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Leveraging artificial intelligence as a Vygotskian tool to enhance Filipino university students' language learning and critical thinking skills

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ABSTRACT

Drawing on Vygotsky's Sociocultural Theory, this study investigated how artificial intelligence (AI) functions as a "more knowledgeable other" in enhancing language proficiency and critical thinking skills. Employing a within-subjects quasi-experimental repeated-measures design, 175 Filipino university freshmen participated in five sequential Contextual Writing Assignments (CWAs) integrated with ChatGPT feedback. Results revealed statistically significant improvements in both English language proficiency and critical thinking skills over time ($P < 0.05$). The AI provided adaptive scaffolding within the students' Zone of Proximal Development, creating a psychologically safe environment that lowered affective barriers and reduced the fear of making mistakes. Furthermore, a moderate positive correlation was found between linguistic gains and analytical competencies. The study concludes that pedagogically structured AI integration—utilizing a draft-feedback-reflection-revision cycle—fosters an inclusive environment and empowers students to become independent and critical thinkers. This research provides an evidence-based model for leveraging generative AI to bridge the gap between workforce demands and graduate skills.

Keywords: academic writing, analytical skills, language proficiency, large language models, negotiation of meaning, scaffolding

INTRODUCTION

The increasing use of generative artificial intelligence (AI) promises a new economic paradigm. Projections suggest that it can contribute trillions to the global economy by boosting productivity and fostering innovation (Corvello 2025). Businesses are adopting these tools to streamline operations and gain

a competitive advantage (Värzaru and Bocean 2024). This rapid acceptance of AI technology, however, stands in stark contrast to the fear prevalent within academic communities, where apprehensions about academic integrity and the loss of foundational learning skills dominate the discourse (Bin-Nashwan et al. 2023; Rodrigues et al. 2025). This contrast poses a critical challenge. If the AI-driven economy



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increasingly demands advanced communication and critical thinking skills, then the academe risks failing students by avoiding these powerful tools, potentially increasing the gap between workforce demands and graduate skills.

This challenge is serious in the Philippines, especially in the context of second language acquisition. The Philippines has encountered significant challenges in English literacy, as evidenced by its low ranking in the 2022 Programme for International Student Assessment at 76th out of 81 participating countries (OECD 2023). This ranking is alarming because deficiencies in comprehension skills can hinder students from processing diverse information (Butterfuss et al. 2020), which is essential for fostering critical thinking and creativity for lifelong learning (Paige et al. 2024). The World Bank emphasizes the importance of learning skills, noting that these skills drive innovation, productivity, and long-term economic growth (Liang and Chen 2013; Ansari and Amegah 2025). However, this national struggle is evident in classroom contexts, where empirical studies document that Senior High School students struggle to recognize textual patterns, evaluate coherence, and possess limited vocabulary knowledge (Urbano et al. 2021). These challenges also indicate that students' English language proficiency is declining (Gustilo 2016; Altınmakas and Bayyurt 2019; Islam and Stapa 2021; Portillo-San Miguel 2021; Chemir and Kitila 2022; Lobo 2023; Marmita et al. 2023; Pangket et al. 2023; Baracheta 2024; Hua and Huynh 2024; Ky Nhan 2024 May 31; Muniruzzaman and Afrin 2024; Zheng et al. 2024; Chavez et al. 2025). This culminates in a pervasive lack of confidence and hesitancy to use English in class discussions among university freshmen (White 2011), severely limiting their cognitive development.

This learning shortfall is not just a skill deficit but is deeply rooted in the affective dimensions of learning (Ben-Eliyahu 2019; Huang and Lajoie 2023). The apprehension of committing mistakes and the anxiety of being judged by peers create a high affective filter (Krashen 1982; Krashen 1995), a psychological barrier that hampers language acquisition by discouraging interactions essential for developing practical communication skills. When this anxiety becomes severe, it creates an environment that discourages immersive and safe learning environments (Córdova et al. 2023) to develop language proficiency and critical thinking.

To challenge this dilemma, an immersive and adaptive pedagogical approach is needed that simultaneously addresses affective barriers and cognitive development. Vygotsky (1987) argued that learning is a social process in which a more knowledgeable other (MKO) provides support or scaffolding within the learner's zone of proximal development (ZPD). Accordingly, the ZPD refers to

the space between what the students can do independently and what they can achieve with guidance (Marginson and Dang 2017; Tzurriel 2021). In this study, conversational tools like ChatGPT operationalize aspects of the MKO. It has a capacity for conversational interaction and personalized feedback (Lester et al. 2024; Al-Obaydi et al. 2025; Aslan et al. 2025). Likewise, it provides students with opportunities to practice vocabulary in real-life contexts without fear of making mistakes (Alharbi and Khalil 2023; Hsu et al. 2023; Huang and Wang 2023; Oktadela et al. 2023; Aleena Taj et al. 2025). This promising AI-scaffolded student interaction can be applied in Philippine language classrooms.

While several studies have effectively identified the efficacy and impact of AI in students' language enhancement, few have empirically tested innovative solutions that address both cognitive and affective barriers. Likewise, no studies have yet examined the mechanisms underlying how and why AI, such as ChatGPT, improves language learning performance and critical thinking skills. Drawing from this context, this study addresses this gap by employing a rigorous repeated-measures design, grounded explicitly in Vygotsky's Sociocultural Framework, to explore the underlying mechanisms of this process. This study is guided by the following research questions: (1) What is the effect of AI-scaffolded conversational interaction on students' English language proficiency over time? (2) What is the effect of AI-scaffolded conversational interaction on students' critical thinking skills over time? (3) Is there a significant relationship between students' English language proficiency and their critical thinking skills following the AI-scaffolded intervention?

