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EFL UNIVERSITY STUDENTS' MOTIVATION, COGNITIVE LOAD, AND SATISFACTION WITH USING GENAI FOR ENGLISH LEARNING

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Abstract
This study examined how the integration of GenAI affects students' writing learning experiences, examining factors related to motivation, cognitive load, and satisfaction. Data collection involved an end-of-semester survey assessing these three dimensions in the context of AI-integrated writing pedagogy. The results indicate that EFL students generally hold positive perceptions of GenAI's value and utility for writing development, expressing interest in learning more about AI-assisted writing tools and recognizing their practical importance for academic writing tasks. Students' motivation was high regarding the relevance and engaging nature of GenAI in writing contexts. The analysis of cognitive load showed moderate levels of mental effort when integrating GenAI into writing processes. The satisfaction data underscore the writing course's success in fostering enthusiasm, engagement, and practical application of AI writing knowledge, with participants rating the AI-integrated writing course favorably. However, areas such as knowledge retention of AI writing strategies and clarity of understanding AI's role in writing suggest opportunities for improvement. These findings highlight the potential of GenAI integration in EFL writing instruction, while also identifying specific areas for enhancing writing-focused learner outcomes.

Keywords: cognitive load, EFL, ELLs' motivation, English writing, GenAI, student satisfaction

Introduction
The emergence of generative artificial intelligence (GenAI) technologies has fundamentally transformed the landscape of higher education, offering opportunities for enhancing teaching and learning across diverse academic disciplines (Punar Özçelik & Yangın Ekşi, 2024; Shim et al., 2023; Yan, 2023). Among these innovations, ChatGPT has garnered particular attention for its sophisticated natural language processing capabilities and user-friendly interface that enables real-time, text-based interactions between learners and AI language models (Dang et al., 2022; Su et al., 2023). This technology presents especially promising applications in English as a Foreign Language (EFL) writing instruction,

where ELLs can leverage AI-generated responses, suggestions, and feedback to support their academic and creative endeavors (Baskara, 2023; Shin & Lee, 2023).

Academic writing instruction in higher education contexts demands not only linguistic proficiency but also mastery of complex disciplinary conventions, critical thinking skills, and genre-specific rhetorical strategies (Walter, 2024; Zhou et al., 2023). For ELLs, these challenges are particularly acute, as they must simultaneously navigate linguistic barriers while developing sophisticated academic discourse competencies in specialized genres such as research proposals and literature reviews (Teng, 2024). GenAI tools like ChatGPT offer unique affordances for addressing these challenges by providing real-time feedback, suggesting structural improvements, refining arguments, and enhancing clarity throughout the writing process (Sun et al., 2024).

Recent research has demonstrated significant potential for GenAI integration in writing instruction, particularly within EFL contexts where students face distinctive linguistic and rhetorical challenges (Dang et al., 2022; Ding et al., 2023; Wu, 2024). Studies have revealed diverse student perspectives, with some acknowledging GenAI's innovative role in enhancing writing skills and motivation, while others express concerns about accuracy and potential overreliance on technology (Song & Song, 2023). Additionally, research has highlighted the importance of institutional support and professional development, as effective GenAI utilization requires clear instructional guidelines and adequate preparation time for both students and educators (Barrett & Pack, 2023; Chan, 2023; Kim & Lee, 2023).

However, the integration of GenAI into educational contexts is not without significant challenges and concerns. Chan and Hu's (2023) survey of 399 undergraduate students revealed that while students recognize ChatGPT's potential benefits, they simultaneously harbor concerns about result accuracy, privacy issues, moral implications, and the potential impact of AI reliance on personal development, employment prospects, and societal values. Similarly, Abbas et al. (2024) identified broader consequences of ChatGPT usage among university students, emphasizing the critical importance of carefully considering the circumstances and frameworks through which academic institutions introduce AI tools to avoid unintended adverse outcomes. These concerns encompass issues of academic integrity, educational equity, and the potential undermining of critical thinking development (Baskara, 2023).

