

Exploring ChatGPT and the Thinking Process in Writing

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DOI: <https://doi.org/10.47772/IJRISS.2026.100601134>

Received: 24 June 2026; Accepted: 30 June 2026; Published: 13 July 2026

ABSTRACT

In today's world, the use of artificial intelligence tools such as ChatGPT, Gemini, and Perplexity has transformed the landscape of academic writing and learning. It is seen as something that is indispensable in both academic and non-academic settings. This study examined the relationship between ChatGPT use and the thinking process in writing among undergraduates. Specifically, the study investigated differences based on gender and academic discipline and examined learners' perceptions of the phonological loop, episodic buffer, visuo-spatial sketchpad, and ChatGPT. The study also explored the relationship between ChatGPT and the thinking process in writing. Data were collected from 127 university students using purposive sampling through a structured questionnaire. This study stems from the Working Memory Theory by Baddeley and Hitch (1974). The study investigates three components of the thinking process in writing: the phonological loop, the episodic buffer, and the visuo-spatial sketchpad. The instrument consisted of three sections, including the demographic profile, and this five-point Likert scale questionnaire was adapted from Raoofi et al. (2017) and Youssef et al. (2024). Data were analysed using SPSS, and the findings revealed no statistically significant differences in ChatGPT usage and the thinking processes in writing across gender and disciplines. Respondents demonstrated positive perceptions towards the use of metacognitive, effort regulation, and cognitive strategies in writing, alongside favourable perceptions of ChatGPT in supporting critical thinking, academic achievement, and engagement. It is implied that ChatGPT may function as a useful tool in the writing process for students, and future studies may explore the long-term effects of AI-assisted writing on students' independent writing abilities.

Keywords: ChatGPT, Thinking process in writing, Phonological loop, Episodic buffer, Visuo-spatial sketchpad

INTRODUCTION

Background of Study

For centuries, writing has been an academic achievement that demands not just linguistic competence but also the capacity to organise thoughts, build arguments, and foster critical thinking. Scholars like Zimmerman and Bandura (1994) and Oxford (1990), have emphasised the importance of writing strategies where they carefully plan, write, edit, and improve their works. Students negotiating second language contexts, especially need these approaches since vocabulary, grammar, and coherence problems frequently impede successful communication (Xu & Jumaat, 2024). At the same time, the rapid advancement of artificial intelligence (AI) has brought fresh dynamics into the writing process. Among these, developed by OpenAI, ChatGPT has emerged as one of the most powerful technologies capable of generating human-like writing, assisting with brainstorming, and providing real-time feedback (Malik et al., 2024).

Recent studies acknowledge that ChatGPT has become a popular tool for academic writing, assisting students with the development of ideas, improving structure and overcoming writer's block (Fauzi et al., 2024). Simultaneously, studies indicate that students often view AI as an aid instead of a replacement, employing it to

boost creativity and productivity while grappling with its restrictions and ethical implications (Banfi & Pedroni, 2026). The convergence of artificial intelligence-driven technologies and writing techniques raises major questions about ethics, teaching, and the trajectory of intellectual production. While this technology helps with writing support tools, such as grammar checkers, as well as in plagiarism detection, its use in educational settings has been criticised (Selwyn, 2019). According to Cui and Alias (2024), though traditional approaches emphasise human creativity and critical thinking, artificial intelligence offers both opportunities and threats. While ChatGPT can help students acquire knowledge and use language correctly, it also raises fears regarding plagiarism, excessive usage, and a lack of originality.

This study examines the relationship between conventional writing approaches and the use of ChatGPT, explaining the significance of this topic despite ample previous investigations (Naznin et al., 2025; Balraj, 2025; Dwivedi et al., 2023), thus placing itself within the evolving context. Although artificial intelligence revolutionises the educational landscape, writing skills continue to be crucial for students (Xu & Jumaat, 2024). Consequently, incorporating ChatGPT into writing practices requires thoughtful consideration; it presents opportunities to support the cognitive processes of writing while also encouraging teachers and students to uphold creativity, originality, and active engagement.

Based on the studies highlighted above, it is undeniable that ChatGPT offers many benefits in academic settings. Hikmah and Walida (2024) pointed out that students nowadays rely heavily on ChatGPT in various writing aspects. This includes helping them with idea generation and sentence crafting, and some even mentioned that ChatGPT could produce quality writing. According to Bishop (2023) and Zhai (2022), as cited in Hikmah and Walida (2024), ChatGPT assists learners, especially during the brainstorming stage, in producing a paper. Despite the number of benefits that the AI tool brings, there have been concerns surrounding it as well. One of them is regarding their ability to think critically due to their over-reliance on the tool (Hikmah & Walida, 2024). This is worrying, as learners should still be able to think mostly on their own rather than relying more on ChatGPT. This was also supported by Oates and Johnson (2025). They believed that a prolonged dependence on AI could affect learners' thought processes, as the use of AI can influence their thinking and hence suppress their unique ideas and thought processes. They also pointed out that ChatGPT shouldn't replace the cognitive thinking that learners bring to the classroom and encouraged more future studies to be carried out to investigate how well students are able to think critically in their work. In fact, Janah, Tusino and Dewi (2026) concurred with Hikmah and Walida (2024) and Oates and Johnson (2025), and they suggested that there's limited empirical evidence on how ChatGPT supports students' writing development and critical thinking processes in vocational secondary education. Elkatmis (2024) believes that more work should be done to evaluate ChatGPT's influence on the academic writing process and skills and to see the impact on students' academic work. Meniado, Duong and Panyadilokpong's (2024) study on how AI tools enhance L2 writing skills, also suggested that studies on the use of AI tools to enhance L2 writing skills, including thought process, be carried out in the ASEAN region and across all education levels. Meniado, Duong and Panyadilokpong's (2024) study on how AI tools enhance L2 writing skills, also suggested that studies on the use of AI tools to enhance L2 writing skills, including thought process, be carried out in the ASEAN region and across all education levels. In a study conducted by Meniado, Duong, and Panyadilokpong (2024) on how AI tools enhance L2 writing skills, it was also suggested that studies on the use of AI tools to enhance L2 writing skills, which include the thought process, should be carried out in the ASEAN region and across all education levels. They further added that future studies should also look into students' perceptions and engagement with ChatGPT and how it affects their writing performance. Hence, the recommendations by the authors above strengthen the reason behind this study.

