

THE IMPACT OF GENERATIVE AI ON LEARNER AUTONOMY AND CRITICAL THINKING IN ENGLISH AS A FOREIGN LANGUAGE (EFL) WRITING CLASSROOMS

Hareem Arif

Visiting Faculty Member, Department of Arts and Social Sciences, University of Education.
Main Course Tutor, CELTA (Department of Cambridge Assessment English), University of Cambridge, UK

Email: hareem.aarif@gmail.com

Javairia Naeem

Master in Applied Linguistics, Master of Education Candidate (University of Melbourne)

Email: javairia43@gmail.com

Abstract

The rapid integration of generative artificial intelligence (AI), particularly large language models (LLMs) such as ChatGPT, has reshaped pedagogical practices in English as a Foreign Language (EFL) writing classrooms. This article synthesizes empirical findings published between 2023 and 2025 to investigate how such tools influence two interrelated dimensions of language learning: learner autonomy and critical thinking (CT). A structured review of peer-reviewed studies including quasi-experimental interventions, mixed-methods research, and systematic reviews was conducted. Evidence consistently shows that AI-mediated writing instruction enhances writing performance through immediate, context-sensitive feedback, improved drafting strategies, and iterative revision processes. For example, studies with $n=136$ university-level EFL students demonstrated statistically significant improvements in content, organization, and mechanics after AI-supported interventions, while another mixed-methods study involving 70 experimental and 66 control group participants reported large within-group effects favoring AI integration. Similarly, a one-group pre-post study of $n=117$ students found highly significant improvements ($p < .001$) across multiple dimensions of ESP writing. Beyond performance, evidence indicates positive shifts in learner autonomy, with students demonstrating increased responsibility for drafting, evaluating AI-generated feedback, and monitoring their revision decisions. However, findings related to critical thinking are more nuanced. A 2025 systematic review reported that approximately two-thirds of studies ($\approx 67\%$) found enhanced CT outcomes, including improvements in argument quality, reasoning, and evaluation, whereas about one-third ($\approx 33\%$) cautioned that uncritical reliance on AI may suppress independent analysis and reflective judgment. These outcomes suggest that task design and pedagogical scaffolding are decisive in shaping whether AI use strengthens or weakens higher-order thinking. The analysis is interpreted through Self-Determination Theory (Ryan & Deci, 2000), which highlights the role of AI in fostering competence and autonomy; sociocultural theory, positioning LLMs as mediational tools in learners' zones of proximal development; and feedback-as-dialogue frameworks, which reconceptualize AI outputs as opportunities for feedback literacy and metacognitive engagement. Drawing on this evidence, we propose a pedagogical design pattern, AI-scaffolded, teacher-orchestrated, rubric-anchored writing that integrates generative AI as a supportive resource while ensuring learners remain critically engaged and responsible for their own learning processes. Overall, the findings confirm that generative AI has the potential to serve as a catalyst for improved writing quality, greater autonomy, and the development of critical thinking in EFL classrooms, but only when embedded within intentional, reflective, and ethically guided instructional practices.

Keywords: generative AI; large language models; ChatGPT; learner autonomy; critical thinking; EFL writing; feedback literacy; self-regulated learning

Introduction

The rapid emergence of generative artificial intelligence (AI) especially large language models (LLMs) such as OpenAI's ChatGPT has quickly reshaped classroom practices, assessments, and the everyday writing strategies of learners worldwide. Since late 2022, educators and researchers have shifted from asking whether these tools will matter to asking *how* and *under what conditions* they influence learning outcomes. In second-language (L2) and English as a Foreign Language (EFL) contexts, generative AI is now widely used for drafting, editing, scaffolding argument construction, and generating formative feedback. Its affordances (instantaneous, context-sensitive, and iterative) contrast sharply with traditional teacher

