International Journal of Computer-Assisted Language Learning and Teaching
Volume 15 • Issue 1 • January-December 2025

Evaluating the Effectiveness of AI Tools Across the Essay Writing Process:

A Comparative Study of Pre-Writing, Drafting, and Post-Writing Stages

Hassan Saleh Mahdi
https://orcid.org/0000-0003-4023-8219
Arab Open University, Saudi Arabia

Marine Milad
https://orcid.org/0009-0000-0703-3604
Arab Open University, Kuwait

Aziz Thabit Saeed
Arab Open University, Kuwait
Received: July 22nd, 2025 | **Accepted:** September 30th, 2025

ABSTRACT

This study investigates how English as a Foreign Language students interact with artificial intelligence (AI) tools at different stages of the writing process. To achieve this aim, the study employed an experimental research design, with pre-and post-tests, and recruited 47 English as a Foreign Language learners at Arab Open University, Kuwait to participate. The students were divided randomly into an experimental group and a control group. The experimental group used AI tools in their writing tasks, while the control group did not. The treatment comprised 10 sessions covering the mechanics of writing in four rhetorical patterns (narrative, causative, comparative, and argumentative essays), with each session lasting for two hours. Results indicated that there were statistically significant differences. The students in the experimental group who used AI tools demonstrated a significant improvement in their writing performance in comparison to the control group.

KEYWORDS

Artificial Intelligence (AI) Tools, Essay Writing Stages, Pre-Writing, Drafting, Post-Writing, EFL

INTRODUCTION

The incorporation of artificial intelligence (AI) technologies has revolutionized the way one develops writing skills. These pioneering tools have become essential components of language learning. AI tools have been used in writing to enhance the entire writing process, from initial brainstorming to final proofreading and editing (Chan & Hu, 2023). The use of these tools in writing has been examined in many studies, including those by Barrot (2023), Huang et al. (2022), Jeon (2021), and Wang (2024), among others. These studies have found that utilizing AI tools in writing is useful in generating ideas, outlining, content improvement, organization, editing, proofreading, and post-writing reflection. The tools have also been found to improve writing proficiency, self-efficacy, and self-regulation.

DOI: 10.4018/IJCALLT.391354

Although AI tools have long been utilized in writing, their usage has increased dramatically in the past two years owing to the advent of advanced systems like ChatGPT, Chatbot, Copilot, and Gemini. Nonetheless, only a few empirical studies have been conducted examining their effectiveness across different stages of essay writing. Most existing studies focus on either a single stage or a specific AI tool, leaving a gap in our understanding of how AI tools influence each stage of essay writing. In addition, some studies explored the perceptions of students toward using AI tools in different writing stages, rather than exploring the effectiveness of these tools in developing the different stages of essay writing. For example, Meniado et al. (2024) examined how English as a Foreign Language (EFL) learners perceive and use ChatGPT in all stages of the writing, but the effect of AI tools in each stage of writing is not fully examined in that study and other similar ones.

Studies conducted in Arab countries have shown that Arab EFL learners face difficulties in generating ideas, organizing arguments coherently, and applying appropriate academic writing conventions (Alrabai, 2020). For example, Arab learners tend to use long sentences (Al-Khatib, 2001), repetition (Alsamadani, 2010),and presentation and elaboration (Almehmadi, 2012). These challenges weaken students' ability to produce well-structured essays. Integrating AI tools effectively may help address these challenges by supporting idea generation and organization and enhancing linguistic accuracy (Barrot, 2023; Chan & Hu, 2023). However, more studies are required to examine how such tools support Arab EFL learners across different stages of the writing process.

The current study is an attempt to address this gap. It investigates the impact of AI tools on developing EFL students' writing skills across each stage of the writing process—brainstorming, outlining, drafting, and editing a final draft—identifying which stage benefits most from AI assistance. The study will also lay the groundwork for future studies that tackle different aspects of this topic, thus contributing to the optimal integration of AI technology in the teaching–learning process.

LITERATURE REVIEW

Process of Writing

Understanding the theoretical foundations of writing instruction is essential for developing effective pedagogical approaches in academic contexts. Two approaches to writing have been advocated: the process approach and the product approach (Samsudin, 2016). While the former continues to be widely used, the latter has proven ineffective for meaningful learning, as it focuses on the final product at the expense of the learning process (Badger & White, 2000). The majority of recent studies concerned with the measurement of strategy training for second-language (L2) or foreign-language learners have been product-oriented (Chen, 2007). Kroll (2001, p. 220) defined the process approach as follows: "the term captures the fact that student writers engage in their writing tasks through a cyclical approach rather than a single-shot approach." They are not expected to produce and submit complete and polished responses to their writing assignments without going through stages of drafting and receiving feedback on their drafts, whether from peers or from the teacher, followed by revision of their evolving texts. The process approach addresses students' needs in learning to write, helping them construct texts and manage writing challenges.

However, the process approach has limitations. First, the instruction provided in process writing classrooms is not strong enough to ensure that students acquire needed writing skills and processes (Graham & Harris, 1997). Second, very little time is given to explicitly teaching students strategies for carrying out basic writing processes such as planning and revising (Cutler & Graham, 2008). In addition, it has been found that the process approach to writing instruction does not improve struggling or at-risk students' overall writing quality (Graham & Sandmel, 2011). According to Graham and Sandmel (2011), the process writing approach does not enhance students' motivation.

Effective writing requires students to follow several stages in the writing process. Scholars have proposed various sets of stages. Some of them have proposed a more detailed framework. For example, Williams (2003) identified eight stages ranging from pre-writing to publishing. On the other

hand, some scholars have proposed a smaller number of stages. For example,. Tompkins (1990) and Johnson (2008) both identified five stages. For this study, the stages are combined into three broad categories—pre-writing, drafting, and editing—since these capture the essential phases emphasized across the different models.

To start writing is a challenging task for many students. Therefore, pre-writing techniques are vital for them to learn. This stage prepares students for writing by guiding them to decide what to write, how to write it, and why. The purpose of this stage is to enable students to explore possible topics in an unstructured manner before working on formal essays (Widodo, 2008). During this stage, students engage in different activities when carrying out these tasks. Seow (2002) suggested a number of activities that can be used in this stage, including brainstorming, clustering, rapid free-writing, and wh-questions. The second stage is drafting, where students put their ideas into writing. In this stage, students are required to write their ideas into rough drafts without considering grammatical accuracy (Widodo, 2008). Fulwiler (1996) pointed out that teachers and students could accept drafts with some errors at early stages. Thus, at this stage, students need to focus only on conveying their ideas effectively in the light of the previous stage, recalling and retrieving information from their schemata. The post-writing stage involves revising and editing. According to Levine et al. (2025), revising includes checking the organization, main points, supporting details for main ideas, examples, and connections between ideas. The second component of this stage is editing. According to Tompkins (1990, p. 88), editing is "putting the piece of writing into its final form." It involves correcting grammatical, lexical, spelling, punctuation, and other kinds of mistakes. In addition, Seow (2002, p. 319) suggests that "proofreading includes activities such as publishing, sharing, reading aloud, transforming texts for stage performances, or displaying texts on noticeboards.