Objective of the Study and Research Questions

This study is done to explore ChatGPT and the thinking process in writing. Specifically, this study is done to answer the following questions;

- Is there a significant relationship between ChatGPT across (a) gender and (b) disciplines?

H₀₁: There is no significant relationship between ChatGPT across (a) gender and (b) disciplines.

- Is there a significant relationship between the thinking process in writing across (a) gender and (b) disciplines?

H₀₂: There is no significant relationship between the thinking process in writing across (a) gender and (b) disciplines

- How do learners perceive the use of the phonological loop as a writing strategy?
- How do learners perceive the use of episodic buffer as a writing strategy?
- How do learners perceive the use of visuo-spatial as a writing strategy?
- How do learners perceive ChatGPT in writing?
- Is there a significant relationship between CHATGPT and the thinking process (phonological loop, episodic buffer, visuo-spatial) in writing?

H₀₃: There is no significant relationship between the thinking process and CHATGPT in writing.

LITERATURE REVIEW

Theoretical Framework of the Study

• Working Memory Theory and Writing Strategies

When writers are deep into their writing task, the writing strategies they use to complete the assignment reflect the thinking process of the working memory. According to Baddeley and Hitch (1974), the main thinking process is known as the central executive (refer to Figure 1). These components manage the whole process. In the context of writing, this is where the writers use cognitive skills to complete the task. This central executive is influenced by three main factors. The first is the phonological loop. This is also known as the inner voice. In writing, the first stage of the writing process requires the writer to make plans, and making plans in writing is often a quiet process in the writer's mind. This is facilitated by the use of metacognitive strategies. The next factor is the visuo-spatial sketchpad. This is the stage where a person stores visual information. In writing, this involves the mental capacities of the writer to remember words and vocabulary to be used in the writing. In writing, this involves the writer having enough background knowledge to perform the writing task. The last factor in thinking is the episodic buffer, and this refers to the ability of the person to bind information together. In writing, this corresponds to the effort taken by the writer to synthesize the information needed to complete the writing task.

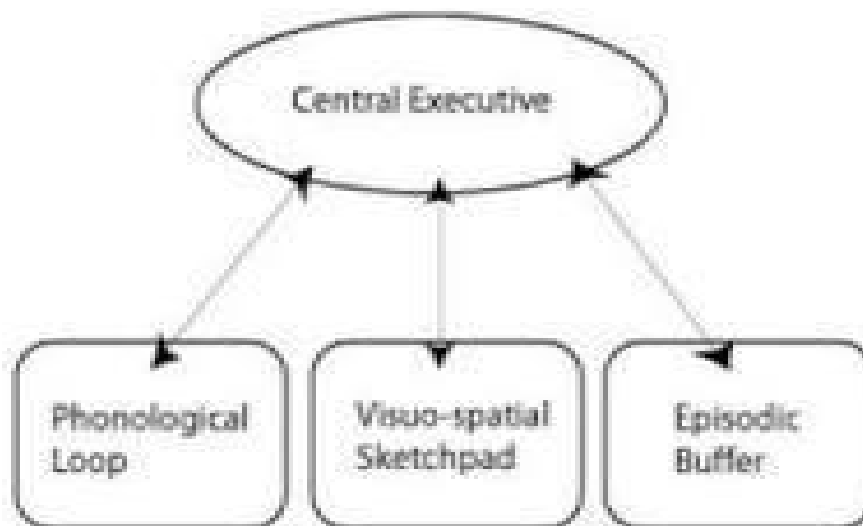


Figure 1- The Working Memory Theory

• ChatGPT in Writing

The use of ChatGPT in writing classrooms has brought about significant changes for students. Several studies have highlighted the benefits that it brings to students when they are working on their writing assignments. Based on a systematic literature review conducted by Imran and Almusharraf (2023), it was found that ChatGPT helped students in many ways. Namely, in a study conducted by Lund et al. (2023) as cited in Imran and Almusharraf (2023), it was discovered that ChatGPT saves students time and effort when it comes to producing work. This is

because the software can help students to generate coherent and well-written content; hence, students can focus on other tasks in the classroom. Other than that, it can also help students in idea generation (Kasneci et al., 2023), as cited in Imran and Almusharraf (2023). ChatGPT can help students to generate new ideas, especially when they face writer's block. It can suggest topics, themes, and others. In another study conducted by Hikmah and Walida (2024), the use of ChatGPT has helped students, especially in the brainstorming process. The objective of the study was to explore the role of ChatGPT in helping students develop their critical thinking skills when writing their academic papers. It was highlighted in the paper that ChatGPT helps to initiate the thinking process, as students can provide a few keywords and basic concepts.

Past Studies

Studies investigating how ChatGPT supports writing and influences learners' thinking processes during idea generation, drafting, revision, and critical evaluation have been actively conducted in recent years. Generally, previous studies have found that ChatGPT is often used as a writing assistant for brainstorming, organising ideas, improving language accuracy, and revising drafts. Meniado et al. (2024) investigated issues related to students' experiences and perceptions using ChatGPT for second language writing. The research focused on Thai and Vietnamese EFL learners from three educational institutions, involving 357 survey respondents and 16 interviewees. A mixed-method design was applied, consisting of a survey and follow-up interviews. The findings showed that the learners perceived ChatGPT positively and mainly used it for brainstorming, organising ideas, refining outlines, clarifying concepts, and editing drafts for appropriateness and accuracy. The study also implies that ChatGPT does function as a useful support tool in the writing process, particularly at the planning and revising stages, and that curriculum design and teacher development should consider how such tools may be integrated responsibly into L2 writing instruction.