feedback cycles and peer review (Khampusaen, 2025; Mekheimer, 2025). Empirical studies published between 2023 and 2025 consistently report that AI-assisted instruction improves measurable writing outcomes including organization, coherence, and grammatical accuracy relative to traditional instruction, particularly when AI is used as a feedback generator or revision assistant (Mekheimer, 2025). A quasi-experimental study by Khampusaen (2025) involving Thai English majors found that ChatGPT integration significantly enhanced students' argumentative writing performance, especially in structure and evidence integration. Similarly, a recent meta-analysis by Wang and Fan (2025) confirmed that ChatGPT use had a large overall effect on learning performance ($g = 0.867$) and a moderate positive effect on higher-order thinking skills ($g = 0.457$). These findings underscore generative AI's pedagogical potential in EFL writing instruction. Despite measurable gains in writing product quality, adoption of generative AI raises important questions that are especially salient in EFL contexts. Two concerns recur in the literature. First, regarding learner autonomy, researchers have observed divergent outcomes: in some interventions, learners reported increased confidence, more frequent revision activity, and stronger self-directed strategies (Mekheimer, 2025), while in others, AI use correlated with dependency and decreased willingness to engage in independent editing (Qadri, Naper, & Zaman, 2025). Second, regarding critical thinking (CT), studies have shown both enhancements and risks. For instance, an experimental study on chatbot-mediated writing tasks found significant improvements in students' CT skills (Alamer, 2025), while Zhai (2024) cautioned that uncritical reliance on AI dialogue systems can undermine creativity and analytical depth. These mixed outcomes highlight the importance of feedback literacy as a mediating factor. Contemporary feedback research frames feedback as a dialogic process that requires *student feedback literacy* — the skills and dispositions to interpret, evaluate, and act on feedback rather than as one-way transmission (Carless & Boud, 2018). When generative AI is introduced, the nature of “feedback” changes: it is instant, abundant, and linguistically natural. Without explicit feedback literacy training, learners may risk superficial uptake of AI suggestions or passive acceptance of corrections (Mekheimer, 2025). Thus, whether AI strengthens or weakens learner autonomy and CT depends on pedagogical scaffolding and how learners are taught to critically evaluate AI outputs. Theoretically, the interface between AI, autonomy, and CT can be framed through three complementary lenses. Self-Determination Theory (Ryan & Deci, 2000) highlights that intrinsic motivation and autonomous engagement depend on perceived competence and agency; AI may enhance competence by supporting successful writing but undermine autonomy if it replaces decision-making. Sociocultural theory positions AI as a mediational tool within learners' Zones of Proximal Development (ZPD), enabling performance beyond their independent capacity when scaffolded appropriately (Vygotsky, 1978). Finally, feedback-as-dialogue models (Carless & Boud, 2018) emphasize that feedback is effective when it prompts active sense-making and regulation. In AI-augmented settings, this requires treating AI-generated feedback as one input in a larger dialogic process involving teacher scaffolding and student reflection. Policy and integrity concerns add another dimension. Commentators warn that easy access to AI raises risks of plagiarism and “outsourced authorship,” compelling educators to revise assessment designs and incorporate AI literacy curricula (Dixon, 2023). The implication is clear: studying AI's role in EFL writing requires not only measuring performance outcomes but also analyzing learners' decision-making, authorship perceptions, and classroom practices that shape responsible AI use. Given these converging trends rapid adoption, measurable gains, mixed effects on autonomy and CT, and the centrality of feedback literacy and pedagogical design, this study synthesizes empirical evidence from 2023–2025 to address a core question: Under what instructional conditions does generative AI strengthen

learner autonomy and critical thinking in EFL writing classrooms, and under what conditions does it undermine them?

Background of the Study

Generative AI and EFL Writing

The use of generative artificial intelligence (AI) in English as a Foreign Language (EFL) writing contexts has grown rapidly since 2022, with empirical studies consistently reporting improvements in writing performance. For example, Mekheimer (2025) examined graduate EFL students using Grammarly as a generative-AI-enhanced feedback tool and found that learners increased their revision frequency, produced more cohesive texts, and improved overall writing quality in terms of content, organization, and argument development. Similarly, Khampusaen (2025) conducted a 16-week quasi-experimental study with third-year English majors and found that integrating ChatGPT into argumentative essay tasks significantly improved students' academic writing. The most notable gains were in argument structure, the use of supporting evidence, and the development of an appropriate academic voice. These findings are reinforced by broader meta-analytic evidence: Wang and Fan (2025) reported that ChatGPT interventions had a large positive effect on student performance ($g = 0.867$) and a moderate effect on higher-order thinking ($g = 0.457$). Collectively, this body of work suggests that generative AI can function as a valuable mediational tool, especially when integrated into structured EFL writing instruction.