Despite growing interest in GenAI applications for writing instruction, significant gaps remain in our understanding of how structured AI integration specifically affects the writing learning process from a pedagogical perspective. While existing research has explored general technical applications of AI tools, there is insufficient empirical investigation of ELLs' experiential responses to AI integration within formal writing courses. The complexity of AI-assisted writing pedagogy extends beyond mere text generation to encompass scaffolding, feedback provision, ideation support, and revision assistance, all of which require specialized instructional approaches and evidence-based implementation frameworks.

Furthermore, current literature lacks a comprehensive examination of how GenAI integration affects critical pedagogical factors such as student motivation, cognitive load, and learning satisfaction in EFL writing contexts. Understanding these elements is essential, as they are pivotal in shaping students' engagement,

learning behaviors, and ultimately, their writing outcomes. The absence of systematic investigation into these experiential dimensions represents a significant limitation in developing effective pedagogical strategies for AI-enhanced writing instruction.

Therefore, this study addresses the critical need to examine ELLs' multifaceted responses to GenAI integration in formal writing courses, specifically investigating how structured AI implementation affects students' motivational factors, cognitive load experiences, and overall satisfaction with the learning process. Understanding these interconnected dimensions is essential for developing evidence-based pedagogical frameworks that maximize GenAI's benefits while mitigating potential risks to student learning and well-being. By employing post-course surveys after sustained engagement with AI writing tools, this research aims to establish empirical evidence for developing best practices that balance GenAI's pedagogical benefits with concerns regarding academic integrity, critical thinking development, and equitable access to learning resources. The findings will inform ELT educators in creating evidence-based frameworks for empowering ELLs with the tools and knowledge necessary to navigate the evolving landscape of AI-enhanced academic writing instruction.

Given the urgent need to understand how GenAI integration affects the fundamental aspects of EFL writing education, this study poses the following research questions:

1. How does integrating GenAI into EFL writing courses impact university students' motivation to develop writing skills?
2. How does using GenAI in writing instruction affect university students' cognitive load when completing writing tasks?
3. How does GenAI integration in writing courses influence university students' satisfaction with their writing learning experience?

Method

Design

This study employed a quantitative survey design to investigate EFL university students' motivation, cognitive load, and satisfaction with GenAI integration in writing instruction. This approach was selected as the most appropriate methodology for capturing students' experiential responses at a specific point in time following their sustained engagement with AI-assisted writing tools throughout a complete academic semester.

The research design was structured as a post-course evaluation study, where all participants experienced the same AI-integrated writing curriculum before completing the assessment instrument. The study's primary objective justified this design choice to understand the general patterns and variability in student experiences with GenAI integration rather than to establish causal relationships or compare different instructional approaches. The post-course timing of data collection was strategically chosen to ensure that participants had sufficient exposure to AI writing tools and could provide informed reflective assessments of their learning experiences.

The quantitative nature of the study enabled systematic measurement of the three key constructs—motivation, cognitive load, and satisfaction—through standardized Likert-scale items, facilitating statistical analysis and comparison

across participants. This approach aligned with the research questions, which sought to examine how GenAI integration affects students' experiential responses in EFL writing contexts. The survey methodology provided an efficient means of collecting data from the entire participant cohort while maintaining participant anonymity.

The study's design incorporated several methodological considerations to enhance validity and reliability. First, the timing of data collection occurred at the end of the 15-week semester, allowing students to develop comprehensive perspectives on AI-assisted writing through exposure to all three course modules: introduction to AI-assisted writing, applied AI writing strategies, and advanced integration and critical evaluation. Second, the voluntary participation framework and anonymous response collection minimized social desirability bias and encouraged honest reporting of experiences. Third, the bilingual questionnaire administration (English and Korean) accommodated participants' language preferences, potentially improving response accuracy and completion rates.

