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A Comprehensive Analysis of Generative AI Integration in Enhancing Syntactic Complexity for Undergraduate Academic Writing

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Abstract: This study explores how Generative Artificial Intelligence (GAI) can be integrated to improve the syntactic complexity of academic writing of undergraduate students in the English as a Second Language (ESL) setting. Syntactic complexity is one of the primary indicators of writing proficiency, yet an area of persistent difficulty for undergraduate students. This is typically characterized by the employment of a narrow range of sentence structures and an overuse of simple sentence structures. This study used a quasi-experimental design and involved undergraduate students in writing tasks with and without AI support. Data was collected in the form of writing samples before and after the intervention and analyzed using a set of predetermined linguistic measures, including the mean length of T-unit, clauses per sentence, and subordination index. Using AI writing tools showed the greatest increase in the students' writing syntactic sophistication. There was considerable increase in the number of students using writing tools to produce complex and compound sentences and there were more integrated clauses. Improvements in coherence and syntactic variety and in the overall structure and organization of the students' writing were noted in the qualitative data. The study also showed the potential Generative AI has as a scaffolding tool in the advancement of writing proficiency and a tool for helping students to develop a more sophisticated control of the language. Guided use of AI writing tools in the classroom setting, the study argues, helps to minimize the risk of students becoming overly reliant on the tools and of the tools discouraging engagement with the material. The study also adds to the expansive body of research on technology and language learning and offers recommendations for using AI technology in the writing instruction of undergraduate students.

Key Words: generative artificial intelligence, syntactic complexity, academic writing, undergraduate students, esl writing, language pedagogy, ai-assisted learning

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Introduction

In higher education, the writing is clear, focused and sophisticated enough to meet the requirements of the discipline. Writing a complex document is a common issue for undergraduates. The degree of the writing development and the writers competency can be determined by the level of syntactic complexity, which can be illustrated by the use of complex sentence, subordination, and longer sentences (Sukying & Barrot, 2025; Fredrick & Craven, 2025). New literacies suggest that AI can shape writing by providing a new type of input and scaffolding that can assist in syntactic development (Zamorano, 2025; Sanz-Tejeda et al., 2025). Studies of writing in the classroom show that AI has a positive impact when it is combined with good teaching (Wang & Ren, 2024). The potential of AI is still being developed (Chanpradit, 2025). Students spend years in school studying sentence structure, but when assessed, show a lack of syntactic variety and complexity. These deficiencies impact a writer's ability to articulate ideas with clarity and depth of the argument. A persistent problem of lack of development of syntax in a L2 of writing exists, and

focused instruction is needed (Bahari, 2025). AI-assisted writing have provide a range of opportunities to develop the use of more complex structures but AI engagement and instruction have define the outcome (Kim et al., 2025; Kim et al., 2025). Analyses show that there is a difference in variation and syntactic complexity between student texts and AI texts (Wu, 2025). The objective of this study is to find the limits of how much generative AI influences the development of syntactic complexity in academic writing. Using a linguistic methodology, it analyses student writing using relevant syntactic measures before and after writing interventions supported by AI.

This study analyses the problem of the limited syntactic complexity in undergraduate academic writing and its consequences on the writing quality in higher education. The study provides a linguistic perspective on AI-assisted writing and how, with some degree of control, AI could foster and promote more complex writing from a syntactic perspective. This study is relevant to teaching.

