



Academic Writing Performance in EFL Higher Education: The Roles of AI Literacy, Ethical AI Use, and Self-Efficacy

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Abstract

Academic writing methods have changed as a result of the quick adoption of artificial intelligence writing tools in higher education, especially in the setting of English as a Foreign Language. However, a lack of AI literacy, ethical concerns, and low writing self-efficacy make it difficult for many Thai EFL undergraduates to use these tools effectively. This study investigates the relationships of AI literacy and ethical AI use with perceived academic writing performance, with self-efficacy examined as a mediator and ethical AI use as a moderator. It draws on [Bandura's \(1997\)](#) Social Cognitive Theory, contemporary AI literacy frameworks, and international AI ethics standards. A quantitative cross-sectional design was employed with 401 EFL undergraduates from four Thai universities. A questionnaire measuring perceived academic writing performance, self-efficacy, ethical AI use, and AI literacy was used to gather data. Direct, mediating, and moderating associations between variables were tested using structural equation modeling. The findings showed that both AI literacy and ethical AI use were significantly and positively associated with perceived academic writing performance. Self-efficacy partially mediates the effects of ethical AI use and AI literacy on writing performance. Additionally, ethical AI use strengthens the relationship between AI literacy and writing performance. Supplementary sub-dimensional analyses further indicated the importance of application skills and adaptive confidence, critical engagement and transparent behavior, and core writing confidence. These results show that successful AI-supported writing requires integrating technical proficiency, ethical engagement, and learner confidence. The study provides critical pedagogical and empirical insights for ethical AI integration in EFL higher education.

Keywords: AI literacy; ethical AI use; self-efficacy; academic writing performance; EFL undergraduates

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Introduction

Higher education has seen a sharp increase in the usage of artificial intelligence (AI)-assisted writing tools, which has changed how students prepare, write, edit, and assess academic papers. Applications like grammar checkers, automated feedback systems, and generative language models are becoming more and more integrated into university learning settings, especially in courses that prioritize academic writing. These tools, which provide learners with scaffolding that might not otherwise be available, are frequently emphasized in English as a Foreign Language (EFL) context as supports for linguistic accuracy, coherence, and efficiency (Gayed et al., 2022; Hwang & Tu, 2021). Badpa and Beikian (2025), in their comparative evaluation of academic writing textbooks, also recommended integrating AI-driven tools to enhance learners' engagement and interaction. Their recommendation provides further support for considering AI as part of academic writing instruction, although their study did not directly examine AI literacy or writing performance. As a result, AI-assisted writing is becoming an emerging part of academic literacy practices rather than a peripheral one. As Feng et al. (2025) documented in their systematic review of 112 studies on AI-integrated L2 writing, the majority of research has focused on undergraduate EFL learners, confirming the centrality of this population in current AI-assisted writing research.

The ethical and pedagogical ramifications of AI-supported writing are still little understood despite this quick uptake, particularly in non-Western EFL environments. There is little agreement on how students effectively interact with AI tools as part of their learning process, despite the fact that previous research typically reports increases in surface-level writing quality, such as grammar accuracy or lexical choice (Dai & Liu, 2024; Neshkovska, 2025). Their use is further complicated by issues with plagiarism, transparency, and an excessive dependence on automated systems, which raise concerns about academic integrity and responsible engagement rather than just technical efficacy (Eager & Brunton, 2023; UNESCO, 2023).

As a result, an increasing amount of research has started to highlight AI literacy as a crucial skill for students. Beyond operational abilities, AI literacy includes the capacity to assess AI outputs, strategically use tools for particular tasks, and identify their limitations (Alavi & Pakbaz, 2026; Alghamdy, 2023). This paradigm is consistent with more general frameworks for technology integration that highlight how technological tools, pedagogical intent, and domain-specific knowledge interact (Mishra & Koehler, 2006). AI literacy is especially important in EFL writing environments because students need to make both technological and linguistic decisions. However, empirical data indicates that students' levels of AI literacy differ significantly, frequently influenced by curriculum design, institutional support, and training accessibility (Polrak et al., 2024). These differences are particularly apparent in situations where national policies encourage digital transformation but implementation at the classroom level is still uneven. More broadly, Silva and Matsuda (2001) have argued that effective L2 writing pedagogy requires teachers to understand the diverse characteristics and experiences of L2

writers, a principle that extends to preparing students for AI-integrated writing environments.

A related and equally significant issue is the ethical application of AI. Transparency, accountability, and bias awareness are the cornerstones of responsible AI integration in education, according to international norms (UNESCO, 2024). However, students often express confusion regarding what is appropriate for using AI in academic writing, especially when it comes to originality, authorship, and citation (Meniado et al., 2024). This uncertainty could result in a complete avoidance of AI tools in EFL contexts or, on the other hand, an unthinking reliance on content produced by AI. Both answers complicate assessment procedures and undercut AI's instructional potential.

Beyond technical and ethical issues, the psychological aspect of AI-assisted writing, more especially, students' self-efficacy, is a crucial but understudied component. Self-efficacy is crucial in determining students' involvement, perseverance, and performance, according to [Bandura's Social Cognitive Theory \(1997\)](#). Self-efficacy affects how students handle challenging assignments, react to criticism, and control their learning techniques in writing environments. Foundational L2 composition scholarship has long recognized the importance of learner psychology; for instance, [Ferris and Hedgcock \(2023\)](#) situated writing pedagogy within learners' cognitive and affective domains, while [Hedgcock \(2005\)](#) emphasized that theoretical orientations in L2 teaching must account for learner confidence and engagement. According to recent studies, the use and perception of AI tools can either increase or decrease writing self-efficacy ([Apridayani & Teo, 2021](#); [De Vleeschauwer, 2023](#)). Some students benefit from AI's ability to boost their confidence, while others feel more dependent and anxious about their ability to function on their own.

AI literacy, ethical AI use, and self-efficacy have all been studied separately in the past, but their combined and interacting effects on perceived academic writing ability are still little understood, especially in EFL higher education environments outside of Western settings. Instead of treating self-efficacy as a psychological mechanism via which AI-related competencies transform into performance, existing research frequently examines it as an outcome variable. In a similar vein, ethical AI use is usually considered normatively rather than experimentally as a factor that influences or enhances the efficacy of AI literacy. Because of this, there isn't much actual data that explains how and when AI literacy improves writing results. Historically, [Leki et al. \(2008\)](#) synthesized decades of L2 writing research and noted persistent gaps between research and pedagogy, while [Silva and Leki \(2004\)](#) traced how L2 writing's interdisciplinary roots (composition studies and applied linguistics) have created both richness and fragmentation, tensions that remain visible in the fragmented treatment of AI, ethics, and self-efficacy today.

In the case of Thai EFL, this disparity is particularly noticeable. As [Ferris and Hedgcock \(2023\)](#) emphasized in their pedagogical framework, effective L2 composition instruction must be responsive to local contexts, including institutional

support and teacher preparedness. Through national initiatives like Thailand 4.0, Thailand has actively promoted digital transformation in higher education; however, studies consistently report low adoption of AI writing tools among undergraduates and limited institutional guidance on ethical use (Krajka & Olszak, 2024; Subaveerapandiyana et al., 2024; Samngamjan et al., 2024; Worapongpat, 2025). Thai EFL students frequently experience ongoing difficulties with academic writing while also showing reluctance to use AI technologies because of inadequate training, moral ambiguity, and low confidence. Thailand is a theoretically and pedagogically relevant setting for investigating the relationship between self-efficacy, ethical involvement, and AI literacy because of these factors.

In order to close this gap, the current study examines the relationships of ethical AI usage and AI literacy on the perceived academic writing ability of EFL undergraduates, using self-efficacy as a mediating mechanism and ethical AI use as a moderating factor. The paper offers a conceptual model that takes into consideration the technical, moral, and psychological aspects of AI-assisted writing by fusing Bandura's (1997) Social Cognitive Theory with AI literacy and ethics frameworks. The study intends to: (1) investigate the direct relationships of ethical AI use and AI literacy on academic writing performance; (2) assess the mediation function of self-efficacy; and (3) investigate whether ethical AI use enhances the link between AI literacy and writing performance. Feng et al. (2025) recently called for further research on AI literacy development in L2 writing. Although the present cross-sectional design cannot examine longitudinal development, it contributes by testing the relationships among AI literacy, ethical AI use, self-efficacy, and perceived writing performance.