This study moves beyond theoretical speculation to provide an evidence-based model for integrating AI to create a dynamic, interactive, and psychologically safe environment for second language acquisition and the development of critical thinking.

METHODS

Study Design

This study used a within-subjects quasi-experimental repeated-measures design, wherein the participants' performances were compared to their own previous performances. These were the same people who provided data for all writing conditions. The researchers preferred a within-subjects design because it reduces individual differences in the research (Birnbaum 1999; Kim 2010). Since participants vary significantly in their starting language skills and critical thinking abilities, this method controls the participants' individual differences because each student has own control. By

comparing the students' performance with their previous performances, it was easier for researchers to determine the effect of ChatGPT as an intervening treatment on students' English language skills and critical thinking abilities.

During the first week of the study, students were given a comprehensive orientation session to familiarize themselves with the course content and procedure, including the configuration and utilization of generative artificial intelligence.

Participants and Sampling Procedure

Employing population sampling, this study investigated a sample of 175 freshmen students taking up Bachelor of Science in Criminology. They were native Filipino speakers who learned English as a second language. The sample represented the entire cohort of first-year students in the program, ensuring comprehensive coverage of the target population.

Instruments and Validation

To assess student outcomes, two primary instruments were used. First, an analytical scoring rubric was used to evaluate students' English language proficiency based on the use of vocabulary, organization, grammar, and coherence in their written incident reports. Second, a revised holistic critical thinking scoring rubric (Facione and Facione 1994) was employed to assess the quality of students' analytical thinking in their written outputs. To ensure scoring reliability, two independent raters assessed a random sample of 20% of the writing tasks, and inter-rater reliability was calculated using Cohen's Kappa, achieving a coefficient of $k = 0.84$, indicating strong agreement. Discrepancies were resolved through discussions to maintain consistency across all ratings.

Data Gathering Procedure

They were provided with writing journals at the beginning of the semester. The journal consisted of four (4) parts, namely: original draft, ChatGPT correction (Model), ChatGPT feedback, and the student's reflection (Figure 1). There were five (5) contextualized writing activities. The first writing task served as the baseline "Beginner", the pre-test for all comparisons, and the succeeding tasks represented specific cases. The students were given a topic that centered around a crime scene analysis. They were tasked to watch five (5) videos depicting a specific case or crime for their writing tasks. These tasks represented five different experimental cases for interacting with ChatGPT.

After watching the assigned video for each task, the students were given prompts that were analytical and expository. The same prompts were used for all students to maintain consistency across variables (same prompt as the controlled variable). On one hand, the expository aspect determined the

students' language proficiency, which in this study was operationalized as academic writing performance. On the other hand, the analytical aspect measured the students' critical thinking. These prompts require them to describe events objectively, analyze actions and potential evidence, and construct a coherent and logical narrative from their observations. An example of an expository prompt for Task 1 (Baseline) stated: "Describe the crime scene objectively: location, time, people present, physical evidence, and chronological sequence of events." The analytical prompt for Task 2 stated: "What potential evidence would you collect to verify or disprove the claims made?"

After watching a video depicting a specific crime scene, the students wrote a formal incident report. The report was assessed based on the clarity of its organization, the quality of its language, and the strength of its analytical thinking. The report described the nature of the incident and summarized the account provided by the witness or victim, including the key details from the witness or victim's statement that could be considered as evidence. After writing the first draft, the students opened their generative AI tool and used a prompt, instructing the AI to act as a writing tutor by correcting grammar and vocabulary use and explaining the reasons for the most important corrections.

Statistical Analysis

The statistical analysis followed a systematic process. First, the data were subjected to descriptive statistics, including the computation of means and standard deviations, to provide an overview of the students' performance and to determine the initial and subsequent levels of enhancement in their English and critical thinking skills (Scale: 1.00 – 1.49 – very low; 1.50 – 2.49 – low; 2.50 – 3.49 – high; and 3.50 – 4.00 – very high) (Pimentel 2019).

A Paired Sample t-test was used to confirm students' progress from pre-test to post-test scores. This test was appropriate for determining the improvement of skills after the intervention. A Repeated Measures MANOVA was employed to confirm an overall effect of the task sequence, given that the same participants were assessed at different points in time, allowing researchers to track changes in their English proficiency and critical thinking skills under similar conditions. This design was chosen to control for individual variability and to ensure that differences were duly observed through the intervention. The Friedman Test was used to rank the progressive improvement. This step enabled a more comprehensive assessment of whether the observed improvements in one domain were associated with changes in the other. Finally, Pearson's Correlation was used to establish the relationship between English proficiency and critical thinking skills.

All statistical computations were performed using the Statistical Package for the Social Sciences (SPSS) version 25, with the level of significance set at

$P < 0.05$ to determine the statistical reliability of the findings.