AI and Writing

Several types of technology have emerged and have been integrated into writing. These technologies have improved writing and made it highly digital in nature. They have changed the writing processes, writers' behaviors, and the teaching of writing (Wang, 2024). One of these technologies is AI. AI tools have been widely used in writing, providing many opportunities ranging from supporting the writing process to assessing written works. These tools are used to analyze language features, identify errors, and gauge essays. AI tools improve students' overall writing accuracy (Abduljawad, 2024; Hongxia & Razali, 2025; Song & Tang, 2025) and metalinguistic awareness (Barrot, 2023), offer a wide range of context-specific writing assistance (Barrot, 2023; Su et al. 2023), and enhance students' vocabulary and grammar by providing immediate suggestions and feedback (Jeon, 2021). AI tools also have a positive impact on self-efficacy (Lai, 2025), engagement (Teng, 2024), and collaborative writing tendency (Teng, 2024). In addition, AI tools can support personalized learning (Huang et al., 2022) and reduce students' cognitive barriers (Gayed et al., 2022).

The innovation of AI tools, especially large language models, creates prospects and challenges for both language teachers and learners. Some studies (e.g., Sawangwan, 2024; Steiss et al., 2024) have found that teacher instruction and feedback led to higher scores and greater improvement than the use of ChatGPT revisions. However, some studies have found that there was substantial agreement between GPT-3.5's ratings and human ratings (Li, 2024). In addition, AI tools may deprive language learners of essential learning experiences (Tseng & Warschauer, 2023). Overreliance on AI is another issue that can affect the development of students' critical thinking skills (Barrot, 2023). Researchers have raised concerns regarding using AI tools, such as authorship and plagiarism (Su et al., 2023) and the threat to academic honesty and educational equity (Yan, 2023). Shi and Aryadoust (2023) expressed concerns regarding AI tools' exactness and their potential misrepresentation of the social nature of writing. In addition to these concerns, some studies (e.g., Kohnke et al., 2023; Memarian & Doleck, 2023) highlighted technological concerns, including concerns about the willingness of teachers and students to adopt these tools.

AI Tools and Writing Stages

Writing involves multiple stages, and AI tools can enhance each stage of the process. They assist students in the pre-writing stage by generating ideas and structuring them into an outline. For the drafting stage, AI tools can enhance vocabulary, organization, and coherence. In the post-writing stage, these tools assist learners by identifying grammatical errors and ensuring accurate punctuation. AI tools can significantly enhance the pre-writing stage in many ways, including brainstorming and organization. First, learners can use AI to generate ideas for a selected topic. Then, they can structure these ideas into a well-organized outline, thus providing a strong base for their writing. AI tools are used to support idea generation and planning (Ghafouri et al., 2024; Lindén & Runby, 2025). Nguyen et al. (2024) explored how EFL learners employ ChatGPT during the pre-writing stage and found that learners employed a broader range of strategies, leading to improved text quality in later stages. AI tools can be used to enhance the drafting stage in different ways. First, AI tools can help learners to structure sentences and improve organization. Several studies (e.g., Mahapatra, 2024) have confirmed that AI tools significantly improved text organization. Accuracy has also been shown to improve through the use of AI tools (Boudouaia et al., 2024; Ghafouri et al., 2024; Mahapatra, 2024). In addition, interacting with ChatGPT has been found to support learners in tracking the writing process. Fathi and Rahimi (2024) attributed this benefit to an AI tool's ability to engage learners as active participants in the writing process. AI tools can be used to enhance the post-writing stage in various ways. For example, AI tools can identify grammatical errors, suggest vocabulary improvements, and check for proper punctuation (Guo et al., 2024). Proofreading and editing can also be facilitated by the use of AI tools in revising by checking organization, main points, supporting details, examples, and connections between ideas (Levine et al., 2025).

Writing instruction with the help of AI tools can be understood under the framework of some theories, such as cognitive load theory (Sweller et al., 2011). According to Clark et al. (2011, p. 7), cognitive load theory refers to "a universal set of learning principles that are proven to result in efficient instructional environments as a consequence of leveraging human cognitive learning processes." On the basis of this notion, it seems sensible to apply cognitive load theory in the context of using AI tools in writing skills. Writing is a mental process, and using AI tools may create an overload on a learner's limited working memory capacity, thereby impeding the writing process and leading to poor writing with a relatively high frequency of errors. Zhang et al. (2025) examined how AI use affected the cognitive load associated with writing among postgraduates. The findings showed that AI tools significantly benefited only those with lower L2 literacy: AI use positively predicted increased writing self-efficacy without affecting perceived cognitive load. In contrast, for postgraduates with higher L2 literacy, increased AI use did not correlate with improved writing self-efficacy or reduced cognitive load.

Previous studies highlighted the importance of following the process of writing to support learners in writing effectively. At the same time, recent studies have highlighted the effectiveness of implementing AI tools in writing and enhancing the outcomes of writing. Most of the previous studies examined this issue in general without explicit focus on the effectiveness of AI tools in each stage. This leaves a gap in understanding how AI tools can help in supporting language learners in writing at each stage. The present study investigates the extent to which AI-integrated tools are effective in enhancing Arab Open University (AOU) students' writing skills across the three stages of the writing process. More specifically, the study seeks answers to the following two research questions:

RQ1: What is the impact of AI-integrated tools on improving the writing performance of AOU EFL students at each stage of the writing process?

RQ2: Which stage(s) of the writing process (pre-writing, drafting, and editing stages) benefit most from AI-integrated tools?

METHOD

Research Design

This research employed a quasi-experimental approach to identify the impact of using AI tools on enhancing AOU students' writing skills throughout the three stages of writing (pre-writing, drafting, and editing). A comparison of students' pre-post test scores on the achievement test in the control and experimental groups was conducted. The present study was conducted in the first semester of the academic year 2024/2025 on a random sample of students registered in the academic writing course (EL117) at the Faculty of Language Studies, AOU, Kuwait. The duration of the experiment was 10 two-hour sessions.

Participants

The participants of the current research were AOU students registered in the first year of English major studies. They enrolled in one of the writing courses at the university (EL117) after meeting the language admission requirement, which is either passing EL111 and EL112 or providing proof of a score of 500 on the Test of English as a Foreign Language or 5.5 on the International English Language Testing System. Most of the participants had passed EL111 and EL112. They were randomly divided into two groups: 24 students in the control group and 23 students in the experimental group. The study was conducted following the receipt of written informed consent from all participants.

Instruments

To achieve the aims of the study, the following tools were used. First, a pre-post test (see Appendix A) for the control and experimental groups was administered to measure students' proficiency in English writing skills. Second, a writing task for both the control and the experimental groups on a cause-and-effect essay was administered to measure students' performance in the three writing stages.

