Writing with AI: ESL Undergraduates' Use of Artificial Intelligence in Academic Writing

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ABSTRACT

The rapid integration of artificial intelligence (AI) tools such as ChatGPT, Grammarly, and QuillBot reflects the growing role of digital technologies in transforming language learning and academic writing practices. In line with the broader shift toward technology-enhanced learning, this study examines how English as a Second Language (ESL) undergraduates use AI tools in academic writing and explores their perceptions of AI-assisted learning. A group of ESL undergraduate students participated in a post-task survey after using AI tools to complete academic writing assignments. The study investigates patterns of AI use across different stages of the writing process, namely pre-writing, drafting, and revision, and evaluates students' perceptions in terms of usefulness, ease of use, writing confidence, and learner autonomy. Quantitative data were analysed using descriptive statistics, while qualitative responses were analysed thematically. The findings indicate that AI tools are primarily used for idea generation, language support, and grammatical improvement, especially during drafting and revision. Students reported increased efficiency and confidence, although varying levels of dependence were also observed. While most participants viewed AI as a valuable learning aid, concerns regarding overdependence, reduced originality, and academic integrity were also identified. Importantly, students tended to conceptualise AI as a writing partner rather than a replacement for human effort. Grounded in the Technology Acceptance Model (TAM) and Self-Regulated Learning (SRL) theory, the study highlights how perceived usefulness and perceived ease of use influence AI adoption, while learner autonomy mediates responsible engagement with AI tools. The findings suggest that AI-assisted writing, when pedagogically scaffolded, can enhance ESL learners' writing development without undermining independent learning. The study offers practical implications for integrating AI tools ethically and effectively in ESL writing instruction.

Keywords: Artificial intelligence, ESL writing, AI-assisted writing, learner autonomy, academic writing

INTRODUCTION

The 21st century has witnessed the rise of artificial intelligence (AI) in foreign language education, where AI is increasingly used to support students' language learning. One example is online machine translation (MT) as a quick solution for English language learners (ELLs) encountering English writing difficulties (Bahri & Mahadi, 2016; Stapleton & Kin, 2019). The rapid advancement of artificial intelligence (AI) technologies has significantly transformed academic writing practices, particularly among English as a Second Language (ESL) learners. AI-powered tools such as ChatGPT, Grammarly, and QuillBot provide real-time feedback, automated text generation, and language enhancement features that support students in composing academic texts. These developments are especially beneficial for English as a Second Language (ESL) learners, who often face linguistic and cognitive challenges in academic writing.

Recent studies indicate that AI tools can improve writing quality, organisation, and grammatical accuracy while reducing cognitive load during writing tasks (Marzuki et al., 2023; Zhai, 2022). Additionally, AI-driven feedback systems have been shown to enhance writing fluency and learner confidence, particularly among ESL

students (Sharmithashini & Hashim, 2025; Wang & Han, 2024). However, despite these benefits, concerns have emerged regarding over-reliance, reduced originality, and potential threats to academic integrity (Cotton et al., 2023; Kasneci et al., 2023).

The increasing integration of AI tools has also raised important pedagogical questions about learner autonomy. While AI can act as a scaffold for writing development, excessive dependence may hinder critical thinking and self-regulated learning processes (Zulkefli & Ismail, 2024; Zimmerman, 2002). Furthermore, the role of AI as a "learning partner" rather than a replacement for human effort has become a central issue in current educational discourse (Luckin et al., 2016; Holmes et al., 2022).

These tools are especially beneficial for ESL learners, who often face challenges related to grammar, vocabulary, and idea development. AI tools can reduce cognitive load, improve writing fluency, and enhance overall writing quality. In education, AI has transformed writing practices by providing automated feedback, grammar correction, and content generation. Studies show that AI tools can enhance writing quality and reduce cognitive load, particularly for ESL learners. However, scholars warn that the use of AI tools in academic writing may lead to over-reliance, ethical concerns, and reduced critical engagement (Kasneci et al., 2023; Cotton et al., 2023). While these tools offer significant advantages, they also raise issues related to originality and academic integrity (Zhai, 2022; Holmes et al., 2022). Given these opportunities and challenges, this study contributes to the growing body of research by examining ESL undergraduates' actual usage patterns and perceptions of AI-assisted writing within a technology-enhanced learning environment.