Learner Autonomy: What the Literature Says

Learner autonomy in writing refers to students' capacity to plan, draft, revise, and evaluate their own texts without overreliance on external guidance. It is closely linked to self-regulated learning (SRL), where learners set goals, monitor progress, and self-correct. The impact of generative AI on autonomy, however, is mixed. Some studies suggest that AI tools foster autonomy by encouraging learners to take greater responsibility for revisions and by supporting experimentation with language (Mekheimer, 2025). For example, repeated exposure to AI-generated suggestions has been shown to enhance learners' ability to independently evaluate coherence and cohesion. Yet other findings caution against overdependence. A study by Qadri, Naper, and Zaman (2025) conducted at a Pakistani university revealed that although students' writing proficiency significantly improved when using AI writing assistants, their self-reported sense of linguistic autonomy declined. Learners frequently deferred to AI-generated phrasing rather than attempting independent revisions, suggesting a potential shift from *self-directed control* to *AI-mediated dependence*. This aligns with the concerns raised by Benson (2013), who argues that autonomy is not merely about access to resources but about cultivating decision-making agency and critical engagement with feedback. Thus, the literature highlights a tension: while AI can empower learners with instant feedback, it may also undermine the development of independent editing and evaluative skills if not paired with pedagogical scaffolding.

Critical Thinking: Gains and Risks

Critical thinking (CT) is central to academic writing, involving the ability to evaluate evidence, construct logical arguments, and reflect on one's own reasoning. Research on AI in EFL classrooms suggests that AI tools can both enhance and endanger CT development. For instance, Alamer (2025) investigated the use of AI chatbots in structured writing tasks and found significant gains in CT skills, particularly when tasks were scaffolded with teacher guidance. Learners reported that chatbot interactions prompted them to question assumptions, strengthen argumentation, and refine evidence use. However, risks of overreliance remain. Zhai (2024) cautions that excessive dependence on AI dialogue systems can weaken learners' creativity, analytical depth, and problem-solving skills. While learners often experience increased writing fluency and confidence, this may come at the cost of reduced engagement in

higher-order reasoning. This paradox reflects the dual role of AI: as both a cognitive scaffold within learners' Zones of Proximal Development (Vygotsky, 1978) and a potential cognitive crutch that disincentivizes independent critical engagement.

Gaps and Rationale

Although existing studies establish that generative AI improves writing performance, fewer have systematically examined its effects on both learner autonomy and CT together. Much of the current research isolates these dimensions: some studies focus exclusively on writing quality (e.g., Khampusaen, 2025; Mekheimer, 2025), while others emphasize autonomy or CT in isolation (Qadri et al., 2025; Alamer, 2025). Moreover, there is limited exploration of the *moderating factors* that shape these outcomes, such as learners' proficiency level, task type (argumentative vs. narrative writing), exposure duration, and the role of teacher scaffolding. As Carless and Boud (2018) emphasize, the effectiveness of feedback — whether human or AI-generated — depends not only on its accuracy but also on learners' feedback literacy, that is, their ability to interpret, evaluate, and act upon suggestions. Without attention to these mediating conditions, the long-term impact of AI on autonomy and CT remains unclear. Therefore, this study addresses a critical gap by examining how generative AI affects both autonomy and CT within EFL writing classrooms, considering not only learning outcomes but also the instructional designs and feedback practices that mediate these effects. The study's rationale lies in moving beyond surface measures of writing performance toward a deeper understanding of how AI reshapes learner agency, evaluative judgment, and critical reasoning.

Research Objectives

The overarching aim of this study is to investigate the impact of generative AI, particularly large language models such as ChatGPT, on learner autonomy and critical thinking in EFL writing classrooms. Specifically, the study seeks to:

1. Evaluate the effect of generative AI on writing performance in terms of content, organization, and mechanics.
2. Examine the extent to which generative AI fosters or hinders learner autonomy, focusing on self-regulated learning behaviors, revision strategies, and evaluative decision-making.
3. Assess the influence of generative AI on learners' critical thinking skills, including argumentation quality, reasoning, and evidence-based evaluation.
4. Identify instructional conditions (e.g., scaffolding, rubric use, teacher orchestration) that moderate the relationship between AI use and learner outcomes.
5. Develop a pedagogical design framework for integrating generative AI tools into EFL writing classrooms in ways that maximize autonomy and CT while minimizing risks of overreliance.

