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ChatGPT's Impact on ESP Writing Proficiency and Learner Autonomy: An Experimental Study



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Abstract

This study investigates ChatGPT's efficacy in fostering autonomous ESP writing development across different proficiency levels, while systematically evaluating its strengths and limitations in enhancing specific writing competencies. A quasi-experimental pretest-posttest design was employed with a purposively sampled cohort of 176 Saudi university students (A1-B1 proficiency) over 8 weeks. Standardized email-writing assessments measured progress in Content, Format/Structure, Grammar/Punctuation, and Clarity/Cohesion, with ANOVA and effect size analyses determining significant changes. Results showed significant improvements ($p < .001$) in rule-based skills: Content (A1: $d = 2.68$; A2: $d = 1.56$; B1: $d = 2.06$) and Format/Structure (A1: $d = 2.59$; A2: $d = 1.10$; B1: $d = 1.18$).

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Data Availability Statement: All relevant data are within this paper.

Grammar improved for A1 ($d = 0.74$) and A2 ($d = 0.58$) but not B1 ($p = .210$). Clarity/Cohesion showed no significant gains ($p > .05$), highlighting ChatGPT's limitations in scaffolding abstract, discourse-level competencies. The model explained 57–74% of variance (R^2), with strongest effects for A1 learners. This study provides the first empirical evidence of ChatGPT's proficiency-dependent effectiveness in ESP writing, establishing (1) clear thresholds for AI's optimal utility across skill levels, (2) critical limitations in developing higher-order writing skills, and (3) a foundation for blended AI-human writing pedagogy in ESP contexts.

Keywords: AI in education, autonomous language learning, ChatGPT, educational technology, ESP.

Introduction

The notion of learner autonomy in English as a Foreign Language (EFL) education has garnered considerable attention in recent years, especially within English for Specific Purposes (ESP) contexts. Learner autonomy, which refers to students' ability to manage their own learning processes (Namaziandost & Rezai, 2024), has gained significance as educational paradigms transition from teacher-centred to learner-centred methodologies. This shift is particularly vital for ESP instruction, where learners must develop discipline-specific writing skills relevant to academic and professional communication (Almusharraf, 2020; Tuan, 2021).

Despite its recognized importance, fostering genuine autonomy in ESP writing remains a significant challenge, particularly for Saudi EFL learners. Research shows that learning to write in English for Specific Purposes is uniquely challenging, marked by persistent teacher dependence (Alrabai, 2021), limited authentic practice, and the difficulty of juggling linguistic rules with complex ideas. This work involves two distinct skill sets: concrete, rule-based elements like grammar and formatting, and more abstract skills like coherence and argumentation (Kissling, 2021; Özdemir et al., 2021). Studies suggest that while rule-based elements respond well to structured feedback, abstract competencies require deeper, sustained cognitive engagement (Tater et al., 2022).

While traditional methods like peer collaboration and teacher scaffolding promote autonomy, their benefits can be limited by a lack of immediacy and personalization (Godwin-Jones, 2019; Mohamed et al., 2025). This gap highlights the growing need for innovative strategies in ESP writing that offer timely, adaptive, and learner-controlled support.

The emergence of AI tools such as ChatGPT presents a promising response to these challenges. ChatGPT's capacity to provide immediate feedback, generate writing models, and support independent learner engagement (Alfaleh et al., 2025; Bin-Hady et al., 2023; Jmaiel et al., 2025) introduces innovative opportunities to enhance autonomy in ESP contexts. In this study, "short-term autonomy" refers to measurable progress in learners' ability to self-regulate and improve writing performance over a two-month period with minimal teacher intervention. However, several critical questions remain underexplored: (1) the extent to which ChatGPT can foster short-term autonomy in ESP writing, (2) whether its impact differs between rule-based and abstract writing skills, and (3) how it can be effectively integrated into ESP pedagogy.

By investigating how ChatGPT can strengthen autonomous learning among Saudi ESP students, this study aims to fill these empirical and pedagogical gaps. Specifically, it evaluates ChatGPT's short-term impact on learners' independent writing development, compares its effects on rule-based and abstract skills, and proposes an instructional framework for its optimal use in ESP classrooms.

The study offers several contributions to the field: (1) it provides empirical evidence on AI's influence on short-term autonomous learning outcomes in ESP writing, (2) it identifies how different writing skills respond to AI-mediated feedback, and (3) it offers practical guidelines for incorporating ChatGPT into Saudi ESP instruction, where developing professional communication in English remains a key challenge. By addressing these dimensions, the research enhances theoretical understanding and practical application of AI tools in language education, offering valuable insights for scholars and practitioners working in comparable ESP contexts.

Research Problem

Saudi EFL students face persistent challenges in mastering both rule-based (e.g., grammar, formatting) and abstract (e.g., coherence, critical analysis) writing skills (Jmaiel et al., 2025; Nasim et al., 2024), coupled with a strong reliance on teacher guidance and limited authentic practice opportunities. Although ChatGPT and other AI tools have emerged as promising solutions, it remains unclear how effectively they foster short-term autonomy, how their influence varies between skill types, and how they can be systematically integrated into ESP curricula. This study addresses these questions by investigating ChatGPT's effectiveness, limitations, and pedagogical value in promoting autonomous ESP writing development across proficiency levels.