Another study on ChatGPT and the writing process was conducted by Elkatmis (2024), where he looked at ChatGPT and the creative writing process. The study focused on master's students' experiences of using ChatGPT to enhance creative writing at a state university in Turkey. Similar to Meniado et al. (2024), the findings of the study also indicated that ChatGPT was perceived as effective in accelerating the writing process, creating new ideas, increasing motivation, encouraging creative thinking, improving text flow, and enhancing text quality. However, Elkatmis (2024) posited that the use of ChatGPT should be balanced carefully because concerns remain regarding originality, naturalness, and depth of thought. The study implied that though ChatGPT may be beneficial for idea generation and motivation in writing, students still need to maintain ownership of ideas and depth of thinking in their written work.

In investigating issues of whether ChatGPT would enhance students' writing skills and how it affects the components of writing, Shahsavar et al. (2024) conducted a study on medical students enrolled in a compulsory academic writing course at Shiraz University of Medical Sciences. The findings of the study demonstrated that although the gains in language use were not significant, ChatGPT significantly improved students' academic writing, especially in content, organisation, vocabulary, and mechanics. The implication is that ChatGPT can be a valuable supplementary writing tool, especially for improving written structure and development, but it should not be treated as a complete solution because higher-level skills still require human guidance and thoughtful engagement. Next, the study by Oates and Johnson (2025) also looked at ChatGPT and students' critical evaluation during academic writing tasks. The instruments used included an AI-generated essay writing task, a subsequent critical evaluation task, a structured questionnaire in Microsoft Forms, and a focus group discussion. The findings showed that ChatGPT performed well in structural coherence and grammatical accuracy, but it did not improve essay marks beyond students' usual module performance. The implication of this study is especially relevant to the thinking process in writing: while ChatGPT may make drafting easier and save time, students still need to apply analysis, judgment, and critical reflection to produce meaningful academic work (Oates & Johnson, 2025).

Another relevant study is that of Youssef et al. (2024), which was done to investigate issues of ChatGPT usage and its effects on student engagement, critical thinking abilities, and academic achievement in higher education. This research involved 353 university students in Ajman, United Arab Emirates. The findings showed that ChatGPT may contribute positively to learning and thinking when students use it as a supportive academic tool rather than as a replacement for their own effort. In relation to writing, this study also reinforces the idea that the

thinking process can still be strengthened through the use of AI if learners engage actively with the tool's suggestions and responses.

Overall, existing studies show that ChatGPT has been widely explored as a tool that can support writing performance, idea generation, revision, motivation, and critical engagement. It could be seen that ChatGPT does help students in tasks such as brainstorming, drafting, improving language quality, and evaluating text, but findings have also emphasised that ChatGPT has clear limitations, especially in relation to originality, deep analysis, critical thinking, and intellectual ownership. Hence, it can be said that ChatGPT is not merely a writing tool; it also affects the thinking process behind writing.

Conceptual Framework of the Study

Figure 1 presents the conceptual framework of the study. This study explores the thinking process in writing and its influence on ChatGPT. Writing can be considered a thinking process. A lot goes into the mind of the writer as he/she completes the writing assignment. According to Rahmat (2020), the act of writing mirrors the thinking process. According to Baddeley and Hitch (1974), the thinking process involves three factors; phonological loop, the visuo-spatial sketchpad, and the episodic buffer.

The writing process is a complex task. Writers undergo different stages as they complete their writing task. The task is facilitated by the use of writing strategies (Khairuddin, 2021). According to Raoofi et al. (2017), during writing, writers use strategies such as metacognitive, effort regulation, cognitive, social, and affective. Three of the strategies involve the writer using their thinking capacity. metacognitive, effort regulation, and cognitive strategies. These three thinking capacities in writing mirror Baddeley and Hitch's (1974) three factors in the main thinking process and are represented in Figure 1 as the conceptual framework. These days, many have depended on ChatGPT to assist in their thinking process. According to Youssef et al. (2024), ChatGPT has the capacity to influence a person's critical thinking abilities, their achievement, and engagement. Additionally, this study seeks to investigate whether there is a relationship between ChatGPT and all aspects of thinking in writing.