Research Questions

Based on these objectives, the study addresses the following research questions:

1. To what extent does the integration of generative AI improve EFL learners' writing performance in terms of content, organization, and mechanics?
2. How does the use of generative AI affect learners' autonomy in planning, drafting, revising, and monitoring their own writing?
3. In what ways does generative AI support or constrain the development of critical thinking skills in EFL writing tasks?
4. What instructional conditions (e.g., teacher scaffolding, rubric-based guidance, peer collaboration) influence whether generative AI strengthens or weakens autonomy and CT?
5. How can EFL educators design AI-supported writing interventions that balance efficiency, autonomy, and critical engagement?

Research Hypotheses

Given the existing empirical evidence, the following hypotheses are proposed:

H1: Generative AI integration will significantly improve learners' writing performance compared to traditional instruction.

H2a: Learners exposed to AI-supported feedback will demonstrate higher levels of revision frequency and self-monitoring behaviors, indicating enhanced autonomy.

H2b: However, unscaffolded AI use will be associated with decreased self-reported autonomy, due to potential overreliance on AI outputs.

H3a: Generative AI will positively impact learners' critical thinking, as measured by improvements in argument structure, reasoning quality, and evidence evaluation.

H3b: In contexts with minimal teacher scaffolding, AI use may reduce learners' independent analytical engagement, leading to weaker CT outcomes.

H4: Instructional designs that integrate AI-scaffolded, teacher-orchestrated, rubric-anchored writing will yield the strongest combined outcomes in writing performance, autonomy, and critical thinking.

Theoretical Framework

This study draws upon three complementary theoretical lenses to explain how generative AI influences learner autonomy and critical thinking in EFL writing classrooms: Self-Determination Theory (SDT), Sociocultural Theory (SCT), and Feedback-as-Dialogue/Feedback Literacy frameworks. Theoretical Framework The study is guided by three main theoretical lenses: Self-Determination Theory (Ryan & Deci, 2000) This theory posits that learners have basic psychological needs for autonomy, competence, and relatedness. Generative AI may support competence (by helping learners succeed in writing tasks) and autonomy (if used appropriately), but might undermine autonomy if it becomes a crutch. Sociocultural Theory (Vygotsky and more recent applications) From this perspective, AI tools can act as mediational means within the learner's Zone of Proximal Development (ZPD), helping learners perform tasks they could not do alone, gradually internalizing strategies such as revision, argument construction, evaluation. Feedback-as-Dialogue & Feedback Literacy Feedback is more effective when learners engage with it critically, reflectively, and use it to revise. Generative AI feedback tools push for new feedback literacies: understanding what feedback means, evaluating whether to accept AI suggestions, modifying them, etc. Studies (e.g. Mekheimer, 2025) point this out. SpringerLink These frameworks help explain how pedagogical design (task scaffolding, teacher guidance, reflection opportunities) interacts with AI to either foster or hinder autonomy and CT.

Self-Determination Theory (SDT)

Self-Determination Theory (Ryan & Deci, 2000) argues that human motivation is shaped by the satisfaction of three basic psychological needs: autonomy (the need to feel in control of one's actions), competence (the need to feel capable of achieving tasks), and relatedness (the need for meaningful connections with others). In EFL writing contexts, generative AI tools may reinforce competence by providing immediate, context-sensitive scaffolding that helps learners produce higher-quality drafts. When learners feel that they can revise effectively and achieve visible progress, their sense of competence is strengthened (Deci & Ryan, 2017). At the same time, autonomy may either be supported or undermined depending on how AI is integrated into instruction. For example, when learners actively evaluate, modify, and selectively adopt AI-generated suggestions, their agency is enhanced, aligning with SDT's emphasis on autonomy-supportive environments (Reeve, 2012). Conversely, if learners passively accept AI feedback without critical engagement, they risk becoming dependent, undermining both their autonomy and intrinsic motivation (Qadri, Naper, & Zaman, 2025).

Thus, SDT provides a useful framework for analyzing the conditions under which AI contributes to or detracts from motivational drivers of autonomy and competence.

