESL students generally hold favourable perceptions of AI-powered writing feedback and its role in supporting independent learning. Students reported that AI feedback enabled them to revise their writing with less reliance on immediate teacher assistance and increased their confidence in self-editing.

These perceptions align with Self-Regulated Learning Theory, which emphasises learners' capacity to manage and evaluate their own learning processes. AI-powered writing tools support self-regulation by providing instant feedback that learners can review and apply independently. The relatively high mean scores for items related to evaluating and revising based on AI feedback suggest that students engaged actively with the feedback rather than accepting it uncritically.

From a Sociocultural Theory perspective, AI-powered writing tools can be viewed as mediational resources that support learners within their Zone of Proximal Development. By guiding students during the revision process, AI feedback assists learners in performing tasks that may otherwise be challenging. Nevertheless, slightly lower confidence-related scores indicate that independent learning develops progressively and continues to require teacher scaffolding.

Overall, the findings suggest that students perceive AI-powered writing feedback as beneficial for fostering independent learning, particularly when AI tools are used as revision supports rather than content generators.

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## What challenges do ESL students face when using AI-powered writing tools?

Despite the overall positive perceptions, ESL students also identified several challenges associated with the use of AI-powered writing tools. One prominent concern was the potential for excessive reliance on AI feedback, which may limit opportunities for independent language problem-solving and critical thinking. This concern echoes previous studies that caution against overdependence on automated feedback systems (Bozkurt & Sharma, 2023).

Another challenge relates to uncertainty about the accuracy and suitability of AI-generated feedback. Some students reported difficulty determining whether AI suggestions aligned with their intended meaning or writing context. This reflects current limitations of AI tools, particularly in addressing discourse-level and contextual nuances that require human judgement.

Additionally, differences in students' language proficiency and digital literacy may have influenced how effectively they used AI tools. Learners with lower proficiency levels may have found it more challenging to critically evaluate AI feedback, increasing the risk of inappropriate revisions. These findings suggest that explicit instruction and teacher guidance are essential to help students use AI-powered writing tools effectively.

In summary, while AI-powered writing tools offer considerable benefits, their effectiveness depends largely on learners' critical engagement and the manner in which the tools are integrated into classroom instruction.

### Implications of the Study

The results of this research offer several insights for ESL writing instruction and future studies, especially regarding the use of AI-powered writing tools in secondary classrooms. While AI tools were found to support improvements in grammar, vocabulary, sentence construction, and learner autonomy, the study also highlighted challenges such as potential technological dependence and difficulties in interpreting AI feedback. These findings underscore the importance of implementing AI tools in a pedagogically informed and theoretically grounded manner to maximise benefits and minimise risks.

### Pedagogical Implications

The study's findings suggest multiple applications for ESL teaching. First, AI grammar checkers and paraphrasing tools can be integrated effectively into writing instruction to support grammatical accuracy, vocabulary enhancement, and sentence restructuring. Teachers may consider using these tools as formative resources during drafting and revision processes.

Second, given the benefits of critical engagement, students should be explicitly trained to evaluate AI feedback rather than accept suggestions uncritically. Activities such as justifying revisions or comparing AI recommendations with teacher feedback can help develop this skill.

Finally, to address the risk of over-reliance on technology, AI tools should serve as supplementary aids rather than primary instruction sources. A blended approach, combining AI feedback with teacher guidance and peer review, can optimise learning outcomes while limiting potential drawbacks.

### Theoretical Implications

This study contributes to research on AI-assisted language learning by reinforcing principles from Second Language Acquisition (SLA) and the SAMR model. Findings align with interactionist and cognitive SLA perspectives, which emphasise feedback, noticing, and active learner engagement. AI tools provide personalised, immediate feedback that may enhance learners' awareness of errors and encourage deeper processing of language forms.

Evidence of independent revision and critical evaluation suggests that AI tools can operate at the augmentation and modification levels of the SAMR model when used appropriately. However, observed technological

dependence highlights the need for theoretical models that consider learner agency, metacognition, and ethical AI use in writing contexts. Future frameworks should integrate autonomy, critical literacy, and responsible technology use.

### **Limitations of the Study**

Several limitations should be considered. First, part of the study relied on self-reported questionnaire data, which may be influenced by response bias and might not accurately reflect actual writing improvements. Students' perceptions may differ from objectively measured outcomes.