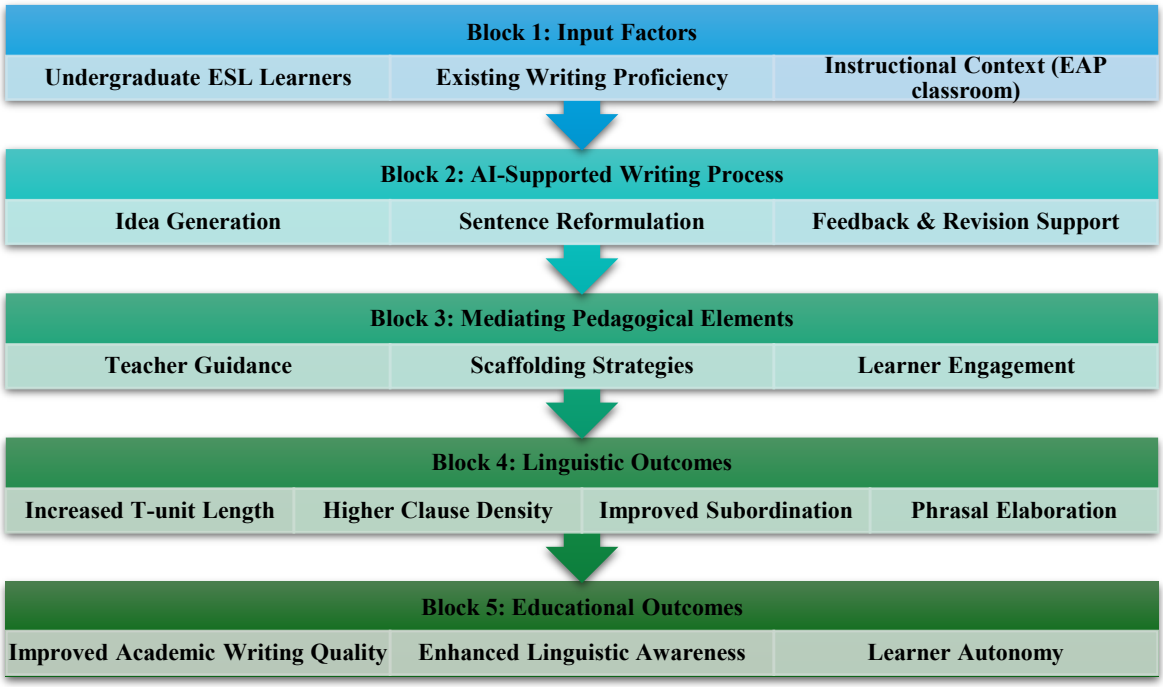

Figure 1: Conceptual Framework of Generative AI Integration for Enhancing Syntactic Complexity in Academic Writing

Figure 1 provides a detailed model showing how undergraduate ESL students in an academic writing environment interact with AI writing supports that include brainstorming, sentence rephrasing, and revision based on feedback, in relation to teaching and learning elements such as teacher control, scaffolding, and student engagement, and how these factors affect the writing qualities of larger T-unit, greater clause density, more subordination and extensive phrasing, and how these factors improve academic writing, contribute to better linguistic awareness, and increase learner autonomy.

The rest of the paper is structured in a clear sequence. Section II provides a review of earlier studies on syntactic complexity, approaches to teaching academic writing, and the role of technology in writing development, with a focus on recent work in generative AI. Section III explains the methodology, describing the research design, participant details, classroom procedures, and the linguistic measures used for analysis. Section IV reports the findings, bringing together numerical results and close examination of student writing. Section V interprets these findings by linking them to second language writing

development and classroom practice, while also noting key limitations. The final section summarizes the main points of the study and outlines possible directions for further research.

Review of Related Literature

A central dimension of second language (L2) writing proficiency is the ability to produce sentences of different structures and levels of hierarchy, and consequently, the construction of a variety of sentence structures becomes a hallmark of L2 writing. Some of the traditional measures of syntactic complexity, including T-unit length, the number of clauses per sentence, and the subordination ratio, continue to be useful in assessing L2 writing development. Other studies have also included phrasal elaboration when assessing advanced levels of academic writing. Studies have noted the AI-generated writing is denser in terms of sentence structures than typical student writing, leading to questions on the impact of this variance in density on student writing (Goulart et al., 2024). At the same time, corpus-informed AI applications are being used to design activities that help students learn and practice specific syntactic structures (Cheung & Crosthwaite, 2025). When it comes to teaching academic writing, the process approach has dominated, with drafts, revision, and feedback sessions. These techniques help in building control of syntactic structures. The advent of generative AI allows for new avenues for differentiated feedback, and in-process writing, feedback is offered in real-time. Some researchers have indicated that AI-writing feedback is beneficial to students for helping them to revise their writing to use more complex syntactic structures (Urzúa et al., 2025). Other studies have shown writing quality improvement in students when AI tools are used in process writing activities as long as students actively engage in the writing task and use the AI tools (Yang et al., 2025; Robillos, 2024). The design of the tasks and the use of AI tools for writing quality improvement is left to the teacher (Wang & Dang, 2024). More and more studies note that generative AI is being integrated into academic writing at the ideation, drafting, and revision stages (Raitskaya & Tikhonova, 2024). Students, overall, report positive experiences (including boosted confidence and efficiency), and, in the meantime, AI tools are being integrated into higher education writing and research (Rodafinos, 2025; Özdere, 2025). While studies are emerging that report writing performance that are more holistic and than skill specific, writing performance studies that feature AI and report on the specific syntactic and grammatical writing competencies appear very few in number, culminating in the research gap being described (Tiandem-Adamou, 2024).