The contribution of this study lies in integrating technical, ethical, and psychological dimensions of AI-assisted academic writing within a single explanatory model. Previous research has examined AI-assisted writing, AI literacy, ethical AI use, and learner self-efficacy, but these dimensions have often been investigated separately. The present study connects these dimensions by examining AI literacy and ethical AI use in relation to perceived academic writing performance, while also testing self-efficacy as a mediating mechanism and ethical AI use as a moderator of the AI literacy–writing relationship. Thus, rather than examining whether AI use alone is associated with writing, the proposed model considers how technical competence, responsible use, and learner beliefs operate together in AI-supported EFL writing. This integrated approach provides a more specific account of these relationships among EFL undergraduates in the Thai higher education context.

Literature Review and Hypothesis Development

AI Literacy and Academic Writing Performance

With AI-powered tools increasingly mediating students' writing processes, AI literacy has become a crucial ability in modern higher education. The operational definition of AI literacy in this study is the capacity of students to comprehend, assess, and use AI tools in academic writing assignments in an appropriate and successful manner. In line with recent educational conceptualizations that frame AI

literacy as a higher-order cognitive competence rather than a purely digital skill, this definition goes beyond basic technical operation to include evaluative judgment and strategic application (Alghamdy, 2023; Mishra & Koehler, 2006; Samngamjan et al., 2024).

Previous studies have not reported uniformly positive outcomes from AI-assisted writing. While AI writing tools can support linguistic accuracy, writing efficiency, and feedback during the writing process (Gayed et al., 2022; Zhao, 2023), other research has raised concerns about over-reliance on AI and insufficient critical engagement with AI-generated output (Zou et al., 2024). Bahremand et al. (2026) examined AI-supported microlearning in relation to vocabulary, grammar, and discourse competence among EFL learners. Their study provides a relevant context for examining the linguistic dimensions of AI-supported learning. These differences suggest that access to AI tools alone may not determine writing outcomes. One possible explanation is variation in students' AI literacy, which involves not only the ability to use AI tools but also the capacity to evaluate their outputs and apply them appropriately for particular tasks (Alghamdy, 2023; Samngamjan et al., 2024). Students with limited evaluative competence may accept AI-generated suggestions without sufficient critical examination, increasing the risk of inaccurate content, inappropriate language, or reduced authorial control. In contrast, stronger AI literacy enables students to evaluate AI-generated information and make more strategic decisions about when and how AI support should be incorporated into their writing (Alghamdy, 2023). Therefore, differences in students' ability to evaluate and strategically apply AI may help explain why AI-assisted writing produces different outcomes across learners and contexts.

Learner-level educational factors may further shape how students engage with AI-supported writing. Yan et al. (2026), for example, examined feedback-seeking interactions between EFL writers and GenAI and found that differences in language proficiency and technological competence were associated with different interaction patterns. The learner with stronger language and technological competence developed more sophisticated prompting strategies and engaged more effectively in dialogic interaction with GenAI, whereas the moderately proficient learner relied on simpler prompts and showed weaker sustained engagement. These findings suggest that students' ability to benefit from GenAI-supported writing may depend not only on access to AI tools but also on their language proficiency, technological competence, and ability to seek and process feedback through interaction.

Although direct empirical evidence linking AI literacy to academic writing performance remains limited, the broader literature on AI-assisted writing provides a reasonable basis for examining this relationship. AI literacy involves not only technical knowledge but also the ability to evaluate AI-generated information and apply AI tools strategically to academic tasks (Samngamjan et al., 2024). These competencies may help students make more informed decisions when using AI during writing rather than accepting generated content uncritically. At the same time, the mixed findings reported in the broader AI-assisted writing literature suggest that access to and use of AI alone do not consistently produce better writing

outcomes. Therefore, the relationship between AI literacy and academic writing performance remains an empirical question rather than an established effect. Accordingly, this study examines whether higher AI literacy is associated with better academic writing performance among EFL undergraduates.

H1: AI literacy is positively associated with EFL undergraduates' perceived academic writing performance.

Ethical AI Use in Academic Writing

Ethical considerations have become central to debates surrounding AI integration in education, particularly in relation to academic writing. Ethical AI use is commonly framed around principles such as transparency, accountability, and bias awareness, as articulated in international guidelines (UNESCO, 2023, 2024). In educational settings, these principles translate into practices such as acknowledging AI assistance, critically reviewing AI-generated content, and recognizing the limitations or biases embedded in algorithmic systems (Amini et al., 2026).

Much of the existing literature treats ethical AI use primarily as a matter of academic integrity or policy compliance. From this perspective, ethics is positioned as a constraint on AI use rather than as a factor that shapes learning outcomes. However, emerging research suggests that ethical engagement with AI may be directly relevant to performance, particularly in writing tasks that require originality, coherence, and critical reasoning (Eager & Brunton, 2023; Subaveerapandiyan et al., 2025).

Students who engage transparently and responsibly with AI tools are more likely to maintain authorial control over their texts, integrate AI suggestions selectively, and verify content against disciplinary norms (Wang et al., 2026). In contrast, unethical or unreflective use, such as copying AI-generated text without evaluation, can undermine text quality, introduce inaccuracies, and weaken argumentative coherence. Ethical AI use, therefore, functions not only as a normative requirement but also as a *performance-relevant behavior* that influences how effectively AI tools contribute to writing outcomes.

In EFL contexts, ethical ambiguity is particularly pronounced. Studies report that many students are uncertain whether using AI tools constitutes plagiarism, how AI-generated content should be cited, or where the boundary lies between assistance and substitution (Meniado et al., 2024). This uncertainty can lead to avoidance of AI tools altogether or to overreliance without critical engagement, both of which may limit learning gains. Importantly, these patterns are not evenly distributed; they often reflect institutional guidance, cultural norms, and individual differences in ethical awareness.

Existing research therefore provides stronger evidence for the importance of ethical AI use in maintaining academic integrity and responsible authorship than for a direct relationship between ethical AI use and writing performance. Studies

have raised concerns about plagiarism, inappropriate attribution, over-reliance on AI-generated text, and uncertainty about acceptable AI assistance in academic writing (Eager & Brunton, 2023; Meniado et al., 2024; UNESCO, 2023, 2024). At the same time, responsible AI engagement may support writing by encouraging students to critically review AI-generated content, retain control over their texts, and make deliberate decisions about whether and how AI suggestions should be incorporated. However, empirical research directly testing whether ethical AI use is associated with stronger academic writing performance remains limited. Thus, rather than assuming that ethical AI use produces better writing, the present study empirically tests whether a positive relationship exists between these variables.

H2: Ethical AI use is positively associated with EFL undergraduates' perceived academic writing performance.

Self-Efficacy in AI-Supported Writing

Self-efficacy, defined as individuals' belief in their capability to perform specific tasks successfully, is a well-established predictor of academic performance (Bandura, 1997). In writing research, self-efficacy has been linked to greater persistence, more effective strategy use, and higher-quality written output. Students with strong writing self-efficacy are more likely to engage in revision, seek feedback, and regulate their writing processes effectively (Geng, et al., 2024). However, research on other psychological characteristics has not always identified significant relationships with writing ability. Esmaeili et al. (2015), for example, found no significant relationship between overall emotional intelligence and writing ability among Iranian EFL university students. Although emotional intelligence differs conceptually from self-efficacy, this finding suggests that relationships between psychological characteristics and writing performance should be examined empirically rather than assumed.

The introduction of AI tools complicates this relationship. On one hand, AI can function as a scaffold, reducing cognitive load and providing immediate feedback, thereby enhancing learners' confidence and perceived competence (Selim, 2023). On the other hand, excessive reliance on AI may undermine students' belief in their independent writing ability, leading to anxiety or dependency (De Vleeschauwer, 2023). As a result, AI-assisted writing environments may both strengthen and weaken self-efficacy, depending on how tools are integrated into learners' practices.

From a social cognitive perspective, self-efficacy provides a plausible psychological mechanism connecting students' AI-related competencies with their writing outcomes. Bandura (1997) explains that self-efficacy develops partly through mastery experiences and influences how individuals approach tasks, sustain effort, and respond to difficulties. In writing research, stronger self-efficacy has also been associated with greater persistence, strategy use, and writing performance. However, AI-supported writing introduces a more complex relationship. Students

who understand how to evaluate and strategically use AI may experience greater control over the writing process, while responsible AI use may encourage them to retain ownership of their decisions rather than depend uncritically on generated content. These experiences may strengthen confidence in managing academic writing tasks. Conversely, limited AI literacy or excessive dependence on AI may reduce perceived control and confidence in independent writing (De Vleeschauwer, 2023; Selim, 2023). Self-efficacy may therefore represent one psychological pathway through which AI literacy and ethical AI use are associated with academic writing performance.