Second, the intervention period was relatively short, limiting the ability to assess long-term effects of AI tools on ESL writing development. Writing proficiency is a complex skill that generally develops over time, and brief exposure may not produce measurable gains.

Third, the absence of a control group prevents strong causal claims about the effects of AI tool use. Without comparison to a group receiving traditional instruction alone, improvements cannot be attributed solely to AI-assisted writing.

Finally, the use of AI tools raises concerns about potential over-scaffolding. Excessive reliance on AI feedback could reduce opportunities for independent language processing if not carefully guided. These limitations indicate that findings should be interpreted with caution, while still offering valuable insights into ESL learners' experiences with AI writing tools in authentic classroom settings.

### **Recommendations for Future Research**

Future research could adopt longitudinal designs to explore the sustained effects of AI-powered writing tools on ESL students' writing proficiency. Incorporating experimental or quasi-experimental approaches with control groups would strengthen claims of causality.

Additionally, mixed-method studies combining quantitative writing assessments with qualitative approaches, such as interviews or reflective journals, could provide richer insights into learners' strategies, cognitive engagement, and challenges with AI tools. Investigating teachers' perspectives and instructional practices related to AI integration would also enhance understanding of effective implementation in ESL writing contexts.

## **CONCLUSION**

This study explored ESL students' perceptions of AI-powered grammar checkers, paraphrasing tools, and feedback systems, as well as their views on how these technologies affect writing proficiency, confidence, and learning independence. Overall, the results indicate that AI writing tools play a largely positive role in supporting ESL learners, particularly in enhancing grammatical accuracy, vocabulary use, sentence structuring, and overall writing efficiency. Most students reported frequent use of these tools and expressed favorable attitudes toward their usefulness, suggesting that AI technologies have become an important part of their writing practices.

A key finding is that AI grammar checkers help students become more aware of grammatical rules and improve their error correction skills. Learners perceived tangible improvements in identifying and rectifying mistakes, showing that AI tools function not only as corrective mechanisms but also as educational aids. This supports the view that immediate, detailed feedback promotes noticing and internalizing language forms—particularly valuable for ESL learners who may not receive sufficient individualized feedback in traditional classrooms. In this way, AI grammar tools appear to fill a critical gap by providing consistent and accessible support outside the classroom.

The study also highlights the benefits of AI paraphrasing tools in expanding lexical range and improving sentence construction. Many participants felt that these tools helped them communicate ideas more clearly, restructure sentences more effectively, and use a wider variety of vocabulary. Such tools can serve as scaffolds that expose learners to alternative linguistic patterns and expressions. When applied critically, AI paraphrasing

tools may support language development by modelling more natural and varied language, which is particularly useful for learners at intermediate and advanced proficiency levels.

Another important conclusion relates to learner autonomy and confidence. AI feedback tools were reported to encourage independent revision and boost students' confidence in writing without external guidance. This suggests that these technologies can foster self-directed learning by motivating students to draft, revise, and reflect on feedback before finalizing their work. Nevertheless, the findings also indicate moderate concern about over-reliance on AI tools, highlighting the need for guided, pedagogically informed integration to prevent dependence.

Reliability analysis confirmed acceptable internal consistency for the research instrument, supporting the credibility of the findings. The lack of significant differences between subgroups indicates that students' perceptions of AI tools were relatively consistent across different proficiency levels. This reinforces the conclusion that AI-assisted writing support is generally seen as beneficial among ESL learners.

In conclusion, the study provides evidence that AI-powered writing tools have the potential to enhance ESL students' writing skills, confidence, and engagement. While these tools should not replace teacher feedback or foundational instruction, they can serve as valuable supplements when integrated thoughtfully into teaching. Educators are encouraged to promote critical use of AI, ensuring students understand the rationale behind suggested corrections rather than accepting them passively.

Overall, this research contributes to the growing literature on AI in language learning by highlighting both its advantages and limitations, emphasizing the need for balanced, ethical, and pedagogically sound use of technology in ESL writing development. The findings suggest that AI tools are effective in improving writing proficiency, encouraging independent learning, and fostering critical engagement with feedback. Concerns regarding over-dependence were moderate and manageable when the tools were used strategically, demonstrating that AI-powered writing technologies can meaningfully support ESL writing development when implemented thoughtfully.

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