Literature Review

AI-Mediated Autonomy in Language Learning

Building on foundational autonomy frameworks by Holec (1981) and Little (1991), which define self-directed learning through three core capacities (detachment, critical reflection, and decision-making), recent scholarship has shifted focus to examining how AI tools like ChatGPT transform self-directed learning into compressed timeframes (Zhang & Zou, 2022). These classical theories established autonomy as cyclical processes of goal setting, monitoring, and evaluation (Cook & Artino, 2016), while contemporary research reveals AI's unique capacity to accelerate these processes through instant, iterative feedback, particularly valuable for ESP writing, where discipline-specific competencies must be rapidly acquired. This technological mediation creates a new paradigm of "scaffolded autonomy" (Holec, 1981; Little, 1991; Huang & Benson, 2013), where learners maintain metacognitive control over their writing process while receiving AI support at critical thresholds (Ludwig & Tassinari, 2023; Mohamed, A. & Shaaban, 2023). The synthesis of these theoretical layers, from Holec's original definition to Huang's scaffolded model, provides a robust framework for analyzing ChatGPT's role in ESP writing autonomy.

Emerging evidence suggests this AI-human collaboration yields superior outcomes to pure self-direction in short-term interventions. Okumus Ceylan's (2021) findings on autonomy readiness align with studies showing ChatGPT enhances moderate-autonomy learners' confidence in ESP tasks through just-in-time support (Chan & Hu, 2023). However, critical gaps remain regarding: 1) optimal duration of AI-mediated autonomous practice, 2) skill-specific efficacy (rule-based vs. abstract competencies), and 3) ethical risks including over-reliance and prompt dependency (Dergaa et al., 2023) - issues this study explicitly addresses.

ESP Pedagogy in the AI Era

Modern ESP scholarship emphasizes dynamic needs analysis beyond Hutchinson and Waters' (1987) foundational model, particularly regarding technological integration (Enesi et al., 2021). Recent empirical work by Jmaiel et al. (2025) demonstrates ChatGPT's measurable impacts on ESP writing

skills across gender and disciplinary groups, while Tran (2025) provides evidence for its effectiveness in self-instructed learning contexts. The TPACK framework (Mishra & Koehler, 2006) proves especially relevant for ESP writing, where AI tools must align with both disciplinary communication norms and pedagogical objectives, a principle supported by Chen's (2025) Termsoup study and Ashrafganjoe's (2025) findings with the Hemingway app, which collectively highlight the need for tool-specific instructional adaptations. Current research identifies three key challenges in AI-enhanced ESP instruction: maintaining authenticity in simulated professional scenarios, as observed in Choi et al.'s (2025) analysis of teacher experiences with generative AI; balancing automated feedback with human oversight (Escalante et al., 2023); and addressing cognitive variability in technology adoption (Alyoussef, 2022; Li, 2018), particularly in EFL environments like those examined by Jmaiel et al. (2025).

ChatGPT's Dual Role in Writing Development

As both a writing assistant and an autonomy scaffold, ChatGPT demonstrates unique affordances and limitations. While Tambunan et al. (2022) and Marzuki et al. (2023) document its efficacy in grammatical accuracy and paraphrasing, concerns persist regarding its capacity to develop higher-order competencies like rhetorical cohesion and discipline-specific genre conventions (Barrett & Pack, 2023). The tool's dialogic potential (Winstone & Carless, 2020) supports autonomous learning through the continuous negotiation of feedback, yet it requires careful monitoring to prevent superficial engagement (Barrot, 2023; Fu et al., 2024)

This literature synthesis reveals a critical need for empirical studies that: 1) measure ChatGPT's short-term autonomy-facilitation in ESP contexts, 2) identify skill-specific thresholds for AI effectiveness, and 3) propose frameworks for ethical integration - the precise gaps this study addresses through its examination of 176 Saudi ESP learners' writing development over two months.

This study addresses three underexplored gaps in AI-assisted language learning research: (1) the lack of empirical data on ChatGPT's efficacy in short-term (≤ 2 month) ESP writing interventions, (2) limited evidence about which specific writing skills (rule-based vs. abstract) benefit most from AI-mediated autonomy, and (3) minimal research on AI integration in Saudi ESP contexts where discipline-specific writing demands intersect with unique L2 challenges (Al-khresheh et al., 2023; Bin-Hady et al., 2023). Unlike broader studies of AI in language learning, we provide granular, skill-level analysis of ChatGPT's impact on Content, Format, Structure, Grammar, Clarity, and Cohesion through pre/post-testing of 176 learners across proficiency levels.

We defined "ChatGPT-facilitated autonomous learning" here as learners' self-directed use of ChatGPT for writing practice, evaluated through three measurable outcomes: (a) frequency of iterative revisions, (b) reduction of instructor-dependent feedback requests, and (c) improvement scores on rubric-assessed writing components. Effects are quantified through ANOVA comparing pre-intervention baselines with post-intervention performance across these metrics.

Research Gap

Despite growing interest in using AI tools like ChatGPT for language learning, empirical studies on their impact in fostering short-term ($\leq$ two-month) autonomous ESP writing development remain scarce. Most research targets general EFL writing and overlooks skill-specific outcomes (e.g., content, format, grammar, cohesion) and proficiency-level variations in AI-assisted instruction. In the Saudi EFL context, where learner autonomy is still emerging, little is known about how generative AI supports individualized ESP writing progress. This study addresses these gaps through a skill-level,

proficiency-based analysis of ChatGPT's influence on autonomous writing performance across A1, A2, and B1 learners, providing early evidence of AI's potential to promote short-term autonomy and balanced skill development in Saudi ESP contexts.

Research Question

RQ1: How does ChatGPT-assisted autonomous learning affect Saudi EFL learners' ESP writing in terms of writing autonomy, rule-based and abstract skill development, and proficiency-level performance (A1, A2, B1)?

Methodology

Research Design

This study employed a quantitative, quasi-experimental approach using a one-group pretest-posttest design to evaluate the impact of ChatGPT on ESP students' academic writing performance (Supriyatno et al., 2020). The within-subjects design allowed for the comparison of writing outcomes before and after the intervention within the same cohort, with each participant serving as their own control (Kim, 2010; Ary et al., 2010; Cipani, 2009).