Research Objectives

This study aims to:

1. Examine the extent of AI tool usage among ESL undergraduates.

2. Identify the purposes for which AI tools are used.

3. Explore students' perceptions of AI in academic writing.

4. Identify the benefits and challenges associated with AI use.

5. Provide recommendations for educators and institutions.

LITERATURE REVIEW

The rapid advancement of artificial intelligence (AI) technologies has significantly reshaped academic writing practices, particularly within English as a Second Language (ESL) contexts. AI-powered tools such as ChatGPT, Grammarly, and other automated writing assistants are increasingly being adopted to support learners in generating ideas, improving linguistic accuracy, and enhancing overall text coherence. Empirical evidence suggests that these tools can substantially improve writing quality by reducing grammatical errors and facilitating better organization of ideas. For instance, Marzuki et al. (2023) demonstrate that AI-assisted writing tools enhance ESL learners' ability to produce more structured and linguistically accurate texts. Similarly, Zhai (2022) argues that AI systems reduce cognitive load by automating lower-level writing processes, thereby allowing learners to focus more on higher-order skills such as argumentation and content development.

Beyond linguistic support, AI tools have also been linked to increased learner engagement, confidence, and motivation. Research indicates that immediate and personalized feedback provided by AI systems plays a critical role in sustaining writing development. In this regard, Wang and Han (2024) found that AI-based feedback significantly improves students' writing performance and motivation compared to traditional feedback approaches. Likewise, Sharmithashini and Hashim (2025) highlight that automated feedback systems provide consistent and timely support, which is particularly beneficial for ESL learners who may lack access to individualized instructor feedback. These findings suggest that AI tools can function as effective scaffolding

mechanisms that support learners throughout the writing process.

However, despite these pedagogical benefits, a growing body of literature raises concerns regarding the potential negative implications of AI-assisted writing. One of the most prominent issues is the risk of over-reliance, which may reduce learners' cognitive engagement and critical thinking. As noted by Kasneci et al. (2023), excessive dependence on AI-generated content may lead to passive learning behaviors, where students accept outputs without critical evaluation. Similarly, Cotton et al. (2023) argue that the increasing use of AI in academic contexts poses significant challenges to academic integrity, particularly in relation to authorship, originality, and plagiarism. These concerns highlight the need for a balanced approach that maximizes the benefits of AI while mitigating its potential drawbacks.

In addition to ethical considerations, the integration of AI tools raises important questions about learner autonomy. From a theoretical perspective, learner autonomy is closely linked to the concept of Self-Regulated Learning, which emphasizes learners' ability to plan, monitor, and evaluate their own learning processes. According to Zimmerman (2002), self-regulated learners actively engage in metacognitive strategies that enable them to take control of their learning. Within the context of AI-assisted writing, this suggests that the effectiveness of AI tools depends largely on how learners regulate their use. Supporting this view, Zulkefli and Ismail (2024) found that AI can enhance learner autonomy when used critically and reflectively, but may undermine it when used as a substitute for independent thinking.

Complementing this perspective, the Technology Acceptance Model (TAM) provides a useful framework for understanding students' adoption of AI tools. The model posits that users' acceptance of technology is influenced by perceived usefulness and perceived ease of use. In the context of AI-assisted writing, students are more likely to adopt AI tools when they perceive them as effective in improving writing performance and easy to use. Recent studies confirm that these factors play a significant role in shaping students' attitudes towards AI in educational settings, further reinforcing the relevance of TAM in explaining AI adoption.

Furthermore, contemporary discussions in educational technology increasingly conceptualise AI as a "learning partner" rather than a replacement for human cognition. Holmes et al. (2022) argue that AI should be viewed as a tool that augments human learning by providing guidance, feedback, and support. Similarly, Luckin et al. (2016) emphasize that AI can enhance learning experiences when integrated within pedagogically sound frameworks that promote active engagement. This perspective shifts the focus from AI as a threat to AI as a collaborative tool that supports learning.