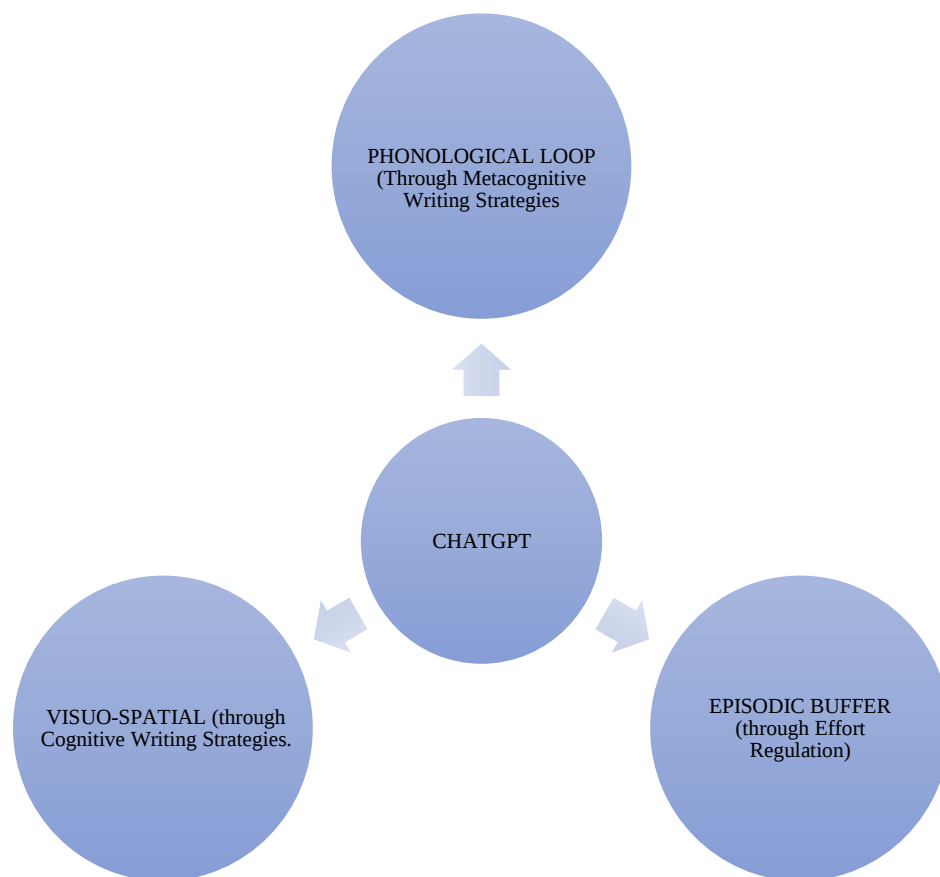


Figure 2-Conceptual Framework of the Study

ChatGPT and Writing as a Thinking Process

METHODOLOGY

This quantitative study is done to explore writing as a thinking process and ChatGPT. A convenient sample of 127 participants responded to the survey. The instrument used is a 5 Likert-scale survey and is rooted in Raoofi et.al (2017) & Youssef, et.al (2024) to reveal the variables in Table 3 below. Table 1 below shows the categories used for the Likert scale; 1 is for Strongly Disagree, 2 is for Disagree, 3 is for Undecided, 4 is for Agree and 5 is for Strongly Agree.

Table 1- Likert Scale Use

1	Never
2	rarely
3	Sometimes
4	Often
5	Always

Table 2- Distribution of Items in the Survey

SECTION	VARIABLE	CONSTRUCT	NO OF ITEMS	Cronbach Alpha
B	THINKING PROCESS IN WRITING	Phonological Loop (Metacognitive strategies)	10	.862
		Episodic Buffer (Effort Regulation Strategies)	4	.705
		Visuo-Spatial (Cognitive Strategies)	6	.827
C	CHATGPT	Critical thinking abilities	5	16(.894)
		Academic achievement	4	
		ChatGPT usage	4	
		Student engagement	3	
				36 (.921)

Table 2 presents the distribution of items and internal reliability of the survey instrument rooted in Raoofi et.al (2017) and Youssef, et.al (2024) works. The survey consisted of two primary sections, consisting of 36 items and an overall Cronbach alpha value of .921. Section B of the survey consisted of 20 items. This section evaluates the variable “Thinking process in Writing” through three different constructs. They are the Phonological Loop (Metacognitive strategies), Episodic Buffer (Effort regulation Strategies), and Visuo-Spatial (Cognitive Strategies). Each construct has ten, four, and six items, respectively. Besides that, each construct also has a Cronbach value of .892, .705, and .827. Next, Section C of the survey focuses on the variable ‘ChatGPT’. This variable consists of four constructs and 16 items in total. They are Critical Thinking Abilities (5 items), Academic Achievement (4 items), ChatGPT (4 items), and Student Engagement (3 items). All constructs show a reliable coefficient of .894.

Table 3- Reliability Levels, Cronbach’s Alpha Ranges, and Their Interpretations

Reliability Level	Cronbach’s Alpha range	Interpretation
Excellent	0.9 and above	Indicates very high internal consistency
Good	0.80-0.89	Reflects strong internal consistency
Acceptable	0.70-0.79	Indicates acceptable internal consistency

Questionable	0.60-0.69	Reflects questionable internal consistency
Poor	Below 0.6	Indicates poor internal consistency

Table 3 presents the reliability levels by Ahmad et al. (2014). The analysis of Cronbach's alpha is also presented in Table 2. The analysis shows a Cronbach alpha of .862 for Phonological Loop, .705 for Episodic buffer, .827 for visuo-spatial, and .894 for ChatGPT. The overall Cronbach alpha for all 36 items is .921; thus, revealing a good reliability of the instrument chosen/used. Further analysis using SPSS is done to present findings to answer the research questions for this study.

FINDINGS

Demographic Analysis

According to Zienefuss et al. (2021), researchers report demographic data in percentages to establish sample representativeness and allow for generalizability to a larger population. The reporting also provides an overview of participants' characteristics. Percentages offer a clear and understandable picture of the sample makeup.

Table 4- Percentage for Demographic Profile

Question	Demographic Profile	Categories	Percentage (%)
1	Gender	Male	24%
		Female	76%
2	Discipline	Science & Technology	23%
		Social Sciences & Humanities	77%

Table 4 shows the demographic distribution of respondents, with more responses from females (76%) compared to male participants, accounting for 24%. In terms of academic discipline, the majority of respondents (77%) were from the Social Sciences and Humanities faculties, with a lesser proportion (23%) representing Science and Technology. While these numbers give useful context about the composition of the sample, the research stays focused on understanding how university students interact with ChatGPT as a tool for writing development rather than demographic differences.

Inferential Statistics

According to Shah (2024), there are three main functions of a T-test. Firstly, T-tests are done to compare means. This test is also done to determine if the average scores (mean) or values of two groups, or one group against a known value, are different enough to be considered statistically meaningful and are not just due to random chance. Secondly, a T-test is done to test hypotheses. Researchers use t-tests to test hypotheses about means, such as whether a new treatment significantly impacts a variable or if there's a difference in performance between two distinct groups. Lastly, the T-test is used to identify significant differences. The output of a t-test provides a p-value (significance value). If this p-value is below a predetermined threshold (often 0.05), it indicates a statistically significant difference, allowing researchers to draw conclusions about the populations from which their samples were drawn.

Gender for ChatGPT and Thinking in Writing

This section presents data to answer the research question 1- Is there a significant relationship between (a) ChatGPT and (b) Thinking in Writing across gender?