Over the course of eight weeks, 176 Saudi university students enrolled in ESP courses engaged in structured, daily 30-minute sessions with ChatGPT, following comprehensive training on ethical and effective use of AI tools. Writing skills were assessed using standardized scoring rubrics focused on Content, Format and Structure, Grammar and Punctuation, and Clarity and Cohesion. Repeated measurements and consistent time intervals enhanced the internal validity of the design (Ary et al., 2010), although the absence of a control group is acknowledged as a limitation.

Given the practical constraints and educational context, the quasi-experimental design was deemed appropriate for capturing measurable changes in autonomous writing development resulting from AI-assisted learning (Supriyatno et al., 2020). Three main factors supported this design: first, it allowed for accurate tracking of individual progress across proficiency levels; second, it complied with recent methodological approaches in AI-assisted language learning research; and third, it accommodated the real-world constraints of intact classroom settings where random assignment was impractical (Jmaiel et al., 2025; Kohnke et al., 2023).

Participants

This study involves students enrolled in the ESP course at the Applied College, Northern Border University, during the third term of the academic year 2023/2024. They were first-year students, aged between 18 and 21, pursuing different majors, including E-commerce, Legal Assistant, Human Resources, and Information Technology. The course primarily aims to develop their academic, business, or professional English proficiency. The researchers employed two non-probability sampling techniques: convenience and purposive sampling. This decision was taken due to the researchers' direct access to and familiarity with this group of students, who possess desirable features and whose performance is well-known to the researchers. Out of all the ESP students accessible to the researchers, a cohort of 176 students, consisting of 54 males and 122 females, willingly gave their consent to take a placement test. This test was administered by the faculty at the beginning of the academic year and served as a standard institutional tool for proficiency-based student classification. The latter aimed to showcase a range of skills and to assess performance across different ability levels. Based on the results of the level placement test, students were grouped into three proficiency levels (A1, A2, and B1).

as depicted in Table 1. The proficiency levels A1, A2, and B1 reflect the students' varying levels of language proficiency. Participants were grouped by proficiency: A1 (beginner), A2 (pre-intermediate), and B1 (intermediate). This framework provided a clear baseline for assessing their initial skills and measuring subsequent progress.

Table 1 *Study Sample Group*

	Male	Female	Total per proficiency level
Proficiency Level A1	20	58	78
Proficiency Level A2	24	38	62
Proficiency Level B1	10	26	36
Total Number of Participants	54	122	176

Study Instrument

Students completed identical formal email assignments as pre- and post-tests to measure proficiency gains. This established design was selected for its documented benefits in enhancing listening (Badianti, 2023; Geldhof et al., 2018), strengthening memory (Sana & Carpenter, 2023), and deepening critical understanding of complex tasks (Gupta et al., 2023; Jmaiel et al., 2025).

Students had to write courteous emails in response to predetermined prompts as part of this assessment tool. Language proficiency levels (A1, A2, and B1) are paired with tasks using carefully designed prompts for each competency level (see Table 2). Every task comprised comprehensive guidelines, specifying the objective, intended audience, and desired format. Furthermore, the study tool offered learners a reliable and precise method for evaluating their email composition abilities. This approach enabled students to assess their performance based on established criteria that corresponded with research tasks suitable for their skill level.

Table 2 *Pre-Assessment Test Specification*

Question	Skill assessed	Proficiency level	Maximum score
1	Requesting a meeting	A1	20
2	Writing a thank-you email	A2	20
3	Complaining and requesting	B1	20

A performance rubric was developed to assess the students' writing. As shown in Table 3 below, this rubric specifies the evaluation criteria for formal emails, including overall effectiveness, organization, clarity, language, and vocabulary. Each criterion is assigned a unique rating scale, enabling a consistent and objective assessment of the students' writing skills.

To ensure both face and content validity of the pre- and post-tests, subject matter experts, academics specializing in ESP teaching, assessed the test items. Upon the completion of the tests' initial draft, the researchers examined the jury members' qualitative assessment of their opinions about the pre- and post-test items. The researchers computed a ratio based on the percentage of jury members who agreed with the items versus those who disagreed, based on the quantification of the members' viewpoints. The degree of agreement among the jury members ranged from 80 to 100%.

Table 3 *Test Rubrics*

Criteria	Points	Description	Scoring rules
Content	8	Provides a clear reason for the meeting, expresses gratitude in a thank-you email, and articulates concerns while requesting a resolution.	7–8: Comprehensive; 5–6: Clear but limited; 3–4: Vague; 0–2: No clarity.
Format and structure	6	Follows proper email format, including appropriate salutations, subject lines, and closing remarks.	5–6: Proper format; 3–4: Minor errors; 1–2: Significant errors; 0: No format.
Grammar and Punctuation	4	Demonstrates basic grammatical accuracy and punctuation usage.	4: Minimal errors; 2–3: Some errors; 1: Frequent errors; 0: Numerous errors.
Clarity and Cohesion	2	Expresses ideas clearly and coherently.	2: Clear and logical; 1: Somewhat clear; 0: Unclear.
Total	20		

Procedures

As part of the study procedures (Figure 1), a sample of 176 students who were enrolled in the ESP course at the time was chosen. The participants were provided access to ChatGPT, version GPT-3.5, launched in early 2022, for approximately two months and were acquainted with the self-directed learning process. Students are directed to allocate 30 minutes every day, excluding weekends, to practice writing emails using ChatGPT. They set objectives and followed guidelines regarding word count, formal language, and email protocol. They received instructions on how to utilize ChatGPT, check their drafts, receive feedback and corrections and tips after receiving training on the AI platform. Additionally, they assessed their own progress by seeking feedback from peers. Through an iterative learning approach and multiple training sessions, students learned how to use and enhance their skills with this program. Instructors provided additional resources to students, as well as assessed their completed email writing projects. Self-directed learning was used to advance autonomous language learning and enhance formal email writing skills using ChatGPT.