Participants

The study involved 57 undergraduate students from a university. Among the participants, 57.9% (n = 33) were male and 42.1% (n = 24) were female. In terms of grade distribution, the majority were first-year students, accounting for 86.0% (n = 49), followed by fourth-year students at 10.5% (n = 6), and second-year students at 3.5% (n = 2). Regarding their majors, 64.9% (n = 37) were from science and engineering fields, 14.0% (n = 8) were from humanities and social sciences, 10.5% (n = 6) were from education, and 10.5% (n = 6) were from interdisciplinary (fusion) programs. In terms of the test of English for international communication (TOEIC) scores, 71.9% (n = 41) had no score, 19.3% (n = 11) scored 600 points or less, 5.3% (n = 3) scored 700 points or less, and 3.5% (n = 2) scored 900 points or less.

Table 1. Demographic information about study participants

Category		Frequency (n = 57)	Percentage (%)
Gender	Male	33	57.9
	Female	24	42.1
Grade	Freshman	49	86.0
	Sophomore	2	3.5
	Senior	6	10.5
Major	Science and Engineering	37	64.9
	Humanities and Social Sciences	8	14.0
	Education	6	10.5
	Convergence	6	10.5
TOEIC Score	900 points or less	2	3.5
	700 points or less	3	5.3
	600 points or less	11	19.3
	No score	41	71.9

GenAI implementation procedure

The AI-based writing course was implemented as a structured 15-week semester course specifically designed to integrate GenAI into EFL writing instruction. The course curriculum was organized into three sequential modules: (1) introduction to AI-assisted writing (weeks 1-5), covering fundamental concepts of

GenAI tools, ethical usage guidelines, and basic prompt engineering for writing tasks; (2) applied AI writing strategies (weeks 6-10), focusing on genre-specific applications including argumentative essays, research proposals, and literature reviews; and (3) advanced integration and critical evaluation (weeks 11-15), emphasizing independent AI tool usage, critical assessment of AI-generated content, and portfolio development.

Throughout the course, ELLs developed multiple interconnected writing competencies through the integration of AI. Core writing skills included constructing academic arguments using AI-assisted brainstorming and outline development, synthesizing evidence and analyzing it through AI-supported research and source evaluation, and enhancing awareness via AI-generated alternative phrasings and style suggestions. ELLs also acquired AI literacy skills, including crafting effective prompts for various writing purposes, critically evaluating AI-generated content for accuracy and appropriateness, and making ethical decisions regarding AI usage in academic contexts. The course emphasized metacognitive development, encouraging students to reflect on their writing processes and assess the effectiveness of AI tools in improving their compositional strategies.

Survey instrument

We used an end-of-semester questionnaire to collect quantitative data on three key areas: (1) motivation, (2) cognitive load, and (3) satisfaction. The survey items were adapted from Woo et al.'s (2024) study, with 29 questions. The survey period was conducted during December 2024, spanning one month to allow sufficient time for student participation and ensure comprehensive data collection. The questionnaire was available in both English and Korean to accommodate students' language preferences, as many participants were more comfortable responding in Korean. All participation was voluntary, and students were informed that their responses would remain confidential and would not affect their course grades, ensuring ethical compliance with institutional research standards. The questionnaire was administered via Google Forms, ensuring efficient data collection, easy accessibility, and secure data storage.

Reliability testing indicated that Cronbach's alpha values ranged from .853 to .941 for the individual sections, with an overall reliability of .933 for the entire set of 29 questions, which is considered excellent. The structure of the questionnaire is detailed in Table 2.