Despite the established relationship between self-efficacy and academic performance, its specific mediating role in AI-assisted EFL writing remains insufficiently examined. Previous research provides theoretical and empirical support for self-efficacy as an important psychological factor in writing, but considerably less is known about whether it explains the relationship between students' AI-related competencies and their academic writing performance. In particular, limited evidence has tested self-efficacy as a mediator between AI literacy and writing performance or between ethical AI use and writing performance. The present study therefore examines these indirect relationships rather than assuming that AI-related competencies translate directly into stronger writing outcomes.

H3: Self-efficacy mediates the relationship between AI literacy and academic writing performance.

H4: Self-efficacy mediates the relationship between ethical AI use and academic writing performance.

Conceptual Framework and Hypotheses

Drawing on Social Cognitive Theory and contemporary AI literacy and ethics frameworks, this study proposes a conceptual model in which AI literacy and ethical AI use function as antecedent variables associated with academic writing performance directly and indirectly through self-efficacy. AI literacy represents students' technical and evaluative competence, while ethical AI use reflects responsible engagement with AI tools. Self-efficacy is positioned as a psychological mechanism that translates these competencies into effective writing behavior.

Beyond its direct relationship with academic writing performance, ethical AI use may also function as a condition that shapes how students apply their AI literacy in writing. AI literacy provides students with the knowledge and evaluative skills needed to use AI tools, but these competencies do not necessarily ensure that AI is used responsibly. Students with similar levels of AI literacy may differ in how transparently they acknowledge AI assistance, how critically they evaluate generated content, and how much authorial control they retain during writing. Existing literature emphasizes that responsible AI engagement requires critical evaluation, transparency, accountability, and awareness of the ethical boundaries of AI-assisted

academic work (Meniado et al., 2024; UNESCO, 2023, 2024). Therefore, ethical AI use may strengthen the relationship between AI literacy and academic writing performance by encouraging students to apply their AI-related competencies in ways that preserve critical judgment and authorial responsibility. However, because direct empirical evidence for this moderating relationship remains limited, the proposed interaction is treated as a relationship to be empirically tested rather than an established effect.

H5: Ethical AI use moderates the relationship between AI literacy and academic writing performance, such that the relationship is stronger at higher levels of ethical AI use.

Together, these hypotheses form an integrated model that accounts for technical, ethical, and psychological dimensions of AI-assisted academic writing in EFL higher education.

Methodology

Research Design

This study adopted a quantitative, cross-sectional research design to investigate the relationships among AI literacy, ethical AI use, self-efficacy, and perceived academic writing performance among EFL undergraduates. Structural equation modeling (SEM) was employed to test the hypothesized direct, mediating, and moderating relationships, as SEM enables the simultaneous estimation of complex relationships among latent constructs while accounting for measurement error (Hair et al., 2019). This approach is widely used in educational and applied linguistics research examining psychological and behavioral variables in technology-enhanced learning contexts.

Participants and Context

Participants were EFL undergraduates recruited from four Thai universities offering bachelor's degree programs in English or closely related EFL-oriented majors. A purposive sampling strategy was employed, targeting second-, third-, and fourth-year students, as these cohorts are more likely to have sustained experience with academic writing tasks and exposure, formal or informal, to AI-assisted writing tools. A total of 421 questionnaires were collected. Following data screening procedures, including checks for incomplete responses, response patterns, and multivariate outliers, 401 valid questionnaires were retained for final analysis. This sample size exceeded recommended minimum thresholds for SEM analysis and provided adequate statistical power for testing the proposed model (Kline, 2016; Hair et al., 2019).

The final sample consisted of 401 Thai EFL undergraduates from four universities. Participants represented different age groups, genders, and academic years. The demographic characteristics of the sample are presented in Table 1.

Table 1
Demographic Characteristics of Participants (N = 401)

Demographic Variable	Category	N	%
Age Group	18–20 years	165	41.1
	21–23 years	175	43.6
	24–26 years	48	12.0
	27 years and above	13	3.2
Gender	Male	132	32.9
	Female	263	65.6
	Other	6	1.5
Academic Year	1st Year	146	36.4
	2nd Year	156	38.9
	3rd Year	76	19.0
	4th Year	22	5.5
	5th Year and above	1	0.2

As shown in Table 1, most participants were between 18 and 23 years old (84.7%), and approximately two-thirds were female (65.6%). First- and second-year students constituted the largest academic-year groups, together accounting for 75.3% of the sample.

Participants were enrolled in university programs involving English-language study and academic writing. Individual English proficiency was not independently assessed using a standardized measure such as IELTS or TOEFL. Academic year and participation in English-related university programs therefore provide information about participants' educational exposure but should not be interpreted as standardized indicators of English proficiency. The absence of an independent proficiency measure is acknowledged as a limitation of the study.

Most participants had previous experience with AI tools, with 345 (86.0%) reporting prior AI use and 56 (14.0%) reporting no previous experience. AI use was also relatively frequent: 183 participants (45.6%) reported using AI often and 104 (25.9%) very often, while 92 (22.9%) reported using it sometimes, 18 (4.5%) rarely, and four (1.0%) never. ChatGPT was the most frequently reported AI tool (97.0%, $n = 389$), followed by Grammarly (13.5%, $n = 54$), QuillBot (3.5%, $n = 14$), and DeepSeek (3.0%, $n = 12$). Because participants could report more than one AI tool, percentages for tool use do not sum to 100%.

Instruments

Data were collected using a questionnaire consisting of demographic and AI-use questions followed by 60 Likert-scale items comprising four 15-item constructs: perceived academic writing performance (AWP), AI literacy (AIL), ethical AI use (EAU), and self-efficacy (SE). Responses were recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The items

were developed for the present study and informed by relevant theoretical and empirical literature, with wording contextualized to AI-supported academic writing in EFL higher education.

Academic Writing Performance (AWP) comprised 15 researcher-developed items assessing students' perceived performance across three dimensions: organization, content development, and language accuracy. These dimensions were informed by academic writing assessment literature identifying text structure, argument development and supporting evidence, and language use as central components of academic writing performance (Yung & Cai, 2020). The items were contextualized to EFL academic writing rather than adapted from a pre-existing questionnaire. Because AWP was measured through questionnaire responses, it is interpreted as perceived or self-reported academic writing performance rather than an objective assessment of writing ability. A representative item was, "Each paragraph I write has one main idea with supporting details."

AI Literacy (AIL) comprised 15 items across operational knowledge, application skills, and adaptive confidence. Item development was informed by AI-literacy literature, particularly work conceptualizing AI literacy as involving the knowledge and skills required to understand, use, evaluate, and appropriately engage with AI (Ng et al., 2024; Zhang et al., 2025). The items were contextualized to academic writing and addressed students' understanding of AI writing tools, ability to apply and critically evaluate AI-generated suggestions, and confidence in adapting AI use to different writing needs. A representative item was, "I evaluate AI suggestions for relevance to my topic."

Ethical AI Use (EAU) comprised 15 items across responsible practices, critical engagement, and transparent behaviors. Item development was informed by UNESCO's Recommendation on the Ethics of Artificial Intelligence, particularly the principles of transparency and explainability, responsibility and accountability, human oversight, awareness and literacy, and fairness and non-discrimination (UNESCO, 2022). These principles were contextualized into student-level statements concerning responsible AI use, critical evaluation of AI outputs, transparency regarding AI assistance, and awareness of potential bias. The items therefore represent a contextual operationalization of UNESCO's principles rather than an adaptation of a pre-existing UNESCO questionnaire. A representative item was, "I critically evaluate all AI suggestions before use."

Self-Efficacy (SE) comprised 15 items across writing process, AI integration, and core confidence. Item development was informed by Bandura's (1997) task-specific conception of self-efficacy and contextualized to academic writing and AI-supported writing. The items addressed students' perceived capability to manage writing tasks, make appropriate decisions about AI integration, overcome writing difficulties, and produce academic writing successfully.

Before the main data collection, the questionnaire underwent translation and review for linguistic and conceptual appropriateness. Two bilingual experts independently translated the English questionnaire into Thai, and a third linguist back-translated the Thai version into English to check consistency. Three Thai EFL

instructors then reviewed both versions to resolve discrepancies and confirm conceptual equivalence. The questionnaire was subsequently pilot-tested with 30 students.

Supplementary Writing-Sample Analysis

To supplement the questionnaire findings, 31 final written assignments were obtained for a limited exploratory analysis of textual overlap. At each data collection site, the lecturer assisting with data collection was asked whether anonymized assignments from students in the participating classes could be made available for supplementary analysis. The number of assignments therefore depended on their availability across the participating sites, resulting in a total of 31 samples. All assignments were anonymized by the lecturers before being provided to the researcher. The assignments were screened using Turnitin's Similarity Report to identify patterns of textual overlap. Similarity indicators were treated as preliminary screening evidence rather than definitive evidence of plagiarism or academic misconduct. This supplementary analysis was not included in the SEM but was used to provide contextual evidence for interpreting students' self-reported ethical AI practices.