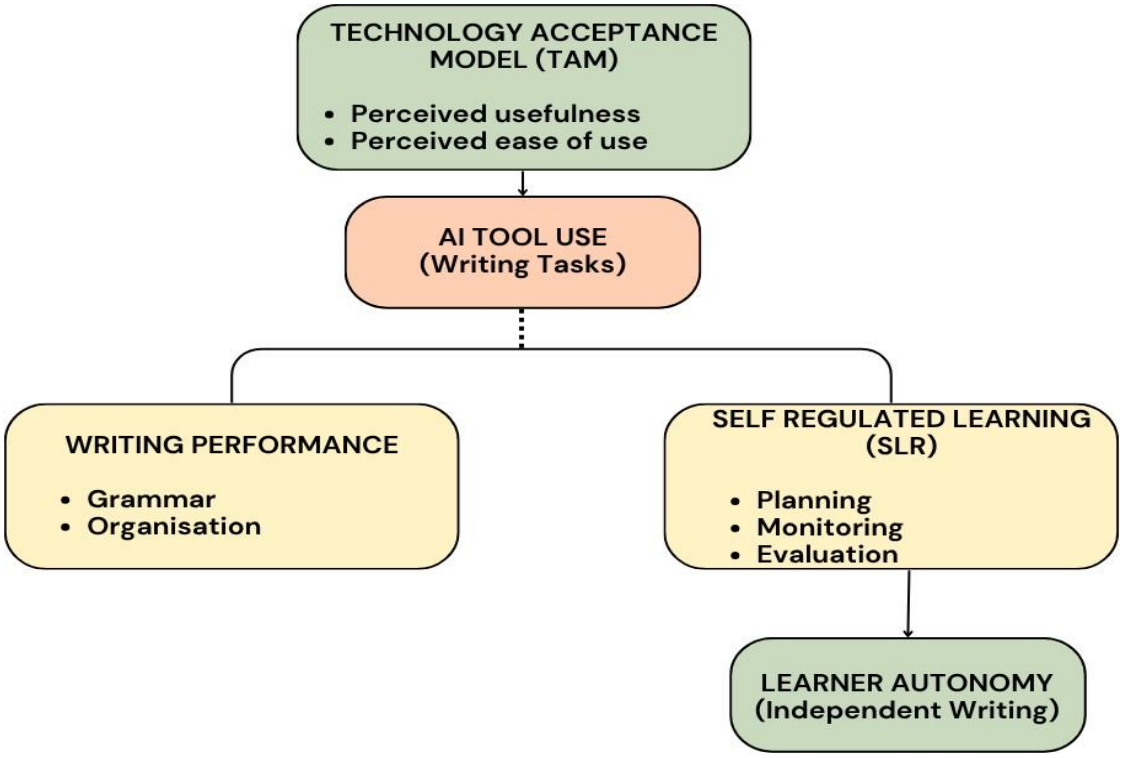
Despite the growing body of research, several gaps remain. First, much of the existing literature focuses on the general benefits and challenges of AI in education, with limited attention given to ESL undergraduates' actual usage patterns across different stages of the writing process. Second, few studies adopt an integrated theoretical approach that combines both technology acceptance and learner autonomy perspectives. Addressing these gaps, the present study examines ESL undergraduates' use of AI tools in academic writing through the combined lenses of TAM and SRL, providing a more comprehensive understanding of both adoption behaviors and learning processes.

While AI tools offer significant advantages, scholars also emphasize associated risks. Over-reliance on AI may reduce critical thinking and hinder the development of independent writing skills (Kasneci et al., 2023; Cotton et al., 2023). Additionally, concerns about plagiarism and ethical use have been widely discussed (Zhai, 2022; Holmes et al., 2022).

THEORETICAL FRAMEWORK

To examine both the opportunities and challenges of AI-assisted writing, this study adopts an integrated theoretical framework combining the Technology Acceptance Model and Self-Regulated Learning. While TAM explains students' acceptance of AI tools based on perceived usefulness and ease of use (Davis, 1989), SRL explains how learners regulate their use of AI to maintain autonomy and engage in metacognitive processes (Zimmerman, 2002). Figure 1 shows the theoretical framework.