Rubric

To evaluate the students' performance in the three writing stages, a rubric was used (see Appendix B). The rubric was adapted from Brookhart (2013) and Stevens and Levi (2023). Each stage was given 10 marks, with a total of 30 marks. The rubric evaluated each stage separately. For the pre-writing stage, four criteria were proposed: thesis statement development; planning and organization; idea generation and research; and understanding of comparison requirements. For the drafting stage, five criteria were proposed: comparison depth; use of evidence and examples; organization and structure; language use and style; and transitions between points. For the post-writing stage, four criteria were proposed: revision quality; editing (grammar, spelling, and mechanics); analysis of feedback; and conclusion refinement. Each criterion was rated from "Excellent" (4) to "Needs Improvement" (1).

Procedure

The study was conducted over 10 sessions in which AOU students in both groups (control and experimental) received a two-hour tutorial once a week covering the following writing skills and four rhetorical patterns.

Sessions 1 and 2

These sessions constituted a course introduction (a walk-through of the course and the assessment plan). Both groups received in-class tutorials on writing mechanics and performed the following in-class writing without AI intervention: writing complete sentences; writing topic sentences; writing thesis statements; writing and developing paragraphs; using transitional words and phrases to create a better flow; and writing and developing multi-paragraph essays (an introduction, body paragraphs, and a conclusion).

Sessions 3 and 4

Both groups received in-class tutorials, but the experimental group used ChatGPT to enhance their writing throughout the three stages (the pre-writing, drafting, and editing stages). In other words, both groups were trained to do the following:

- identify real-world applications for writing a narrative essay;
- recognize the qualities of an effective narrative essay;
- analyze narrative readings;
- apply the qualities of narrative writing;
- conduct discussions of the students' outlines, drafts, and editing (hook, thesis, topic sentences, restatement of the thesis, conclusion).

Sessions 5 and 6

Both groups received in-class tutorials, with the experimental group using ChatGPT to enhance their writing throughout the three stages (the pre-writing, drafting, and editing stages), with the following learning objectives:

- identifying real-world applications for explaining a cause-and-effect essay;
- spotting the qualities of cause-and-effect writing;
- analyzing cause-and-effect readings;
- conducting discussions of the students' outlines, drafts, and editing (hook, thesis, topic sentences, restatement of the thesis, conclusion).

Sessions 7 and 8

Both groups received in-class tutorials to enhance their writing throughout the three stages (pre-writing, drafting, and editing stages); the learning objectives were as follows:

- identifying real-world applications for explaining a compare-and-contrast essay;
- understanding the qualities of compare-and-contrast writing;
- analyzing compare-and-contrast readings;
- applying the qualities of compare-and-contrast writing;
- conducting discussions of the students' outlines, drafts, and editing (hook, thesis, topic sentences, restatement of the thesis, conclusion).

Sessions 9 and 10

Both groups received in-class tutorials, and the experimental group made use of specified AI tools to enhance their writing throughout the three stages (pre-writing, drafting, and editing stages), with the following learning objectives:

- identifying real-world applications for explaining an argumentative essay;
- detecting the qualities of argumentative writing;
- analysing compare-and-contrast readings;
- applying the qualities of argumentative writing;
- conducting discussions of the students' outlines, drafts, and editing (hook, thesis, topic sentences, restatement of the thesis, conclusion).

After in-class tutorials, the students were requested to conduct three writing tasks enhanced by AI tools, as presented in Figures 1 and 2.

Figure 1. Screenshot of Writing Task 1 on Learning Management System (LMS)

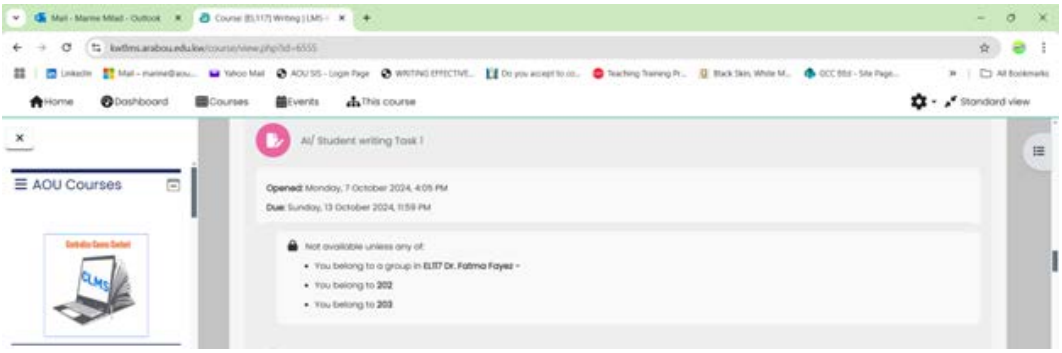
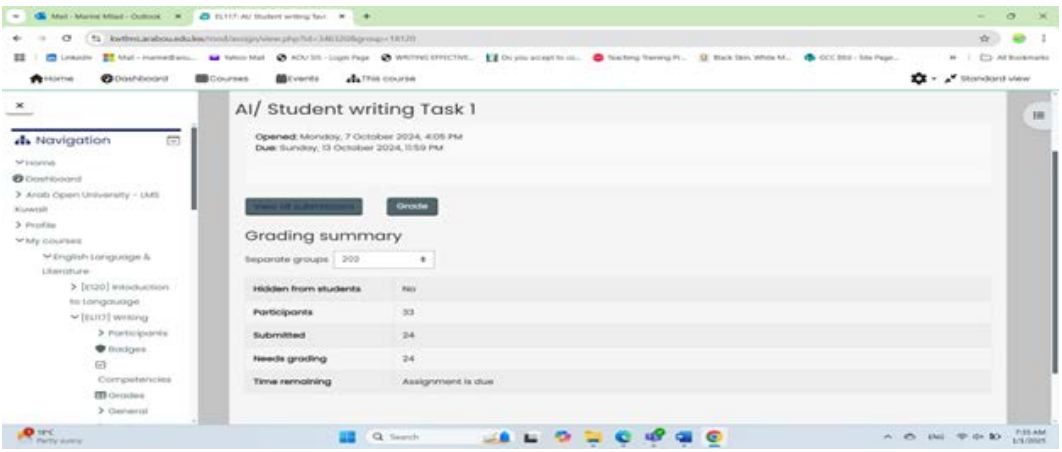
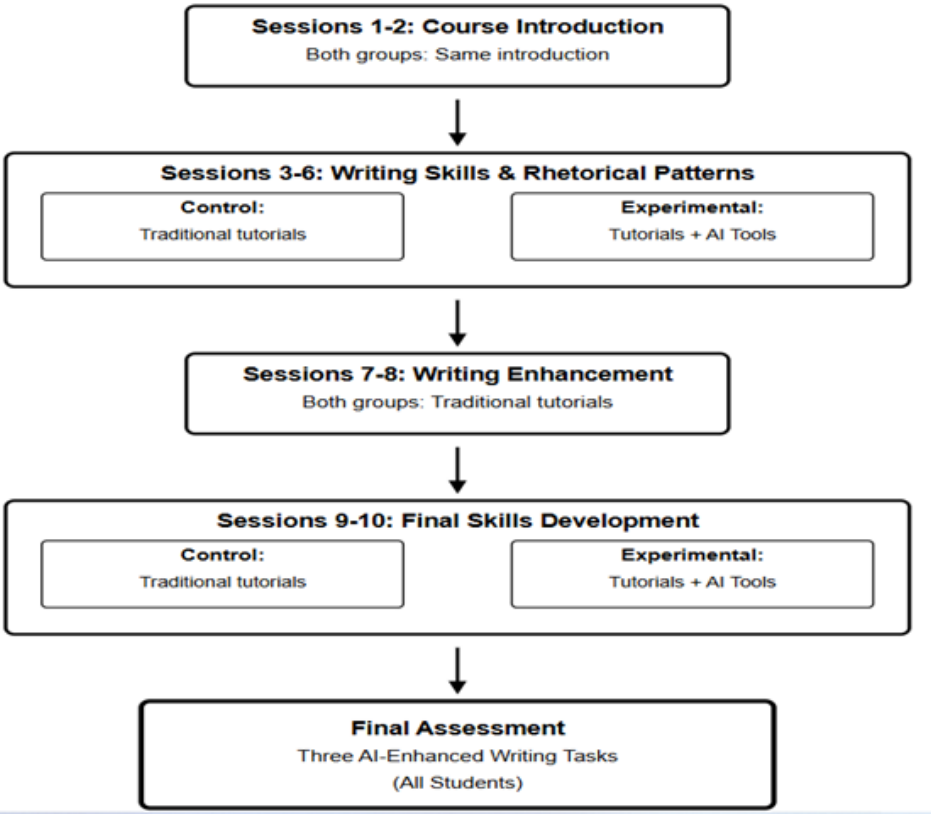