Table 2. Questionnaire structure and reliability

Category	Number of questions	Cronbach's alpha
Motivation	7	.876
Cognitive load	8	.853
Satisfaction	14	.941
All questions	29	.933

Data analysis

The collected quantitative data were analyzed to examine EFL students' motivation, cognitive load, and satisfaction with GenAI integration in writing

instruction. Prior to conducting the primary analyses, several preliminary steps were undertaken to ensure data quality and reliability. All survey responses were initially screened for completeness and consistency, with missing data analysis conducted to identify any patterns of non-response. Cases with excessive missing values were carefully examined, though the voluntary nature of participation and clear instructions resulted in minimal missing data. Outliers were identified using standard statistical procedures, but no extreme values requiring removal were found in the dataset.

The questionnaire items were coded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating more positive responses for motivation and satisfaction measures. In comparison, higher scores for cognitive load items indicated greater perceived difficulty or mental effort required. Internal consistency reliability was assessed using Cronbach's alpha coefficient for each subscale and the overall instrument, revealing excellent reliability across all dimensions: motivation ($\alpha = .876$), cognitive load ($\alpha = .853$), satisfaction ($\alpha = .941$), and the total scale ($\alpha = .933$). These values exceeded the commonly accepted threshold of .70, confirming that the instrument demonstrated strong reliability for measuring the three constructs within the current sample.

Results and Discussion

Results

Students' motivation

The descriptive statistics for the survey responses highlight participants' attitudes regarding the integration of GenAI tools into EFL writing instruction across various dimensions of learning motivation and engagement. The findings suggest a generally positive view of the value and importance of acquiring GenAI-assisted writing skills, with notable variability in personal commitment to independent exploration of AI writing tools.

Table 3. Descriptive statistics results of university students'motivation to learn about generative AI

	Question	*M*	*SD*
1.	I think learning generative AI, such as ChatGPT, is interesting and valuable.	3.67	.873
2.	I would like to learn more and observe more in the workshop on using generative AI, such as ChatGPT.	3.65	.790
3.	It is worth learning how to use generative AI, such as ChatGPT.	3.79	.818
4.	It is important for me to learn generative AI, such as ChatGPT, well.	3.60	.923
5.	It is important to know the knowledge related to generative AI, such as ChatGPT.	3.61	.921
6.	I will actively search for more information and learn about generative AI, such as ChatGPT.	3.40	.776
7.	It is important for everyone to take the workshop on how to use generative AI, such as ChatGPT.	3.47	.868

ELLs rated the significance of acquiring skills for effectively using GenAI in academic writing contexts the highest ($M = 3.79$, $SD = .818$), indicating strong agreement on the practical value of these tools in enhancing their writing

capabilities for academic and professional purposes. This high rating reflects students' recognition that AI-assisted writing skills are essential for developing competency in academic genres such as argumentative essays and literature reviews. Similarly, ELLs agreed on the engaging and beneficial nature of learning about GenAI for writing tasks, reflecting its appeal as both an interesting technological innovation and a valuable skill for improving writing quality and efficiency (M = 3.67, SD = .873).

The interest in gaining further knowledge and hands-on experience with GenAI writing applications was also notable (M = 3.65, SD = .790), demonstrating students' enthusiasm for structured learning opportunities that facilitate a more profound understanding of AI-assisted writing processes. Students particularly sought to develop skills in prompt engineering for various writing stages, the effective integration of AI-generated content with original ideas, and the critical evaluation of AI output for academic appropriateness.

However, the importance of personally developing proficiency in AI-assisted writing was rated slightly lower (M = 3.60, SD = .923), suggesting that while ELLs recognize the value of AI writing tools, individual commitment to mastering these technologies for writing enhancement varies. This finding suggests that students may need additional scaffolding and motivation to move from passive appreciation to active skill development in AI writing integration. Responses also showed strong agreement on the need to understand foundational AI writing strategies and techniques (M = 3.61, SD = .921). Students recognized the importance of learning how to effectively use AI for brainstorming, outlining, drafting, and revision processes. Despite this recognition, students were less inclined to independently seek additional resources or actively explore AI writing applications outside structured learning environments (M = 3.40, SD = .776). This lower score highlights a potential gap between recognizing the importance of AI writing skills and the motivation to pursue self-directed learning in this domain.