Writing, in the artificial intelligence (AI) context, is assumed to be about the writing process and learner engagement without much attention to the process and the outcomes, especially in terms of syntactic complexity. The current study aims to bridge the mentioned gap by integrating the AI-supported writing process with the engagement, in this instance, of undergraduate students in the writing process and syntactic analysis.

Methodology

Research Design and Participant Profile

This study utilized a quasi-experimental and classroom-based research design to assess the effect of AI-assisted instruction on the level of syntactic complexity in academic writing of undergraduates. The participants were 60 undergraduate students who were taking an English for Academic Purposes (EAP) course in a post-secondary institution. The learners were in the majority ESL and were split into two groups. The experimental group received AI-supported writing instruction while the control group continued with the traditional writing instruction. The participants were of varying levels of proficiency,

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as determined by the assessment of the participants in the previous course, and this is reflective of an actual classroom setting. The study spanned one academic semester and took place in a controlled teaching context which allowed the researcher to closely supervise the participants' level of achievements.

Table 1: Participant Profile and Group Distribution

Category	Control Group (n=30)	Experimental Group (n=30)
Age Range	18–21 years	18–21 years
Gender Distribution	Mixed	Mixed
Language Background	ESL	ESL
Proficiency Level	Intermediate–Upper	Intermediate–Upper
Instruction Type	Traditional Writing	AI-Assisted Writing
Course Type	EAP	EAP

Table 1 contains the demographic and academic information of the participants of this study, such as age, language background, proficiency level, and group membership (including whether the control group received traditional writing instruction and the experimental group received AI writing instruction). The table provides a good understanding of the group and shows that the participants in both groups had the same level of starting point, which justifies the comparison of complexity of syntax the participants developed.

Instructional Procedure and AI Integration

All groups were assigned similar academic writing activities of both argumentative and non-argumentative essays which were sequenced activities based on the course syllabus. For the control group, the writing activity was completed through the traditional process of writing, which is brainstorming, drafting, peer review, and feedback from the teacher. For the other group, they were able to experience the generative AI tools during the drafting and feedback phases of writing. The students were instructed to use AI to write options of sentences, improve the structure of the clauses, and improve the logical flow of the ideas in the writing. Most importantly, the use of AI in this case was structured through the guide to reinforce the critical review and not the copy review. The period of the intervention was designed for eight weeks with weekly writing activities to increase the students' syntactic sophistication. The teacher's monitoring kept AI use integrated with pedagogy and kept the focus on the learning outcomes.

Figure 2 outline the study's sequential design, which begins with the study participants and group formations and ends with the implementation of the organized writing activities coupled with different instructional methods. The figure describes the intervention that includes one or more drafting and revision cycles, and the ensuing organized data collection from the two groups. The structure demonstrates the linguistic analysis related to the specific syntactic measures, which leads to the evaluation of the study outcomes based on quantitaive comparison and qualitative description. It provides an overview of the AI integration and the research process.

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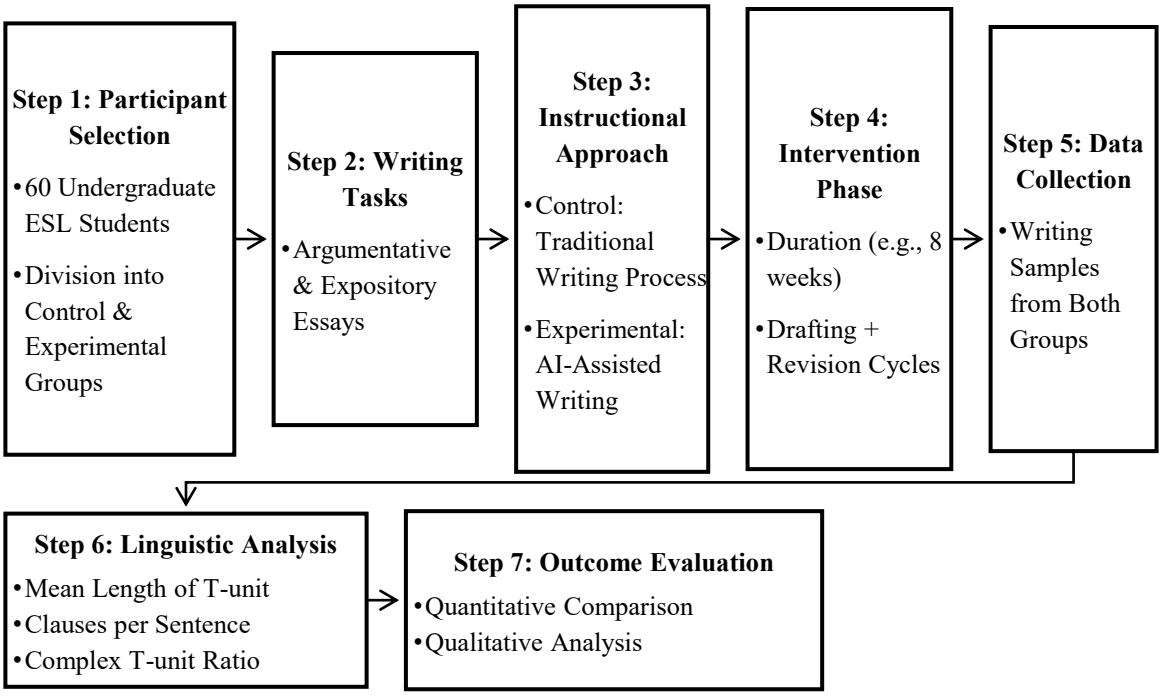