After the two months intervention, the participants sat for the posttest to measure the difference happening after practicing writing formal emails autonomously using ChatGPT. The results were analysed statistically to provide answers to the research question. After that, the results were discussed to better understand the study findings.

Data Collection

To assess the development of formal email writing skills, participants completed an identical pre- and post-test in which they composed emails for specific professional scenarios. Their responses were evaluated using a detailed rubric covering content, format and structure, syntax and punctuation, and clarity and cohesiveness. The data collection process prioritized ethical standards, including informed consent and confidentiality, to ensure the accurate and reliable documentation of student performance against established benchmarks.

Data Analysis

The study employed multiple analytical tools to evaluate ChatGPT's self-directed learning approach and student outcomes across A1, A2, and B1 proficiency levels. Descriptive statistics (mean, median,

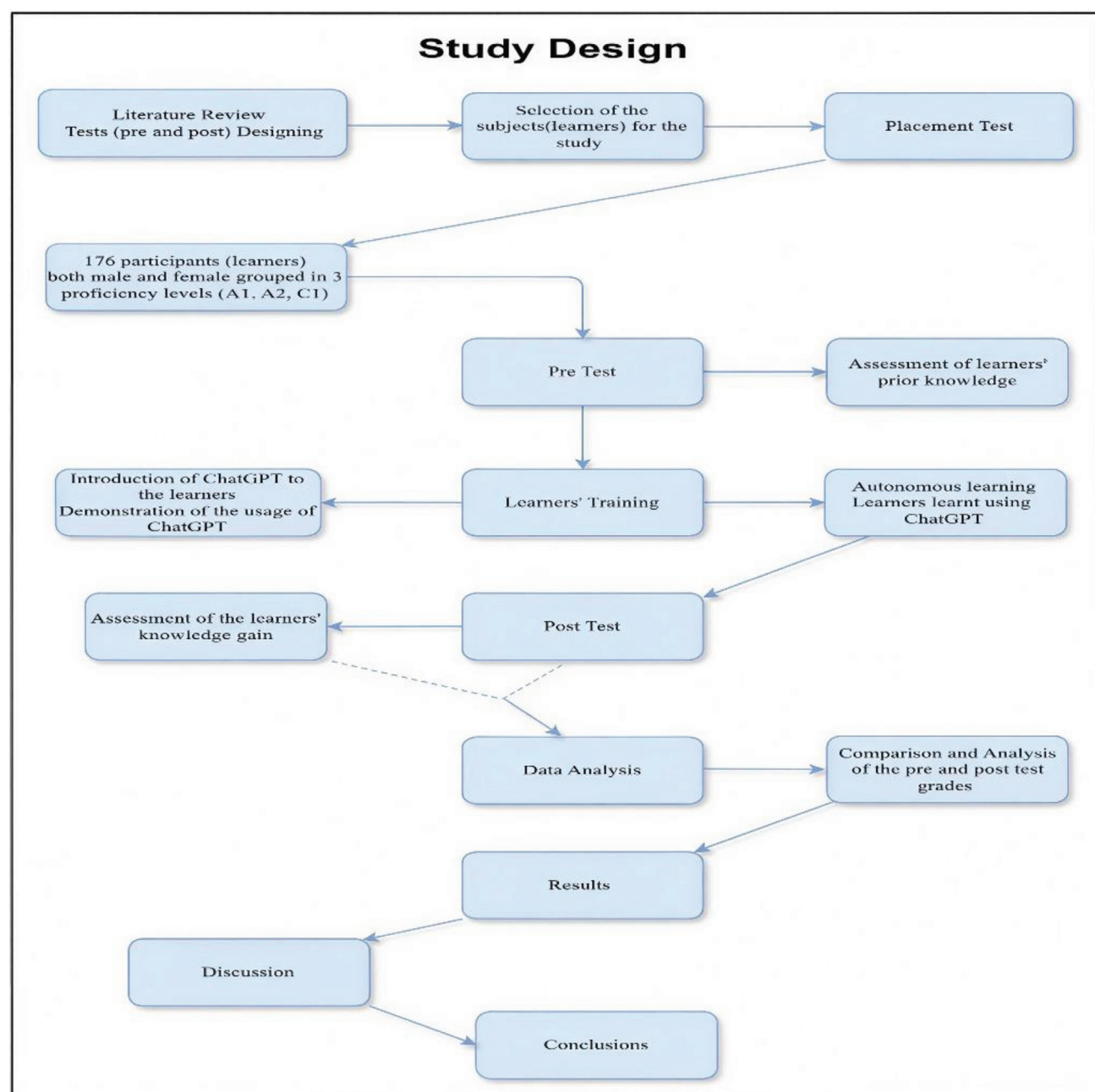


Figure 1 Study Design.

standard deviation) were used to analyze score distributions, while comparative assessments identified performance differences between levels. One-way ANOVA with Tukey's HSD (Honestly Significant Difference) assessed statistical significance. Rubric-based analysis revealed strengths and weaknesses, and pre-post score comparisons measured progress in formal email writing. Additionally, ChatGPT interaction data was examined to identify common student queries, helping refine instructional strategies and assess feedback effectiveness.

Prior to the ANOVA, the data were confirmed to meet the necessary assumptions of normality (Shapiro-Wilk test) and homogeneity of variances (Levene's test). The minimal missing data (<2%), handled by pairwise deletion, was randomly distributed and did not threaten the analysis. Effect sizes were calculated using partial eta squared (η^2) to standardize the assessment of the intervention's impact.

Ethical Considerations

The study complied with recognized ethical standards. The data was anonymized to safeguard individual identities, supported by stringent measures to ensure participant confidentiality. Participants were provided with detailed information about the study's scope, methodology, and their rights, including the option for voluntary participation and the ability to withdraw at any time. A comprehensive ethical review process was undertaken prior to the commencement of data collection, obtaining approval from the appropriate institutional ethical committees. The study was validated as ethically sound and reliable.