The similarity index was treated as an indicator of textual overlap rather than as evidence of plagiarism. No fixed similarity threshold was used to classify an assignment as plagiarized, because the interpretation of similarity depends on the nature and source of the matched text. AI-generated authorship was also not inferred from the similarity reports, and no separate AI-detection procedure was applied to these assignments.

Data Collection Procedure

Data collection took place during the academic semester. The questionnaire was administered onsite, and participation was voluntary. Students were informed of the study's purpose and assured of anonymity and confidentiality prior to participation. No academic incentives or penalties were associated with participation. Ethical approval was obtained in accordance with institutional research guidelines.

Data Analysis

Data analysis was conducted using SPSS and AMOS. Initial screening procedures included checks for missing data, normality, and outliers. Descriptive statistics were computed for all variables. A confirmatory factor analysis (CFA) was conducted before structural testing to evaluate the measurement model. Internal consistency was assessed using Cronbach's α and composite reliability (CR), while convergent validity was examined through standardized factor loadings and average variance extracted (AVE). Discriminant validity was evaluated using the Fornell–Larcker criterion and heterotrait–monotrait (HTMT) ratios. Model fit was assessed using CFI, TLI, RMSEA, and SRMR following established cutoff criteria (Hair et al., 2019).

The structural model was then tested to examine hypothesized direct effects (H1–H2). Mediation effects involving self-efficacy (H3–H4) were assessed using bootstrapping procedures with bias-corrected confidence intervals. Moderation analysis (H5) was conducted using a latent interaction SEM approach. An interaction term representing AI Literacy $\times$ Ethical AI Use was specified within the structural model, and the significance of the interaction coefficient was used to assess the moderating effect. The interaction pattern was further examined at low (-1 SD), mean, and high ($+1$ SD) levels of ethical AI use.

Methodological Rigor and Limitations

Although the study employed a robust analytical approach, certain limitations should be acknowledged. Academic writing performance was assessed through students' self-reported perceptions rather than an objective standardized writing test. Therefore, the findings represent perceived academic writing performance and should not be interpreted as direct evidence of students' actual writing competence. Self-reported assessments may also be influenced by students' confidence, self-awareness, or response tendencies. Future studies should incorporate objective writing assessments or independently rated writing tasks to examine whether the observed relationships are also reflected in demonstrated writing performance.

In addition, the purposive sampling strategy and the characteristics of the participating sample limit the generalizability of the findings beyond the participating Thai EFL contexts. Individual English proficiency was not independently assessed using a standardized proficiency measure, which also limits conclusions regarding whether the observed relationships differ across proficiency levels. In addition, purposive sampling from four Thai universities limits the generalizability of the findings beyond the participating Thai EFL contexts. Individual English proficiency was not independently measured, which also limits conclusions regarding whether the observed relationships vary according to proficiency level. The supplementary writing samples provided additional contextual evidence alongside the self-reported questionnaire data.

Results

Preliminary Analyses

Prior to hypothesis testing, the dataset was screened for completeness, normality, and multivariate outliers. Of the 421 questionnaires collected across four universities, 20 responses were excluded due to incomplete data or response patterns indicating low engagement, resulting in a final sample of 401 participants. Descriptive statistics indicated acceptable distributional properties for all observed variables, with skewness and kurtosis values within recommended ranges for SEM analysis.

Correlations among the main constructs were positive and statistically significant, providing preliminary support for the proposed relationships. No indications of multicollinearity were observed, as variance inflation factor (VIF) values remained well below commonly accepted thresholds.

Descriptive Statistics and Correlations

Table 2 presents the means and standard deviations of the main study variables. Ethical AI use showed the highest mean score, followed by AI literacy, perceived academic writing performance, and self-efficacy. No evidence of multicollinearity was observed, with correlation coefficients remaining below critical thresholds.

Table 2

Descriptive Statistics

Construct	N Items	Mean	SD
Writing Performance	15	3.72	0.68
AI Literacy	15	3.85	0.73
Ethical AI Use	15	4.02	0.71
Self-Efficacy	15	3.65	0.76

As shown in Table 2, mean scores ranged from 3.65 for self-efficacy to 4.02 for ethical AI use, indicating generally moderate-to-high levels across the four constructs.

Measurement Model

As shown in Table 3, a confirmatory factor analysis (CFA) was conducted to assess the adequacy of the measurement model prior to hypothesis testing. The model included four higher-order constructs: AI Literacy, Ethical AI Use, Self-Efficacy, and Perceived Academic Writing Performance.

Table 3

Measurement Model Reliability and Convergent Validity

Construct	Items	Standardized Loading Range	Cronbach's α	CR	AVE
Perceived Academic Writing Performance	15	.68–.82	.91	.92	.58
AI Literacy	15	.71–.84	.85	.89	.61
Ethical AI Use	15	.73–.86	.86	.88	.63
Self-Efficacy	15	.69–.83	.90	.93	.59

Note. All standardized factor loadings were significant at $p < .001$. CR = composite reliability; AVE = average variance extracted.

All standardized factor loadings were significant ($p < .001$) and ranged from .68 to .86. Cronbach's α (.85–.91) and CR (.88–.93) exceeded the recommended .70 threshold, indicating satisfactory internal consistency. AVE values ranged from .58 to .63 and exceeded .50, supporting convergent validity. Discriminant validity was also supported: the square root of AVE for each construct exceeded its correlations with the other constructs, satisfying the Fornell–Larcker criterion, and all HTMT ratios (.53–.73) were below the conservative .85 threshold.

The four-factor measurement model also demonstrated acceptable fit, $\chi^2/df = 2.31$, CFI = .94, TLI = .93, RMSEA = .049, and SRMR = .043, supporting its adequacy for subsequent structural analysis.

Supplementary Sub-Dimensional Analysis

A supplementary sub-dimensional analysis in Table 4 was conducted to examine the relative contribution of the theoretically defined dimensions within each construct. Proxy subscale loadings were calculated by averaging the standardized item loadings within each five-item subscale. These values were used as supplementary indicators of the relative contribution of each sub-dimension to its corresponding construct rather than as independently estimated structural effects.

Table 4

Supplementary Sub-Dimensional Analysis

Construct	Sub-dimension	Proxy Loading
Perceived Academic Writing Performance	Organization	.594
	Content Development	.570
	Language Accuracy	.614
AI Literacy	Operational Knowledge	.520
	Application Skills	.618
	Adaptive Confidence	.674
Ethical AI Use	Responsible Practice	.546
	Critical Engagement	.542
	Transparent Behavior	.556
Self-Efficacy	Writing Process	.592
	AI Integration	.468
	Core Confidence	.658

Note. Proxy loadings represent the average standardized item loadings within each theoretically defined sub-dimension and should not be interpreted as independently estimated structural effects.

The results showed variation in the relative contribution of the sub-dimensions. Language Accuracy showed the highest proxy loading for perceived academic writing performance (.614). Within AI Literacy, Adaptive Confidence had the highest loading (.674), followed by Application Skills (.618), while Operational Knowledge showed the lowest loading (.520). The three Ethical AI Use dimensions showed relatively similar loadings (.542–.556), indicating balanced contributions to the overall construct. Within Self-Efficacy, Core Confidence showed the highest loading (.658), followed by Writing Process (.592), whereas AI Integration showed the lowest loading (.468).

Structural Model and Direct Effects

The structural model results in Table 5 were examined to test the hypothesized direct relationships of AI literacy and ethical AI use with perceived academic writing performance, as well as the proposed indirect and moderating relationships. Overall model fit remained satisfactory and comparable to the measurement model.