Figure 2: Methodological Framework for AI-Assisted Writing Intervention and Analysis

Data Collection and Linguistic Analysis Methods

Data were collected from both groups through pre- and post-intervention writings. Each participant submitted controlled essays for the collection in order to maintain uniformity. The focus of the analysis was on syntactic complexity measures of mean length of T-unit (MLT), clauses per sentence (C/S), and complex T-unit ratio (CT/T). The analysis of phrasal elaboration was done qualitatively in order to examine the phenomenon of structural development. In the population of the study, quantitative analysis was performed using appropriate statistical comparison techniques in order to study the variables of time and groups qualitatively. The study was enhanced through qualitative analysis, that in addition to the quantitative results, was able to study the variations in the syntax on the sentences and the layers that made the writing development due to the AI instruction.

Results

Quantitative Findings on Syntactic Development

There is significant evidence concerning the extent of growth that students experience in terms of syntactic complexity when students implement AI-assisted writing instruction. In particular, MLT, C/S, and CT/T all produce higher values for the experimental group as opposed to the control group. The differences in values of these metrics elucidate the fact that AI-assisted writing instruction enables students to produce longer sentences that have more complex structures and greater use of subordinate clauses. The control group, however, demonstrated only very small changes as a group in these metrics, which reflects a more simple progression in syntactic structures.

Table 2 demonstrates the differences in metrics used to assess syntactic complexity for both groups. The experimental group, having employed more AI-assisted writing instruction, demonstrates more advanced metrics.

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Table 2: Syntactic Complexity Measures Across Groups

Measure	Control Group	Experimental Group
Mean Length of T-unit	11.5	14.2
Clauses per Sentence	1.42	1.78
Complex T-unit Ratio	0.48	0.67

Comparative Analysis of Writing Outputs

As far as the analysis of writing output is concerned, there is evident structural variation and more developed sentence construction that is most pronounced in the experimental group, which possesses a more extensive range of sentence structures, and in particular more complex and compound sentence structures that utilize subordinate clauses more frequently. The control group demonstrates sentence construction at a more elementary level, which is a more simplistic pattern. The results support the argument that AI-assisted writing instruction allows students to develop more complex syntactic structures that are deemed more appropriate for academia.

Table 3: Comparative Syntactic Features in Writing

Feature	Control Group	Experimental Group
Sentence Variety	Limited	High
Use of Subordination	Moderate	Extensive
Clause Integration	Basic	Advanced
Overall Syntactic Range	Restricted	Expanded

Table 3 shows the differences in syntactic features that are most pronounced for the two groups and supports the argument that AI-assisted writing instruction allows students to develop more complex and diverse sentence structures.

Qualitative Analysis of Student Writing

The qualitative analyses conducted attest to the students' level of syntactic development. Analyzing the writing samples of the two groups, the control group's samples are characterized by brevity, showing little to no embedded clauses, while the experimental group samples are characterized by extensive use of complex constructions and a significant improvement in the logically cohesive strands of the writing. The presence of subordinate clauses and varied sentence protasis indicate the level of development that has been reached aided by the mature AI responses.

Table 4: Illustrative Examples of Sentence Development

Writing Type	Sample Sentence
Control Group	"Students use technology. It helps learning. It is useful."
Experimental Group	"Although students rely on technology for learning, its effectiveness depends on how it is meaningfully integrated into academic contexts."

