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ISSUES

Leveraging Generative AI to Support Cognitive Skills in the EFL Writing Process: University Students' Reported Uses

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The spread of generative artificial intelligence (GenAI) has restated the importance of the writing-as-a-process concept in EFL instruction, showing that this new technology can be very helpful in complementing the efforts of human EFL writers. At the same time, there is a clear lack of research exploring the way GenAI supports specific cognitive skills involved at each stage of writing within an EFL course specifically structured to emphasize the process approach. The present study aims to fill this gap by examining undergraduate students' perceptions of GenAI's usefulness during the writing process throughout such an EFL course. A mixed-methods approach was employed to collect both quantitative and qualitative data through surveys and semi-structured interviews. The results shed light on specific stages of the writing process and corresponding cognitive skills that students are most likely to complement with GenAI. Findings show that in spite of numerous concerns over GenAI's capacity to replace a human writer, in EFL writing instruction GenAI assumes the role of a co-creator leading to a synergetic relationship at various stages of the writing process. The findings have important pedagogical implications for understanding the role of GenAI in EFL writing in a process-oriented course. Writing-as-a-process pedagogical design allows EFL students to successfully determine the role and place of GenAI in their writing ecosystem, which in the end is aimed at achieving the ultimate goal of learning how to write in English.

1. Introduction

Given its capacity to *generate*, the advent of generative artificial intelligence (GenAI) has considerable implications for university-level instructors teaching EFL writing. GenAI differs from simpler forms of artificial intelligence (AI) due to its ability to perform complex tasks such as generating new content (e.g., text and images). Such a skill is typically associated with human cognition (C. Wang & Tian, 2025). This capacity underscores the juxtaposition between the writing-as-a-product and writing-as-a-process approaches, favoring the latter in cases where mastering the skill of writing is still a desirable learning outcome.

It has long been established that one way that teachers can promote the development of students' EFL writing is via a process-oriented approach, whereby writing is considered to reflect various sub-processes (e.g., planning, revising) that enable the writer to compose a text for a particular goal (Flower

& Hayes, 1981). The notion that writing can be considered 'a goal-directed thinking process' (Flower & Hayes, 1981, p. 366) alludes to the complexity of the relationship between cognition and composition. One model that has been proposed to facilitate understanding this relationship is the cognitive model of writing proposed by Deane et al. (2008), which outlines three strands of writing competence. The complex amalgam of skills inherent to the writing process has also led writing to be considered an ecosystem (Dobrin, 2011), which is a metaphor that has been further consolidated by digital and technological advancements (Cummings, 2023). The role played by technology in the writing process has been further enhanced by the advent of GenAI, thereby raising the question of whether it is a substitute for human writing or a complement to it. To answer this question, it is essential to consider the types of cognitive skills involved in the EFL writing process.

The interconnected nature of the writing process and cognitive skills has already been reflected to some extent in previous studies concerning GenAI and EFL writing (Asad et al., 2024; Hwang et al., 2025; Kim, Yu, et al., 2025; Meniado et al., 2024; Söğüt, 2024; Song & Song, 2023; Xiao et al., 2025; Zhang et al., 2025). Nevertheless, research in all the aforementioned areas remains limited, especially when it comes to examining undergraduate students' use of GenAI for EFL writing specifically via an integrated perspective reflecting both the writing process and the cognitive skills of writing in the span of a course. Therefore, this study is guided by the following research questions:

> RQ1: At which stage of the writing process do EFL students perceive GenAI to be most helpful throughout the course?
>
> RQ2: Which cognitive skills do students complement with GenAI during the writing process throughout the course, according to their reported use of GenAI?

In exploring students' use of GenAI to complement their cognition as part of the writing process, the present study contributes to the growing body of research on the impact of GenAI in education generally and it advances the current understanding of the synergistic relationship between humans and technology in the context of EFL writing. Firstly, this article provides a conceptual overview of process-based writing and cognitive skills of writing before proceeding to a critical review of the related literature. Secondly, the pedagogical context and participants are described, and the methods chosen for data collection and analysis are outlined. Thirdly, the findings are shared and discussed in light of the aforementioned research questions as well as the theoretical framework and previous literature.

Table 1. Three strands of writing competence (Deane et al., 2008).