Figure 2. Screenshot of Submitted Writing Task 1 on LMS



Essays were evaluated by independent raters using the standardized rubric (see Appendix B) to achieve inter-rater reliability. The study procedures are shown in Figure 3.

Figure 3. Study Procedures



AI Tools

To implement AI tools in writing, the study utilized ChatGPT-3. During the brainstorming (pre-writing) stage, students in the experimental group were asked to outline a topic of their choice in class. They were then instructed to use ChatGPT to produce an outline on the same topic. Following this, students compared the AI-generated outline with their own. They were asked to critically evaluate both versions and incorporate ideas from the AI tool to improve their own outlines. Next, students began drafting their essays and again requested ChatGPT-3 to construct an essay on the same topic. Then the students were instructed to critically compare their draft essays with the ones produced by the tool, focusing on various aspects such as vocabulary choice, grammatical structures that serve to convey the ideas better, supporting details, organization, coherence, and cohesion, together with other relevant aspects. During the editing stage, students proofread and edited their essays, using the ideas provided by ChatGPT to enhance their drafts. Finally, students submitted their essays in picture format to the AI tool for further editing and proofreading.

Data Analysis

The writing test scores were analyzed using descriptive statistics (mean, standard deviation, and standard error mean) and inferential statistics (paired-samples *t*-test). The paired samples *t*-test was used to examine the differences in students' writing performance in the pre-test and post-test. The data were analyzed using SPSS (version 27.0). To choose the appropriate analysis, a test of normality was conducted.

To determine the appropriate statistical analyses, normality of the data was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. As shown in Table 1, all p-values were greater than .05, indicating that the distributions for the experimental and control groups were not significantly different from a normal distribution. Therefore, the assumptions of normality were met, and parametric tests were considered appropriate for the analyses.

Table 1. Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Total	experimental	.103	23	.200*	.97	23	.68
	Control	.132	22	.200*	.95	22	.43
Pretest	experimental	.113	23	.200*	.97	23	.73
	Control	.169	22	.103	.92	22	.09
Post-test	experimental	.123	23	.200*	.95	23	.36
	Control	.150	22	.200*	.95	22	.32

Note. degree of freedom
sig.= significance
*This is a lower bound of the true significance.
a. Lilliefors Significance Correction

RESULTS

In answer to the first research question (about the impact of AI-integrated tools on improving writing performance at each stage of the writing process), the study yielded the following results. The results in Table 2 show the total scores for both groups in the pre-test. The mean pre-test scores for the experimental group (M = 3.82, SD = 1.78) and the control group (M = 3.81, SD = 1.86) were almost identical, with no significant difference between them (t (43) = 0.015, p = 0.98). This indicated that both groups started at a similar level of writing competence.

Table 2. Pre-Test Scores of the Two Groups

	Groups	N	Mean	Standard Deviation	Standard Error Mean	T	df	Sig. (2-tailed)	Cohen's d
Pre-test	Experimental	23	3.82	1.78	.37	.015	43	.98	.004
	Control	22	3.81	1.86	.39				

Note. N= number of participants, T= t-value, degree of freedom, sig.= significance

The results in Table 3 show the total scores for both groups in the post-test. The experimental group scored higher in the post-test (M = 22.47, SD = 3.30) than the control group (M = 13.45, SD = 5.107). This difference was statistically significant, as indicated by the t-test results (t (43) = 7.072, p < .001). The mean difference was 9.02 points, with a large effect size (Cohen's d = 2.10).

Table 3. The Total Scores of the Two Groups in the Post-Test

Groups	N	Mean	Standard Deviation	Standard Error Mean	t	df	Sig. (2-tailed)	Mean Difference	Cohen's d
Experimental	23	4.78	1.55	1.55	1.01	43	.315	.53	2.10
Control	22	4.25	1.95	1.95					

Note. N= number of participants, t= t-value, degree of freedom, sig.= significance

To find out the impact of AI tools for each stage, a paired-samples *t*-test was conducted for each stage.

The results in Table 4 show the total post-test scores for both groups in the pre-writing stage. The experimental group scored higher in the post-test (M = 6.95, SD = 1.46) than the control group (M = 5.00, SD = 2.13). The *t*-test results (t (43) = 3.59, p = .001) indicated that this difference is statistically significant. The effect size, represented by Cohen's d (1.07), suggested a large impact of AI tools on the pre-writing stage.

Table 4. Results of Using Artificial Intelligence Tools on Improving the Pre-Writing Stage

Groups	N	Mean	Standard Deviation	t	df	Sig.	Cohen's d
Experimental	23	6.95	1.46	3.59	43	.001	1.07
Control	22	5.00	2.13				

Note. N= number of participants, T= t-value, degree of freedom, sig.= significance

The results in Table 5 demonstrated the positive impact of AI tools on improving the drafting stage of writing. The experimental group achieved a higher mean score (M = 7.45, SD = 0.864) than the control group (M = 6.34, SD = 2.123). The *t*-test results (t (43) = 2.32, p = .025) indicated that this difference was statistically significant. The effect size, represented by Cohen's d (0.694), suggested a moderate impact of AI tools on the drafting stage.