Table 4 presents a sample of the sentence construction, illustrating the complexity and cohesion shift in AI mediated writing.

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Discussion

Interpretation of Linguistic Outcomes

The data shows learners producing a desired form. From a second language acquisition view, learners have demonstrated a notable change in syntactic behavior. The usage-based view suggests that mediated-AI feedback supports pattern strengthening. This pattern also assists uptake facilitating observed changes in expanding T-units and clause integration. Prompt and feedback mediated attention, invited learners to gap fill, and made them re-structure at a level that required more complexity. The prompted increased re-structuring was sustained by the demand to shift from coordination to subordination and phrasal elaboration. Changing the prevalent coordination in sentences and subordination to more phrasal elaboration was in response to a higher demand academic level. The learners engagement with the tool was highly variable, and the tool's influence here was limited by the extent to which learners really worked with the feedback, engage with the underlying structure and patterns, and abandon the tendency to surface level pattern replication.

Pedagogical Implications for English Language Teaching

In classroom practice, Artificial Intelligence can be positioned as a scaffold for process writing, as opposed to a means to a finished text. Teachers may frame assignments where students (i) produce and explain alternative versions for a target sentence, (ii) choose between competing options for clause type and information structure, and (iii) articulate rationales for revisions using metalanguage (e.g., subordination, nominalization). Draft–AI feedback–human revision cycles, along with time-bound peer reviews, can be combined to prompt purposeful attention to form without losing sight of meaning. Syntactic goals (e.g., at least one complex sentence per paragraph) and variety of clause opening checklists can guide purposeful use. Students can remain engaged in peer review by evaluating original and AI-revised sentences to foster critical awareness. Teachers should demonstrate how to diagnose AI outputs and articulate accuracy, appropriateness, and coherence in order to encourage learners to be in control of their form, rather than dependent on AI.

Limitations and Ethical Considerations

The scope of the study limits generalization. In terms of external validity, the single-institution setting and the sample size are both limiting. The intervention window may not capture the longer retention span for the syntactic gain. Measured focused on a selected frame. Additional metrics such as phrasal complexity would yield a fuller picture. The ethically compliant consideration is the risk of over-reliance on AI. The adoption, in an academic setting, would bring cognitive effort to a minimum. Uncritical adoption obscures authorship. Thus, specific guidelines are necessary to describe clear boundaries in acceptable use, require AI use to be made explicit, and assign evaluation to both process and product. Tasks that require an explanation for the revision made, help mitigate uncritical reliance on AI while also preserving the benefit of the scaffold.

Conclusion

The study shows that integrating generative AI into teaching undergraduates academic writing helps improve writing quality in terms of syntactic complexity, especially clause variation, longer T-units, and better subordination and phrasal elaboration. AI is most effective when designed as a pedagogical scaffold, and students, rather than relying on it in a passive way, engage in some critical questioning and thinking

about AI. In terms of curriculum design, the findings advocate for AI-type revision tasks to be incorporated into process writing where the revision is combined with explicit teaching of certain syntactic features along with some guided practice and teacher intervention. This approach balances user cognitive engagement, academic integrity, and language structure awareness. The study notes the limited time, sample size, and syntactic measures, and a longer-term study with a wider participant sample, greater linguistic measures, and more nuanced writing metrics is warranted to build on the study. Furthermore, a different AI pedagogical design with an interdisciplinary position that combines writing, language, and instruction would facilitate learner autonomy and writing skill and improve the understanding of technology integration in language education.

References

Bahari, A. (2025). Balancing syntactic complexity and clarity: the role of AI in enhancing academic writing proficiency. *Saudi Journal of Language Studies*, *5*(4), 271-290. https://doi.org/10.1108/SJLS-10-2024-0062

Chanpradit, T. (2025). Generative artificial intelligence in academic writing in higher education: A systematic review. *Edelweiss Applied Science and Technology*, *9*(4), 889-906. https://doi.org/10.55214/25768484.v9i4.6128

Cheung, L., & Crosthwaite, P. (2025). CorpusChat: Integrating corpus linguistics and generative AI for academic writing development. *Computer Assisted Language Learning*, 1-27. https://doi.org/10.1080/09588221.2025.2506480

Fredrick, D. R., & Craven, L. (2025, September). Lexical diversity, syntactic complexity, and readability: A corpus-based analysis of ChatGPT and L2 student essays. In *Frontiers in Education* (Vol. 10, p. 1616935). Frontiers Media SA. https://doi.org/10.3389/feduc.2025.1616935