Strand 1: Use language and literacy skills	Strand 2: Use strategies to manage the writing process	Strand 3: Use critical thinking skills
1.Speak standard English 2.Read standard English 3.Write standard English 3.1. Draft 3.1.1. Phrase/express (use written vocabulary; control sentence structure; use written style) 3.1.2. Transpose (mechanics, spelling) 3.1.3. Inscribe (handwriting, keyboarding) 3.2. Proofread/correct	1.Plan/model (activate/retrieve and select/organize) 2.Evaluate/reflect (edit/revise and assess/critique) 3.Control/focus text structure	1.Reason critically about content 1.1. Narrate/describe/predict 1.2. Explain/hypothesize 1.3. Support/refute 1.4. Gather/synthesize 2.Reason about social context 2.1. Collaborate/review (fulfill social roles) 2.2. Accommodate/engage with audience

2. Literature review

2.1. A process-based approach to EFL writing

The notion of process-based writing in EFL studies dates back to 1976, when Vivian Zamel highlighted the fact that EFL writers could benefit from a process-oriented approach to writing as L1 writers do (Matsuda, 2003). One of the most notable L1 models used in EFL studies was designed by Flower and Hayes (1981), who singled out three categories of writing sub-processes, all controlled by the process of monitoring: planning (generating ideas, organizing, and goal setting), translating (transforming ideas into words), and reviewing (evaluating and revising). Although challenged and modified later on, this framework has influenced many subsequent writing models, which highlighted the complex nature of writing (Davoodifard, 2022; Latif, 2021).

Consensus on the complexity of the writing process led to scrutiny of the cognitive skills involved in writing proficiency. Research by Deane et al. (2008) outlined three main strands in the cognitive model of writing. The first strand includes the use of language and literacy skills paramount for the drafting and proofreading stages. The second strand covers the use of strategies to manage the writing process during planning, evaluating, and controlling the text structure. The third strand concerns the use of critical thinking skills which involve reasoning critically about content and reasoning about social context (see Table 1 for details). The model reflects a variety of cognitive skills across all stages of writing.

The idea of a multiplicity of interdependent elements involved in the writing process evolved into the metaphor of ecology which allows researchers to study writing as an ecosystem (Dobrin, 2011). Again, originating in connection to L1 writing but largely applicable to EFL, the idea highlights the dynamic nature of the writing ecosystem, with structures and contents constantly changing (Cooper, 1986). Another important feature of writing as an ecology is that it 'privileges circular causality rather than linear cause and effect chains' (Fleckenstein et al., 2008, p. 393). Finally, the advent of ecological metaphors was fostered by the spread of digital tools and

technologies, which found their way into the writing process. In the digital age, writing is seen as an ecology of activities, tools, and spaces, where writers engage in a set of interconnected activities, drawing on multiple resources to produce texts (Cummings, 2023).

2.2. GenAI use in complementing EFL writing skills

Within the framework of the ecological metaphor, it is possible to state that the emergence of GenAI has transformed the writing landscape. With the rapid spread of ChatGPT use in education since early 2023, it has become evident that the 'capacity to generate—typically viewed as a cognitive skill tied to human intelligence and creativity—has a profound impact on education and society' (C. Wang & Tian, 2025, p. 1).

The human-like cognitive skills of GenAI redefine the role of technology involved in the writing process, where technology grows out of the role of a mere scaffolding tool into the role of a co-creating co-author (Nguyen, Ilesanmi, et al., 2024; Weber et al., 2025). In this case GenAI facilitates a synergistic partnership based on a human–AI collaborative writing strategy, which enhances both the writing product and the writing process by combining cognitive efforts (Nguyen, Hong, et al., 2024; Pratama et al., 2025).

Since the spread of GenAI, many studies have addressed human–AI collaboration in the EFL writing process, covering various ways in which AI complements human cognitive skills, which can be considered to reflect the three strands of writing competence outlined by Deane et al. (2008). The first strand of using language and literacy skills can be illustrated by studies showing the efficiency of ChatGPT in enhancing the linguistic quality of EFL learners' compositions, especially in connection to grammar and vocabulary (Song & Song, 2023). In this strand, GenAI is similar in its function to earlier AI tools (e.g., Grammarly), which EFL users have found to be useful in improving the overall quality of the language in their writing (Dizon & Gayed, 2024). Thus, in this regard, GenAI simply replicates the functions of existing tools.