Figure 1. Integrated Theoretical Framework (TAM + SRL in AI-Assisted Writing)



While previous studies have explored AI in writing, there is limited research focusing on:

- ESL undergraduates' actual usage patterns
- Integration of TAM and SRL
- Students' perceptions across writing stages

This study addresses these gaps.

METHODOLOGY

Research Design

This study employed a descriptive survey design, supported by qualitative data, to examine ESL undergraduates' use of artificial intelligence (AI) tools in academic writing. A survey design was considered appropriate because the study aimed to investigate students' usage patterns, perceptions, and experiences in a systematic and structured manner. Survey research is widely used in educational studies to collect self-reported data on participants' behaviours, attitudes, and practices, particularly when the objective is to describe trends within a specific population rather than to establish causal relationships (Creswell & Creswell, 2018; Check & Schutt, 2012).

In addition to the quantitative component, the study incorporated qualitative support through open-ended questionnaire items. This allowed the researchers to complement the numerical data with richer explanations of students' experiences, perceived benefits, and concerns regarding AI-assisted writing. The inclusion of both closed-ended and open-ended responses enabled a broader understanding of the phenomenon by capturing not only the frequency and extent of AI use, but also the meanings students attached to such use (Creswell & Plano Clark, 2018). As such, the research design was suitable for exploring an emerging issue in language education, namely the role of AI in supporting ESL academic writing.

Participants

The participants consisted of 31 undergraduate students from a public university who were enrolled in an academic writing course. These students were selected because they were directly engaged in academic writing tasks and therefore represented an appropriate group for investigating the use of AI tools in academic writing contexts. Their participation in an academic writing course also meant that they had relevant experience with the different stages of the writing process, including planning, drafting, revising, and editing written assignments.

The study used convenience sampling, as the participants were readily accessible to the researchers within the course setting. Convenience sampling is commonly employed in exploratory educational research, particularly when the purpose is to obtain initial insights from a specific and relevant group of learners (Etikan et al., 2016). However, because non-probability sampling does not provide every member of the wider target population with an equal chance of selection, the findings should be interpreted with caution and should not be generalised beyond the immediate study context. Although the sample size was relatively small, it was considered adequate for the exploratory and descriptive nature of the study, which sought to document students' practices and perceptions rather than establish population estimates or causal relationships. In small-scale descriptive studies, sample size is often determined by the specific scope of the inquiry and practical access to participants, rather than by the need for broad generalisation (Lakens, 2022). Future research would benefit from probability sampling techniques and larger samples across multiple institutions in order to strengthen methodological rigour and improve generalisability.

Instrument

Data were collected using a structured questionnaire designed to gather both quantitative and qualitative information related to students' use of AI tools in academic writing. The questionnaire consisted of three sections: multiple-choice items, Likert-scale items, and open-ended questions.

The multiple-choice items were used to obtain factual information about students' awareness of AI writing tools, frequency of use, extent of use in academic assignments, and citation or acknowledgement practices. The Likert-scale items were included to measure students' perceptions of AI in terms of usefulness, ease of use, ethical acceptability, and its influence on writing confidence and learning. These dimensions were aligned with the theoretical framework of the study, particularly the Technology Acceptance Model (TAM) and Self-Regulated Learning (SRL), which guided the interpretation of students' engagement with AI tools. The open-ended questions were included to provide students with an opportunity to elaborate on the perceived benefits, challenges, and suggestions related to the use of AI in academic writing. Combining closed-ended and open-ended items within one questionnaire is particularly useful when researchers seek both measurable response patterns and more detailed explanatory insights (Creswell & Creswell, 2018).

To strengthen content validity, the questionnaire items were developed directly from the study objectives and aligned with the constructs represented in the Technology Acceptance Model (TAM) and Self-Regulated Learning (SRL) framework. However, the instrument was not formally pilot tested prior to administration, and reliability indices such as Cronbach's alpha were not calculated for the Likert-scale items. This should be recognised as a methodological limitation. Future studies should pilot the questionnaire with a comparable group of learners, refine ambiguous items, and report internal consistency coefficients in order to provide stronger evidence of instrument validity and reliability.