Finally, students agreed on the universal importance of formal training, such as workshops, for understanding and applying GenAI tools in writing contexts (M = 3.47, SD = .868). This finding suggests that while participants value structured learning opportunities for integrating AI writing, they may not consider such training essential for all students, possibly reflecting varying levels of writing confidence and perceived need for AI assistance.

Students' cognitive load

The descriptive statistics reveal the cognitive and emotional challenges ELLs faced when integrating GenAI into their writing processes during the writing course. The results suggest that the overall level of perceived difficulty and mental effort was moderate, with mean scores ranging from 2.95 to 3.18 across eight items, indicating that students found AI writing integration cognitively demanding yet manageable.

Table 4. Descriptive statistics results of university students' cognitive load to learn about generative AI

Question	*M*	*SD*
1. The learning content in this AI-based course was difficult for me.	2.96	.844
2. I had to put a lot of effort into answering the questions in this AI-based course.	3.16	.751
3. It was troublesome for me to answer the questions in this AI-based course.	3.14	.875
4. I felt frustrated answering the questions in this AI-based course.	3.09	.950
5. I did not have enough time to answer the questions in this AI-based course.	2.95	1.007
6. During this AI-based course, the way of instruction or learning content presentation caused me a lot of mental effort.	3.18	.909
7. I need to put lots of effort into completing the learning tasks or achieving the learning objectives in this AI-based course.	3.11	.939
8. The instructional way in the AI-based course was challenging to follow and understand.	3.02	.876

The highest-rated item indicated that ELLs experienced significant mental effort when learning to use AI tools for writing tasks (*M* = 3.18, *SD* = .909). This cognitive load was primarily attributed to the complexity of mastering multiple skills simultaneously, including understanding AI capabilities and limitations, developing effective prompting strategies for various writing purposes, and learning to evaluate and integrate AI-generated content critically. Students found it particularly challenging to balance maintaining their authentic voice while effectively incorporating AI assistance for tasks such as idea generation, argument development, and language refinement. Similarly, ELLs reported that completing AI-assisted writing tasks required considerable effort (*M* = 3.16, *SD* = .751) and that integrating AI tools effectively into their writing process was troublesome (*M* = 3.14, *SD* = .875). These difficulties stemmed from the need to develop new metacognitive strategies for writing with AI, including determining when and how to use AI assistance, evaluating the quality and relevance of AI suggestions, and synthesizing AI-generated content with their original ideas while maintaining coherence and academic integrity.

ELLs also reported that achieving writing improvement objectives through AI integration required substantial effort (*M* = 3.11, *SD* = .939) and experienced frustration during the learning process (*M* = 3.09, *SD* = .950). The frustration was particularly evident when students encountered difficulties formulating effective prompts for specific writing genres, when AI-generated content failed to meet their expectations, or when they struggled to maintain their writing autonomy while benefiting from AI assistance. Regarding time constraints, students indicated moderate difficulty (*M* = 2.95, *SD* = 1.007), with the highest variability among all items. This result suggests that while some students adapted quickly to integrating AI writing, others required more time to develop proficiency in using AI tools effectively for writing enhancement.

The instructional approach for AI writing integration was perceived as somewhat challenging to follow and understand (*M* = 3.02, *SD* = .876), indicating that students found the pedagogical framework for learning AI-assisted writing complex. The difficulty in understanding AI writing integration content was rated

slightly below (*M* = 2.96, *SD* = .844), suggesting that while the conceptual aspects were generally accessible, the practical application of AI writing strategies posed greater challenges.

Students' satisfaction

The descriptive statistics provide insight into ELLs' satisfaction with an AI-based writing course. The responses generally indicate positive feedback, with mean scores ranging from 3.32 to 3.60 across the 14 items, reflecting favorable attitudes toward the course content, engagement, and its potential applications.