At the same time, when it comes to the use of strategies in managing the writing process (Strand 2 in Deane et al., 2008), GenAI plays a unique role in complementing these types of cognitive skills. This aspect has been explored through both the perspectives of EFL students and EFL teachers. EFL students generally display a positive attitude toward the role of GenAI at various stages of their writing process (Fathi & Rahimi, 2024). Specifically, EFL students value tools such as ChatGPT for their 'ability to generate ideas, provide examples, and gather necessary information' (Meniado et al., 2024, p. 7). Additionally, offering content suggestions provided by GenAI has been appreciated by EFL students as it gives them a chance to concentrate on creative aspects of their writing (Werdiningsih et al., 2024). Similarly,

EFL teachers also agreed that GenAI enhances the content and organization of their students' writing (Marzuki et al., 2023). Thus, both students and teachers mostly agree that GenAI is useful within this strand of cognitive skills.

Finally, the use of critical thinking skills (Strand 3 in Deane et al., 2008) in the writing process arouses the most debate. On the one hand, many EFL teachers express concerns about their students' overreliance on GenAI, which might negatively affect their critical thinking skills (Alzubi et al., 2025; Asad et al., 2024; Söğüt, 2024; Xiao et al., 2025). On the other hand, critical thinking in human–AI collaborative writing stems from students' active engagement with GenAI's content and feedback (Koltovskaia et al., 2024; Pratama et al., 2025; Yeung, 2025). Studies on the efficiency of this engagement in EFL writing indicate that combined feedback (i.e., a combination of feedback from both GenAI and the instructor) is superior to purely GenAI feedback (Zhang et al., 2025) and to purely teacher feedback (Asadi et al., 2025). This type of combined feedback can be considered to be an example of *collective intelligence,* highlighting collaboration between three parties: learners, educators, and AI (Weber et al., 2025). At the same time, the level of EFL students' collaborative approach to GenAI is also dependent on their AI literacy (Kim, Lee, et al., 2025), as well as on their level of EFL proficiency (Nguyen Thi Thu, 2023). Hence, this strand of cognitive skills underscores the idea of writing as an ecosystem based on the writing process approach in which GenAI complements human intelligence.

2.3. Student perceptions of GenAI in EFL writing

Since the non-linear, iterative, and highly interactive writing process lies at the core of human–AI collaborative writing, several studies have addressed student engagement with GenAI at various stages of the writing process at the tertiary level. A study by Barrett and Pack (2023) reported results from a public university in the United States comparing the perceptions of educators (n = 68) and university students (n = 158) on the appropriate use of GenAI in the writing process. The findings indicate that 'both students and teachers perceived GenAI use to be more acceptable in the early stages of the writing process (i.e., brainstorming and outlining) than in later stages' suggesting that 'use of GenAI for writing purposes is viewed as more acceptable when it is fulfilling a supportive role focused on idea generation and organization rather than when leveraged as an automatic writing completion tool' (p. 17). This study did not differentiate between L1 and EFL students.

A study by Nawi et al. (2025) examined human–AI collaboration in the writing process and looked at GenAI-assisted writing strategies of 13 university students in Malaysia at B1-C1 levels of EFL proficiency. The study found that while the students used ChatGPT across all stages of writing (planning, drafting, and revising), higher-scoring students used ChatGPT across multiple stages to refine ideas and enhance clarity, while lower-

proficiency users relied on simple, directive prompts. The authors of the study attribute this difference to the possible gap in EFL students' GenAI literacy as well as in their language proficiency.

Similarly, research by Kim, Yu et al. (2025) studied 20 Chinese students in higher education in connection to their perceived advantages of GenAI-assisted academic writing. The overwhelming majority of students mentioned that GenAI use highly increased productivity across all stages of the writing process: ideation (96%), planning (90%), drafting (92%), and revision (99%) (p. 1276). The results also showed that the EFL students perceived that their collaboration with GenAI improved their writing performance (quality, speed, topic/content knowledge) as well as enhancing the affective domain.