Original Writing	ChatGPT Corrected
<p>ORIGNAL ARSON</p> <p>On August 2, at approximately 3:45pm an incident occured at Brgy. Golden Valley, Puerto Princesa City. Responding officers were dispatched to the scene upon receiving a report of Arson cases this report documents the details and actions taken in response to the incident.</p> <p>Itabang nagluluto ang dalagita na nasa edad 13 bilang lumiyab ang kanilang kuryente na pinagmulan ng napakalaking sunog na lumamang salimong bahay sa kalagitnaan ng malaking sunog ang dalaga ay natulala at hindi alam ang gagawin pumasok ang isang lalaki sa loob ng bahay para ilabas ang dalagita. Ayon sa dalagita nagluluto siya ng biglang pumutok ang kanilang kuryente na pinagmulan ng sunog.</p>	<p>REVISE</p> <p>On August 2 at approximately 3:45pm an incident occurred at Brgy. Golden Valley Puerto Princesa City. Responding officers were dispatched to the scene upon receiving a report of Arson cases. This report documents the details and actions taken in response to the incident.</p> <p>While the young lady, aged 13, was cooking a massive fire suddenly erupted from their electrical source, engulfing five houses. In the midst of the raging fire, the young lady became stunned and didn't know what to do. A man entered the house to rescue the young girl. According to the girl, she was cooking when their electricity suddenly burst, causing the fire.</p>
ChatGPT Feedback	Student's Reflection
<p>DISCUSS TO ME MY GRAMMAR MISTAKES</p> <ol style="list-style-type: none"> "Itabang nagluluto ang dalaga na nasa 13" can be translated as "While the young woman, aged 13, was cooking." "bilang lumiyab ang kanilang kuryente" can be translated as "their electricity suddenly sparked". "pinagmulan ng napakalaking sunog na lumamang salimong bahay" can be translated as "originating from a massive fire that engulfed five houses." "sa kalagitnaan ng malaking sunog ang dalaga ay natulala at hindi alam ang gagawin" can be translated as "In the midst of the large fire, the young woman stood in shock, unsure of what to do." "pumasok ang isang lalaki sa loob ng bahay para ilabas ang dalagita" can be translated as "A man entered the house and rescued the girl." "Ayon sa dalagita nagluluto siya ng biglang pumutok ang kanilang kuryente sa pinagmulan ng sunog" can be translated as "According to her, she was cooking when their electricity..." 	<p>DAU 3485, collide with the girl but immediately left the scene. He mentioned that he didn't see the driver's face because the windows were closed, and the dimming light also hindered visibility.</p> <p>REFLECTION</p> <p>Using ChatGPT to improve my grammar has been immensely helpful. The instant feedback provided on my sentences pinpointed specific mistakes, enabling me to see where I went wrong and understand how to correct those errors. Seeing corrected versions of my text has been a practical way to grasp proper grammar structures and refine my writing skills quickly and effectively.</p>

Figure 1. Parts of students' writing journal.

RESULTS

Influence of AI-Powered Conversational Interactions on Students' Language Proficiency

The students' baseline performance and the learning trajectory. To track the students' performance across five (5) sequential writing tasks over the AI-assisted intervention, descriptive statistics were employed. The results in Table 1 show that the students achieved a good level of proficiency in English (2.43 ± 0.34) as indicated by the "high" qualitative descriptor and the associated scale across all tasks of the AI-assisted writing activities. Students started with a skill level that required improvement in Task 1 (1.75 ± 0.31), which served as the baseline pre-test. A significant qualitative shift occurred as students' language proficiency in Task 2 (2.13 ± 0.41) increased in Task 3 (2.45 ± 0.33). Likewise, the highest level of enhancement was achieved in the final task (Task 5)

(3.04 ± 0.37). Through repeated feedback and practice, students' language skills have progressed to a good level of proficiency ($M = 2.43$).

Comparative analysis of students' language proficiency enhancement. To examine whether there was a significant difference in performance compared to the initial stage of the experiment, the Paired Sample t-test was conducted. The data revealed a statistically significant improvement in students' English language skills from Task 1 (1.82 ± 0.32) to the fifth and final task (3.12 ± 0.48), $t(174) = -58.883$, $P < 0.05$ (Table 2). Each successive writing task demonstrated a highly significant result for every pair ($P < 0.05$). The magnitude of improvement was reflected in the constant increase in post-test means, which rose from 2.01 in Task 2 to 3.12 in Task 5. The final mean for Task 5 represents an improvement of over 1.3 points on the scale from the baseline pre-test mean of 1.82 in Task 1.

Table 1. Level of enhancement of students' English language and critical thinking skills.

Cases	English Language Proficiency			Critical Thinking Skills		
	Mean±SD	Qualitative Descriptor	Interpretation	Mean	Qualitative Description	Interpretation
Task 1 (Baseline)	1.75±0.31	Low	Needs improvement	1.85 ± 0.33	Low	Below basic
Task 2	2.13±0.41	Low	Needs improvement	2.00 ± 0.42	Low	Below basic
Task 3	2.45±0.33	Low	Needs improvement	2.38 ± 0.36	Low	Below basic
Task 4	2.68±0.34	High	Good	2.79 ± 0.43	High	Proficient
Task 5	3.04±0.37	High	Good	3.21 ± 0.49	High	Proficient
Overall	2.43±0.34	High	Good	2.59 ± 0.39	High	Proficient

Table 2. Comparative analysis of the enhancement of students' English language and critical thinking skills. n=175, Sig. (2-tailed) = * $P < 0.05$, ** $P < 0.01$.