The questionnaire was administered after students had completed academic writing tasks using AI tools so that their responses would be grounded in actual experience rather than hypothetical assumptions.

Data Analysis

The quantitative data were analysed using descriptive statistics. Responses from the multiple-choice and Likert-scale items were summarised using frequencies and percentages in order to describe patterns of AI awareness, usage, perceptions, and ethical practices among the participants. Descriptive statistics were

considered appropriate because the study aimed to present a clear overview of the participants' responses rather than to test inferential relationships. Given the exploratory design, small sample size, and use of convenience sampling, inferential procedures were not applied in the present study. Nonetheless, future studies with larger and more representative samples could employ inferential statistics, such as correlation or regression analysis, to examine relationships between variables including perceived usefulness, perceived ease of use, writing confidence, and actual AI usage.

The qualitative data obtained from the open-ended responses were analysed using thematic analysis. Thematic analysis is a flexible and widely used qualitative method for identifying, organising, and interpreting recurring patterns of meaning within a dataset (Braun & Clarke, 2006). In this study, the researchers first familiarised themselves with the responses by reading the data repeatedly. Initial codes were then generated based on meaningful patterns within the responses. Related codes were subsequently grouped into broader themes, which were reviewed and refined to ensure coherence and relevance to the research objectives. Through this process, several recurring themes were identified, including grammatical support, idea generation, time-saving, over-reliance, plagiarism concerns, and difficulties in crafting effective prompts.

The use of thematic analysis enabled the researchers to interpret students' written responses in a systematic manner while preserving the depth and richness of their perspectives. Together, the quantitative and qualitative analyses provided a more comprehensive understanding of how ESL undergraduates use AI tools in academic writing and how they perceive the opportunities and challenges associated with such use.

FINDINGS

Awareness and Use of AI Tools

All respondents (100%) reported being aware of AI writing tools such as ChatGPT, Grammarly, and QuillBot. In terms of usage frequency, 6.5% of students indicated that they always use AI tools in their writing, 54.8% reported often using them, and 38.7% reported using them sometimes. These findings indicate that AI tools are widely recognised and commonly used among ESL undergraduates, suggesting that such tools have become normalised in students' academic writing practices.

Usage Frequency	Percentage
Always	6.5%
Often	54.8%
Sometimes	38.7%

The findings indicate that nearly all students integrate AI into their writing process to some degree, showing the widespread adoption and normalisation of these tools.

Extent of AI Use in Writing

The findings show that 51.6% of respondents used AI tools for 26% to 50% of their assignments, 25.8% used them for 1% to 25%, 19.4% used them for 51% to 75%, and 3.2% used them for 76% to 100% of their work. The largest proportion of students therefore relied on AI for a moderate portion of their writing tasks. This suggests that while AI plays a meaningful role in supporting academic writing, most students still attempt to balance AI assistance with their own effort, indicating moderate reliance rather than complete dependence.

51.6% use AI for 26–50% of their assignments

25.8% use AI for 1–25%

19.4% use AI for 51–75%

3.2% use AI for 76–100%

Perceptions Toward Ethical Use

With regard to ethical use, 67.7% of respondents believed that AI is acceptable if properly acknowledged, 29.0% believed that AI is acceptable only for minor edits, and 3.2% considered AI use completely acceptable. These results suggest that most students recognise the ethical boundaries associated with AI-assisted writing and generally view AI as a support tool rather than a substitute for original authorship. However, the variation in responses also indicates differing interpretations of what constitutes acceptable AI use in academic writing.

- 67.7% believed AI is acceptable with proper acknowledgement.
- 29.0% believed AI is acceptable only for minor edits.
- 3.2% believed AI is completely acceptable.

Citation and Acknowledgement Practices

In terms of citation and acknowledgement practices, 74.2% of students reported that they sometimes acknowledge their use of AI tools, 9.7% reported that they always do so, and 16.1% acknowledged AI use inconsistently. These findings reveal a gap between students' ethical awareness and their actual practices. Although many students appear to understand the importance of acknowledging AI use, this awareness is not consistently translated into systematic citation behaviour.