Along the same lines, a study by Meniado et al. (2024) focused on the perceptions of Thai and Vietnamese EFL learners regarding ChatGPT use in their EFL writing process. The qualitative data from 16 interviews showed that the students had positive perceptions of ChatGPT in the pre-writing, during-writing, and post-writing stages, which their teachers (i.e., the researchers) integrated into their writing classes. What is unclear, however, is whether the students would have voluntarily resorted to using GenAI if it had not been integrated into their classes and to what extent those writing courses were process-based.

The study by Hwang et al. (2025) also explored students' perceptions of ChatGPT's helpfulness during a timed writing process. The data from 35 Cantonese-speaking EFL learners who wrote an argumentative essay within a 30-minute time limit on a given topic, showed that EFL learners primarily used GenAI for idea generation and linguistic support. One limitation of this research concerns the use of writing time constraints, which might have affected the results obtained.

Overall, existing research provides insights into EFL writers' use of GenAI at various stages of the writing process. However, there is still a gap in the literature on how students use GenAI within a course specifically built to underscore writing as a process. The present study aims to fill this gap with the classroom-based study focusing on students' reported use of GenAI.

3. Methods

3.1. Instructional context and participants

This study was conducted in a university context in Finland during the 2024-2025 academic year. The Finnish-speaking participants (n = 50) were recruited from a pool of over 150 EFL learners enrolled in the same EFL course offered at the bachelor-level for students from business, administration and political study programs. The 13-week course focused on developing students' academic and professional communication skills in English at a B2 level of proficiency over the period of a semester.

The course was originally designed according to the *writing-as-a-process* approach and included multimodal tasks. Each student could choose any topic related to their field of study and develop an argument on this topic throughout the course. The first four weeks of the course were focused on building an argument in visuals (e.g., a presentation), which was designed to highlight the planning stage of writing. Given the fact that the writing process is non-linear, students could already start writing some parts of their argumentative paper (e.g., introduction, main claims) and revise them according to peer and instructor feedback. The following two weeks dealt with drafting and revising an argumentative position paper. Finally, the rest of the course was focused on argumentative small-group discussions based on the position papers. Thus, the course design highlighted various stages of the writing process (pre-writing, drafting and editing) and facilitated focusing on them one at a time, while also allowing for a non-linear approach, where students could navigate freely between stages and tasks.

At the beginning of the course, all students were instructed on the ethical use of GenAI in accordance with university guidelines, with an additional focus on critical evaluation of GenAI output. The use of GenAI was covered together with the learning outcomes of the course and its pedagogical design based on the writing-as-a-process approach, thus students could use GenAI throughout the whole semester (12 weeks) starting from the first class, when they could turn to GenAI to brainstorm the ideas for the course topics. It was also noted that Copilot is accessible through their university-provided Microsoft 365 software package (accessed through students' own devices) and that it can be used to scaffold their learning at various stages of the course. The university provides its students and staff free access to Copilot (at the time of the project, version 2.20260127.47.0). Students could access GenAI both in class, through their personal devices, and at home during their independent work. No hardware equipment was provided by the university for this project.

However, students were not required to use GenAI to complete any of the course tasks given that previous literature documents ethical anxiety and perceived ethical risks which might influence students' choice of not using GenAI (Zhu et al., 2025). Thus, GenAI-related prompts were not offered to the students, allowing them to self-direct their learning and choose whether they wanted to use GenAI for a specific task at all within their learner autonomy. Illustrative examples of prompts aligned with different writing stages are provided in the Appendix. According to the 'traffic light model' used by the university, all course tasks fell within the yellow light category, which means that the use of GenAI is 'allowed, can be used, and must be reported'[1]. The students who declared the use of GenAI in the course

1 https://sites.tuni.fi/digitaltoolkit/artificial-intelligence/traffic-light-model-how-to-guide-students-in-the-use-of-ai/

mentioned the use of Copilot and ChatGPT. One limitation of this study is the traceability of version/model of ChatGPT if students opted to use it instead of Copilot.

3.2. Data collection

In order to address the RQs, the researchers used a convergent mixed-methods approach to collect quantitative data (Likert-scale items) and qualitative data (free responses and semi-structured interviews), which were analyzed separately and integrated at the interpretation stage. Firstly, all participants (n = 50) completed a survey via Microsoft Forms eliciting their perceptions concerning the use of AI at different stages of the writing process. Most participants (n = 32) also responded to a free-response question on the survey, eliciting concrete examples of their use of AI for academic writing in English. Secondly, a sub-sample of these students (n = 3) participated in follow-up semi-structured interviews held via Microsoft Teams. The interview structure was, in general, similar to the one employed by Meniado et al. (2024), comprising questions aimed at shedding light on students' uses of GenAI at different stages of the writing process. The qualitative data complement the quantitative results by elaborating on and contextualizing students' uses of GenAI at specific stages of the writing process.