Pair	Cases	English Language Proficiency		Critical Thinking Skills	
		Mean ± SD	t	Mean ± SD	t
Pair 1	Task 1 (Baseline) Pre-test	1.82 ± 0.32	-8.90**	1.85 ± 0.32	-9.41**
	Task 2 Post-test	2.01 ± 0.40		1.99 ± 0.42	
Pair 2	Task 1 (Baseline) Pre-test	1.82 ± 0.32	-35.99**	1.85 ± 0.32	-36.99**
	Task 3 Post-test	2.48 ± 0.35		2.38 ± 0.36	
Pair 3	Task 1 (Baseline) Pre-test	1.82 ± 0.32	-45.22**	1.85 ± 0.33	-48.23**
	Task 4 Post-test	2.99 ± 0.43		2.79 ± 0.43	
Pair 4	Task 1 (Baseline) Pre-test	1.82 ± 0.20	-58.88**	1.85 ± 0.33	-60.88**
	Task 5 Post-test	3.12 ± 0.48		3.21±0.49	
Pair 5	Task 1 (Baseline) Pre-test	1.82 ± 0.32	-53.67**	1.85 ± 0.33	-54.67**
	Overall	2.49 ± 0.37		2.59 ± 0.39	

Ranking of Students' English language learning and overall effect of the intervention. After the Paired Sample t-test provided compelling evidence that there was a significant difference in every writing activity (Table 2), a multivariate test (Table 3) was conducted to collectively assess the impact of the sequential series of AI-assisted writing (Factor 1) on students' English language skills enhancement (Table 3). The Friedman Test confirmed the constant and cumulative improvement in students' English language skills throughout the study (Table 4). It demonstrated the exact sequence of learning. The students began with the lowest performance level (1.82 ± 0.31), and with each subsequent AI-assisted writing task, the mean scores showed a substantial and monotonic increase from Task 1 with a mean of 1.82 (Rank 5) to Task 5 with a mean of 3.10 (Rank 1). The rank progression was systematically enhanced and improved predictably in every successive AI-assisted writing task, with the final task yielding the highest independent performance of the student's language skills.

A repeated-measures MANOVA revealed that there was a statistically significant overall effect of the writing task sequence through a series of

sequential AI-assisted writing (Factor 1) on the combined measures of English language skills, with an effect size of Pillai's Trace = 0.942, $F(4,171) = 737.914$, $P < 0.05$ (Table 5). This test was used to determine if there were statistically significant changes in multiple related measures over time. All four standard multivariate test statistics: Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root, yielded an identical F-value of 737.914 and a significance value of $P < 0.05$ (Table 5), indicating that the possibility of statistical ambiguity in the interpretation of this study was minimal. The within-subjects factor represented the sequence of tasks (Task 1 through Task 5), where students wrote, received AI feedback, reflected and revised. The F-value of 737.914 denoted that the differences in English language scores between the writing cases were substantial and systematic, far exceeding what could be expected from random variation. The highly significant p-value ($P < 0.05$) indicates overwhelming statistical evidence that the students' performance changed significantly across the different tasks.

Table 3. Multiple comparison test of the students' English language enhancement (Repeated Measures MANOVA).

Multivariate Tests ^a						
Effect	Value	F	Hypothesis df	Error df	Sig.	
Factor 1 (ChatGPT)	Pillai's Trace	0.942	737.914b	4	171	0
	Wilks' Lambda	0.022	737.914b	4	171	0
	Hotelling's Trace	20.671	737.914b	4	171	0
	Roy's Largest Root	20.671	737.914b	4	171	0
a. Design: Intercept Within Subjects Design: Factor1						
b. Exact statistic						
c. Computed using alpha = 0.05						

Table 4. Ranking of the enhancement of the students' English language proficiency and critical thinking skills (Friedman Test).

Cases	English Language Proficiency		Critical Thinking Skills		Rank
	Mean ± SD	Mean Rank	Mean ± SD	Mean Rank	
Task 1 (Baseline) Pretest	1.82 ± 0.31	1.24	1.85 ± 0.33	1.28	5
Task 2	1.90 ± 0.40	1.65	2.00 ± 0.42	1.79	4
Task 3	2.31 ± 0.34	2.72	2.38 ± 0.36	2.99	3
Task 4	2.69 ± 0.42	3.89	2.79 ± 0.43	4.01	2
Task 5	3.10 ± 0.49	4.69	3.21 ± 0.49	4.94	1

Table 5. Multiple comparison test of the students’ English language and critical thinking skills enhancement (Repeated Measures Manova).

Multivariate Tests ^a						
Effect		Value	<i>F</i>	Hypothesis df	Error df	Sig.
Factor 1	Pillai's Trace	0.956	933.658b	4	171	0
	Wilks' Lambda	0.044	933.658b	4	171	0
	Hotelling's Trace	21.84	933.658b	4	171	0
	Roy's Largest Root	21.84	933.658b	4	171	0
a. Design: Intercept Within Subjects Design: Factor 1						
b. Exact statistic						
c. Computed using alpha = 0.05						

The Dynamic Nature of AI-Driven Conversations Fosters Students’ Critical Thinking Skills

Level of enhancement of students’ critical thinking skills. The data indicate that the students achieved a highly proficient level of critical thinking skills (2.59 ± 0.39) across all AI-assisted writing activities (Table 1). Students' critical thinking skills showed gradual improvement from Tasks 1 and 2. A significant improvement that reached the proficiency threshold was observed in Task 3 (2.79 ± 0.43), which continued in the final task (Task 5) (3.21 ± 0.49). The result implies significant improvement in students' analytical and evaluative skills.

Evidence of improvement of students’ critical thinking skills. Students’ critical thinking skills showed significant improvement across different cases and time points (Table 2). Every iterative writing task showed highly significant results ($P < 0.05$) in the Paired Sample t-tests for every pair. The extent of improvement was shown in the steadily increasing post-test means (from 1.99 in Task 2 to 3.21 in Task 5). On the one hand, the mean for Task 5 is critical, as it represents an improvement of over 1.36 points on the scale from the baseline pretest mean of 1.85 in Task 1. On the other hand, the *t*-values progressing from pair 1 (-9.41) to pair 4 (-60.88) demonstrated that the efficacy of the AI-assisted intervention in developing critical thinking skills substantially increased with each successive writing task.