- Sometimes acknowledged AI use: 74.2%
- Always acknowledged AI use: 9.7%
- Applied citation practices inconsistently: 16.1%

The findings highlight a gap between awareness and practice; students agree on the need for acknowledgement but rarely apply it systematically.

Perceived Benefits (Qualitative Insights)

Analysis of the open-ended responses revealed several perceived benefits of AI-assisted writing. Students reported that AI tools helped them improve grammar, sentence structure, and writing clarity. They also identified time savings and greater productivity, as well as support for idea generation and organisation. In addition, students noted that AI tools increased their confidence in writing and helped them expand their vocabulary and improve their writing style. These responses suggest that students perceive AI not merely as a correction tool, but also as a form of linguistic, cognitive, and creative support throughout the writing process.

Several themes from open-ended responses:

- Improved grammar, sentence structure and writing clarity
- Time savings and productivity
- Better idea generation and organisation
- Increased confidence in writing ability
- Expansion of vocabulary and writing style

Most students viewed AI not simply as a correction tool, but as a creative and educational support system that enhances cognitive scaffolding in writing.

Challenges and Concerns

Despite these benefits, students also identified a number of concerns related to AI use in academic writing. Frequently mentioned issues included over-reliance on AI tools, reduced critical thinking, plagiarism risk, anxiety about Turnitin detection, inaccurate or overly generic outputs, difficulty crafting effective prompts, and limited access due to account or premium restrictions. These findings indicate that students are aware of

the limitations of AI tools and remain concerned about the implications of excessive reliance, particularly in relation to academic integrity and independent learning.

Frequently cited issues:

- Over-reliance on AI tools and reduced critical thinking
- Plagiarism risk and Turnitin detection anxiety
- Inaccurate, misleading, or generic outputs
- Difficulty crafting effective prompts
- Limited access (account or premium restrictions)

Students are aware of limitations and risks, especially regarding academic integrity and cognitive dependency.

Student Suggestions

Students offered several suggestions for institutions and educators regarding the responsible use of AI in academic writing.

Recurring suggestions for institutions:

- Establish clear ethical guidelines on acceptable AI usage.
- Provide training or seminars on the responsible use of AI in writing.
- Teach prompt-writing techniques to improve output quality.
- Encourage fact-checking and critical evaluation of AI suggestions.
- Clarify citation standards for AI-assisted work.
- Promote AI as a learning aid, not a replacement for original thought.

These suggestions reflect students' desire for clearer guidance and more structured support in navigating AI use in academic settings.

DISCUSSION AND IMPLICATIONS

The findings of this study demonstrate that AI tools have become an important part of ESL undergraduates' academic writing practices. The widespread awareness and frequent use of tools such as ChatGPT, Grammarly, and QuillBot indicate that AI is no longer peripheral but is increasingly embedded in students' writing routines. This finding is consistent with the literature reviewed earlier, which suggests that AI-powered writing tools are increasingly integrated into language learning and academic writing, particularly among ESL learners who require support in grammar, vocabulary, and idea development (Marzuki et al., 2023; Zhai, 2022). In the present study, students reported using AI mainly for idea generation, grammatical improvement, language refinement, and organisational support, which closely reflects previous findings that AI can reduce cognitive load and assist learners in managing lower-level writing demands while focusing on content development.

The findings also strongly support the relevance of the Technology Acceptance Model (TAM) in explaining students' use of AI tools. According to TAM, technology adoption is influenced by users' perceptions of a tool's usefulness and ease of use (Davis, 1989). In this study, students' positive views of AI tools in terms of saving time, improving productivity, increasing writing confidence, and supporting language accuracy indicate a high level of perceived usefulness. At the same time, the frequent use of these tools suggests that students found them accessible and manageable, reflecting perceived ease of use. These results align with studies by Wang and Han (2024) and Sharmithashini and Hashim (2025), which found that AI-based feedback and automated writing support enhance students' motivation, writing performance, and engagement. Therefore, from a TAM perspective, students' adoption of AI tools in this study can be understood as a result of their belief that these tools are both helpful and easy to integrate into their writing practices.