Table 5. Results of Using Artificial Intelligence Tools in Improving the Drafting Stage

Groups	N	Mean	Standard Deviation	t	Df	Sig.	Cohen's
Experimental	23	7.45	.86	2.32	43	.025	.694
Control	22	6.34	2.12				

Note. N= number of participants, T= t-value, degree of freedom, sig.= significance

The results in Table 6 highlight the significant impact of AI tools on improving the post-writing stage. The experimental group achieved a substantially higher mean score (M = 8.06, SD = 1.48710) than the control group (M = 2.11, SD = 1.90). The *t*-test results (t (43) = 11.700, p < .001) indicated that this difference was highly statistically significant. The effect size, represented by Cohen's d (3.489), suggested an extremely large impact of AI tools on the post-writing stage. The lower scores of the control group can be attributed to various reasons. First, using AI tools provided different lexical

choices, which enhanced writing. However, the students in the control group had limited choices. Second, AI tools provided a structured and factual outline that helped students to write more. Third, AI paraphrased and restructured the whole essay in the post stage, while the student's editing focused on grammar structure and mechanics. The students in the control group did not have enough time to reflect on their writing with a new perspective.

Table 6. Results of Using Artificial Intelligence Tools in Improving the Post-Writing Stage

Groups	N	Mean	Std. Deviation	t	df	Sig.	Cohen's
Experimental	23	8.06	1.48	11.70	43	.00	3.48
Control	22	2.11	1.90				

Note. N= number of participants, T= t-value, degree of freedom, sig.= significance

In answer to the second research question (asking which stage of the writing process benefits most from AI-integrated tools), the study yielded the following results. The results in Table 7 show the total post-test scores of the experimental group in the post-test. The highest mean score was for the post-writing stage (M=8.06, SD=1.48), followed by the drafting stage (7.45, SD = 0.86). The lowest mean score was for the pre-writing stage (M=6.95, SD = 1.46).

Table 7. Results of Using Artificial Intelligence Tools on All Writing Stages

Groups	Mean	Standard Deviation
Prewriting	6.95	1.46
Drafting	7.45	0.86
Post-writing	8.06	1.48

DISCUSSION

The results of the post-test reveal that the students in the experimental group who used AI tools demonstrated a significant improvement in their writing performance in comparison to the control group. This finding indicates that AI tools can enhance writing skills among EFL learners. AI tools provide personalized feedback and corrections in grammar and style. The findings of this study are in line with Barrot (2023) and Jeon (2021), who found that AI tools help learners improve their writing skills. AI tools provide immediate feedback that enables learners to correct their mistakes and errors immediately. This suggests that the accessibility and responsiveness of AI tools foster a more autonomous and reflective learning environment, where students can revise in real-time without waiting for teacher intervention. There are two contradictory ideas about the time of feedback. Some studies have found that immediate feedback yields better learning and retention than delayed feedback (Azevedo & Bernard, 1995). However, other studies have indicated the opposite (Butler & Roediger, 2008; Carpenter & Vul, 2011; Mullet et al., 2014). This study supports the idea that immediate feedback is better than delayed feedback. AI tools provide immediate feedback that enables students to identify their mistakes and correct them immediately. This could be attributed to the lower cognitive load imposed by real-time assistance, which allows learners to focus on the application of feedback while the task is still fresh in their minds. This finding aligns with cognitive load theory, which suggests that learners benefit when

extraneous processing demands are minimized, thus enabling them to devote more working memory resources to integrating corrective feedback into long-term knowledge (Sweller, et al., 2011).

Regarding the stages of writing, the students in the experimental group performed significantly better than the students in the control group in all stages. This improvement can be attributed to the nature of structured assistance supported by AI tools. Students who used AI tools generated more ideas and were provided with a wide range of vocabulary that they were able to use in their writing. This structured guidance, especially in vocabulary and idea development, may have scaffolded students' progression through complex writing tasks more effectively than unguided approaches.

Regarding the second research question, the students in the experimental group scored highest in the post-editing stage, followed by the drafting stage. The lowest scores were in the pre-writing stage. The superior performance in the post-editing stage suggests that AI tools are most effective when the input is already concrete, allowing learners to focus on refining rather than creating content. The highest scores of the post-editing stage may be attributed to the assistance they had received throughout the different ChatGPT consultation attempts. The tool provided real-time, personalized feedback on different aspects of writing, such as grammar, mechanics, organization, coherence, and cohesion. Students benefited from AI tools at this stage and refined their work according to the provided comments and suggestions. These tools act as "always-available tutors," enabling iterative improvement cycles that are often impractical in traditional settings because of time or resource constraints.

Regarding the drafting stage, AI tools assisted learners with sentence structure and vocabulary choice. Students were able to improve the quality of their drafts by incorporating some of the suggestions and feedback provided by the AI tools, as well as the insights they gained from critically reviewing the draft proposed by the tool. This reflects the dual role of AI as both a linguistic enhancer and a metacognitive scaffold that supports learners in evaluating their own writing process. Such findings reinforce the argument that AI tools serve not only as linguistic correctors but also as dialogic partners in meaning-making (Fathi & Rahimi, 2024), prompting students to engage in self-reflection and critical monitoring of their drafts. This finding suggests pedagogical potential for using AI in formative assessment, where learners iteratively refine their drafts while simultaneously developing evaluative expertise.

The lowest scores in the pre-writing stage can be attributed to the nature of the assistance that AI tools provide. This stage needs careful consideration; students should be trained on how to effectively interact with tools to maximize the assistance the tools could provide. One possible explanation is that pre-writing requires a higher level of initiative and creativity, areas where learners may struggle to take full advantage of AI tools without proper training or prompts. Another reason is that students may underestimate the significance of this stage and, as a result, may not attempt to fully utilize the AI tools. This implies a pedagogical gap: Students must be explicitly taught the value of the pre-writing phase and how to employ AI strategically rather than passively. This contrasts with the findings of Nguyen et al. (2024), who showed that students could harness AI effectively for planning when given explicit strategy training. Thus, the discrepancy suggests that AI's effectiveness in pre-writing is highly context-dependent, contingent on learner preparedness, instructional design, and the specificity of scaffolds provided. From a pedagogical perspective, integrating explicit pre-writing strategy instruction alongside AI use could help mitigate this limitation.

The findings of this study are in line with the findings of several previous studies (e.g., Guo et al., 2024) that found that learners benefit from AI tools in the post-writing stage by identifying grammatical errors, suggesting vocabulary improvements, and checking proper punctuation. Likewise, the findings of this study confirm those of previous studies, including those by Boudouaia et al. (2024), Ghafouri et al. (2024), and Mahapatra, (2024), that found that learners benefited from AI tools in the editing stage in several ways, including improving the accuracy of their writing, improving their vocabulary range use, and enhancing the appropriateness of their style. On the other hand, the findings of this study do not support the findings of Nguyen et al. (2024), who found that

participants used the AI tool effectively in the pre-writing stage and produced better text quality in the later stages. This discrepancy may be due to contextual differences, such as the level of familiarity students had with AI tools, the specificity of the prompts provided, or the nature of training given in using AI during the planning phase.