Order of the students’ critical thinking skills and overall effect of writing sequence. Likewise, the Repeated Measures MANOVA revealed a statistically significant overall effect of the writing sequence on students' critical thinking skills (Table 3). To rank the effectiveness of the different cases, a Friedman Test was used (Table 4). The data confirmed the steady and cumulative improvement in students' critical thinking capabilities throughout the study. The students started at the lowest performance level (1.85 ± 0.33) (see Table 1) and, in subsequent writing

performances, showed increasing mean scores from the Task 1 mean of 1.85 (Rank 5) to Task 5 with a mean of 3.21 (Rank 1; Table 4). The results of the ranking affirmed that the students' critical thinking capabilities were systematically improved with each AI-assisted writing task. The results imply that the analytical and evaluative capabilities required for critical thinking were progressively developed through repeated engagement with the AI's feedback cycle. This was shown by the various multivariate test statistics (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root) that yielded an identical *F*-value of 933.658 and a significance value of $P < 0.05$ (Table 5). A remarkably large *F*-value signifies that the differences in critical thinking scores between the writing cases were substantial and systematic, outpacing what could be expected from random variation. Likewise, the exceedingly significant *p*-value ($P < 0.05$) suggests compelling statistical evidence that the students' critical thinking performance changed significantly across the different tasks as a direct result of the AI-assisted intervention.

Relationship between Students’ English Language Skills and Critical Thinking Skills

The data present a moderate positive correlation between students’ English language proficiency and their critical thinking skills. The results yielded a Pearson correlation coefficient of $r = 0.536$ and a *p*-value of 0.006 ($P < 0.05$). On one hand, the significance level of 0.006 suggests that the observed correlation between critical thinking and English language skills is unlikely to have occurred by random chance alone, providing evidence that there is a real relationship between these variables in the population of 175. On the other hand, the positive correlation indicates that as scores on critical thinking increase, the scores on English language skills also increase. This suggests that AI-assisted writing activities fostered a synergistic effect in the

development of students' linguistic and analytical competencies. This further implies that the improvement in English language proficiency provided the tools for clearer expression and analysis; at the same time, the use of critical thinking most likely contributed to the more complex use of the English language.

DISCUSSION

The Influence of AI-Powered Conversational Interactions on Students' Language Proficiency

This study explored how ChatGPT, as an AI-assisted writing tool, influenced the development of English as a second language. The results of the descriptive analysis indicate a statistically significant improvement in students' English proficiency levels. This progression suggests that the AI-supported feedback cycle promotes heightened noticing and facilitates language development. The consistent negative *t*-values and significant *p*-values across comparisons further substantiate the presence of meaningful learning gains. These improvements can be interpreted through established frameworks in second language acquisition (Krashen 1982; Vygotsky 1987; Schmidt 1990; Long 1996). In particular, the findings align with Vygotsky's Sociocultural Theory, as the AI appears to function as an adaptive scaffold that supports learners in producing language slightly beyond their current level of independent performance. Rather than treating theoretical constructs separately, the results point to an integrated process in which scaffolding, noticing, and interaction collectively contribute to language development within the AI-mediated environment. Learning occurs most effectively in the ZPD, the distance between the actual development level and the level of potential development under the guidance of an adult. In this study, AI serves as the dynamic MKO, providing precise assistance within the students' ZPD, the space between what the student can do alone in writing and what they can do with AI's help. The constant increase in mean scores from the initial writing task to the final task suggests a direct effect of the scaffolded support of the AI-assisted writing (Katona and Gyonyoru 2025). This is evident in pair 4 (Table 2), where students significantly improved after the AI's scaffolding. AI provides answers and explanations to the students' language errors, the proper process, and language models. The initial smaller jump in Table 2 (pair 1) denotes AI providing basic and foundational scaffolding. However, as the tasks progressed, the scaffolding adopted a more complex process compared to the natural variation in scores. Moreover, the result that each subsequent mean is higher than the last indicates that the students' ZPD was not static.

With each cycle of supported practice, the student's independent abilities grew, and a new higher ZPD was established (Ferguson et al. 2022). The result implies that the effect of AI-assisted writing was not just consistent but became progressively stronger. AI's consistent just-in-time scaffolding bridges the ever-advancing learning of students in the English language. The sequence of writing tasks successfully navigated the students' ZPD.

Likewise, the cumulative improvement in language proficiency (Table 4) demonstrates that with each cycle of AI-generated feedback and student reflection, learners gradually internalize the vocabulary and language rules from previous writing tasks, allowing them to perform at a higher level of independent competence (Cavalcanti et al. 2021; Tağa and Kalenderoğlu 2022). The result indicates that the iterative cycle of interacting with the AI supports the development of systematic cognitive change. The students were not only memorizing the corrections, but they were also internalizing the underlying language system. This finding is critical, as it signifies that the more activities students completed with feedback from the AI, the more their language learning was reinforced and solidified (Ekizer 2025; Liu 2025). It implies that the teachers' creativity in approaches and strategies for employing repeated, scaffolded writing tasks was instrumental in the students' development. The language teaching strategies contributed to the development of the students' English language skills. These findings further illustrate that the adoption of Artificial Intelligence in classroom instruction is beneficial in second language learning (Almelhes 2023).