At the same time, the findings highlight the importance of Self-Regulated Learning (SRL) in understanding how students manage AI use in academic writing. SRL emphasises learners' ability to plan, monitor, and evaluate their own learning processes (Zimmerman, 2002). In the present study, most students reported using AI for only part of their assignments, with the majority indicating use for between 26% and 50% of their work. This suggests that students generally used AI as a support mechanism rather than as a full replacement for their own writing. Such a pattern reflects a degree of self-regulation, as students appeared to exercise some control over the extent to which AI was involved in their work. This supports Zulkefli and Ismail's (2024) argument that AI can strengthen learner autonomy when it is used critically and reflectively rather than dependently.

However, the findings also reveal the tension highlighted in the literature regarding the dual role of AI in supporting and potentially undermining learning. Although students identified many benefits of AI, they also expressed concerns about over-reliance, reduced critical thinking, plagiarism risk, and inaccurate or generic outputs. These concerns align with Kasneci et al. (2023) and Cotton et al. (2023), who warn that excessive dependence on AI may encourage passive learning and create challenges related to authorship and academic integrity. From an SRL perspective, this suggests that the value of AI depends not simply on access to the technology, but on the learner's ability to regulate its use responsibly. AI may enhance autonomy when students use it to support revision, generate ideas, or improve language, but it may weaken autonomy when students accept AI-generated content uncritically or rely on it too heavily.

Another important finding that aligns with both the literature review and the theoretical framework is students' ethical awareness. Most respondents believed that AI use is acceptable only when properly acknowledged or when used for minor editing purposes. This suggests that students do not view AI as a complete substitute for their own effort, but rather as a support tool with ethical boundaries. This reflects the perspective of Holmes et al. (2022) and Luckin et al. (2016), who conceptualise AI as a learning partner rather than a replacement for human cognition. However, the findings also show that students' acknowledgement practices were inconsistent. While many recognised the need for attribution, only a small number reported always acknowledging AI use. This gap between awareness and practice suggests that students may understand the principle of ethical AI use, but lack the institutional guidance needed to apply it consistently in academic writing.

Taken together, the findings confirm the usefulness of combining TAM and SRL as an integrated framework for understanding AI-assisted writing. TAM helps explain why students are willing to adopt AI tools, namely because they perceive them as useful and easy to use. SRL, on the other hand, helps explain how students engage with those tools, particularly whether they do so in ways that preserve autonomy, reflection, and critical thinking. The combination of these frameworks is especially valuable because it shows that successful AI integration in writing is not only about acceptance of technology, but also about the quality of learners' regulation and decision-making in using it.

These findings carry important implications for educators and institutions. For educators, the results suggest that AI literacy should be integrated into ESL writing instruction in ways that explicitly connect tool use with critical thinking and writing development. Students should be taught not only how to use AI tools effectively, but also how to evaluate outputs, write better prompts, verify information, and maintain ownership of their ideas and language. This is important because, from an SRL perspective, responsible AI use depends on students' ability to monitor and evaluate the support they receive from technology.

For institutions, the findings highlight the need for clear and consistent policies on AI use in academic work. Since students in this study demonstrated ethical awareness but inconsistent acknowledgement practices, universities should provide explicit guidance on acceptable AI use, disclosure requirements, and citation standards. Institutional workshops and training on ethical AI use, prompt writing, and fact-checking would also help students move from informal experimentation toward more responsible academic use. In this way, AI can be positioned within higher education not as a threat to learning, but as a pedagogically valuable tool that supports writing development when used within clear ethical and educational boundaries.

Overall, the discussion suggests that AI tools can enhance ESL academic writing, but only when their use is guided by both technological acceptance and learner self-regulation. The findings therefore reinforce the central argument of this study: AI is most beneficial when treated as a supportive learning partner that complements, rather than replaces, students' own critical thinking, autonomy, and writing effort.