Table 5

Structural Path Estimates for Direct Effects

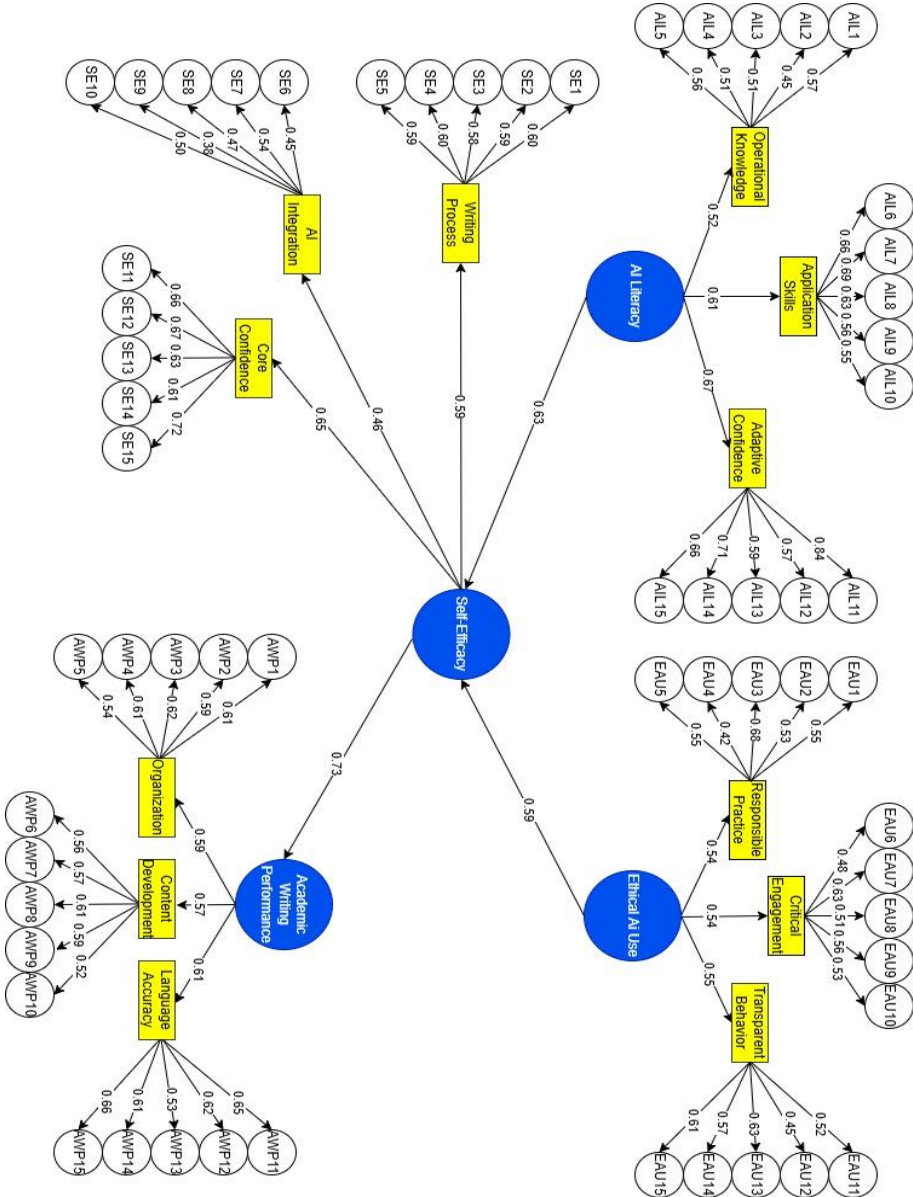
Path	β	SE	t	p
AI Literacy → Writing Performance	.28	.04	6.82	< .001
Ethical AI Use → Writing Performance	.19	.05	4.12	< .001
AI Literacy → Self-Efficacy	.42	.04	9.67	< .001
Ethical AI Use → Self-Efficacy	.31	.05	6.45	< .001
Self-Efficacy → Writing Performance	.46	.04	10.33	< .001

Note. All structural paths were statistically significant at $p < .001$.

Figure 1 presents the final structural model with standardized path coefficients. As illustrated, AI literacy and ethical AI use both showed significant positive direct associations with perceived academic writing performance, while significant indirect associations were also observed through self-efficacy. The model further showed a significant moderating role of ethical AI use in the relationship between AI literacy and perceived writing performance. All reported paths are statistically significant.

Figure 1

Final Structural Model with Standardized Path Coefficients



Mediation Analysis

Bootstrapping procedures (5,000 resamples) were used to test the mediating role of self-efficacy. In table 6, bias-corrected confidence intervals were examined to determine the significance of indirect effects.

Table 6

Mediation Effects of Self-Efficacy

Hypothesis	Indirect Path	β	SE	95% CI	p	Decision
H3	AI Literacy → SE → Writing Performance	.193	.03	[.142, .251]	< .001	Supported
H4	Ethical AI Use → SE → Writing Performance	.143	.03	[.098, .195]	< .001	Supported

Note. Bias-corrected 95% confidence intervals were based on 5,000 bootstrap samples. Indirect effects were considered significant when the confidence interval did not include zero. Both indirect effects were significant at $p < .001$.

In both cases, self-efficacy partially mediated the relationship between the predictor and perceived academic writing performance, as the direct associations remained statistically significant after inclusion of the mediator.

Moderation Analysis

To test Hypothesis 5, a latent interaction term representing AI Literacy × Ethical AI Use was specified within the structural model. The significance of the interaction coefficient was examined to determine whether the relationship between AI literacy and perceived academic writing performance varied across levels of ethical AI use.

Table 7

Moderation Effect of Ethical AI Use

Effect	Std. β	SE	t-value	p-value	95% CI	Interpretation
Main Effect: AI Literacy → WP	0.28	0.04	6.82	< .001	[0.20, 0.36]	Significant
Main Effect: Ethical AI Use → WP	0.19	0.05	4.12	< .001	[0.10, 0.28]	Significant
Interaction: AIL × EAU → WP	0.18	0.04	4.27	< .001	[0.10, 0.26]	Significant Interaction
Self-Efficacy → WP (control)	0.46	0.04	10.33	< .001	[0.38, 0.54]	Significant

Note. AIL = AI Literacy; EAU = Ethical AI Use; WP = Writing Performance. All reported effects were statistically significant at $p < .001$.

Follow-up simple-slopes analysis showed that the association between AI literacy and perceived academic writing performance increased from low ethical AI use (-1 SD; $\beta = .15$, $p = .023$) to the mean ($\beta = .28$, $p < .001$) and high ethical AI use ($+1$ SD; $\beta = .41$, $p < .001$), indicating a stronger positive association at higher levels of ethical AI use. The significant interaction therefore supported H5, indicating that the positive association between AI literacy and perceived academic writing performance was stronger at higher levels of ethical AI use.

Supplementary Evidence from Writing Samples

As a limited exploratory analysis, 31 anonymized writing assignments were examined to illustrate patterns of textual overlap. The assignments were obtained from participating classes based on availability through assisting lecturers. The assignments were screened using Turnitin's Similarity Report. Similarity scores were treated only as indicators of textual overlap and not as measures of writing quality, plagiarism, AI-generated writing, or academic writing performance. This analysis was not included in the SEM.

Table 8

Representative Cases from the Supplementary Writing-Sample Analysis

Case	Course/ Topic	Turnitin Similarity Index	Representative Anonymized Excerpt	Interpretation
Case A	Language Testing	4%	“Testing is important in education because teacher need to know what students already learn. A good test should measure the knowledge and skills that students study in the course. Teacher can also use the test result to find students problem and improve the teaching.”	Only limited textual overlap was identified. The low similarity score suggested that most of the assignment did not match material in the comparison database.
Case B	Learning Strategies	13%	“Students use different learning strategies when they study English. Some students like taking note and repeat the new words, but some students can learn better when practice with their friends. If students choose suitable strategy, it can help them understand lesson and become more independent learner.”	Several short passages showed similarity with existing material. The overlap was limited and was not considered sufficient by itself to establish inappropriate source use.
Case C	Chiang Mai Air Pollution	27%	“Air pollution is serious problem in Chiang Mai, especially in dry season. There are many smoke from forest fire, burning agriculture waste	A greater amount of textual overlap was identified in the assignment. The higher similarity warranted

and also traffic. These can make PM2.5 in the air become higher. It can affect people health and make people difficult to live their daily life.”	closer examination of the matched passages, but the percentage alone was not treated as evidence of plagiarism.
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Note. Turnitin similarity scores indicate textual matches with material in its comparison database and were not treated as direct evidence of plagiarism or AI-generated writing.

The representative cases show that similarity indices reflected different forms of textual overlap across assignments from different academic subjects. The low-similarity case involved only a short common expression, whereas the higher-similarity case contained a longer matched passage that warranted closer examination. These examples were included to make the supplementary analysis transparent and to clarify how the Turnitin results were interpreted. Because the assignments were drawn from different courses and were not scored with a common writing rubric, they were not used as an objective measure of academic writing performance or as evidence of plagiarism or AI-generated writing. Instead, they served only as contextual evidence alongside the questionnaire findings.

Summary of Results

The results in Table 9 provide consistent empirical support for the proposed structural model examining the relationships among AI literacy, ethical AI use, self-efficacy, and academic writing performance among Thai EFL undergraduates. All five hypothesized relationships were supported. AI literacy and ethical AI use were both significantly and positively associated with perceived academic writing performance, indicating that students’ technical–evaluative competence with AI tools and their responsible engagement practices independently were associated with higher perceived writing performance.