Results

To address the study's central research question, a series of one-way ANOVA tests were conducted across three English proficiency levels (A1, A2, and B1) to examine the effect of ChatGPT on students' writing performance. In response to reviewer feedback, this section integrates both statistical results and interpretive synthesis to enhance readability. A visual summary is also referenced at the end of the section to facilitate interpretation.

A) Proficiency Level A1

At the A1 proficiency level, ChatGPT integration yielded significant differences in student performance across all assessed writing dimensions. The analysis assumed independence of observations and homogeneity of variances, with significance set at $\alpha = 0.05$.

Table 4 *Main Hypothesis*

Hypothesis component	Description
Null Hypothesis (H_0)	All group means are equal
Alternative Hypothesis (H_1)	Not all group means are equal
Significance Level (α)	0.05
Assumption	Equal variances assumed

Table 5 *Analysis of Variance for Proficiency Level A1*

Source	DF	Adj SS	Adj MS	F-value	P-value
Factor	7	1407.1	201.011	249.29	0.000
Error	616	496.7	0.806		
Total	623	1903.8			

The significant F -value ($p = 0.000$) confirms that ChatGPT use produced meaningful differences in writing performance across skill categories.

Table 6 *Tukey Simultaneous Tests – A1*

Skill	Difference of means	95% Confidence Interval (CI)	Adjusted P-value
Content	2.679	(2.243, 3.116)	0.000
Format and Structure	2.590	(2.154, 3.026)	0.000
Grammar and Punctuation	0.744	(0.307, 1.180)	0.000
Clarity and Cohesion	0.397	(-0.039, 0.834)	0.104

Table 7 *Model Summary – A1*

S	R-sq	R-sq (adj)	R-sq (pred)
0.897952	73.91%	73.61%	73.23%

At this beginner level, ChatGPT's use led to substantial gains in content generation, organizational structure, and grammatical accuracy. The model demonstrated strong explanatory power ($R^2 = 73.91\%$), suggesting that the AI tool effectively scaffolded students' early writing development. However, the non-significant improvement in clarity and cohesion implies limited progress in discourse-level coherence, indicating that students were still highly dependent on AI guidance. This dependency suggests low but emerging learner autonomy, as students began to internalize ChatGPT feedback while still relying on external support.

B) Proficiency Level A2

At the A2 level, the ANOVA indicated a statistically significant effect of ChatGPT on overall writing performance.

Table 8 *Analysis of Variance for Proficiency Level A2*

Source	DF	Adj SS	Adj MS	F-value	P-value
Factor	7	1042.4	148.911	119.62	0.000
Error	616	766.8	1.245		
Total	623	1809.2			

Table 9 *Tukey Simultaneous Tests – A2*

Skill	Difference of means	95% Confidence Interval (CI)	Adjusted P-value
Content	1.564	(1.022, 2.106)	0.000
Format and Structure	1.103	(0.561, 1.645)	0.000
Grammar and Punctuation	0.577	(0.035, 1.119)	0.027
Clarity and Cohesion	0.321	(-0.221, 0.862)	0.624

Table 10 *Model Summary – A2*

S	R-sq	R-sq (adj)	R-sq (pred)
1.11574	57.61%	57.13%	56.51%

At this intermediate level, ChatGPT continued to enhance content, organization, and grammar, though the model's explanatory strength decreased ($R^2 = 57.61\%$). These results indicate that students began to integrate ChatGPT's feedback more selectively, signaling the development of partial autonomy—that is, the ability to self-correct and refine writing using AI-generated insights. However, the lack of significant improvement in clarity and cohesion implies that deeper discourse-level skills, requiring independent critical thinking, were not yet fully internalized.

C) Proficiency Level B1

At the B1 level, results maintained the overall trend of significant improvement but with skill-specific differentiation.

Table 11 *Analysis of Variance for Proficiency Level B1*

Source	DF	Adj SS	Adj MS	F-value	P-value
Factor	7	1355.6	193.659	161.02	0.000
Error	624	750.5	1.203		
Total	631	2106.1			

Table 12 *Tukey Simultaneous Tests – B1*

Skill	Difference of means	95% Confidence Interval (CI)	Adjusted P-value
Content	2.063	(1.534, 2.593)	0.000
Format and Structure	1.177	(0.648, 1.707)	0.000
Grammar and Punctuation	0.430	(-0.099, 0.960)	0.210
Clarity and Cohesion	0.405	(-0.124, 0.934)	0.282

Table 13 *Model Summary – B1*

S	R-sq	R-sq (adj)	R-sq (pred)
1.09667	64.37%	63.97%	63.45%

At this advanced stage, ChatGPT continued to improve content and format but no longer produced significant gains in grammar or cohesion. This shift reflects a transition toward autonomous writing behaviors—students increasingly used ChatGPT as a collaborative partner rather than a corrective tool. The relatively strong model fit ($R^2 = 64.37\%$) supports this interpretation, indicating that ChatGPT reinforced self-regulated learning by allowing learners to selectively apply feedback while maintaining creative control over their writing.

D) Cross-Level Summary and Theoretical Integration

Across proficiency levels, Content and Format & Structure improved consistently, highlighting ChatGPT's strength in enhancing idea development and structural organization. Gains in Grammar and Punctuation were evident at lower levels but plateaued at B1, while Clarity and Cohesion remained unchanged.

These findings demonstrate a progressive autonomy trajectory:

- A1: Learners depended heavily on AI feedback (low autonomy).
- A2: Learners began applying feedback selectively (developing autonomy).
- B1: Learners demonstrated control and self-regulation in writing (emerging autonomy).