H₀₁: There is no significant relationship between (a) ChatGPT and (b) Thinking in Writing across gender

Table 5: T-Test for ChatGPT and Thinking across Disciplines

Group Statistics					
	Q1GENDER	N	Mean	Std. Deviation	Std. Error Mean
CHAT_GPT	MALE	30	3.8563	.47969	.08758
	FEMALE	97	3.6959	.51108	.05189
THINKING	MALE	30	4.0333	.52017	.09497
	FEMALE	97	4.0093	.43273	.04394

Independent Samples Test											
Levene's Test for Equality of Variances				t-test for Equality of Means							
		F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						One-Sided p	Two-Sided p			Lower	Upper
CHAT_GPT	Equal variances assumed	.505	.479	1.523	125	.065	.130	.16037	.10528	-.04800	.36874
	Equal variances not assumed			1.575	51.036	.061	.121	.16037	.10180	-.04399	.36474
THINKING	Equal variances assumed	2.745	.100	.253	125	.400	.800	.02405	.09495	-.16387	.21198
	Equal variances not assumed			.230	42.160	.410	.819	.02405	.10464	-.18709	.23520

A two-sample t-test was performed to compare (a) ChatGPT and (b) Thinking across gender. There were no significant differences in (a) ChatGPT ($p=0.130$) and (b) thinking ($p=0.800$) across gender. Null hypothesis is accepted for H_{01} .

Disciplines for ChatGPT and Thinking in Writing

This section presents data to answer the research question 2- Is there a significant relationship between (a) ChatGPT and (b) Thinking in Writing across disciplines?

H_{02} : There is no significant relationship between (a) ChatGPT and (b) Thinking in Writing across disciplines

Table 6: T-Test for ChatGPT and Thinking across Disciplines

Group Statistics					
	Q2DIS	N	Mean	Std. Deviation	Std. Error Mean
CHAT_GPT	ST	29	3.7737	.65687	.12198
	SS,H & B	98	3.7219	.45630	.04609
THINKING	ST	29	3.9034	.51823	.09623
	SS,H & B	98	4.0480	.42897	.04333

Independent Samples Test											
Levene's Test for Equality of Variances				t-test for Equality of Means							
		F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						One-Sided p	Two-Sided p			Lower	Upper
CHAT_GPT	Equal variances assumed	8.741	.004	.482	125	.315	.631	.05177	.10742	-.16083	.26437
	Equal variances not assumed			.397	36.353	.347	.694	.05177	.13040	-.21260	.31613
THINKING	Equal variances assumed	2.541	.113	-1.517	125	.066	.132	-.14451	.09523	-.33299	.04397
	Equal variances not assumed			-1.369	40.031	.089	.179	-.14451	.10554	-.35781	.06879

A two-sample t-test was performed to compare (a) ChatGPT and (b) Thinking across disciplines. There were no significant differences in (a) ChatGPT ($p=.631$) and (b) thinking ($p=0.132$) across disciplines. Null hypothesis is accepted for H_{02} .

Descriptive Statistics

Why is there a need to report the mean and standard deviation? According to Vetter (2017), Mean (M) represents the average, or centre of a data set. Standard deviation (SD) indicates the typical distance of individual observations from the mean which shows the data's variability or spread. A low SD means the data points are clustered close to the mean while a high. SD indicates they are more spread out. It is good to have a high SD.

Findings for Phonological Loop

This section presents data to answer research question 1- How do learners perceive the use of the phonological loop as a writing strategy? In the context of this study, this is measured by metacognitive strategies.

(i) Table 5- Mean (M) and Standard Deviation (SD) for METACOGNITIVE (MWS)

ITEM	M	SD
MWSQ 1 I organize my ideas prior to writing.	3.97	0.72
MWSQ 2 I revise my writing to make sure that it includes everything I want to discuss in my writing.	4.20	0.72
MWSQ 3 I check my spelling.	4.38	0.81
MWSQ 4 I check my writing to make sure it is grammatically correct.	4.38	0.71
MWSQ 5 I evaluate and re-evaluate the ideas in my essay.	4.09	0.72
MWSQ 6 I monitor and evaluate my progress in writing.	3.92	0.74
MWSQ 7 I revise and edit an essay two or more times before I hand it in to my teacher.	4.06	0.80
MWSQ8 I go through the planning stages in my writing.	3.91	0.83
MWSQ9 I go through the drafting stages in my writing.	3.97	0.85
MWSQ10 I go through the revising and editing stages in my writing.	4.05	0.76

Table 5 above shows how the respondents perceive the use of the phonological loops as a writing strategy. Overall, 10 items yielded high mean scores ranging from 3.91 to 4.38, indicating that respondents actively employ metacognitive strategies in their writing processes. Items MWSQ3 ("I check my spelling") and MWSQ4 ("I check my writing to make sure it is grammatically correct") show the highest level of agreement, with a mean of 4.38 and a standard deviation of 0.81 and 0.71, respectively. Item MWSQ4 showed the lowest standard deviation, which means the highest consensus. Conversely, item MWSQ8 ("I go through the planning stages in my writing") has a relatively low mean score of 3.91 and a standard deviation of 0.83.

Findings for Episodic Buffer

This section presents data to answer research question 2- How do learners perceive the use of episodic buffer as a writing strategy? In the context of this study, this is measured by effort regulation.

(ii) Table 6- Mean (M) and Standard Deviation (SD) for EFFORT REGULATION (ERS)

ITEM	M	SD
ERSQ 1 I write a lot to develop my writing skills.	3.34	0.78
ERSQ 2 I often work hard to do well in my writing even if I don't like English writing tasks.	3.83	0.81
ERSQ 3 Even if the writing activities are difficult, I don't give up but try to engage in them.	4.15	0.68
ERSQ 4 I concentrate as hard as I can when doing a writing task.	4.13	0.69

Table 6 above shows how learners perceive the use of the episodic buffer as a writing strategy, which is measured by effort regulation. Item ERSQ3 ("Even if the writing activities are difficult, I don't give up but try to engage in the item") reported the highest mean score of 4.15 and, at the same time, the highest consensus with a standard deviation score of 0.68. Next, the item with the lowest mean compared to the other items under this section in the

survey is ERSQ1 (“I write a lot to develop my writing skills”) with a mean of 3.34 and a standard deviation of 0.78. The item with the strongest consistency comes from item ERSQ3 (“Even if the writing activities are difficult, I don’t give up but try to engage in them”), with a standard deviation of 0.68.