To sum up, this research reveals noteworthy differences in grammar and lexical choices between AI-supported writing in the experimental group and student writing in the control group. This supports the hypothesis that AI tools not only correct language but also help elevate the stylistic quality of writing. AI-generated essays showed a structured and factual outline, which reflected the students' personal engagement with the topic. Moreover, students in the experimental group used AI tools to proofread and restructure the whole essay during the post-writing stage. In contrast, students in the control group focused primarily on grammar and mechanics at the expense of other important aspects because of time constraints. The holistic support provided by AI tools allows learners to go beyond surface-level corrections and address deeper issues such as organization and coherence, which are critical for high-quality academic writing.

CONCLUSION

This study investigated students' use of generative AI-assisted writing throughout different stages of the writing process. The study comprised an experimental group that was allowed to make use of AI tools, mainly ChatGPT, and a control group that did not use this AI technology. The results of the study revealed that the students in the experimental group scored higher in their writing tasks than the students in the control group. Regarding the stages of writing, the students in the experimental group scored highest in the post-editing stage, followed by the drafting stage. The lowest scores were in the pre-writing stage. The findings highlight the contribution of this study in representing the potential of AI tools to improve not only the quality of writing products but also the processes by which students develop their work.

Pedagogical Implications

The findings of this study have several pedagogical implications for the field of writing instruction. First, the study highlights the significance of incorporating AI tools to support students in their writing in the different stages of the writing process. Second, the integration of AI tools in writing classes can notably enhance the quality of students' writing. Furthermore, writing assessment methods should be modified; they should assess not merely the final written product but also the whole writing process. A certain percentage of the marks should be allocated to outlining, drafting, and the final draft to help students recognize the importance of AI in all stages. In practice, teachers could integrate AI tools into their instruction. For example, they could use AI during pre-writing for brainstorming, during drafting to generate initial content, and during post-editing to refine coherence and accuracy. Such support would guide students in developing critical judgment about when and how AI assistance is most effective, rather than fostering overreliance.

Limitations and Suggestions for Future Research

This study provides valuable insights into the field of writing instruction. However, it is not without limitations. First, this study explored the impact of AI assistance on students' ability to improve the quality of their essay writing, including compare-and-contrast essays. Diverse types of essays (i.e., descriptive, narrative, comparative, argumentative) may lead to different results when AI tools are used. Future research could further investigate the effect of AI tools for each type of essay. Second, this study did not explore the students' perceptions of using AI tools in writing instructions for each stage. They might have different perceptions for each stage. It would be beneficial for future research to explore students' perceptions of using AI tools in writing instructions for each stage. Third, in this study, the post-writing stage was presented as one stage that merged sub-stages. For example, revision,

editing, and proofreading were considered as stages of post-writing. Future studies can examine the effectiveness of AI tools for each sub-stage in the post-writing phase. Fourth, the participants in this study utilized only one AI tool (ChatGPT) for their AI-assisted writing practices. Future research should investigate how various AI tools might influence students' writing performance. Additionally, the relatively small sample size and single-institution context limit the generalizability of the findings. Expanding future studies to diverse educational settings and larger participant groups would provide stronger evidence of the pedagogical impact of AI tools. By addressing these limitations, future studies can build a more comprehensive understanding of how AI technologies shape writing development and inform evidence-based teaching practices.

CONFLICTS OF INTEREST

The authors of this publication declare that there is no conflict of interest.

FUNDING STATEMENT

The authors extend their appreciation to the Arab Open University for funding this work through the AOU research fund No. (AOUKSA-524008).

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CORRESPONDING AUTHOR

Correspondence should be addressed to Hassan Saleh Mahdi, Faculty of Language Studies, Arab Open University, Saudi Arabia, Email: h.mahdi@arabou.edu.sa

REFERENCES

Abduljawad, S. A. (2024). Investigating the impact of ChatGPT as an AI tool on ESL writing: Prospects and challenges in Saudi Arabian higher education. *International Journal of Computer-Assisted Language Learning and Teaching*, *14*(1), 1–19. DOI: 10.4018/IJCALLT.367276

Al-Khatib, M. (2001). The pragmatics of letter writing. *World Englishes*, *20*(2), 179–200. DOI: 10.1111/1467-971X.00208

Almehmadi, M. M. (2012). A contrastive rhetorical analysis of factual texts in English and Arabic. *Frontiers of Language and Teaching*, *3*, 68–76.

Alrabai, F. (2020). The notion of emotion in EFL learning and teaching in Saudi Arabia: A critical review of 20 years of research. *Arab World English Journal, 11*(4), 31-49. https://ssrn.com/abstract=3764217

Alsamadani, H. A. (2010). The relationship between Saudi EFL students' writing competence, L1 writing proficiency, and self-regulation. *European Journal of Social Sciences*, *16*(1), 53–63.

Azevedo, R., & Bernard, R. M. (1995). A meta-analysis of the effects of feedback in computer-based instruction. *Journal of Educational Computing Research*, *13*(2), 111–128. DOI: 10.2190/9LMD-3U28-3A0G-FTQT

Badger, R., & White, G. (2000). A process genre approach to teaching writing. *ELT Journal*, *54*(2), 153–160. DOI: 10.1093/elt/54.2.153

Barrot, J. S. (2023). Using ChatGPT for second language writing: Pitfalls and potentials. *Assessing Writing*, *57*, 100745. DOI: 10.1016/j.asw.2023.100745

Boudouaia, A., Mouas, S., & Kouider, B. (2024). A study on ChatGPT-4 as an innovative approach to enhancing English as a foreign language writing learning. *Journal of Educational Computing Research*, *62*(6), 1509–1537. DOI: 10.1177/07356331241247465

Brookhart, S. M. (2013). *How to create and use rubrics for formative assessment and grading*. ASCD.

Butler, A. C., & Roediger, H. L. (2008). Feedback enhances the positive effects and reduces the negative effects of multiple-choice testing. *Memory & Cognition*, *36*(3), 604–616. DOI: 10.3758/MC.36.3.604 PMID: 18491500

Carpenter, S. K., & Vul, E. (2011). Delaying feedback by three seconds benefits retention of face-name pairs: The role of active anticipatory processing. *Memory & Cognition*, *39*(7), 1211–1221. DOI: 10.3758/s13421-011-0092-1 PMID: 21494908

Chan, C. K., & Hu, W. (2023). Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *International Journal of Educational Technology in Higher Education*, *20*(43), 1–18. DOI: 10.1186/s41239-023-00411-8

Chen, Y. (2007). Learning to learn: The impact of strategy training. *ELT Journal*, *61*(1), 20–29. DOI: 10.1093/elt/ccl041

Clark, C. R., Nguyen, F., & Sweller, J. (2011). *Efficiency in learning: Evidence based guidelines to manage cognitive load*. Wiley & Sons.