Although autonomy was not directly measured, the behavioral progression observed across levels—moving from dependence to selective use—reflects a gradual internalization of AI-assisted learning strategies, aligning with the theoretical framing of ChatGPT as a mediational tool for fostering learner independence.

Overall, the integration of ChatGPT significantly enhanced learners' writing performance, particularly in areas related to content development and structural organization. The findings reveal an implicit but progressive growth in learner autonomy, with students evolving from guided reliance to self-regulated engagement with the AI tool. This dynamic supports the study's theoretical stance that ChatGPT, when

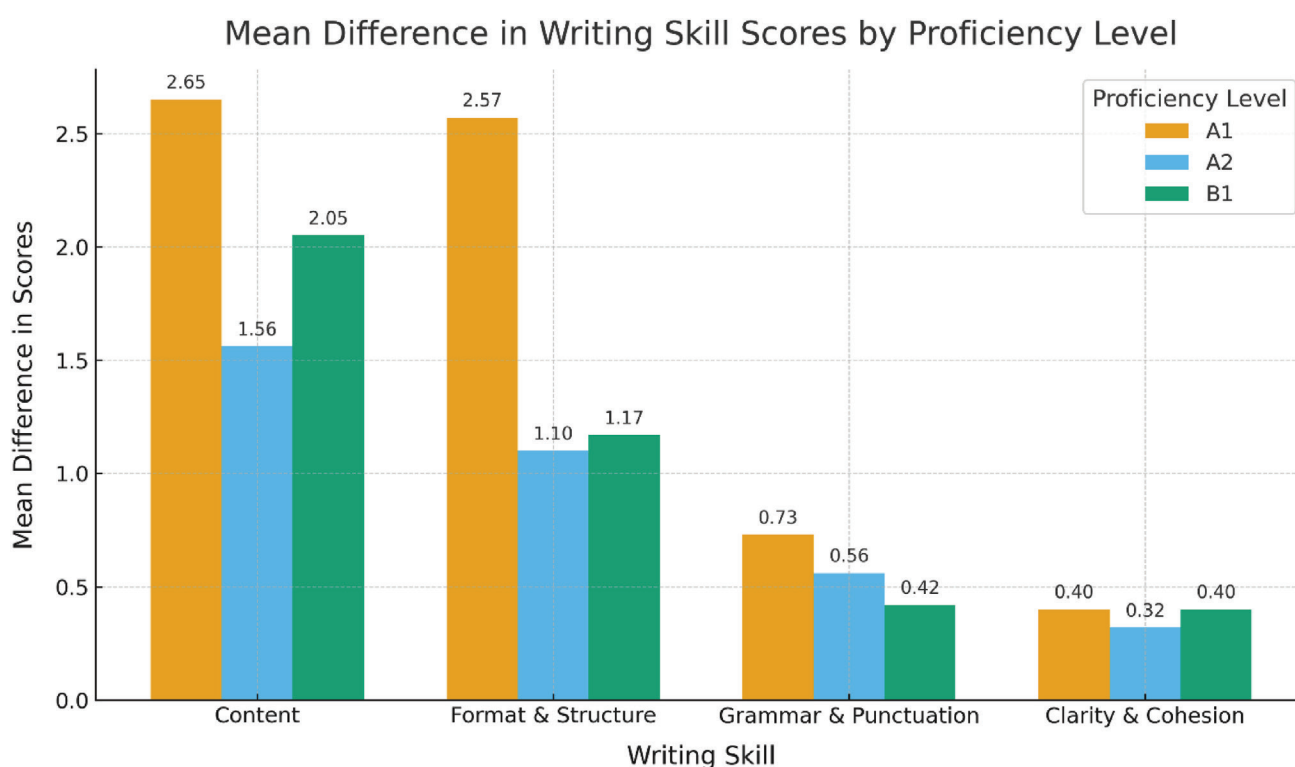


Figure 2 *Comparative Improvement in Writing Skills (Content, Format & Structure, Grammar & Punctuation, and Clarity & Cohesion) Across Proficiency Levels (A1–B1). The Figure Visually Highlights ChatGPT’s Strongest Effects on Content and Format, with Smaller Gains in Grammar and Limited Impact on Cohesion.*

used as a pedagogical mediator, can facilitate not only linguistic accuracy but also the development of independent, reflective language learning behaviors.

Discussion

The findings directly address the study’s main question by showing that ChatGPT significantly enhances rule-based writing skills, Content, Format/Structure, and Grammar, while having little effect on abstract abilities such as Clarity and Cohesion. These gains were strongest among lower-proficiency learners (A1 and A2) and diminished at the B1 level, indicating a proficiency attenuation effect. Learners’ consistent improvement through independent interaction with ChatGPT also suggests the short-term development of writing autonomy, although autonomy was inferred behaviorally from students’ writing revisions, reduced teacher dependence, and evidence of self-directed use of ChatGPT. Overall, the results confirm ChatGPT’s effectiveness as a scaffold for foundational ESP writing skills but highlight its limitations in supporting higher-order rhetorical competence.

Proficiency-Based Analysis of ChatGPT’s Impact on ESP Writing Proficiency

In this study, 176 Saudi university students were evaluated at three competence levels (A1–B1) to determine the usefulness of ChatGPT in promoting independent development of ESP writing. According to the results, ChatGPT has a strong impact on teaching rule-based writing skills but struggles to promote higher-order abilities. The impacts are both significant and variable. Our research adds to the growing body of evidence on AI-assisted language acquisition (Su et al., 2023; Fathi & Rahimi,

2024) and highlights principal factors for ESP pedagogy within the field of generative AI. While these findings confirm the statistical robustness of the analysis, the discussion benefits from framing these effects within socio-constructivist and autonomy-oriented perspectives. From this perspective, ChatGPT's strengths in rule-based accuracy support foundational "other-regulated" learning, while its weaknesses in rhetorical development highlight the limitations of automation in fostering autonomous, higher-order cognition (Agustini, 2023).