Table 9

Summary of Hypothesis Testing

Hyp.	Description	Result
H1	AI literacy → Writing performance	Supported
H2	Ethical AI use → Writing performance	Supported
H3	Mediation by self-efficacy (AI literacy)	Supported (partial mediation)
H4	Mediation by self-efficacy (ethical AI use)	Supported (partial mediation)
H5	Moderation by ethical AI use	Supported

Discussion

The present study examined the relationships among AI literacy, ethical AI use, self-efficacy, and academic writing performance among Thai EFL undergraduates. By integrating technical, ethical, and psychological dimensions within a single structural model, the study responds to recent calls for more holistic investigations of AI-assisted writing in EFL contexts (Dai & Liu, 2024). Overall, the findings provide strong empirical support for the proposed framework and offer several theoretically and pedagogically meaningful insights. Reflecting the intellectual history traced by Silva and Leki (2004), the present study brings together influences from applied linguistics (technical competence) and composition studies (writer psychology and ethics), illustrating how L2 writing research continues to benefit from its interdisciplinary roots.

AI Literacy and Academic Writing Performance

AI literacy was significantly and positively associated with perceived academic writing performance, supporting Hypothesis 1. This finding aligns with prior research suggesting that AI tools can enhance writing outcomes when learners possess sufficient competence to evaluate and apply AI-generated feedback effectively (Gayed et al., 2022; Zhao, 2023). Importantly, the present study extends this line of research by demonstrating that AI literacy functions as a *latent, multidimensional construct*, rather than merely reflecting frequency of tool use.

Within the Thai EFL context, this result is particularly salient. Previous studies have reported low or uneven adoption of AI writing tools among Thai undergraduates, often attributing this pattern to lack of training or institutional support (Polrak et al., 2024; Samngamjan et al., 2024). The present findings suggest that access alone is insufficient; rather, students' ability to critically engage with AI output and strategically integrate AI support into their writing process is associated with higher perceived writing performance. This helps explain why earlier studies have produced mixed results regarding the effectiveness of AI-assisted writing in EFL contexts (Neshkovska, 2025).

The relationship observed in the present study may also be shaped by learner-level educational differences that were not directly modeled. Yan et al. (2026) showed that EFL learners with different levels of language proficiency and technological competence engaged differently in feedback-seeking interactions with GenAI. The learner with stronger language and technological competence used more developed prompting strategies and sustained more effective dialogic interaction, while the moderately proficient learner tended to use simpler prompts and showed less sustained engagement. This suggests that AI literacy may operate differently depending on students' linguistic resources, technological competence, and ability to engage actively with AI-generated feedback. In the present study, individual English proficiency was not independently measured, so future research should examine whether proficiency and feedback-seeking patterns condition the relationships identified in the structural model.

From a theoretical perspective, this finding supports the view of AI literacy as a learner-level competence involving the knowledge and evaluative skills required for meaningful engagement with AI-supported writing. The results suggest that access to AI tools alone is insufficient; students also need the ability to evaluate AI output critically and integrate it strategically into their writing. In this sense, AI literacy functions as an important learner-related competence in technology-mediated writing environments. This finding also responds to the call by [Feng et al. \(2025\)](#) for further research on AI literacy development in L2 writing.

Ethical AI Use as a Performance-Relevant Construct

Ethical AI use was also significantly and positively associated with perceived academic writing performance, supporting Hypothesis 2. This finding challenges the tendency in existing literature to conceptualize ethical AI use primarily as a compliance issue or institutional concern ([UNESCO, 2023, 2024](#)). Instead, the results indicate that ethical engagement with AI tools is positively associated with perceived writing outcomes. Students who reported higher levels of responsible practice, critical engagement, and transparent behavior also tended to report stronger perceived writing performance. This suggests that ethical AI use facilitates more effective writing practices by encouraging students to retain authorial control, critically evaluate AI-generated content, and integrate AI assistance selectively rather than indiscriminately. These behaviors are consistent with recommendations from AI ethics frameworks emphasizing human oversight and accountability ([UNESCO, 2024](#)).

This result is especially important in EFL contexts, where ethical uncertainty surrounding AI use is well documented ([Meniado et al., 2024](#)). Prior studies have shown that ambiguity regarding plagiarism and AI attribution can lead students either to avoid AI tools altogether or to rely on them excessively without critical engagement ([Eager & Brunton, 2023](#)). The present findings suggest that ethical clarity does not restrict learning; rather, it enables more productive use of AI by framing it as a support rather than a substitute for student effort.

The supplementary analysis of student writing assignments provides additional contextual evidence but should be interpreted cautiously. The illustrative cases showed variation in Turnitin similarity indices; however, similarity scores alone could not establish plagiarism, AI-generated writing, or students' ethical AI practices. Therefore, these findings do not independently validate the self-reported ethical AI use measure. Instead, they illustrate the difficulty of inferring responsible or irresponsible AI use from automated similarity indicators alone. Together, these findings support calls for integrating ethical AI instruction directly into writing pedagogy rather than treating it as an external policy concern ([Subaveerapandiyan et al., 2024](#)). From a broader L2 composition perspective, [Ferris and Hedgecock \(2023\)](#) have argued that effective writing instruction must address feedback, error treatment, and learner responsibility, principles that extend naturally to ethical AI use as a contemporary instantiation of responsible writing practice.

The Mediating Role of Self-Efficacy

Self-efficacy was found to partially mediate the relationships between both AI literacy and academic writing performance (Hypothesis 3) and ethical AI use and academic writing performance (Hypothesis 4). These findings are consistent with Bandura's (1997) Social Cognitive Theory, which posits that individuals' beliefs about their capabilities influence how skills are translated into performance. The partial mediation observed in both cases suggests that AI-related competencies influence writing outcomes through dual pathways. On the one hand, AI literacy and ethical AI use exert direct effects by shaping how students engage with writing tasks and AI tools. On the other hand, these competencies indirectly enhance writing performance by strengthening students' confidence in their ability to manage AI-supported writing processes.

This finding helps clarify previously mixed results regarding the psychological impact of AI tools on learners (Apridayani & Teo, 2021). While some studies suggest that AI assistance may undermine learners' confidence, the present results indicate that this outcome is not inherent to AI use itself. Rather, self-efficacy appears to be strengthened when students perceive AI as a controllable resource that supports, rather than replaces, their writing ability. This interpretation aligns with research showing that scaffolding technologies enhance confidence when learners retain agency over task completion (Selim, 2023).

Notably, self-efficacy did not fully mediate either relationship, indicating that psychological confidence is an important but not exclusive mechanism. This nuance is theoretically important, as it cautions against over-psychologizing AI-assisted learning outcomes. Technical competence and ethical engagement retain independent explanatory power, even when accounting for self-efficacy. Historically, Hedgcock (2005) noted that theoretical orientations in L2 teaching, whether cognitive, social, or critical, must account for learner confidence as a pedagogical variable. The present findings empirically support this view, showing that self-efficacy operates alongside, rather than instead of, technical and ethical competencies in AI-supported writing.

Ethical AI Use as a Moderator

Beyond its direct and indirect effects, ethical AI use was found to moderate the relationship between AI literacy and academic writing performance, supporting Hypothesis 5. Specifically, the positive association between AI literacy and perceived writing performance was stronger among students with higher levels of ethical AI use. This interaction effect highlights a critical insight: AI literacy alone does not guarantee improved writing outcomes. Technical and evaluative skills appear to yield maximal benefit only when applied within an ethical framework that emphasizes responsibility, transparency, and critical oversight. In other words, ethical AI use functions as a *contextual amplifier* of AI literacy.

This finding addresses an important gap in literature. While previous studies have examined AI literacy and ethical considerations separately, few have explored how these constructs interact (Polrak et al., 2024). The present results suggest that ethical engagement conditions the effectiveness of technical competence, offering a more nuanced understanding of AI-assisted writing

practices. From an educational standpoint, this implies that training programs focusing exclusively on tool operation or prompt engineering may be insufficient. Without ethical grounding, students may misuse AI tools in ways that limit learning gains or undermine writing quality. This is particularly relevant in cultural contexts such as Thailand, where concerns about academic integrity and fear of misconduct may shape students' engagement with AI tools (Worapongpat, 2025). The moderation finding also resonates with Silva and Matsuda's (2001) argument that effective L2 writing pedagogy requires integrating multiple perspectives, technical, ethical, and psychological, rather than treating them as separate concerns. In AI-supported settings, this integration is not optional but foundational.