Cutler, L., & Graham, S. (2008). Primary grade writing instruction: A national survey. *Journal of Educational Psychology*, *100*(4), 907–919. DOI: 10.1037/a0012656

Fathi, J., & Rahimi, M. (2024). Utilising artificial intelligence-enhanced writing mediation to develop academic writing skills in EFL learners: A qualitative study. *Computer Assisted Language Learning*, 1–40. Advance online publication. DOI: 10.1080/09588221.2024.2374772

Fulwiler, T. (1996). *The college writer's reference*. Prentice Hall Print.

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*, 1–7. DOI: 10.1016/j.caeai.2022.100055

Ghafouri, M., Hassaskhah, J., & Mahdavi-Zafarghandi, A. (2024). From virtual assistant to writing mentor: Exploring the impact of a ChatGPT-based writing instruction protocol on EFL teachers' self-efficacy and learners' writing skill. *Language Teaching Research*. Advance online publication. DOI: 10.1177/13621688241239764

Graham, S., & Harris, K. R. (1997). Whole language and process writing: Does one approach fit all? In Lloyd, J., Kameenui, E., & Chard, D. (Eds.), *Issues in educating students with disabilities* (pp. 239–258). Erlbaum. DOI: 10.4324/9781315864334

Graham, S., & Sandmel, K. (2011). The process writing approach: A meta-analysis. *The Journal of Educational Research*, *104*(6), 396–407. DOI: 10.1080/00220671.2010.488703

Guo, K., Zhang, E. D., Li, D., & Yu, S. (2024). Using AI-supported peer review to enhance feedback literacy: An investigation of students' revision of feedback on peers' essays. *British Journal of Educational Technology*. Advance online publication. DOI: 10.1111/bjet.13540

Hongxia, H., & Razali, A. B. (2025). Impact of ChatGPT on English academic writing ability and engagement of Chinese EFL undergraduates. *International Journal of Instruction*, *18*(2), 323–346. DOI: 10.29333/iji.2025.18218a

Huang, W., Hew, K. F., & Fryer, L. K. (2022). Chatbots for language learning—Are they really useful? A systematic review of chatbot-supported language learning. *Journal of Computer Assisted Learning*, *38*(1), 237–257. https://sci-hub.se/10.1111/jcal.12610. DOI: 10.1111/jcal.12610

Jeon, J. (2021). Chatbot-assisted dynamic assessment (CA-DA) for L2 vocabulary learning and diagnosis. *Computer Assisted Language Learning*, *36*(7), 1338–1364. DOI: 10.1080/09588221.2021.1987272

Johnson, A. P. (2008). *Teaching reading and writing: aguidebook for tutoring and remediating students*. Rowman & Littlefield Education. DOI: 10.5771/9781578868865

Kohnke, L., Moorhouse, B. L., & Zou, D. (2023). Exploring generative artifcial intelligence preparedness among university language instructors: A case study. *Computers and Education: Artifcial Intelligence*, *5*, 1–8. DOI: 10.1016/j.caeai.2023.100156

Kroll, B. (2001). Considerations for teaching an ESL/EFL writing course. In Celce-Murcia, M. (Ed.), *Teaching English as a second or foreign language* (pp. 219–232). Heinle and Heinle.

Lai, Z. C. C. (2025). The impact of AI-assisted blended learning on writing efficacy and resilience. *International Journal of Computer-Assisted Language Learning and Teaching*, *15*(1), 1–21. DOI: 10.4018/IJCALLT.377174

Levine, S., Beck, S. W., Mah, C., Phalen, L., & Pittman, J. (2025). How do students use ChatGPT as a writing support? *Journal of Adolescent & Adult Literacy*, *68*(5), 445–457. DOI: 10.1002/jaal.1373

Li, M. (2024). Leveraging ChatGPT for second language writing feedback and assessment. *International Journal of Computer-Assisted Language Learning and Teaching*, *14*(1), 1–11. DOI: 10.4018/IJCALLT.360382

Lindén, A., & Runby, J. (2025). *Taming the beast: Can EFL learners' writing skills improve from teachers implementing ChatGPT in the writing process?* [Unpublished master's thesis]. Malmo University.

Mahapatra, S. (2024). Impact of ChatGPT on ESL students' academic writing skills: A mixed methods intervention study. *Smart Learning Environments*, *11*(9), 1–18. DOI: 10.1186/s40561-024-00295-9

Memarian, B., & Doleck, T. (2023). Fairness, accountability, transparency, and ethics (FATE) in artificial intelligence (AI), and higher education: A systematic review. *Computers and Education: Artificial Intelligence*, *5*, 100152. DOI: 10.1016/j.caeai.2023.100152

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*, 100313. DOI: 10.1016/j.caeai.2024.100313

Mullet, H. G., Butler, A. C., Verdin, B., von Borries, R., & Marsh, E. J. (2014). Delaying feedback promotes transfer of knowledge despite student preferences to receive feedback immediately. *Journal of Applied Research in Memory and Cognition*, *3*(3), 222–229. DOI: 10.1016/j.jarmac.2014.05.001

Nguyen, L. Q., Le, H. V., & Nguyen, P. T. (2024). A mixed-methods study on the use of ChatGPT in the pre-writing stage: EFL learners' utilization patterns, affective engagement, and writing performance. *Education and Information Technologies*. Advance online publication. DOI: 10.1007/s10639-024-13231-8

Samsudin, Z. (2016). Comparing the process approach with the product approach in teaching academic writing to first-year undergraduates. *AJELP: Asian Journal of English Language and Pedagogy, 4*, 84–104. Available on: https://ir.upsi.edu.my/files/docs/2020/2159_2159.pdf

Sawangwan, S. (2024). ChatGPT vs teacher roles in developing EFL writing. *International Journal of Computer-Assisted Language Learning and Teaching*, *14*(1), 1–21. DOI: 10.4018/IJCALLT.361235

Seow, A. (2002). The writing process and process writing. In Richards, J. C., & Renandya, W. A. (Eds.), *Methodology in language teaching: An anthology of current practice* (pp. 315–320). Cambridge University Press. DOI: 10.1017/CBO9780511667190.044

Shi, H., & Aryadoust, V. (2023). A systematic review of automated writing evaluation systems. *Education and Information Technologies*, *28*(1), 771–795. DOI: 10.1007/s10639-022-11200-7

Song, D., & Tang, A. F. (2025). Exploring AI-assistance in L2 Chinese writing with standardized assessment tasks. *Language Learning & Technology*, *29*(2), 161–189. DOI: 10.64152/10125/73615