Differential Effectiveness Across Proficiency Levels

Learners at different skill levels benefit from ChatGPT-assisted writing practice in diverse ways, according to the study. Students at the A1 level (beginning writers) showed the greatest improvement across the board after using the tool. According to the effect sizes for Content ($d = 2.68$), Format ($d = 2.59$), and Structure ($d = 1.21$), ChatGPT serves as a useful tool for students to establish basic writing standards. The findings support Godwin-Jones' (2022) conclusions about the ability of AI tools to enhance foundational language acquisition through prompt, iterative feedback. This outcome also resonates with Ahmed et al. (2023), who found that ChatGPT fosters linguistic confidence and structural awareness among novice ESP learners through guided, iterative modeling.

At the A2 (pre-intermediate) level, while considerable progress was observed, the effect sizes were less pronounced compared to those of A1 learners. This pattern suggests a "proficiency attenuation effect"; as learners' progress in language development, the benefits of AI-assisted writing support may diminish for certain skills. The finding that improvements in Grammar are statistically significant ($p = .027$) is noteworthy; however, the effect size ($d = 0.58$) at the A2 level is smaller than that seen in A1 learners. The differences in effectiveness among proficiency levels have important implications for educators in the strategic use of ChatGPT within mixed-ability ESP classrooms. This attenuation supports the socio-cognitive interpretation that as learners internalize linguistic control, their dependence on external scaffolds such as ChatGPT diminishes—a developmental trajectory consistent with autonomous learning principles (Agustini, 2023).

The results for B1 (intermediate) learners reveal a more intricate scenario. Although Content and Format/Structure abilities exhibited considerable enhancement, Grammar and Punctuation did not reveal statistically significant improvements ($p = .210$). This discovery questions the presumption of linear scalability in AI writing assistance and indicates that as learners advance to intermediate stages, their grammatical development may necessitate more sophisticated feedback than what ChatGPT presently offers. The total absence of notable enhancement in Clarity and Cohesion at all proficiency levels ($p > .05$ in every instance) further emphasizes this constraint. Such results correspond with Allagui (2023), who showed that while AI feedback is effective for surface-level corrections, it remains limited in supporting higher-order, discourse-based competencies requiring dialogic interaction.

Skill-Specific Patterns of Improvement

By breaking out specific writing abilities, we may see clear patterns that help us understand ChatGPT's pedagogical possibilities. Results showed large effect sizes across all levels of competency (A1: $d = 2.68$; A2: $d = 1.56$; B1: $d = 2.06$), indicating persistent and significant improvements in content generation. This finding suggests that one of ChatGPT's major assets in writing education is its ability to develop ideas, provide organizational frameworks, and provide content-related feedback. Since Format and Structure often correlate with the organization and presentation of material, significant improvements in these areas (A1: $d = 2.59$; A2: $d = 1.10$; B1: $d = 1.18$) support this conclusion.

The fact that there are only minor gains in punctuation and grammar, particularly at higher ability levels, suggests that ChatGPT may have limitations when it comes to providing learners with specific grammatical feedback that meets their evolving needs. The tool helps first-year students understand the basics of grammar, but it does not appear to be highly effective at helping with more complex forms of the language. The complex, context-dependent components of grammatical precision in real communication may be challenging for AI writing tools, as this study supports Kessler's (2020) argument. This echoes Marzuki et al. (2023), who noted that while AI writing tools promote formal accuracy, they rarely address discourse-level clarity or pragmatic appropriateness—both essential for advanced ESP proficiency.

An important challenge to the assumptions about ChatGPT's general usefulness in writing development is the lack of noticeable improvement in Cohesion and Clarity across all competence levels ($p > .05$). Independent practice, even with the help of ChatGPT, does not seem to be enough to improve advanced writing skills, which are defined by complex rhetorical decisions and nuanced textual relationships. Because great professional communication is characterized by clarity and cohesion, this restriction has a major influence on ESP instruction. This limitation reflects the broader issue that AI systems can enhance mechanical competence but cannot yet emulate the dialogic and context-sensitive scaffolding required to foster deep rhetorical awareness (Barrot, 2023).

Theoretical and Pedagogical Considerations

The findings offer robust empirical evidence that contributes significantly to various theoretical debates within the realm of language acquisition and technology. The Vygotskian perspective (Vygotsky, 1978) interprets these outcomes as evidence that ChatGPT can assist with “lower psychological functions,” or fundamental writing skills. Nonetheless, it struggles to promote the development of more advanced psychological functions or intricate skills, as these typically depend on substantial social interaction and feedback tailored to the specific context. The absence of advancement in coherence and clarity—elements reliant on the capacity to anticipate and fulfill the reader's needs, which evolves through dialogue—bolsters this perspective (Winstone & Carless, 2020). From a socio-constructivist standpoint, these results suggest that ChatGPT supports the initial stages of scaffolded learning but does not replace the negotiated meaning-making processes essential for autonomy development (Agustini, 2023).

The results show that ChatGPT's participation in ESP writing classes has to be adjusted based on students' current skill sets and degrees of proficiency. The tool is at its most useful when used for:

- Support beginners in developing basic writing conventions
- Provide immediate feedback on content organization and structural elements
- Offer models and templates for formulaic writing tasks

Conversely, the findings caution against over-reliance on ChatGPT for:

- Advanced grammatical development
- Higher-order writing skills like clarity and cohesion
- Open-ended, creative writing tasks

This pedagogical differentiation underscores that ChatGPT should be integrated as part of a blended learning model, where AI serves as a preliminary scaffold and teachers provide the higher-level interpretive feedback necessary for discourse competence (Anis, 2023).