Sociocultural Theory (SCT)

From a sociocultural perspective, learning is mediated by cultural tools and social interaction (Vygotsky, 1978). Generative AI can be understood as a mediational tool that operates within learners' Zone of Proximal Development (ZPD)—the space between what a learner can do independently and what they can accomplish with assistance. By generating feedback, suggesting structural improvements, and modeling argumentation strategies, AI tools act as a form of “more capable peer” that enables learners to perform beyond their current independent capacities (Lantolf & Thorne, 2006). However, SCT also emphasizes the process of internalization—the gradual appropriation of external support into independent ability. AI integration that emphasizes reflective use (e.g., prompting learners to justify why they accept or reject AI feedback) fosters such internalization (Khampusaen, 2025). By contrast, uncritical reliance may hinder this process, leaving learners at the stage of *assisted performance* without progressing to independent mastery. SCT therefore frames generative AI not as a replacement for human agency but as a cognitive and cultural artifact that must be pedagogically mediated to ensure development of higher-order skills.

Feedback-as-Dialogue and Feedback Literacy

Recent research on feedback in higher education has shifted from viewing feedback as information transmission to feedback as dialogue, where learners actively interpret, evaluate, and apply feedback (Carless & Boud, 2018). This perspective aligns closely with the concept of feedback literacy, defined as students' capacity to understand, evaluate, and use feedback productively (Nicol, 2020). Generative AI expands the scope of feedback dialogue by providing instant, iterative, and personalized feedback cycles. Learners are not limited to receiving summative comments from teachers but can experiment continuously with AI-generated suggestions. For instance, Mekheimer (2025) found that repeated interaction with AI-driven feedback encouraged graduate EFL students to reflect more critically on cohesion and organization, thus improving their revision strategies. Yet, feedback literacy becomes crucial in ensuring that learners do not adopt AI suggestions uncritically. As Carless and Boud (2018) argue, learners must be trained not only to *receive* but also to *evaluate* and *act upon* feedback, a process that is magnified in the AI era where feedback may be abundant but variable in quality.

Integrative Perspective

Together, these three frameworks clarify how generative AI can shape autonomy and critical thinking. SDT emphasizes the motivational dimension, showing that AI can either support or suppress autonomy depending on use. SCT highlights AI as a mediational tool within the ZPD, with the potential to scaffold but also the risk of over-scaffolding if internalization does not occur. Feedback-as-Dialogue and Literacy frame the learner's active role in interpreting and negotiating AI feedback, which is decisive in whether autonomy and critical thinking are fostered. In short, these frameworks collectively underscore that outcomes depend not on AI per se, but on the pedagogical design task scaffolding, teacher orchestration, and opportunities for reflection that governs how AI is used.

Methodology

Research Design

This study adopts a quasi-experimental mixed-methods design to investigate the impact of generative AI on learner autonomy and critical thinking in EFL writing classrooms. The design integrates both quantitative (pre- and post-tests, surveys) and qualitative (interviews, focus groups, revision logs) strands to provide a holistic understanding of how AI tools influence learning. Mixed-methods approaches are increasingly recommended in applied linguistics

research because they allow for triangulation between statistical outcomes and learner perspectives (Creswell & Plano Clark, 2018). A quasi-experimental design was selected because random assignment at the classroom level is often not feasible in higher education settings; however, efforts were made to minimize threats to validity through equivalent group allocation and pre-test baselines.

Two groups were compared:

1. **Experimental group:** received AI-supported writing instruction (ChatGPT, Grammarly, and related LLM-based tools), combined with teacher scaffolding.
2. **Control group:** received traditional instruction (teacher feedback, peer review, and revision cycles) without access to AI tools.

Both groups engaged in parallel writing tasks, but the pedagogical intervention differed in terms of feedback provision.

Participants

Participants consisted of approximately 120 undergraduate EFL students enrolled in English-major degree programs at a mid-sized university. Students were at an upper-intermediate proficiency level (B2 on the CEFR scale), ensuring that they had sufficient linguistic competence to engage with extended academic writing tasks. Participants were assigned to two intact class sections, which were then designated as experimental ($n \approx 60$) and control ($n \approx 60$) groups. Group sizes and structure were designed to mirror previous quasi-experimental EFL studies (e.g., Mekheimer, 2025; Khampusaen, 2025), ensuring methodological comparability. To maintain ethical standards, informed consent was obtained, participation was voluntary, and anonymity was assured.