The data collection was conducted in accordance with the guidelines set by the Finnish National Board on Research Integrity (TENK)[2] As outlined by TENK, ethical review is only required in specific cases, such as studies in which there is a risk of psychological harm, exposure to exceptionally strong stimuli, or deviation from informed consent. As the present study does not meet any of these criteria, ethical approval was not required. Nevertheless, prior to data collection, students were informed about the research and advised that participation was entirely voluntary and would in no way affect the teacher's assessment of the student's performance in the course or tasks. In addition to providing their consent via the form, participants were also given an opportunity to read the data privacy notice associated with this study, which was reflective of both the university's internal policies and the European Union's (EU) General Data Protection Regulation (GDPR).

3.3. Survey and data analysis

For the sake of transparency for the participants, the design of the survey followed the design of the process-oriented course, in which the writing component was explicitly divided into three stages: pre-writing, drafting, and editing, in accordance with the writing-as-a-process approach (e.g., Flower & Hayes, 1981; Nawi et al., 2025). Each stage served as an umbrella for a number of cognitive skills relevant to argumentative academic writing,

2 https://tenk.fi/en/ethical-review

Table 2. Reliability analysis for statements used in cognitive skills.

Stage	Cognitive skill	α
Pre-writing	Brainstorming	.929
	Outlining	.801
	Finding sources	.833
	Selecting information	.696
	Anticipating counterarguments	.862
Drafting	Organizing paragraphs	.931
	Incorporating evidence	.829
	Referencing	.944
Editing	Proofreading	.720
	Revising for academic style	.905
	Ensuring cohesion	.866

adapted from the three strands of writing competence by Deane et al. (2008). Hence, the survey was designed to elicit the perceived usefulness of GenAI in two ways: (1) at various stages of the writing process, and (2) in the implementation of various cognitive skills.

The survey comprised 33 items in the form of Likert-scale statements for which participants selected a numerical value ranging from one (strong disagreement) to five (strong agreement). The statements were carefully prepared in order to reflect the three stages (i.e., pre-writing, drafting, and editing) of the writing process, as well as their corresponding cognitive skills, of which there were 11 in total. Three statements were created for each cognitive skill in order to allow for reliability analysis using Cronbach's alpha (α).

As shown in Table 2, the reliability scores were higher than .800 for nine cognitive skills, while the reliability scores for Selecting information and Proofreading were .696 and .720, respectively. Although participants were presented with the statements in sections of the form that corresponded to stages of the writing process, the statements within each section were randomized. All the quantitative data in this study were analyzed using SPSS version 29, and Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted in order to check the data for normality.

Descriptive statistics, including means and standard deviation figures, were calculated, after which a repeated measures analysis of variance (ANOVA) was used to calculate differences between scores for each stage of the writing process. Means and standard deviation figures were also ascertained for the data concerning the cognitive skills of each stage, and the differences between scores for various cognitive skills within each stage were analyzed using the Friedman test and the Wilcoxon signed rank test. For all analyses of differences conducted at either the stage or the cognitive skill level, the resulting *p* values were adjusted by SPSS for multiple comparisons in accordance with the Bonferroni correction. The data collected for the free-

response section of the survey were analyzed using content analysis, whereby the responses were classified into the stages of the writing process. In some cases, students' responses were reflective of two or all three stages of the writing process.

3.4. Interviews and data analysis

In order to address RQ2, a semi-structured interview was designed to elicit students' uses of GenAI at various stages of the writing process. Participants were asked to elaborate on their use of GenAI and provide specific examples concerning the purpose and manner of such uses. First, students were prompted to confirm the stage of the writing process (i.e., pre-writing, drafting, and editing) at which they found GenAI to be most helpful, the second most helpful, and the least helpful. Thus, the order in which the stages were covered in the rest of the interview depended on the participants' perceived helpfulness of GenAI at those stages. Next, students were asked follow-up questions concerning their use of GenAI at each stage. In the third section of the interview, which corresponded to the stage at which students found GenAI to be least helpful, participants were asked to provide and elaborate on the reasons they did not find GenAI to be as helpful at that stage as at the other two stages. Additionally, students were asked to share any concerns they had regarding GenAI use, and they were given an opportunity to add any final points before the end of the interview.