This nuanced understanding of ChatGPT's strengths and limitations is particularly important in light of students' growing tendency to view AI tools as authoritative sources (Kohnke, 2024; Musthafa, 2024). The study's empirical demonstration of ChatGPT's skill-specific and proficiency-dependent effectiveness provides educators with concrete evidence to guide students in critically evaluating and strategically using AI writing assistance. Although autonomy is central to this study's theoretical framing, it was inferred rather than directly measured; future research should empirically examine how learners' autonomous engagement mediates AI feedback uptake.

Our findings present a nuanced picture of AI in language learning. While they confirm ChatGPT's strength in building rule-based writing skills (Su et al., 2023; Fathi & Rahimi, 2024), they also challenge overly optimistic views of its utility (Marzuki et al., 2023) by revealing a consistent lack of progress in higher-order skills, especially for more proficient learners.

The proficiency observed in this study adds an important dimension to our understanding of AI-assisted language learning. While previous research has often treated ChatGPT's effects as uniform across learner levels, these findings suggest that the tool's effectiveness may follow an inverse relationship with learner proficiency, a phenomenon that warrants further investigation in different learning contexts.

The lack of clarity and coherence makes the ongoing debates about the nature of AI feedback escalate. ChatGPT can find and fix problems with local coherence, like using transition words, but it doesn't seem to help students build the global rhetorical skills they need to communicate well in business. This limitation corresponds with the differentiation articulated by Hyland and Hyland (2019) between feedback focused on superficial attributes and feedback that fosters enhanced writing proficiency. By situating these findings within the autonomy–scaffolding continuum, the study provides a clearer theoretical rationale for the “proficiency attenuation effect,” clarifying how dependence on AI support recedes as learner independence grows.

By highlighting ChatGPT's varying efficacy in supporting autonomous ESP writing development, specifically in rule-based skills (Content, Format/Structure, and Grammar) for A1 and A2 learners, as well as its limitations in scaffolding higher-order competencies such as clarity/Cohesion, this study offers important pedagogical implications. Its rigorous quasi-experimental design, standardized assessment metrics, and strong statistical analyses (ANOVA, effect sizes) are its main strengths. These provide empirical evidence for ChatGPT's proficiency-dependent utility, with the effects being especially strong for beginners (A1: large effect sizes, $d = 2.68$ for Content). The results show that ChatGPT works best as an additional tool for teaching basic writing skills rather than advanced discourse-level development, establishing useful thresholds for AI integration in ESP instruction. Overall, the study contributes a theoretically grounded and empirically validated framework for blended AI-human pedagogy, where ChatGPT functions as an initial scaffold, and teacher feedback sustains higher-order rhetorical growth (Anis, 2023).

Conclusions

The study's findings demonstrate that ChatGPT enhances ESP writers' proficiency in rule-based competencies, such as basic grammar, content organization, and formatting, through self-directed learning. Both A1 and A2 students' learning outcomes demonstrate that ChatGPT is successful in enhancing their fundamental writing skills through the provision of prompt, iterative feedback that motivates learners to actively participate in their own education. The tool is inadequate for more sophisticated writing skills like coherence, clarity, and advanced grammatical accuracy, particularly for intermediate (B1) students. The findings show that while ChatGPT is an excellent tool for teaching ESP writing,

it falls short in assisting students in acquiring the complex, context-dependent abilities required for professional communication. However, it does a good job of reinforcing structural principles.

An interesting pattern emerges from the different effects at different ability levels: although beginners gain a lot from writing with AI's help, more advanced students need more help than what ChatGPT can provide right now. Careful integration within a complete educational framework is necessary to ensure the effectiveness of AI tools, which rely on expertise. This study sheds light on the changing function of generative AI in language classrooms by providing hard data on the technology's revolutionary potential and its present shortcomings in encouraging all-encompassing writing growth. While the results show that ChatGPT can improve ESP writing autonomy in some areas, they also show that it has limits when it comes to advanced language learning.

Limitations of the Study

Several limitations must be acknowledged in interpreting the findings of this study. First, the absence of a control group limits the ability to attribute observed improvements in writing skills solely to the ChatGPT intervention. Without a comparison group receiving traditional instruction or no intervention, it is difficult to rule out alternative explanations such as maturation, test familiarity, or external influences. While the within-subjects design offers valuable insight into changes over time, future studies should employ a randomized controlled trial (RCT) or quasi-experimental design with a matched control group to more rigorously evaluate causality.

Second, the sample size, although adequate for initial analysis, was relatively limited in scope and drawn from a single cultural and institutional context (Saudi university students enrolled in ESP courses). This restricts the generalizability of the results to broader populations with different linguistic backgrounds or educational systems.

Third, the study was conducted over a relatively short time frame (eight weeks), which constrains the ability to assess the long-term effects of AI-assisted instruction on sustained writing development. Writing proficiency evolves gradually, and short-term gains may not translate into lasting improvements without continued practice and support.

Lastly, external validity may also be affected by the structured nature of the intervention and the controlled environment in which students used ChatGPT. Real-world variability in AI usage, access, and motivation may produce different outcomes.

To address these limitations, future research should incorporate longitudinal designs, larger and more diverse samples, and robust experimental controls. Such enhancements would improve the reliability, validity, and generalizability of findings related to the educational impact of generative AI tools like ChatGPT.

Challenges and Considerations

The research emphasises some issues connected to the application of artificial intelligence in language teaching, even with the above-mentioned encouraging findings. First, excessive reliance on artificial intelligence tools is a major worry since it could hinder the growth of students' autonomous writing abilities. So, teachers must be careful and responsible with artificial intelligence and make sure their students acquire their own writing skills. Second, differences in technology availability present another significant obstacle, causing unequal learning possibilities. Therefore, it is necessary for schools to address these problems by providing enough resources and assistance, thereby guaranteeing fair access to artificial intelligence tools.

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