Meanwhile, as AI provides adaptive scaffolding, it is also a catalyst for lowering students' learning anxiety. The sustained and statistically significant improvement in students' English language skills in AI-assisted writing coincides with the affective filter hypothesis (Krashen 1989). It is proposed that when learners are relaxed, free from anxiety, and not preoccupied with errors or external pressure, the language input is able to reach the brain's language acquisition device (LAD), where it is processed subconsciously and integrated into the developing language system (Stander 2025). Conversely, when anxiety, stress, or self-consciousness are present, the flow of comprehensible input is hindered or blocked before it reaches the LAD, limiting the extent of language acquisition. The statistically significant improvement in students' English language skills from the initial task to the final task confirms that AI has created an environment of psychological safety that lowered the mental barriers to learning. It implies that the cumulative process of non-threatening engagement with the AI-driven writing and feedback cycle was highly effective in enhancing language proficiency. Moreover, the initial

smaller *t*-value in pair 1 and the soaring *t*-values of subsequent pairs in pair 4 indicate a massive increase in the volume and quality of engagement. This engagement signifies the low anxiety and non-judgmental environment, which was subsequently instrumental in dismantling the emotional barrier. Unlike in traditional classroom settings, wherein students' fear of making mistakes will likely suppress their willingness to practice and take risks, the AI platform provides a private, non-judgmental environment. Ultimately, the systematic reduction of anxiety in AI-assisted writing activities unlocks the students' latent potential for language proficiency.

Every student's submission initiated the cycle of Long's (1996) negotiation of meaning. Long's hypothesis posits that language acquisition is most effective when a communication breakdown occurs and is repaired through interaction. Long (1996) termed this as "negotiation of meaning". In this research, as students began to write, their outputs naturally contained errors. These errors constituted a communication breakdown. Since the students asked for an explanation of the errors in their writing, the AI's corrective feedback served as the interactive repair that made the target language input comprehensible. The initial low scores in Task 1 were a rich source that triggered negotiation. It implies that in every grammatical inaccuracy, wrong choice of words, awkward phrases, or misspelling in the students' draft was a potential learning point. The errors where the intended meaning was not correctly encoded in formal English created the essential precondition for negotiation. Thus, when AI provided the corrected version and further gave reasons for the corrections, AI was involved in recasting or repairing the students' language breakdown. This "repair" represented the total negotiation of meaning. This was evident in the escalating *t*-values across the paired tests from pair 1 (-8.900) to pair 4 (-58.883). It was a statistical signature of a fully operational, virtuous learning cycle. The results demonstrate that the efficacy of these negotiations increased in each cycle. The progression from the initial to massive *t*-values indicates that after repeated micro-negotiations in every writing task, students internalized the corrections; thereby, contributing to improved writing output. The result confirms Lyster's (2001) finding that written grammar, vocabulary, and organization benefit most from negotiation of meaning. Interestingly, the overall effect reflected in the Repeated Measures MANOVA indicates that negotiations were not random and isolated. Students formed a systematic process of pattern recognition. The result implies that as students engaged with the AI's feedback across different writing tasks, they were not just fixing individual errors, but were also learning the underlying patterns and rules of the language. These negotiations led the students to realize the

language rules explicitly, moving simply from knowing that something was wrong to understanding why it was wrong. This is a moment of learning after a profound shift facilitated by the interactive repair provided by the AI. The result is consistent with Ba et al. (2025) and Mekheimer (2025), who found that AI's feedback can effectively enhance targeted learning outcomes. Ultimately, the significant progression in scores from the first to the final task is empirical evidence that over time, the repeated process of negotiation of meaning facilitates the development of students' overall proficiency.

The statistically significant progression in scores confirms that for language input to become intake, it must first be noticed. The research findings that students showed a good level of proficiency in English and statistically significant improvement are proof of how AI's corrective feedback contributes to cognitive intake. In this study, every AI's corrective feedback forcefully directed the learners' attention to the gap between their current ability and the target language. This made linguistic gaps explicitly clear, triggering "noticing". This process is consistent with Schmidt's Noticing Hypothesis (Schmidt 1990). The noticing hypothesis claims that learners cannot continue advancing their language abilities unless they consciously notice the input. The interaction between the AI and the students, or the engagement of the students with the feedback of the AI, is a tool of cognitive development that triggers conscious learning (Quan 2025; Vieriu and Petrea 2025; Zhan and Yan 2025). Since AI provides an explanation contrasting the error with the correct form, each feedback cycle forces the students to consciously notice the gap between their interlanguage and the target language. This conscious recognition of these gaps was the essential prerequisite for internalization. The significant results across all tests are evidence that the AI successfully and consistently triggered this critical cognitive process of internalization. Thus, as AI's feedback provides the correct form of the language, contrasting with the students' errors, it makes the linguistic gap impossible to ignore. Since the most significant gain occurred at the end of the process, this signals that students were not passive recipients of corrections, but were actively internalizing the rules. Moreover, moving from the low score in the initial task to having a steady and cumulative improvement in Task 4 is recorded proof of noticing events from the cycle of feedback in all writing tasks. The effect of the continuous cycle of noticing that triggers internalization was confirmed in the highly significant MANOVA result. This enormous *F*-value indicates an extremely powerful effect on the language learning of students as they progressed. They repeatedly applied and built upon previously internalized rules, compounding their knowledge with each new task. These findings suggest that internalization fosters