Table 5. Descriptive statistics results of university students' satisfaction with learning about generative AI

Question	*M*	*SD*
1. I believe that I will remember everything taught in the AI-based course.	3.32	.869
2. The AI-based course kept me focused on the content throughout.	3.47	.758
3. I am confident that I will use the content learned in the AI-based course.	3.47	.804
4. This AI-based course made me very enthusiastic about the content taught.	3.60	.884
5. It will be easy to summarize for others what the AI-based course is all about.	3.37	.672
6. It was easy to concentrate on the content of this AI-based course.	3.33	.873
7. I plan to apply the content learned from the AI-based course.	3.56	.824
8. I had a lot of fun during this AI-based course.	3.44	.732
9. I clearly understand everything that was taught in the AI-based course.	3.39	.750
10. The AI-based course was engaging throughout.	3.49	.710
11. I am looking forward to incorporating the content of an AI-based course into my learning.	3.40	.704
12. This AI-based course was delightful for me.	3.46	.629
13. This AI-based course was superior to others I have attended.	3.42	.823
14. Overall, I was delighted with this AI-based course.	3.53	.847

ELLs agreed with the statement, reflecting enthusiasm about the course content (*M* = 3.60, *SD* = .884), suggesting that the course fostered interest and motivation. Similarly, ELLs showed strong intent to apply the knowledge gained from the course in their learning (*M* = 3.56, *SD* = .824), indicating practical relevance and perceived value in the course material. The course was also rated highly for its overall engagement (*M* = 3.49, *SD* = .710) and ability to maintain participants' focus (*M* = 3.47, *SD* = .758). These findings suggest that the course design effectively captured and sustained participants' attention. Furthermore, participants expressed confidence in using the learned content (*M* = 3.47, *SD* = .804) and enjoyment throughout the course (*M* = 3.46, *SD* = .629), indicating a positive and interactive learning experience.

While participants rated their ability to summarize the course content for others moderately high (*M* = 3.37, *SD* = .672), they expressed slightly lower confidence in fully remembering everything taught in the course (*M* = 3.32, *SD* = .869). These results suggest that while participants found the material engaging, there might be opportunities to enhance knowledge retention. ELLs rated the course

favorably compared to others they had attended (M = 3.42, SD = .823) and expressed overall satisfaction with the course (M = 3.53, SD = .847). Despite the generally positive evaluations, responses indicated some variability in participants' perceived clarity of understanding (M = 3.39, SD = .750) and their ability to concentrate on the content (M = 3.33, SD = .873).

The results demonstrate a largely positive reception to the AI-based course, highlighting its engaging nature, practical applicability, and ability to sustain enthusiasm. However, some areas, such as knowledge retention and clarity of understanding, may benefit from further instructional refinement to optimize the learning experience.

Discussion

The findings of this study reveal both the opportunities and challenges of integrating GenAI tools into university-level EFL writing instruction. Drawing on the literature and the study's results, this section examines how GenAI affects students' motivation, cognitive load, and satisfaction in EFL writing contexts, while identifying areas for pedagogical improvement in AI-assisted writing education.

ELLs' motivation in writing contexts

GenAI's ability to engage and motivate learners in writing tasks has been widely recognized in the literature. Song and Song (2023) emphasize the innovative role of AI in increasing students' interest and motivation for academic writing tasks, which aligns with the present study's findings. The findings indicate that students perceived learning AI-assisted writing techniques with GenAI as engaging and valuable, with the highest-rated item reflecting their recognition of AI's practical applications in academic writing contexts. ELLs were particularly motivated by course activities that demonstrated AI's utility in specific writing stages, including brainstorming sessions where AI generated multiple perspectives on essay topics, collaborative outline development using AI-assisted structure suggestions, and revision workshops where students compared AI-generated improvements with peer feedback.