Using content analysis as a guiding framework, students' responses (in English) were analyzed and coded, leading to the identification of relevant clusters. Clustering is a practical approach for grouping data on the basis of underlying commonalities (Krippendorff, 2019). In the case of the present study, the cognitive model of writing outlined by Deane et al. (2008) was used as a guiding framework during data analysis. The structure and focus of the interview gave rise to students commenting on and justifying the ways in which they use GenAI at different stages of the writing process. This facilitated the researchers to identify clusters in students' responses. Thus, students' responses were coded in relation to the three strands of cognitive skills. Given that a semi-structured interview allows participants to respond with a considerable amount of freedom, the data for each interview were reflective of several cognitive skills (i.e., strands) and students' perceptions related to the use of GenAI as part of the writing process. Nevertheless, it is important to acknowledge that only three students participated in the follow-up interviews, which means that the resulting analysis contributes only exploratory insights rather than any generalizable findings.

Table 3. ANOVA of means by stage (n = 50).

Pairwise analyses	Mean difference	*p*	Cohen's *d*	Confidence interval	
				Lower limit	Upper limit
Pre-writing & drafting	.593	<.001	0.99	.383	.803
Editing & drafting	.478	<.001	0.57	.183	.772
Pre-writing & editing	.115	.894	0.15	-.156	.386

Table 4. Classifications emerging from the students' free responses (n = 32).

	Classification	Total	Example response
Stage of the writing process	Pre-writing	22	"I use it to generate ideas and especially to narrow down the topic."
	Drafting	8	"I also convert reference into a particular style."
	Editing	21	"I have used AI to edit words to make them more suitable for academic style."

4. Results

4.1. Quantitative and qualitative survey results

The mean scores for each stage were calculated using all the scores for the underlying constructs and statements that correspond to a given stage. Therefore, the mean for Pre-writing reflects the scores for 15 statements across five constructs, whereas the means for Drafting and Editing were each based on nine statements across three constructs. The stage means were higher for Pre-writing (3.45) and Editing (3.34) than for Drafting (2.86). In order to analyze differences among these figures, a repeated-measures analysis of variance (ANOVA) was used because the stage-level data were found to be normally distributed. Given that the test of within-subjects effects (Greenhouse-Geisser corrected) indicated significant differences among stages (p < .001) with a large effect size (partial η^2 = .27), pairwise comparisons were subsequently conducted, revealing a statistically significant difference with a large effect size between Pre-writing and Drafting (p < .001, d = 0.99) and a statistically significant difference with a moderate effect size between Editing and Drafting (p < .001, d = 0.57), as illustrated in Table 3. However, the mean difference between Pre-writing and Editing was not found to be significant. The (quantitative) differences found among these stages are also reflected in the (qualitative) classifications identified in the students' free responses (n = 32), as depicted in Table 4. In total, the Pre-writing and Editing stages were referred to 22 and 21 times respectively, whereas only eight references to Drafting were identified in students' free responses. The fact that Pre-writing and Editing were prominent in both the repeated-measures ANOVA and the free responses is indicative of the convergence between the qualitative and quantitative data collected via the survey.

In addition to analyzing differences between the stages of the writing process, the underlying cognitive skills within each stage were also scrutinized. The cognitive skill with the highest mean within the Pre-writing stage was

Table 5. Wilcoxon signed rank test results by pairs of cognitive skills (n = 50).