Sub-Dimensional Patterns and Their Implications

Supplementary analyses revealed meaningful differences among sub-dimensions within each construct. Within AI literacy, Adaptive Confidence and Application Skills showed stronger contributions to the overall AI Literacy construct than Operational Knowledge. This suggests that knowing *how* to use AI tools is less important than knowing *when* and *why* to use them, a distinction consistent with higher-order conceptions of digital literacy (Alghamdy, 2023). Within Ethical AI Use, Responsible Practice, Critical Engagement, and Transparent Behavior showed relatively balanced contributions to the overall construct, with Transparent Behavior showing a slightly higher proxy loading. These dimensions align closely with UNESCO's emphasis on accountability and human oversight in AI use (UNESCO, 2023, 2024), suggesting that ethical principles translate into concrete writing behaviors with performance implications.

For self-efficacy, the strongest contribution came from core writing confidence rather than AI-specific confidence. This finding underscores that, even in AI-supported environments, students' fundamental belief in their writing ability remains central. AI tools appear to augment, rather than replace, traditional sources of writing confidence, supporting concerns that over-reliance on AI may be counterproductive if it weakens learners' sense of authorship (De Vleeschauwer, 2023). This pattern is consistent with the synthesis provided by Leki et al. (2008), who concluded after reviewing twenty-five years of L2 writing research that learner beliefs and affective factors consistently mediate the relationship between instructional support and writing outcomes, a principle that holds true even as the nature of that support shifts from teacher feedback to AI assistance.

Implications of the Study

The findings of this study carry important implications for students, particularly EFL undergraduates navigating AI-supported academic writing. The results suggest that students benefit most from AI use when it is accompanied by sufficient AI literacy, ethical awareness, and confidence in their own writing abilities. Rather than functioning as a shortcut or replacement for independent writing, AI tools appear to support learning when students actively evaluate, revise, and contextualize AI-generated output. The mediating role of self-efficacy indicates that students who believe in their capacity to manage writing tasks, both with and without AI, are better positioned to use these tools productively. This implies that students should be encouraged to view AI as a cognitive support that enhances

decision-making and revision rather than as an authoritative source of content, a perspective consistent with social cognitive theory and prior research on learner autonomy in technology-mediated writing (Bandura, 1997; Dai & Liu, 2024; Selim, 2023).

For teachers, the findings highlight the need to move beyond permissive or prohibitive approaches to AI use in writing instruction. The positive relationships observed among AI literacy, ethical AI use, and writing performance suggest that instructional guidance plays a crucial role in shaping how students engage with AI tools. Teachers are therefore positioned not only as gatekeepers of academic integrity but as mediators who model responsible, critical, and reflective AI use. Explicit classroom practices, such as demonstrating how to verify AI output, discuss ethical boundaries, and revise AI-generated text, may help strengthen both writing performance and self-efficacy. These implications align with prior studies emphasizing that technology enhances learning outcomes only when instructors integrate it intentionally into pedagogy rather than treating it as an external add-on (Krajka & Olszak, 2024; Paladhi & Maruthaveeran, 2024). From a teacher preparation standpoint, Ferris and Hedgcock (2023) and Silva and Matsuda (2001) have long advocated for equipping writing instructors with the knowledge and resources to address diverse L2 writer needs. The present findings extend this advocacy to include AI literacy and ethics as core components of contemporary L2 writing pedagogy.

The study also has implications for syllabus and materials designers, particularly in EFL programs undergoing digital transformation. The multidimensional structure of AI literacy and ethical AI use observed in this study suggests that these constructs should be embedded across writing curricula rather than confined to standalone workshops or policy statements. Writing tasks and learning materials can be designed to incorporate guided AI use, reflective prompts, and ethical decision-making alongside traditional writing objectives. Such integration allows students to develop technical competence, ethical awareness, and confidence simultaneously, rather than in isolation.

For institutional leaders and pioneers of technology integration in educational settings, the findings underscore the importance of aligning policy, pedagogy, and student support systems. While national and institutional initiatives often emphasize access to AI tools, this study suggests that meaningful educational impact depends on how those tools are framed and supported within learning environments. Clear, pedagogically informed guidelines on ethical AI use, combined with structured training for both students and instructors, are essential for preventing misuse while maximizing learning benefits. In contexts such as Thailand, where policy-driven digital transformation coexists with uneven classroom implementation, these results point to the need for coordinated strategies that address not only technological infrastructure but also ethical clarity and learner confidence. Without such alignment, the potential of AI to enhance academic writing may remain underrealized despite widespread availability (UNESCO, 2023, 2024). As Leki et al. (2008) observed, sustained progress in L2 writing requires alignment among research, pedagogy, and institutional support, a lesson that applies with renewed urgency to AI integration.

Finally, the study opens several avenues for future research. Longitudinal designs could examine how AI literacy, ethical engagement, and self-efficacy evolve over time and across instructional interventions. Experimental or quasi-experimental studies may test the effectiveness of targeted AI literacy or ethics-focused writing instruction. Additionally, qualitative investigations could explore how students interpret ethical AI use in practice, particularly in relation to cultural norms and disciplinary expectations. Given the study's context-specific focus, comparative research across EFL settings would further clarify the generalizability of the proposed model. These future directions directly echo the call by [Feng et al. \(2025\)](#) for longitudinal studies that focus on AI literacy development in L2 writing, as well as the broader need articulated by [Silva and Leki \(2004\)](#) for L2 writing research to maintain its interdisciplinary vitality while developing context-specific, empirically grounded insights.

Conclusion

This study investigated the combined roles of AI literacy, ethical AI use, and self-efficacy in relation to perceived academic writing performance among EFL undergraduates. By integrating these dimensions into a single structural model and supplementing the self-reported data with exploratory analysis of student writing assignments, the study provides an empirically grounded account of their relationships within AI-supported academic writing. The findings showed that higher AI literacy was positively associated with perceived academic writing performance, particularly when AI literacy extended beyond basic operational knowledge to include evaluative and adaptive competencies. Ethical AI use was also positively associated with perceived writing performance and strengthened the relationship between AI literacy and perceived writing performance. Self-efficacy partially mediated these relationships, suggesting that learner confidence represents one psychological pathway connecting AI-related competencies with perceived writing performance.

Taken together, the results challenge reductive narratives that frame AI as either a threat to academic integrity or a neutral productivity tool. Instead, AI-assisted writing emerges as a complex learning practice shaped by students' skills, values, and beliefs. The effectiveness of AI in academic writing depends not on the presence of technology alone, but on how students are prepared to engage with it critically, ethically, and confidently. From a broader perspective, this study supports calls for pedagogical approaches that integrate AI literacy and ethics within disciplinary learning rather than treating them as add-ons or policy issues. For EFL writing instruction, this entails designing learning environments that emphasize critical evaluation, ethical reflection, and sustained authorial responsibility alongside technological competence.

While the study is limited by its cross-sectional design, reliance on self-reported writing performance, and contextual scope, it provides a foundation for future research using objective writing assessments, longitudinal designs, instructional interventions, and cross-cultural comparisons. As AI tools become increasingly embedded in academic practice, understanding the conditions under which they support rather than undermine learning will remain a central challenge for higher education.

References

- Alavi, S., & Pakbaz, M. (2026). Authorship, authenticity, and academic integrity in the age of generative AI: Evidence from essay corpora. In *2026 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunication Engineering (ECTI DAMT & NCON)* (pp. 258–262). IEEE. <https://doi.org/10.1109/ECTIDAMTNCN67592.2026.11460049>
- Alghamdy, R. Z. (2023). Pedagogical and ethical implications of artificial intelligence in EFL context: A review study. *English Language Teaching*, 16(10), 87-98. <https://doi.org/10.5539/elt.v16n10p87>
- Amini, M., Lee, K. F., Yiqiu, W., & Ravindran, L. (2026). Proposing a framework for ethical use of AI in academic writing based on a conceptual review: Implications for quality education. *Interactive Learning Environments*, 1–25. <https://doi.org/10.1080/10494820.2025.2523382>
- Apridayani, A., & Teo, A. (2021). The interplay among SRL strategies, English self-efficacy, and English proficiency of Thai university students. *Studies in English Language and Education*, 8(3), 1123–1143. <https://doi.org/10.24815/SIELE.V8I3.20213>
- Badpa, H., & Beikian, A. (2025). Evaluating overall quality and intercultural communicative competence in English academic writing textbooks: A comparative study of Iranian and international resources. *Journal of Applied Linguistics and Applied Literature: Dynamics and Advances*, 13(2), 131–154. <https://doi.org/10.22049/jalda.2025.30314.1761>
- Bahremand, A., Fatehi Rad, N., & Jalali, V. (2026). Enhancing vocabulary, grammar, and discourse competence through AI-supported microlearning among EFL learners: A quasi-experimental study. *Journal of Applied Linguistics and Applied Literature: Dynamics and Advances*, 14(2), Online Publication. <https://doi.org/10.22049/jalda.2026.31523.1980>
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman and Company.
- Dai, K., & Liu, Q. (2024). Leveraging artificial intelligence (AI) in English as a foreign language (EFL) class: Challenges and opportunities in the spotlight. *Computers in Human Behavior*, 159, Article 108354. <https://doi.org/10.1016/j.chb.2024.108354>
- De Vleeschauwer, J. (2023). An investigation of the relationships among Thai EFL learners' writing performance, self-efficacy, and anxiety. *European Journal of English Language Studies*, 3(1), 23–36. <https://doi.org/10.12973/ejels.3.1.23>
- Eager, B., & Brunton, R. (2023). Prompting higher education towards AI-augmented teaching and learning practice. *Journal of University Teaching and Learning Practice*, 20(5), 1–19. <https://doi.org/10.53761/1.20.5.02>
- Esmaeili, F., Behnam, B., & Ramazani, A. (2015). A study of relationship between emotional intelligence and writing ability. *Journal of Applied Linguistics*