However, this study's motivation scores were notably more moderate compared to the highly positive attitudes reported in Du and Alm's (2024) research, where students demonstrated 'strong enthusiasm' for ChatGPT integration in English for Academic Purposes contexts. This difference may be attributed to several factors. First, the current study's 15-week intensive exposure to AI writing tools may have led to a more realistic and tempered assessment of GenAI's capabilities and limitations. In contrast, shorter-term studies might capture initial novelty effects. Second, the systematic three-phase pedagogical approach in this study explicitly addressed ethical considerations and critical evaluation skills, potentially fostering more balanced perspectives compared to studies with less structured AI integration.

Interestingly, while Cai et al. (2024) found that students' positive attitudes toward ChatGPT increased significantly over time in language learning contexts, the present study revealed a gap between recognizing AI's value and personal commitment to independent exploration. This contrast suggests that motivation in formal, structured AI writing courses may differ from self-directed language

learning contexts. The formal academic setting may create dependency on instructor guidance rather than fostering autonomous engagement, highlighting the need for pedagogical strategies that bridge structured learning with independent practice.

The three-phase course structure proved especially motivating for students, aligning with Barrett and Pack's (2023) emphasis on structured guidance. However, unlike their findings that students required 'more time' to effectively utilize ChatGPT, the current study's systematic 15-week approach appeared to provide sufficient scaffolding, as evidenced by students' confidence in applying learned content. This suggests that extended, well-structured exposure may be more effective than brief introductory sessions reported in other studies.

Cognitive load in AI writing integration

This study's cognitive load analysis reveals a moderate level of mental effort required for integrating GenAI into writing processes, which contrasts with some previous research findings. While Baskara (2023) suggested that AI tools facilitate writing instruction, the current study's results indicate that AI integration itself creates substantial cognitive demands, particularly in the instructional presentation of content. The difference in research focus may explain this discrepancy: Baskara's work primarily examined AI as a writing support tool, whereas this study investigated the learning process of AI integration skills themselves.

The moderate cognitive load findings differ from Tsai et al.'s (2024) research on ChatGPT-assisted writing for English majors, where students reported primarily positive experiences with minimal mention of cognitive challenges. This contrast can be attributed to several factors. First, the current study's participants were predominantly first-year students from diverse majors, potentially lacking the advanced academic writing skills and digital literacy that English majors possess. Second, the comprehensive three-phase curriculum in this study required students to master multiple complex skills simultaneously—prompt engineering, critical evaluation, and ethical decision-making—creating higher cognitive demands than studies focusing solely on AI as a writing assistant.

The highest cognitive load was associated with learning to use AI for complex writing tasks, which supports but extends Yuan et al.'s (2024) findings about challenges in English academic writing contexts. While Yuan et al. emphasized concerns about academic integrity and overreliance, the current study's cognitive load data suggests that the learning process itself, rather than just ethical concerns, presents significant challenges. This difference highlights the importance of distinguishing between using established AI tools and learning to integrate AI systematically into academic writing processes.

The variability in time constraints contrasts with Ma et al.'s (2024) findings about ChatGPT literacy development, where adaptation appeared more uniform across participants. This difference may reflect the current study's diverse participant backgrounds—students from science, engineering, humanities, and education fields may have varying baseline technology skills and learning paces, requiring more individualized instructional approaches than previously recognized.

Satisfaction with AI writing instruction

Student satisfaction with the AI-integrated writing course was generally high, reflecting positive reception comparable to Punar Özçelik and Yangın Ekşi's (2024) case study findings. However, important differences emerge in specific satisfaction dimensions. While Punar Özçelik and Yangın Ekşi (2024) reported consistently high satisfaction across all measures, the current study identified variability in knowledge retention confidence and clarity of understanding. This contrasts with more uniformly positive satisfaction reports in other studies, which may be attributed to the current study's comprehensive assessment approach. Unlike studies that focus on general satisfaction, this research specifically measured confidence in remembering AI writing strategies and understanding AI's role in writing processes. The more detailed measurement may have revealed nuanced areas for improvement that broader satisfaction surveys might miss.