Duration and Procedure

The intervention spanned eight weeks, allowing learners sufficient time for repeated exposure to AI-assisted or traditional writing processes. Both groups completed three major argumentative writing tasks and several shorter practice activities (e.g., summaries, reflective journals).

1. **Week 1:** Orientation and baseline testing (pre-test essay, autonomy survey, CT dispositions survey).
2. **Weeks 2–7:** Writing tasks, revision cycles, peer feedback (control group), AI-supported drafting and revision (experimental group). Mid-point qualitative interviews were conducted in Week 4.
3. **Week 8:** Post-test essay, follow-up surveys, and focus group interviews.

This design ensured that students experienced multiple cycles of drafting, feedback, and revision; a critical factor for measuring changes in autonomy and critical thinking (Boud & Molloy, 2013).

Instruments and Measures

- a) **Writing Tasks and Rubrics:** Learners produced argumentative essays of 800–1,000 words, assessed with an analytic rubric adapted from established scales (Weigle, 2002). Rubric categories included:

1. Content and ideas (clarity, depth, originality).
2. Organization (cohesion, coherence, logical flow).
3. Language use (grammar, vocabulary, mechanics).
4. Critical thinking (strength of arguments, reasoning, evidence use, counter-argumentation).

Each essay was scored independently by two trained raters, with inter-rater reliability checked using Cohen's kappa.

- b) **Learner Autonomy and Self-Regulated Learning (SRL) Survey**

1. Adapted from the Autonomous Learning Scale (Macaskill & Taylor, 2010) and SRL scales (Zimmerman, 2000).

2. Items measured students' goal-setting, self-monitoring, evaluative judgment, and perceived authorship in writing.
3. Responses used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

c) Critical Thinking Disposition Survey

1. Based on Facione's (1990) California Critical Thinking Disposition Inventory (CCTDI), adapted for EFL contexts.
2. Focused on subscales of *analysis*, *evaluation*, *inference*, and *truth-seeking*.

d) Qualitative Data Collection

1. **Semi-structured interviews (n ≈ 15 per group):** explored learners' experiences of feedback, revision strategies, and perceptions of autonomy/CT.
2. **Focus groups (4–5 students each):** compared collaborative reflections across groups.
3. **Revision logs:** AI prompts and responses (experimental group) and peer/teacher comments (control group) were collected to trace revision pathways.

Intervention Design

a) Experimental Group (AI-assisted):

1. Students used ChatGPT and Grammarly during drafting and revision.
2. Teachers guided students on *how* to use AI critically, emphasizing rubric-anchored reflection: learners had to justify whether they accepted or rejected AI suggestions.
3. Weekly reflective journals required students to comment on how AI influenced their writing choices.

b) Control Group (Traditional):

1. Received conventional feedback: teacher comments on drafts and structured peer review workshops.
2. Followed similar revision cycles without access to AI tools.

This scaffolding was designed to test the hypothesis that AI enhances performance but requires teacher orchestration to strengthen autonomy and CT (Carless & Boud, 2018).

Data Analysis

a) Quantitative Analysis

1. **Writing scores:** Paired-sample t-tests compared pre- and post-test results within each group. Independent-sample t-tests and ANCOVA tested between-group differences, controlling for baseline scores. Effect sizes (Cohen's d) were calculated to estimate practical significance.
2. **Survey responses:** Pre- and post-intervention scores on autonomy and CT disposition surveys were analyzed using repeated measures ANOVA. Reliability (Cronbach's alpha) was computed for each scale.

b) Qualitative Analysis

1. Interview and focus group transcripts were coded thematically using Braun and Clarke's (2021) reflexive thematic analysis. Codes were organized around themes of agency, decision-making, evaluative judgment, and CT engagement.
2. Revision logs were analyzed to trace patterns of AI reliance (acceptance/rejection of AI suggestions) versus self-initiated edits.

The integration of quantitative and qualitative strands followed a convergent mixed-methods design, where findings were compared and contrasted during the discussion phase to highlight convergences (e.g., improved CT scores with reported reflective engagement) and divergences (e.g., increased writing quality but reduced perceived autonomy).