Findings for Visuo-spatial

This section presents data to answer research question 3- How do learners perceive the use of visuo-spatial as a writing strategy? In the context of this study, this is measured by cognitive strategies.

(i) Table 7- Mean (M) and Standard Deviation (SD) for COGNITIVE (CWS)

ITEM	M	SD
CWSQ1 I use memorized grammatical elements such as singular and plural forms, verb tenses, prefixes and suffixes, etc, in my writing	3.89	0.77
CWSQ 2 I put newly memorized vocabulary in my sentences.	3.76	0.83
CWSQ 3 In order to generate ideas for my writing, I usually engage myself in brainstorming.	3.98	75
CWSQ 4 I use different words that have the same meaning.	3.93	0.75
CWSQ 5 I use my experiences and knowledge in my writing.	4.23	0.67
CWSQ 6 I try to use effective linking words to ensure clear and logical relationship between sentences or paragraphs	4.13	0.75

Table 7 details the mean and standard deviation of learners’ perception of the use of visuo-spatial as a writing strategy, which is measured through cognitive strategies. The findings show that item CWSQ5 (“I use my experiences and knowledge in my writing”) has a mean score of 4.23, which is the highest, and a standard deviation of 0.67. This shows that the item has high consensus among respondents. On the other hand, item CWSQ2 (“I put newly memorized vocabulary in my sentences”) has a relatively low mean score, which is 3.76. At the same time, the item has the highest standard deviation score in the dataset, with a score of 0.83. This also indicates that although it is one of the strategies applied by the respondents as part of their writing process, their habit regarding incorporating newly memorized vocabulary in their sentences varies more widely than their other cognitive strategies

Findings for ChatGPT

This section presents data to answer research question 4- How do learners perceive ChatGPT in writing? In the context of this study, this is measured by (i) critical thinking abilities, (ii) academic achievements, (ii) ChatGPT usage, and (iv) student engagement.

(i) Table 8- Mean (M) and Standard Deviation (SD) for CRITICAL THINKING ABILITIES (CT)

ITEM	M	SD
CTQ1 I usually need clarification on the precision and reliability of information provided by ChatGPT, which enhances my critical thinking skills.	3.93	0.70
CTQ2 ChatGPT’s responses made me doubt their validity, leading me to seek further clarification or evidence.	4.06	0.72
CTQ3 I actively explore alternative viewpoints or sources of information when using ChatGPT to ensure a comprehensive understanding of the topic.	4.02	0.66
CTQ4 I need clarification about the accuracy of ChatGPT’s output, which often encourages me to evaluate the information and conduct additional research independently.	4.10	0.72

Table 8 presents the mean and standard deviation scores on learners’ perception of ChatGPT in writing, which is measured through their critical thinking abilities, academic achievements, ChatGPT usage, and student engagement. Based on the table, all items yielded mean scores near or above 4.00 on the 5-point Likert scale.

This indicates that learners strongly agree that ChatGPT promotes critical thinking. Item CTQ4 (“I need clarification about the accuracy of ChatGPT’s output, which often encourages me to evaluate the information and conduct additional research independently”) has the highest mean score of 4.10. Conversely, item CTQ1 (“I usually need clarification on the precision and reliability of information provided by ChatGPT, which enhances my critical thinking skills”) scored a relatively low mean score ($M=3.93$). Notably, item CTQ3 has the lowest standard deviation ($SD = 0.66$) compared to other items, which shows a high consensus among the learners.

(ii) Table 9 - Mean (M) and Standard Deviation (SD) for ACADEMIC ACHIEVEMENTS (AA)

ITEM	M	SD
AAQ1 I actively explore alternative viewpoints or sources of information when using ChatGPT to ensure a comprehensive understanding of the topic.	4.04	0.69
AAQ2 ChatGPT brings innovative ideas that are ready to be shared with students.	3.78	0.76
AAQ3 Students can anticipate robust writing guidance from ChatGPT.	3.57	0.78
AAQ4 ChatGPT has improved my academic performance.	4.08	0.74

Table 9 above shows the mean and standard deviation for academic achievements. Overall, the majority of the learners agree that ChatGPT has improved their academic performance with a mean score of 4.08. While the item with a relatively low mean score comes from item AAQ3 (Students can anticipate robust writing guidance from ChatGPT”) with a mean score of 3.57. Item AAQ1 (“I actively explore alternative viewpoints or sources of information when using ChatGPT to ensure a comprehensive understanding of the topic”) has the lowest standard deviation score ($SD = 0.69$) compared to the other items in the table.

(iii) Table 10- Mean (M) and Standard Deviation (SD) for CHATGPT USAGE (CU)

ITEM	M	SD
CUQ1 ChatGPT is a state-of-the-art writing model that is favorably used today.	3.56	0.90
CUQ2 Students seek help from ChatGPT’s assistance in composing essays and articles.	3.79	0.77
CUQ3 ChatGPT helps students in English language translation.	3.74	0.87
CUQ4 Employing ChatGPT significantly improves human productivity.	3.38	0.95
CUQ5 The advent of ChatGPT marks a groundbreaking transformation in Natural Language Processing capabilities.	3.56	0.86

Based on Table 10 above, it could be seen that overall, the mean scores for all items were in the range between 3.00 and 3.79, with the highest mean score coming from item CUQ2 (“Students seek help from ChatGPT’s assistance in composing essays and articles”). The item had a score of 3.79 and, at the same time, the lowest standard deviation score of 0.77. This shows that the responses from the respondents were highly consistent. Contrastively, item CUQ1 (“ChatGPT is a state-of-the-art writing model that is favourably used today”) has a mean score of 3.56 and a standard deviation score of 0.90.