Interestingly, students' enthusiasm for course content exceeded their confidence in knowledge retention. This pattern differs from Escalante et al.'s (2023) findings, where students demonstrated both high engagement and substantial knowledge consolidation. This discrepancy suggests that while the current study's course design successfully fostered engagement, the rapid pace of AI technology evolution and the complexity of AI writing strategies may challenge long-term retention more than traditional writing instruction methods.

The satisfaction scores also contrast with some concerns raised in Chan and Hu's (2023) large-scale survey, where students expressed significant worries about AI's impact on personal development and learning autonomy. The current study's participants showed strong intent to apply learned content. They rated the course favorably compared to others, suggesting that structured, pedagogically-grounded AI integration may address some of the concerns identified in broader, less systematic AI adoption contexts.

However, the finding that students found it relatively challenging to concentrate on course content aligns with emerging research about the cognitive demands of AI literacy development, contrasting with earlier, more optimistic predictions about AI's ease of integration in educational settings. This suggests that effective AI writing instruction requires careful attention to cognitive load management and sustained focus support, challenging assumptions about AI tools being inherently user-friendly for educational purposes.

The differences between this study's findings and previous research highlight the importance of contextual factors, instructional design, and participant characteristics in determining the success of GenAI integration in EFL writing instruction. These variations underscore the need for evidence-based, context-specific approaches to AI-enhanced writing pedagogy rather than one-size-fits-all solutions.

Conclusion

This study investigated university students' responses to GenAI integration in EFL writing instruction, revealing several key findings. The research demonstrated that students exhibit positive attitudes toward GenAI's educational value and express considerable enthusiasm for its practical applications in academic writing contexts. The findings indicate that students experience moderate cognitive load levels when engaging with AI-assisted writing tasks, though notable variability

exists in individual student experiences. These results suggest that GenAI integration can effectively enhance student motivation and engagement in EFL writing while maintaining manageable cognitive demands when appropriately implemented. The study's empirical evidence supports a three-phase pedagogical framework for GenAI integration: (1) modeling AI prompt engineering across different writing stages, (2) facilitating collaborative peer editing sessions comparing AI-generated and human feedback, and (3) implementing authentic writing tasks requiring critical evaluation of AI output. Additionally, the research highlights the necessity of systematic task decomposition, explicit AI literacy instruction, and comprehensive ethical training to maximize the educational benefits of GenAI tools.

Several limitations must be acknowledged in interpreting these findings. First, the study's scope was limited to university-level EFL students, potentially restricting the generalizability of results to other educational contexts or proficiency levels. Second, the research employed a cross-sectional design, precluding examination of long-term effects of GenAI integration on student writing development and learning outcomes. Third, the study did not control for variations in students' prior technology experience or digital literacy levels, which may have influenced their responses to GenAI tools. Future investigations should address these limitations through several research avenues. Longitudinal studies are needed to examine the sustained effects of GenAI integration on EFL writing proficiency, student autonomy, and long-term learning outcomes. Research should also explore optimal instructional design principles for AI-enhanced learning environments, investigating how different scaffolding approaches, task structures, and assessment methods influence student engagement and achievement.

Additionally, comparative studies examining GenAI effectiveness across diverse educational contexts, proficiency levels, and cultural backgrounds would enhance understanding of contextual factors affecting implementation success. Future research should also investigate the relationship between students' digital literacy backgrounds and their adaptation to AI-assisted writing tools, informing more targeted pedagogical interventions. Furthermore, empirical examination of writing quality improvements, creativity enhancement, and critical thinking development through GenAI integration represents a crucial research priority. Studies should also explore teacher preparation and professional development needs for effective GenAI implementation, as well as institutional factors facilitating or hindering successful adoption.

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