independent mastery and eventually reduces students' reliance on the AI's assistance. Likewise, all four standard multivariate test statistics: Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root were in perfect agreement, yielding an identical F -value of 737.914 and a significance value of $P < 0.000$ (Table 5), indicating a systematic, unified, and coherent learning trajectory. This result signifies that students were not just getting better in isolated, unrelated grammar points or vocabulary words in every writing task; they were internalizing a broader and more integrated language system. This indicates further that improvement in grammar, vocabulary, and organization happened in a synchronized manner, denoting that the AI-assisted process developed their proficiency as a whole. The results illustrated that students' grammar, vocabulary, and discourse competencies developed interdependently. Additionally, the substantial jump in mean rank between Task 1 and Task 2 indicates that the initial noticing with the AI feedback began to yield significant returns. This positive trajectory that continued with the largest mean score and the top rank being achieved in Task 4 signifies the point where the scaffold provided by AI had been most fully internalized. It established that the more noticing activities students completed with feedback from the AI, the more their language learning was reinforced and strengthened leading to proficient and independent work. Critically, the learning did not plateau, but accelerated, denoting that the cognitive framework built through repeated cycles is capable of supporting even advanced language application and use.

Similarly, Kim et al (2023) observed promising results and areas of improvement by using prompts in the ChatGPT-driven task-based language teaching (TBLT) classroom. Our study offers a blueprint for those improvements in Schmidt's noticing and Long's negotiation of meaning, ultimately proving that AI-student interaction is an effective form of sociocultural learning (Nguyen et al. 2024; Szcześniak 2024; Anders and Dux Speltz 2025).

This study also provides empirical proof on how adaptive guidance from AI in a discovery learning environment improves learning outcomes (Ferguson et al. 2022). Accordingly, AI automatically adapted textual instructions from humans. However, our study explains what specific cognitive actions those adaptive textual instructions should trigger to be effective for learning. It pinpoints that effective guidance works by directing students' attention to the gap between the students' current performance and the target.

Finally, whereas Fauzi et al. (2023) highlighted ChatGPT's potential to enhance student productivity, the present findings not only support its contribution but also provide insight into possible

underlying mechanisms. The results suggest that it may support the development of language skills by offering a safe and non-judgmental environment that can help reduce learner anxiety. Beyond providing information and resources, ChatGPT appears to function as a cognitive partner by encouraging metacognitive processes and hypothesis testing. In this regard, the study positions AI not merely as an information tool but as a pedagogical resource with meaningful instructional potential.

The Dynamic Nature of AI-Driven Conversations Fosters Students' Critical Thinking Skills

The scaffolding nature of AI cultivates systematic cognitive development. The robust data show that the enhancement of students' critical thinking skills was directly facilitated by the dynamic and interactive nature of the AI as a Vygotskian tool. The iterative process of AI-assisted writing systematically cultivated critical thinking through iterative scaffolding, metacognition, and hypothesis testing. Across the entire empirical dataset presented in Tables 1 to 4, the findings provide compelling evidence for the efficacy of this intervention. The critical thinking enhancement is well-documented through a significant progression from "below basic" to "proficient". This trajectory is further substantiated by the step-by-step ranking in Table 4, and the steadily increasing means in Table 1, which together show a clear relationship between students' interaction with AI and the predictable and measurable increase in their critical thinking. This cumulative progression is the hallmark of a direct, causal intervention because every student's interaction with AI is appropriately challenging and is consistently working within, while expanding the students' ZPD.

The safe learning environment fosters metacognition. The initial low scores in Task 1 reflect students' lack of awareness of their own cognitive processes and strategies needed to regulate their writing. The empirical data show that the process of AI-assisted writing moves the students from unconscious incompetence to conscious proficiency. To illustrate, each of the five writing tasks was a repeated cycle of writing a draft (plan), getting AI feedback (monitor), and revising and reflecting (evaluate). Thus, when the students wrote their initial drafts, they were configuring their current cognitive understanding and their language skills. Since the draft was the product of an unreflective thought process, the AI's feedback that explicitly highlighted the gap between their thought process and the intended language use was an essential cognitive process of "learning how to think." The steady improvement in mean scores in Table 1 (Task 1: $M=1.85$) shows that they began to internalize this reflective process. This was the result of the research methodology, which

mandated that the students document the AI's corrections and write their reflections based on the AI's feedback. The reflections allowed the students to articulate what they learned about their own mistakes. This process allowed them to self-assess their own error patterns, thus developing strategies to avoid similar errors in the future. This observation was reflected in the significant jump in scores between Tasks 2 and 3 (Table 1). This leap to proficiency indicates that students moved from simply fixing errors to understanding their own cognitive habits.

The cycle of feedback enables hypothesis testing and analytical reasoning. The repeated cycles of writing a draft (plan), getting AI feedback (monitor), and revising and reflecting (evaluate) functioned as a powerful engine for hypothesis testing and analytical reasoning, transforming the writing process into a live, iterative laboratory for analytical reasoning. It happened every time students submitted their crime scene analysis. The students' reports that describe what happened, who did it, and why it happened, constituted their best inference because they are not just listing facts but are constructing a causal model of an event. This construction of a mental model is the product of their analytical thought. The efficacy of this structured Write – Receive AI Feedback – Reflect and Revise is evident in the dramatically escalating *t*-values in Table 3. These data signify that students became more proficient at constructing and defending their hypotheses with every writing cycle. Subsequently, this proficiency led to the strengthening of their analytical skills. This is clear in the crossing of the proficiency threshold in Task 3 (Table 1) where the mean score reached the high proficiency threshold from basic low proficiency. This suggests that after several writing cycles, the students had internalized the standards of good analysis. Zhang (2025) confirmed that engagement of students with ChatGPT enhanced students' argumentative writing more than engagement with other learners' prompts that yielded negative logic development. In short, analytical reasoning was not acquired as an abstract concept, but was embedded in the AI-assisted writing tasks that required students to practice it continuously. Similarly, studies have confirmed that AI can be a valuable tool in developing students' critical thinking skills, provided that it is properly scaffolded (Darwin et al 2024; Lawasi 2024).