(iv) Table 11- Mean (M) and Standard Deviation (SD) for STUDENT ENGAGEMENT (SE)

ITEM	M	SD
SEQ1 ChatGPT is more interactive, human-like, and engaging for the students.	3.27	0.99
SEQ2 ChatGPT increases confidence in my ability to conduct research/to search for materials	3.28	0.93
SEQ3 ChatGPT is easy to use and more engaging for me	3.69	0.89

Referring to Table 11 above, the mean and standard deviation scores for student engagement, it could be seen that item SEQ3 (“ChatGPT is easy to use and more engaging for me”) recorded the highest mean score of 3.69. Conversely, item SEQ1 (“ChatGPT is more interactive, human-like, and engaging for the students”) has the lowest mean score ($M= 3.27$). All three items have an almost similar score when it comes to their standard

deviation. Item SEQ3 has the lowest score ($SD = 0.89$) while item SEQ1 has the highest score ($SD = 0.99$). This shows that item SEQ1 has less group consensus and that their responses vary more compared to item SEQ3.

Exploratory Statistics

According to He (2024), correlation is a statistical technique that shows how strongly two variables are related to each other or the degree of association between the two. It's a common tool for describing simple relationships without making a statement about cause and effect. This section presents data to answer the research question on correlation.

Findings for the Relationship between ChatGPT and thinking processes in writing

This section presents data to answer research question 5- Is there a significant relationship between ChatGPT and the thinking process (phonological loop, episodic buffer, visuo-spatial) in writing?

H_{03} : There is no significant relationship between the thinking process and CHATGPT in writing.

To determine if there is a significant association in the mean scores between ChatGPT and the thinking process (phonological loop, episodic buffer, visuo-spatial) in writing, data is analysed using SPSS for correlations. Results are presented separately in Table 12 below.

Table 12- Correlation between relationship between ChatGPT and the thinking process (phonological loop, episodic buffer, visuo-spatial) in writing

		phonological loop	episodic buffer	visuo-spatial
ChatGPT	Pearson (Correlation	.374**	.386**	.363**
	Sig (2-tailed)	<.001	<.001	<.001
	N	127	127	127

**Correlation is significant at the 0.01 level (2-tailed)

According to He (2024), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0.

Table 12 shows there is an association between ChatGPT and the thinking process (phonological loop, episodic buffer, and visuo-spatial) in writing. Correlation analysis shows that there is a moderately significant association between phonological loop ($r=0.374^{**}$; $p<.001$), episodic buffer ($r=0.386^{**}$; $p<.001$), and visuo-spatial ($r=0.363^{**}$; $p<.001$). Null hypothesis for H_{03} is rejected.

CONCLUSION

Summary of Findings and Discussions

The objective of this study was to explore the relationship between ChatGPT and the thinking process in writing among university learners. The study examined differences across different genders and disciplines, learners' perceptions of the three components of the thinking process in writing (phonological loop, episodic buffer, and visuo-spatial sketchpad), perceptions of ChatGPT in writing, and the relationship between ChatGPT and the thinking process in writing.

Based on the findings, it was discovered that there were no significant differences in ChatGPT usage and thinking processes across genders. This shows that both male and female learners demonstrated similar levels of engagement with ChatGPT and applied comparable writing-thinking strategies. This finding aligns with the study by Youssef et al. (2024), which reported generally positive perceptions of ChatGPT among university students regardless of their demographic background. Meniado et al. (2024) also found a similar result, where learners used ChatGPT primarily for brainstorming, organising ideas, and revising drafts, suggesting that the usefulness

of ChatGPT is not restricted by gender. The present finding, therefore, supports the view that ChatGPT functions as a universally accessible learning tool that can assist learners in the writing process regardless of gender. It was also discovered that there were no significant differences in ChatGPT usage and thinking processes across disciplines. This means that students from Science and Technology disciplines and those from Social Sciences and Humanities disciplines reported similar perceptions of ChatGPT and writing strategies. The findings support the findings in past studies conducted by Shahsavar et al. (2024) and Elkatmis (2024). Shahsavar et al. (2024) pointed out that ChatGPT improved medical students' academic writing in various aspects. Elkatmis (2024) also reported similar findings. Although the respondents in the study consisted of master's students, both studies showed the usefulness of ChatGPT in supporting writing tasks.

In relation to the phonological loop, measured through metacognitive strategies, it is evident that the respondents reported high levels of agreement across all items, with checking spelling and ensuring grammatical correctness recording the highest mean score, while monitoring and evaluating one's progress in writing recorded the lowest. The findings here are in accordance with Raoofi et al. (2017), whose writing strategy scale identified metacognitive strategies as important components of successful writing. Therefore, it could be seen that metacognitive regulation remains an important aspect of writing.

Next, the episodic buffer was measured through effort regulation strategies; learners reported high levels of perseverance and concentration when completing their writing tasks. Besides that, respondents gave their full attention while working on their writing tasks. The finding reflects Zimmerman and Bandura's (1994) point, where they emphasised the importance of self-regulation and persistence in achieving academic success. Other than that, it also shows that students demonstrate resilience while working on their writing tasks.

Moving on, this study examines the visuo-spatial sketchpad through cognitive writing strategies, revealing that learners strongly rely on their past experiences and knowledge when writing. This supports Rahmat's (2020) idea that writing reflects the thinking process, involving the retrieval and organisation of information from memory. Khairuddin et al. (2021) also concurred on this. Overall, it is evident that students will continue to reflect on their knowledge and experiences, although they have the assistance of an AI tool.

The findings also revealed positive perceptions towards ChatGPT in writing. In general, the respondents agreed that ChatGPT enhanced critical thinking abilities, academic achievement, writing support and engagement, and the finding is consistent with Youssef et al. (2024), who found that ChatGPT positively influenced students' critical thinking, engagement, and academic performance. Meniado et al. (2024) also reported that learners perceived ChatGPT positively, as they use it mostly to generate ideas, organise content, and revise drafts. Similar findings were also discovered in the study by Elkatmis (2024). ChatGPT contributed positively to idea generation, creativity, and writing quality. However, the current study highlighted that students apply critical thinking processes and do not simply accept the input by ChatGPT. Students actively evaluate and verify information that they receive. Oates and Johnson (2025) also agreed with this.