Goulart, L., Matte, M. L., Mendoza, A., Alvarado, L., & Veloso, I. (2024). AI or student writing? Analyzing the situational and linguistic characteristics of undergraduate student writing and AI-generated assignments. *Journal of Second Language Writing*, *66*, 101160. https://doi.org/10.1016/j.jslw.2024.101160

Kim, J., Lee, S. S., Detrick, R., Wang, J., & Li, N. (2025). Students-Generative AI interaction patterns and its impact on academic writing. *Journal of Computing in Higher Education*, 1-22. https://doi.org/10.1007/s12528-025-09444-6

Kim, J., Yu, S., Detrick, R., & Li, N. (2025). Exploring students' perspectives on generative AI-assisted academic writing. *Education and Information Technologies*, *30*(1), 1265-1300. https://doi.org/10.1007/s10639-024-12878-7

Özdere, M. (2025). AI in Academic Writing: Assessing the Effectiveness, Grading Consistency, and Student Perspectives of ChatGPT and You. com for EFL Students. *International Journal of Technology in Education (IJTE)*, *8*(1). https://doi.org/10.46328/ijte.1001

Raitskaya, L., & Tikhonova, E. (2024). Appliances of generative AI-powered language tools in academic writing: A scoping review. *Journal of Language and Education*, *10*(4 (40)), 5-30.

Robillos, R. J. (2024). Synergizing Generative Pre-Trained Transformer (GPT) Chatbots in a Process-Based Writing Paradigm to Enhance University Students' Writing Skill. *Journal of Language and Education*, *10*(3 (39)), 79-94. https://doi.org/10.17323/jle.2024.18708

Rodafinos, A. (2025). The integration of generative AI tools in academic writing: Implications for student research. *Social Education Research*, 250-258. https://doi.org/10.37256/ser.6220256517

Sanz-Tejeda, A., Domínguez-Oller, J. C., Baldaquí-Escandell, J. M., Gómez-Díaz, R., & García-Rodríguez, A. (2025). The impact of generative AI on academic reading and writing: a synthesis of recent evidence (2023–2025). In *Frontiers in Education* (Vol. 10, p. 1711718). Frontiers Media SA. https://doi.org/10.3389/feduc.2025.1711718

Sukying, A., & Barrot, J. S. (2025). Syntactic Complexity of AI-Generated Argumentative and Narrative Texts: Implications for Teaching and Learning Writing. *College Composition & Communication*, *77*(1), 148-169. https://doi.org/10.58680/ccc2025771148

Tiandem-Adamou, Y. (2024). Using Generative Artificial Intelligence to Support EFL Students' Writing Proficiency in University in China. *Journal of Educational Technology and Innovation*, *6*(4). https://doi.org/10.61414/jeti.v6i4.213

Urzúa, C. A. C., Ranjan, R., Saavedra, E. E. M., Badilla-Quintana, M. G., Lepe-Martínez, N., & Philominraj, A. (2025). Effects of AI-Assisted Feedback via Generative Chat on Academic Writing in Higher Education Students: A Systematic Review of the Literature. *Education Sciences*, *15*(10), 1396. https://doi.org/10.3390/educsci15101396

Wang, H., & Dang, A. (2024). Enhancing L2 writing with generative AI: A systematic review of pedagogical integration and outcomes. *Preprint*, *2*, 1-30.

https://doi.org/10.13140/RG.2.2.19572.16005

Wang, L., & Ren, B. (2024). Enhancing academic writing in a linguistics course with Generative AI: An empirical study in a higher education institution in Hong Kong. *Education Sciences*, *14*(12), 1329. https://doi.org/10.3390/educsci14121329

Wu, J. (2025). A corpus-based multidimensional analysis of linguistic features between human-authored and ChatGPT-generated compositions. *International Journal of Linguistics, Literature and Translation*, *8*(5), 102-110. https://doi.org/10.32996/ijllt.2025.8.5.10

Yang, K., Raković, M., Liang, Z., Yan, L., Zeng, Z., Fan, Y., ... & Chen, G. (2025, March). Modifying AI, enhancing essays: How active engagement with generative AI boosts writing quality. In *Proceedings of the 15th international learning analytics and knowledge conference* (pp. 568-578). https://doi.org/10.1145/3706468.3706544

Zamorano, C. (2025). Enhancing academic writing in English language education through generative AI integration. *Research Studies in English Language Teaching and Learning*, *3*(3), 424-447. https://doi.org/10.62583/rseltl.v3i3.87