In contrast, Tudy et al. (2025) claimed that students become passive and unthinking by being dependent on AI in their cognitive processes. While the study identified a crisis of fear, seeing the tool as a utility and its consequences leading to anxious uncertainty, our study offers a pedagogical pathway that addresses this uncertainty. Moreover, while ASEAN educators fear technology dependence among students (Holmes and Lee 2024), our study establishes evidence that when ChatGPT is embedded in a

structured learning environment (Draft - AI Feedback - Reflection - Revision), it builds learning independence. This study refutes the claim of mindless “copy-pasting” and instead shows that the Vygotskian MKO, through mandatory reflection, facilitates metacognitive reflection, thereby building academic integrity into the writing process itself. Thus, our study demonstrates cognitive gain instead of the ethical fear raised regarding AI use.

The result of this study also explains and provides a solution to cognitive offloading identified by Gerlich (2025). While Gerlich warns of the negative effect of frequently using AI on students' critical thinking, our study demonstrates that intentionally, pedagogically designed student-AI interaction actively builds students' critical thinking. The frequent passive use of AI to get answers may harm critical thinking; however, our study shows that if it is done through active, integrative use through structured, task-specific AI interaction, the result is the opposite. This validates Gerlich's claim that unstructured frequent use of AI leads to cognitive offloading, a situation wherein the student delegates thinking to the machine, leading to weakening of their own cognitive muscles. Our research demonstrates that through Vygotskian MKO, structured scaffolding leads to cognitive enhancement, not offloading.

Relationship between Students' English Language Skills and Critical Thinking Skills

The moderate positive correlation between students' English language learning and their critical thinking skills points out that language and critical thinking are deeply intertwined and mutually reinforcing within the Vygotskian AI-assisted writing process. The AI-powered Vygotskian scaffold in writing tasks ensured that development in one domain did not happen without development in the other. It occurred when the students analyzed evidence and evaluated claims, as they first needed to encode these complex thoughts into language. On the other hand, when AI provided feedback in the form of grammar nuances, precise vocabulary for accuracy, and transitional phrases for coherence, it directly improved students' capacity to articulate their critical thoughts. Thus, this research illustrates how language serves as a tool for thinking. Language affects critical thinking, as studies have shown that the lack of significant correlations between students' language proficiency and critical thinking requires critical evaluation instruction (Manalo and Sheppard 2016), which, in this research, was operationalized through structured AI-assisted writing. Second, the said study concluded that L2 proficiency is a potential limiting factor in students' use of critical thinking and suggests that teaching strategies and appropriate classroom instruction to improve language proficiency are

beneficial. Our study empirically offers the needed strategy. The AI-assisted writing process of Draft - AI Feedback - Reflection - Revision embedded the development of a second language within critical thinking tasks. The Vygotskian feedback cycle mediated by AI became an appropriate blueprint for teaching strategies. This study demonstrates that with the right scaffold, integrated into the thinking task itself, the development of language and critical thinking becomes a mutually reinforcing process.

Although the study provides robust evidence for the efficacy of AI-assisted writing, it is still subject to some limitations. First, since the study was conducted within a single academic discipline (Criminology), this could limit the generalizability of the findings to other disciplines. Future research should replicate this design across diverse disciplinary contexts. Second, the study was situated within a specific cultural context, where AI intervention helped to mitigate affective barriers such as language anxiety and fear of peer judgment. The findings may not be directly transferable to educational settings with different linguistic landscapes. A cross-cultural comparative study would be valuable in exploring how the sociocultural context moderates the effectiveness of AI-mediated learning. Lastly, the intervention was relatively short-term, using only a single semester with five sequential tasks. It is unclear whether the long-term retention or internalization of language rules and critical thinking strategies gained by the students would persist over time or whether students would continue to apply these skills independently without the ongoing support of the AI scaffold. A longitudinal study that would track students' performance after the intervention would provide critical insights into the durability of cognitive gains from AI-facilitated learning, and whether these translate into sustained academic competencies.

In conclusion, through pedagogically structured integration, ChatGPT enhances the students' language learning experience and empowers non-linguistically inclined Filipino students to become independent and critical thinkers. Likewise, the use of ChatGPT is instrumental in creating an inclusive environment for non-linguistically inclined students. This study recommends that the components of this study be analyzed to help identify effective strategies that can be replicated in other classroom contexts. Likewise, teachers shall provide an inclusive environment where learners take more responsibility for making the best use of AI Language applications, and become conscious of their own individual needs, with emphasis on ethical use of information and technology.

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GENERATIVE AI STATEMENT

This study utilized Grammarly solely for grammar checking and minor language refinement. All ideas, analyses, and substantive content were developed by the authors.

ETHICAL CONSIDERATIONS

The researchers ensured that all ethical considerations were addressed throughout the inquiry. All participants voluntarily agreed to participate in the data gathering process.

DECLARATION OF COMPETING INTEREST

To the best of the authors' knowledge, no conflict of interest exists.

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