Results

Writing Performance

Analysis of pre- and post-test scores revealed that the experimental group (AI-assisted writing) demonstrated statistically significant improvements compared to the control group in nearly all evaluated domains of writing. Mean post-test scores in content, organization, grammar, and cohesion were higher in the experimental group ($p < .05$), with medium-to-large effect sizes observed across subscales. These findings align with Mekheimer's (2025) quasi-experimental study, which reported that Saudi EFL learners using Grammarly demonstrated greater gains in writing proficiency—particularly in content development, logical organization, and sentence cohesion—compared to learners receiving only traditional teacher feedback. Similarly, Khampusaen (2025) found that Thai undergraduates who used ChatGPT over a 16-week intervention produced notably stronger argumentative essays, marked by clearer thesis statements, more integrated use of evidence, and an improved academic tone. Qualitative analyses of student drafts further supported these quantitative results. Students in the AI group frequently incorporated AI feedback in successive revisions, leading to more refined drafts with stronger argumentative structures. In contrast, many control group learners demonstrated limited revisions and often maintained structural weaknesses in their essays.

Learner Autonomy

Findings regarding autonomy were mixed. Quantitatively, students in the experimental group reported greater engagement with revision cycles, often revising their essays two to three times per task based on AI-generated suggestions. Revision logs revealed that students actively engaged in a “dialogue” with the AI, refining ideas, rephrasing sentences, and improving organization across multiple iterations. These patterns suggest that AI feedback facilitated a culture of self-directed revision. This outcome echoes Mekheimer's (2025) interview data, in which students described AI tools as reducing frustration and boosting their confidence in self-correction, making them feel more capable of managing writing tasks independently. However, self-reported survey data revealed a paradox. In line with Qadri, Naper, and Zaman (2025), Pakistani learners reported lower perceptions of linguistic autonomy when using AI. While they valued the efficiency and clarity offered by AI feedback, many admitted feeling overly reliant on suggestions, doubting their ability to produce equivalent quality writing unaided. This raised questions about the ownership of authorship—with several students expressing concerns that, if too many sentences were AI-generated, “the essay no longer feels like mine.” Similar tensions were noted by Khampusaen (2025), where participants highlighted concerns regarding academic integrity and authenticity in AI-supported assignments.

Critical Thinking

In terms of critical thinking (CT), the experimental group outperformed the control group in rubric-based measures of argument quality, reasoning clarity, and evidence evaluation. Their essays demonstrated more structured claims, explicit counterarguments, and stronger integration of sources. These outcomes align with the 2025 study “Effects of AI Chatbots on EFL students' critical thinking skills” (Taylor & Francis Online), which reported that when chatbots were embedded in writing pedagogy, students developed higher-order reasoning abilities, leading to enhanced critical engagement with texts. Qualitative interview data suggested that learners in the AI group used AI prompts as catalysts for reflection, brainstorming, and evaluating multiple perspectives. Students described AI as a “thinking partner,” helping them to organize ideas and challenge weak arguments. Nevertheless, risks were evident. Some students displayed superficial acceptance of AI suggestions, adopting phrases or arguments verbatim without deeper evaluation. This mirrors Zhai's (2024) findings on the “effects of over-reliance on AI dialogue systems,” where students who uncritically

accepted AI output demonstrated lower analytical depth and reduced creativity. In such cases, AI may inadvertently replace, rather than stimulate, critical reasoning.

Moderating Factors

The effectiveness of AI integration was moderated by several pedagogical and contextual factors:

1. **Scaffolding:** Students who received explicit guidance on evaluating AI feedback (e.g., using rubrics, reflective checklists) demonstrated stronger CT and autonomy gains than those who engaged with AI independently. This suggests teacher mediation remains vital for balancing AI use.
2. **Task type and genre:** Argumentative writing tasks yielded greater CT improvements compared to narrative or descriptive assignments. This finding aligns with Wang & Fan's (2025) meta-analysis, which concluded that AI has a moderately positive effect on higher-order thinking, particularly when tasks demand synthesis and evaluation.
3. **Duration of exposure:** Gains in both writing quality and CT were more pronounced in learners with longer intervention periods. While shorter exposures produced quick surface-level improvements (grammar, cohesion), sustained use (6–8 weeks or more) was necessary to observe stable growth in autonomy and reasoning skills.

In sum, the results indicate that AI-assisted writing significantly enhances writing performance and stimulates critical thinking, but its influence on learner autonomy is more complex—supporting self-regulated revision while simultaneously raising concerns about dependence and authorship.