Steiss, J., Tate, T. P., Graham, S., Cruz, J., Hebert, M., Wang, J., Moon, Y., Tseng, W., Warschauer, M., & Olson, C. (2024). Comparing the quality of human and ChatGPT feedback on students' writing. *Learning and Instruction*, *91*, 1–15. DOI: 10.1016/j.learninstruc.2024.101894

Stevens, D. D., & Levi, A. J. (2023). *Introduction to rubrics: An assessment tool to save grading time, convey effective feedback, and promote student learning*. Routledge. DOI: 10.4324/9781003445432

Su, Y., Lin, Y., & Lai, C. (2023). Collaborating with ChatGPT in argumentative writing classrooms. *Assessing Writing*, *57*, 100752. DOI: 10.1016/j.asw.2023.100752

Sweller, J., Ayres, P. L., & Kalyuga, S. (2011). *Cognitive load theory*. Springer. DOI: 10.1007/978-1-4419-8126-4

Teng, M. F. (2024). "ChatGPT is the companion, not enemies": EFL learners' perceptions and experiences in using ChatGPT for feedback in writing. *Computers and Education: Artificial Intelligence*, *7*, 100270. DOI: 10.1016/j.caeai.2024.100270

Tompkins, G. E. (1990). *Teaching writing: Balancing process and product*. Merrill Print.

Tseng, W., & Warschauer, M. (2023). AI-writing tools in education: If you can't beat them, join them. *Journal of China Computer-Assisted Language Learning*, *3*(2), 258–262. DOI: 10.1515/jccall-2023-0008

Wang, Y. (2024). Cognitive and sociocultural dynamics of self-regulated use of machine translation and generative AI tools in academic EFL writing. *System*, *126*, 1–17. DOI: 10.1016/j.system.2024.103505

Widodo, H. P. (2008). Process-based academic essay writing instruction an EFL context. *Bahasa Dan Seni*, *36*(1), 101–111.

Williams, J. D. (2003). *Preparing to teach writing: Research, theory, and practice* (3rd ed.). Lawrence Erlbaum. DOI: 10.4324/9781410607461

Yan, D. (2023). Impact of ChatGPT on learners in a L2 writing practicum: An exploratory investigation. *Education and Information Technologies*, *28*(11), 1–25. DOI: 10.1007/s10639-023-11742-4

Zhang, Z., Wang, C., & Shang, Y. (2025). Are AI Tools effective in reducing cognitive load or boosting writing self-efficacy for L2 postgraduates? *The Asia-Pacific Education Researcher*. Advance online publication. DOI: 10.1007/s40299-025-01031-8

APPENDIX A

Essay Writing Task

Name
University ID

Dear EL117 Students,

After several weeks of training on essay writing skills, we would like to evaluate your progress. This task will assess your essay writing skills through three mandatory stages: pre-writing, drafting, and post-writing. Please read the following instructions carefully.

Choose ONE topic from the five options below:

1- Texting vs. talking to friends
2- Career in a private corporation vs the government sector
3- Reading books vs watching movies.
4- Cold weather vs hot weather
5- Happy ending vs sad ending in movies

Stage 1: Brainstorming (30 minutes)

Write down your main ideas, supporting points, and examples. You can use mind mapping, free writing, listing, or any other technique you prefer.

Stage 2: Drafting (60 minutes)

1- Use the ideas that you created in stage 1 to develop your essay. Write an introduction, body paragraphs, and a conclusion.
2- Follow a clear essay structure.
3- Include relevant examples and evidence to support your arguments.

Stage 3: Post-writing (30 minutes)

1- Revise your essay for clarity and coherence.
2- Check grammar, punctuation, and spelling.
3- Ensure proper paragraph transitions.
4- Verify that your argument flows logically.

Important Notes:

1- You must use the same topic throughout all three stages.
2- Each stage must be completed within the allocated time.
3- Your final essay should be approximately 200–250 words.

Good luck!

APPENDIX B

Table 8. Rubric for Evaluating Essays

Stage	Criteria	Excellent (4)	Good (3)	Fair (2)	Needs Improvement (1)
Pre-Writing	1. Thesis Statement Development	Clear, specific thesis that thoroughly addresses the comparison and contrast.	The thesis addresses comparison and contrast but lacks specificity.	The thesis is vague or does not fully address the comparison.	No clear thesis: Comparison is not evident.
	2. Planning and Organization	Detailed plan with a clear structure for comparing and contrasting.	Some planning, with an organized structure.	Minimal planning: Structure is unclear or inconsistent.	Little to no planning evident; lacks structure.
	3. Idea Generation and Research	Multiple relevant ideas and examples are generated; thorough research is conducted.	Some relevant ideas generated, with moderate research.	Few ideas or limited research conducted.	Very few or no relevant ideas generated; no research.
	4. Understanding of Comparison Requirements	Fully understands the purpose of comparing and contrasting.	Understands but may not address all aspects of the comparison.	Limited understanding of what is required.	Misunderstands or fails to grasp comparison requirements.
During Writing	1. Comparison Depth	Thorough comparison with insightful analysis of similarities and differences.	Adequate comparison with some analysis; lacks depth.	Comparison is limited to basic analysis.	Little to no comparison or analysis is present.
	2. Use of Evidence and Examples	Strong, relevant evidence supports all points, with well-chosen examples.	Evidence is present but may not fully support all points.	Limited evidence: Examples are insufficient or unclear.	Lacks evidence or examples to support points.
	3. Organization and Structure	Well-organized, with a clear, logical structure that enhances the essay.	Organized, with some minor issues in flow or clarity.	Inconsistent organization: Transitions are weak.	Poor organization; Lacks clear structure.
	4. Language Use and Style	Uses varied and sophisticated language appropriate for the audience.	Language is appropriate but lacks variety or precision.	Limited vocabulary or inappropriate style.	Basic, repetitive language; inappropriate style.
	5. Transitions Between Points	Smooth transitions clearly connect ideas, making comparisons easy to follow.	Transitions are present but could be smoother.	Transitions are weak or inconsistent.	Few or no transitions, making the essay difficult to follow.

continued on following page

Table 8. Continued

Stage	Criteria	Excellent (4)	Good (3)	Fair (2)	Needs Improvement (1)
Post-Writing	1. Revision Quality	Significant improvements have been made to the content and organization.	Moderate improvements are made; some areas still need refinement.	Minimal revisions, with only minor changes.	Little to no evidence of revision.
	2. Editing (Grammar, Spelling, and Mechanics)	Corrects nearly all errors, resulting in polished writing.	Corrects some errors but misses others.	Few corrections made; many errors remain.	Makes little or no effort to correct errors.
	3. Analysis of Feedback	Effectively integrates feedback to strengthen the essay.	Uses feedback, but with inconsistent integration.	Limited use of feedback, with minimal impact.	Ignores or misuses feedback.
	4. Conclusion Refinement	The conclusion is revised to clearly summarize and reinforce the comparison.	Adequate conclusion that summarizes the main ideas.	Weak conclusion that does not fully summarize the essay.	No conclusion, or an unclear conclusion.