- and *Applied Literature: Dynamics and Advances*, 3(1), 41–63. <https://doi.org/10.22049/jalda.2018.13685>
- Feng, H., Li, K., & Zhang, L. J. (2025). What does AI bring to second language writing? A systematic review (2014–2024). *Language Learning & Technology*, 29(1), 1–27. <https://doi.org/10.64152/10125/73629>
- Ferris, D. R., & Hedgcock, J. S. (2023). *Teaching L2 composition: Purpose, process, and practice* (4th ed.). Routledge. <https://doi.org/10.4324/9781003004943>
- Gayed, J. M., Carlon, M. K. J., Oriola, A. M., & Cross, J. S. (2022). Exploring an AI-based writing assistant's impact on English language learners. *Computers and Education: Artificial Intelligence*, 3, Article 100055. <https://doi.org/10.1016/j.caeai.2022.100055>
- Geng, Q., Amini, M., Binti Hashim, S. N. A., & Zhu, M. (2024). The mediating roles of academic self-efficacy and learning interest in the relationship between teaching style and math behavior engagement among junior high school students in China. *PLOS ONE*, 19(10), Article e0311959. <https://doi.org/10.1371/journal.pone.0311959>
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24. <https://doi.org/10.1108/eb-11-2018-0203>
- Hedgcock, J. S. (2005). Taking stock of research and pedagogy in L2 writing. In E. Hinkel (Ed.), *Handbook of research in second language teaching and learning* (pp. 597–613). Lawrence Erlbaum Associates. <https://doi.org/10.4324/9781410612700>
- Hwang, G.-J., & Tu, Y.-F. (2021). Roles and research trends of artificial intelligence in mathematics education: A bibliometric mapping analysis and systematic review. *Mathematics*, 9(6), 584. <https://doi.org/10.3390/math9060584>
- Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford. <https://www.guilford.com/books/Principles-and-Practice-of-Structural-Equation-Modeling/Rex-Kline/9781462551910>
- Krajka, J., & Olszak, I. (2024). Artificial intelligence tools in academic writing instruction: Exploring the potential of on-demand AI assistance in the writing process. *Roczniki Humanistyczne*, 72(6), 123–140. <https://doi.org/10.18290/rh247206.8>
- Leki, I., Cumming, A., & Silva, T. (2008). *A synthesis of research on second language writing in English*. Routledge. <https://doi.org/10.4324/9780203930250>
- Meniado, J. C., Huyen, D. T. T., Panyadilokpong, N., & Lertkomolwit, P. (2024). Using ChatGPT for second language writing: Experiences and perceptions of EFL learners in Thailand and Vietnam. *Computers and Education: Artificial Intelligence*, 7, Article 100313. <https://doi.org/10.1016/j.caeai.2024.100313>
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>

- Neshkovska, S. (2025). The benefits and risks of AI-assisted academic writing: Insights from current research. *ELOPE: English Language Overseas Perspectives and Enquiries*, 22(1), 55–68. <https://doi.org/10.4312/elope.22.1.55-68>
- Ng, D. T. K., Su, J., Leung, J. K. L., & Chu, S. K. W. (2024). Artificial intelligence (AI) literacy education in secondary schools: A review. *Interactive Learning Environments*, 32(10), 6204–6224. <https://doi.org/10.1080/10494820.2023.2255228>
- Polrak, M., Kedcham, A., & Chansri, C. (2024). Metacognitive learning strategies and English language proficiency of EFL undergraduate science students: The mediating role of self-efficacy. *PASAA: Journal of Language Teaching and Learning in Thailand*, 69, 195–231. <https://doi.org/10.58837/chula.pasaa.69.7>
- Samngamjan, N., Phettom, P., Sangunsat, K., & Philuek, W. (2024). A survey study on AI literacy of Nakhon Sawan Rajabhat University's digital technology teacher students in Thailand. *Shanlax International Journal of Education*, 13(1), 33–40. <https://doi.org/10.34293/education.v13i1.8355>
- Selim, A. S. M. (2023). The transformative impact of AI-powered tools on academic writing: Perspectives of EFL university students. *International Journal of English Linguistics*, 14(1), Article 14. <https://doi.org/10.5539/ijel.v14n1p14>
- Silva, T., & Leki, I. (2004). Family matters: The influence of applied linguistics and composition studies on second language writing studies—Past, present, and future. *The Modern Language Journal*, 88(1), 1–13. <https://doi.org/10.1111/j.0026-7902.2004.00215.x>
- Silva, T., & Matsuda, P. K. (2001). *On second language writing*. Routledge. <https://doi.org/10.4324/9781410600899>
- Subaveerapandiyan, A., Kalbande, D., & Ahmad, N. (2025). Perceptions of effectiveness and ethical use of AI tools in academic writing: A study among PhD scholars in India. *Information Development*, 41(3), 728–746. <https://doi.org/10.1177/02666669251314840>
- Subaveerapandiyan, A., Paladhi, M. M., & Maruthaveeran, V. (2024). Evaluating AI literacy proficiency among LIS researchers in ASEAN. *Library Hi Tech News*, 41(4), 6–8. <https://doi.org/10.1108/LHTN-07-2023-0121>
- UNESCO. (2022). *Recommendation on the ethics of artificial intelligence*. <https://unesdoc.unesco.org/ark:/48223/pf0000381137>
- UNESCO. (2023). *Guidance for generative AI in education and research*. <https://doi.org/10.54675/EWZM9535>
- UNESCO. (2024, December 12). *Ethics of AI*. <https://www.unesco.org/en/articles/ethics-ai>
- Wang, Q., Wang, Y., & Amini, M. (2026). Associations of task technology fit and perceived usefulness with responsible generative AI use among university students. *Scientific Reports*, 16, Article 2759. <https://doi.org/10.1038/s41598-025-32692-6>

- Worapongpat, N. (2025). Mindfulness in the use of artificial intelligence for learning among graduate students in private universities in Bangkok, Thailand. *Asian Education and Learning Review*, 3(2), Article 1. <https://doi.org/10.14456/aclr.2025.6>
- Yan, D., Kasuma, S. A. A., & Amini, M. (2026). Revisiting dialogic feedback in the age of GenAI: An investigation into L2 writers' feedback seeking interactions. In G. Durak, S. Çankaya, & M. Sharples (Eds.), *Generative AI in education: Theories, applications, and ethical frontiers* (pp. 261–281). Springer Nature Singapore. https://doi.org/10.1007/978-981-95-4871-2_14
- Yung, K. W. H., & Cai, Y. (2020). Do secondary school-leaving English examination results predict university students' academic writing performance? A latent profile analysis. *Assessment & Evaluation in Higher Education*, 45(4), 629–642. <https://doi.org/10.1080/02602938.2019.1680951>
- Zhang, Q., Nie, H., Fan, J., & Liu, H. (2025). Exploring the dynamics of artificial intelligence literacy on English as a foreign language learners' willingness to communicate: The critical mediating roles of artificial intelligence learning self-efficacy and classroom anxiety. *Behavioral Sciences*, 15(4), Article 523. <https://doi.org/10.3390/bs15040523>
- Zhao, X. (2023). Leveraging artificial intelligence (AI) technology for English writing: Introducing wordtune as a digital writing assistant for EFL writers. *RELJ Journal*, 54(3), 890–894. <https://doi.org/10.1177/00336882221094089>
- Zou, X., Su, P., Li, L., & Fu, P. (2024). AI-generated content tools and students' critical thinking: Insights from a Chinese university. *IFLA Journal*, 50(2), 228–241. <https://doi.org/10.1177/03400352231214963>

Author's Biography



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