Implications and Suggestions for Future Research

Theoretical and Conceptual Implications

The findings of this study support Baddeley and Hitch's (1974) Working Memory Theory by showing that ChatGPT is positively related to the three constructs of the thinking process in writing: the phonological loop, episodic buffer, and visuo-spatial sketchpad. This means that ChatGPT supports students at the developing stage of their writing process. Besides that, the AI tool also supports the conceptual framework of the study, which proposes that ChatGPT is related to students' thinking processes when they work on their writing.

Pedagogical Implications

The findings suggest that educators can encourage students to use ChatGPT in the writing classroom, as the AI tool can assist students in their writing process. Educators can show them how to use it ethically when it comes to brainstorming and developing ideas, revising and checking their work. Since it was discovered that students evaluate and check information from ChatGPT, therefore, it encourages critical thinking in students, and educators should encourage this.

Suggestions for Future Research

Firstly, future research should look into the long-term impact of ChatGPT on students' writing-thinking processes through longitudinal studies. This is to see whether prolonged use of ChatGPT strengthens or weakens students' writing abilities and critical thinking skills, for instance. A longitudinal study would provide a deeper insight into the area of study. Secondly, a mixed-method study would provide richer insights into students' thinking processes when using ChatGPT. Interviews or classroom observations could provide more insights.

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APPENDIX

WRITING STRATEGIES & CHAT GPT

REFERENCE (This instrument is adapted from Raoofi, et. al, 2017 & Youssef, et. al, 2024)

SECTION	VARIABLE	CONSTRUCT	NO OF ITEMS
B	THINKING PROCESS IN WRITING	Phonological Loop (Metacognitive strategies)	10
		Episodic Buffer (Effort Regulation Strategies)	4
		Visuo-Spatial (Cognitive Strategies)	6
C	CHAT GPT	Critical thinking abilities	5
		Academic achievement	4
		ChatGPT usage	4
		Student engagement	3

SECTION A-WRITING STRATEGIES

(iii) MTEACOGNITIVE (MWS)

ITEM	1	2	3	4	5
MWSQ 1 I organize my ideas prior to writing.					
MWSQ 2 I revise my writing to make sure that it includes everything I want to discuss in my writing.					
MWSQ 3 I check my spelling.					
MWSQ 4 I check my writing to make sure it is grammatically correct.					
MWSQ 5 I evaluate and re-evaluate the ideas in my essay.					
MWSQ 6 I monitor and evaluate my progress in writing.					
MWSQ 7 I revise and edit an essay two or more times before I hand it in to my teacher.					
MWSQ8 I go through the planning stages in my writing.					
MWSQ9 I go through the drafting stages in my writing.					
MWSQ10 I go through the revising and editing stages in my writing.					

(v) EFFORT REGULATION (ERS)

ITEM	1	2	3	4	5
ERSQ 1I write a lot to develop my writing skills.					
ERSQ 2I often work hard to do well in my writing even if I don't like English writing tasks.					
ERSQ 3Even if the writing activities are difficult, I don't give up but try to engage in them.					
ERSQ 4I concentrate as hard as I can when doing a writing task.					
ERSQ I spend a lot of time and energy on writing good English assignments.					

(vi) COGNITIVE (CWS)

ITEM	1	2	3	4	5
CWSQ1 I use memorized grammatical elements such as singular and plural forms, verb tenses, prefixes and suffixes, etc, in my writing					
CWSQ 2I put newly memorized vocabulary in my sentences.					
CWSQ 3In order to generate ideas for my writing, I usually engage myself in brainstorming.					
CWSQ 4I use different words that have the same meaning.					
CWSQ 5I use my experiences and knowledge in my writing.					
CWSQ 6I try to use effective linking words to ensure clear and logical relationship between sentences or paragraphs					

SECTION B-CHATGPT

(vii) CRITICAL THINKING ABILITIES (CT)

ITEM	1	2	3	4	5
CTQ1 I usually need clarification on the precision and reliability of information provided by ChatGPT, which enhances my critical thinking skills.					
CTQ2 ChatGPT's responses made me doubt their validity, leading me to seek further clarification or evidence.					
CTQ3 I actively explore alternative viewpoints or sources of information when using ChatGPT to ensure a comprehensive understanding of the topic.					
CTQ4I need clarification about the accuracy of ChatGPT's output, which often encourages me to evaluate the information and conduct additional research independently.					

(viii) ACADEMIC ACHIEVEMENTS (AA)

ITEM	1	2	3	4	5
AAQ1 I actively explore alternative viewpoints or sources of information when using ChatGPT to ensure a comprehensive understanding of the topic.					
AAQ2 ChatGPT brings innovative ideas that are ready to be shared with students.					
AAQ3 Students can anticipate robust writing guidance from ChatGPT.					
AAQ4 ChatGPT has improved my academic performance.					

(ix) CHATGPT USGAE (CU)

ITEM	1	2	3	4	5
CUQ1 ChatGPT is a state-of-the-art writing model that is favorably used today.					
CUQ2 Students seek help from ChatGPT's assistance in composing essays and articles.					
CUQ3 ChatGPT helps students in English language translation.					
CUQ4 Employing ChatGPT significantly improves human productivity.					
CUQ5 The advent of ChatGPT marks a groundbreaking transformation in Natural Language Processing capabilities.					

(x) STUDENT ENGAGEMENT (SE)

ITEM	1	2	3	4	5
SEQ1 ChatGPT is more interactive, human-like, and engaging for the students.					
SEQ2 ChatGPT increases confidence in my ability to conduct research/to search for materials					
SEQ3 ChatGPT is easy to use and more engaging for me					