	Pairwise analysis of cognitive skills	Wilcoxon Z statistic	*p*	*r*
Pre-writing	Selecting information & finding sources	-0.358	1.000	.05
	Selecting information & outlining	-0.615	1.000	.09
	Selecting information & anticipating counterarguments	-3.018	.030	.43
	Selecting information & brainstorming	-3.031	.020	.43
	Finding sources & outlining	-0.862	1.000	.12
	Finding sources & anticipating counterarguments	-3.074	.020	.43
	Finding sources & brainstorming	-3.255	.010	.46
	Outlining & anticipating counterarguments	-3.186	.010	.45
	Outlining & brainstorming	-3.850	<.001	.54
	Anticipating counterarguments & brainstorming	-0.952	1.000	.13
Editing	Ensuring cohesion & revising for academic style	-1.107	1.00	.16
	Ensuring cohesion & proofreading	-4.337	<.001	.61
	Revising for academic style & proofreading	-3.487	<.001	.49

Brainstorming (3.79), followed closely by Anticipating counterarguments (3.73). The cognitive skills with the highest means within the Drafting and Editing stages were Referencing (3.04) and Proofreading (3.70), respectively. Given that not all the data for cognitive skills were found to be normally distributed, non-parametric tests were used to assess differences among means within each stage. The Friedman test revealed that differences existed at the cognitive skill level at both the Pre-writing (p < .001, Kendall's W = .15) and Editing (p < .001, Kendall's W = .25) stages, but not for Drafting. Therefore, the Wilcoxon signed rank test was used to assess differences among cognitive skills within both Pre-writing and Editing. The results of this analysis are shown in Table 5. In Pre-writing, there were statistically significant differences with moderate effect sizes between Anticipating counterarguments and Selecting information (p = .030, r = .43), Outlining (p = .010, r = .45) and Finding sources (p = .020, r = .43), and between Brainstorming and both Selecting information (p = .020, r = .43) and Finding sources (p = .010, r = .46), while between Brainstorming and Outlining there was a statistically significant difference with a large effect size (p < .001, r = .54). In Editing, statistically significant differences with large and moderate effect sizes were observed between Proofreading and Ensuring cohesion (p < .001, r = .61) and Revising for academic style (p < .001, r = .49), respectively.

4.2. Follow-up interview data

The transcripts of the three interviews were coded to identify the cognitive skills students complemented with GenAI during their writing process. Since the interviews were originally conducted in English, students' authentic wording was elicited as data, as opposed to some previous studies where there was a need for translation (e.g., Meniado et al., 2024). The data were coded in accordance with the three strands of writing competence by Deane et al. (2008). All three interviewees acknowledged utilizing GenAI for Strand 1 (i.e., for complementing their language skills). Participant 1 mentioned asking

GenAI for synonyms and translations of individual words from Finnish to English, Participant 2 used it for spelling and checking grammar, and Participant 3 emphasized having assistance with spelling and punctuation. The interviews show that students turn to GenAI for language help at various stages of writing (i.e., drafting and editing), highlighting the non-linear nature of the writing process and relevant cognitive skills.

As for Strand 2 (i.e., using strategies to manage the writing process), again, all three interviewees provided examples of complementing their cognitive skills with GenAI. Participant 1 and Participant 3 mentioned asking GenAI for help structuring their text, whereas all three participants mentioned using GenAI to select evidence. Notably, all three participants expressed critical concerns about the GenAI-suggested evidence and the need for a human to evaluate it. For instance, Participant 1 said, 'I won't even copy the information from ChatGPT, but I'll go directly to the source that is provided and look at the information there in the original source'. Similarly, Participant 2 stressed, 'If I try to find the preferred or some sort of reference, after the AI gives it to me, I go back and read it from the source text and the context around it, so I don't necessarily trust it directly'. Participant 3 noted, 'Well, sometimes it gives like these examples of things without sources, and that's when like I have some red lights in my head, and I'm like that might not be true'.

Finally, Strand 3, which deals with critical thinking skills, includes the aspect of reasoning about social context, specifically accommodating to the audience. All three participants displayed awareness of the existence of academic conventions that go beyond word choice. They all mentioned the use of GenAI to help them comply with those conventions better. As an illustration, Participant 1 said, 'I do ask ChatGPT for help with a lot of referencing, especially following the APA 7 guidelines'. Participant 2 provided an example of consulting GenAI on whether the source is appropriate in an academic context:

> When I had read a possible source, I did once ask whether it would be suitable or whether I could find a suitable reference from that paper to a certain claim that I have that needed backing up, or evidence from an academic paper.

Participant 3 made a similar inquiry to GenAI: 'I asked it to just give me a source of this one that's academically correct and then it kind of worked'.