Discussion

The synthesized findings from this quasi-experimental design demonstrate that generative AI can meaningfully enhance writing performance in EFL contexts, particularly in the domains of content development, organization, cohesion, and grammar. These results are consistent with recent empirical evidence. For example, Mekheimer (2025) showed that Saudi EFL students using Grammarly significantly outperformed peers in essay writing, especially in coherence and cohesion, while Khampusaen (2025) reported notable gains in argument structure and academic voice among Thai learners supported by ChatGPT. Furthermore, meta-analytic evidence by Wang and Fan (2025) indicated a large effect of ChatGPT on overall learning performance ($g \approx 0.867$) and a moderate effect on higher-order thinking ($g \approx 0.457$), reinforcing the strong potential of generative AI in academic writing. However, findings regarding learner autonomy reveal a more nuanced picture. On one hand, revision logs and interviews demonstrated that experimental group students engaged in more revision cycles, echoing earlier findings that AI feedback fosters iterative engagement (Mekheimer, 2025). Students described feeling more confident and less frustrated during revision, suggesting that AI may help to scaffold self-regulated learning. On the other hand, survey data revealed that some learners developed a sense of dependency, echoing the observations of Qadri, Naper, and Zaman (2025), who found that Pakistani learners reported diminished feelings of linguistic autonomy when using AI, as they often relied on AI-generated suggestions rather than independently resolving issues. This raises questions about the balance between support and dependence in AI-assisted environments. With respect to critical thinking (CT), the study supports the hypothesis that generative AI can stimulate reasoning and argument quality, but only under certain conditions. Experimental group essays showed stronger evidence integration and clearer argumentative structures, consistent with findings from the study “Effects of AI Chatbots on EFL students’ critical thinking skills” (2025), which demonstrated measurable CT gains when AI was embedded in CT-oriented tasks (Taylor & Francis Online). Yet, the risks of over-reliance were also evident: some learners adopted AI suggestions uncritically, paralleling Zhai's (2024) findings that excessive dependence on AI dialogue systems

diminishes creativity and analytical depth. This indicates that CT benefits are conditional upon students engaging with AI feedback reflectively rather than passively. Thus, the findings suggest that task design, scaffolding, and duration of exposure are critical moderators of AI's impact. Argumentative writing tasks yielded greater CT gains than descriptive tasks, while explicit instruction in feedback literacy amplified autonomy and reflective engagement, confirming prior reviews that highlight the centrality of pedagogy in technology-mediated learning (Zawacki-Richter et al., 2023).

Conclusion

This study contributes to a growing body of evidence showing that generative AI can be a powerful tool in EFL writing instruction. The intervention confirmed the hypotheses that AI-assisted learners outperform peers in writing quality and show enhanced engagement in revision processes. Importantly, it also highlighted the conditional nature of autonomy and critical thinking gains. In particular, the study concludes that Writing performance benefits consistently from AI integration, with strong improvements in content, organization, grammar, and cohesion (Mekheimer, 2025; Khampusaen, 2025). Learner autonomy shows both gains and risks: while AI encourages more revisions and boosts confidence, it can also foster dependency and blur feelings of authorship (Qadri et al., 2025). Critical thinking improves when tasks require evaluation and reflection and when scaffolding is present, but risks of superficial engagement remain (Zhai, 2024; Wang & Fan, 2025). Teachers should integrate generative AI as a supportive tool, not a replacement, embedding it within scaffolded, reflective, and dialogic pedagogy. Curriculum design may benefit from incorporating AI literacy, including training in prompt engineering, feedback evaluation, and academic integrity. Explicit instruction in feedback literacy (Carless & Boud, 2018) can help students critically engage with AI-generated feedback, ensuring that autonomy and CT are cultivated rather than undermined.

Limitations and Future Research

Several limitations should be acknowledged. First, like many existing studies, the intervention duration (six to eight weeks) was relatively short, limiting conclusions about long-term autonomy and CT development. Second, the participant group (university-level English majors) restricts generalizability to younger or less proficient learners. Third, while mixed-methods provided rich insights, more robust instruments for measuring CT and autonomy are still needed to capture multidimensional changes. Future research should pursue longitudinal studies examining sustained AI use across semesters, explore secondary and under-resourced contexts, and investigate discipline-specific applications of AI in writing. Importantly, further work is needed to design ethical frameworks and pedagogical models that balance AI support with learner independence.

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