CONCLUSION

This study examined ESL undergraduates' use of AI tools in academic writing, focusing on their awareness, extent of use, ethical perceptions, citation practices, perceived benefits, and challenges. The findings show that AI tools such as ChatGPT, Grammarly, and QuillBot are widely used and generally viewed positively by students, particularly for idea generation, grammar improvement, language refinement, organisation, and revision. These findings support existing literature suggesting that AI can serve as a useful scaffold in ESL writing by reducing linguistic difficulties and supporting writing development.

From the perspective of the Technology Acceptance Model (TAM), the study indicates that students adopted AI tools largely because they perceived them as useful and easy to use. Their responses showed that AI tools were valued for saving time, improving productivity, and increasing writing confidence. From the perspective of Self-Regulated Learning (SRL), the findings suggest that most students used AI in a selective and moderate manner, indicating that they still retained some control over their writing processes. In this sense, AI was generally perceived as a support mechanism rather than as a complete substitute for students' own effort.

However, the study also highlights important ethical and pedagogical concerns. Although students recognised the usefulness of AI, they also expressed concerns about over-reliance, reduced critical thinking, plagiarism risk, inaccurate outputs, and inconsistent acknowledgement practices. These findings suggest that while AI has considerable potential to enhance ESL writing, its educational value depends on how it is used. When used critically and responsibly, AI can support learner autonomy and writing confidence; when used unreflectively, it may weaken originality, independent thinking, and academic integrity.

Overall, this study concludes that AI tools can play a constructive role in supporting ESL undergraduates' writing, but their integration must be guided by clear pedagogical support and ethical standards. The combined use of TAM and SRL in this study demonstrates that successful AI-assisted writing depends not only on students' acceptance of the technology, but also on their ability to regulate its use critically and responsibly. AI should therefore be positioned as a learning partner that supports writing development while preserving students' authorship, autonomy, and critical engagement.

Several limitations should nevertheless be acknowledged. First, the sample size was relatively small, involving only 31 undergraduate students, which limits the extent to which the findings can be generalised to broader ESL populations. Second, the study relied on convenience sampling within a single public university and an academic writing course, meaning that the findings reflect a specific educational context and may not represent learners from other institutions, disciplines, or proficiency levels. Third, the study relied on self-reported questionnaire responses, which may be influenced by personal perceptions, memory, or social desirability bias, particularly in relation to the ethical use and acknowledgement of AI tools. Fourth, although the study was informed by TAM and SRL, the analysis remained primarily descriptive and therefore did not examine statistical relationships between key variables. Finally, while the questionnaire was aligned with the study objectives and theoretical framework, more detailed evidence of instrument validation, such as pilot testing and reliability coefficients, was not reported.

In light of these limitations, future research should involve larger and more diverse samples across multiple institutions and academic disciplines in order to provide a broader understanding of AI use in ESL writing. Where feasible, probability sampling techniques would strengthen methodological rigour and improve the external validity of the findings. Comparative studies could also examine whether patterns of AI use differ according to students' proficiency levels, institutional settings, or disciplinary backgrounds. In addition, future research could incorporate inferential statistics, such as correlation or regression analysis, to investigate relationships between variables including perceived usefulness, perceived ease of use, writing confidence,

learner autonomy, and actual AI usage. Experimental, longitudinal, or mixed-method designs would also be valuable for examining the actual effects of AI use on writing performance, particularly in terms of grammatical accuracy, coherence, originality, and critical depth. Future studies should further strengthen the measurement instrument by conducting pilot testing and reporting formal validity and reliability evidence.

Longitudinal studies would also be valuable in exploring how sustained AI use shapes learners' writing development, confidence, and autonomy over time. Since the present study identified both benefits and risks associated with AI-assisted writing, future research could further investigate how students develop self-regulatory strategies for using AI responsibly within academic contexts. Finally, future studies may explore teachers' perspectives, institutional readiness, and the effectiveness of AI literacy training in writing classrooms. Such research would contribute to a more comprehensive understanding of how AI can be integrated into ESL writing instruction in ways that are pedagogically effective, ethically responsible, and supportive of long-term learner development.

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