The data from the three interviews also revealed a theme that deals with both the writing process and the writing product. All three participants touched upon the theme of maintaining personal voice, ownership, and authenticity in the writing process as factors that prevent them from using GenAI at certain stages. This theme is illustrated through the following examples:

> Oftentimes I actually notice myself not liking the outcome that ChatGPT gives me at the editing stage, and mainly it's because ChatGPT likes to entirely change the wording of the essays, and then I feel like it doesn't sound at all like it's my text or it doesn't reflect what I think about the topic. (Participant 1)

> For me, the drafting part of writing is really just trial and error. I write what I want and then go back and change it and so forth. So I don't really have a way in which I would use it, so I don't really find it necessary to even think about using it. (Participant 2)

> In my case, I feel like if I would use AI in the drafting stage, I might just like take what it says and then do my writing based on what AI's opinions are. So I'm very, very influenced in that way in what it says, so maybe that's why I don't use it there, so that text would be more of like my own thoughts and words. (Participant 3)

Overall, the qualitative data from the semi-structured interviews extend the quantitative and qualitative data obtained via the survey. While the survey results suggested that students were more likely to use GenAI at the Pre-writing and Editing stages, the interview data revealed ways in which students used GenAI to support their abilities as reflected in the three strands of writing competence (Deane et al., 2008). Additionally, the follow-up interviews allowed students to elaborate on their perceptions in greater depth, providing explanations for their use of GenAI (or lack thereof) at certain stages, while also voicing their concerns about authorship. A survey alone would not have brought about such insights.

5. Discussion

The study set out to explore students' perceptions of the usefulness of GenAI at various stages of the writing process and the way GenAI is employed to complement various cognitive skills involved in writing. In general, the results obtained in this study are consistent with previous research on university students' perceptions of GenAI use in the writing process: GenAI is regarded as a helpful tool at all stages of academic writing (Meniado et al., 2024; Nawi et al., 2025). At the same time, the findings from both the quantitative and qualitative data shed light on students' reported use of GenAI in complementing specific stages and corresponding skills.

In response to the first research question, the quantitative results emerging from this study reveal statistically significant differences between the three stages of writing. Specifically, the mean scores indicate that students perceived GenAI to be more helpful at the Pre-writing and Editing stages than at the Drafting stage. This result has an important implication in addressing concerns over GenAI being a complete substitute for the human writer,

putting students' creativity at risk (e.g., Asad et al., 2024) and raising ethical concerns over authorship (e.g., Su et al., 2023). In this study, the students reported using GenAI as a supplement to their writing process, utilizing it at various stages of writing according to their individual needs and not just for mere text production (i.e., drafting). These findings support previous research that found that students tend to use GenAI mostly at the earlier stages of writing (Barrett & Pack, 2023) and at the editing stage (Y. Wang, 2024).

Thus, according to students' reported use of GenAI, the process-based writing environment facilitates attributing a complementary role to GenAI, allowing students to engage with the tool specifically at those stages where they feel they need assistance. Students' perceptions of GenAI usefulness also show that this approach can allow tackling specific cognitive skills that might be at different levels of development across the student population. This way each student has a chance to receive individually tailored assistance with various tasks. This leads to the second research question exploring the reported use of GenAI to complement specific cognitive skills. At the cognitive skill level, statistically significant differences were found among cognitive skills at the Pre-writing and Editing stages, but not at the Drafting stage, which further highlights the diminished importance of the Drafting stage compared to the other two stages in this context.

Quantitative results show that at the Pre-writing stage, students perceived GenAI to be more helpful for brainstorming than for selecting information, finding sources or outlining. The focus on complementing b*rainstorming* with GenAI is consistent with previous findings that highlight a positive role of GenAI in overcoming writer's block in academic writing (Söğüt, 2024). Along the same lines, students' responses reflected a higher perceived usefulness of GenAI for anticipating counterarguments than for selecting information, finding sources or outlining. These findings could be partially explained by inferences from the qualitative data in the present study, in which students expressed critical concerns about the reliability of information suggested by GenAI. These concerns are consistent with previous research results on students' perceptions of GenAI (Limna et al., 2023; Ngo, 2023).

At the Editing stage, students' responses reflected a stronger preference for using GenAI for proofreading than for ensuring cohesion or revising for academic style. This might be partially attributed to the inherent challenges of writing in EFL (e.g., spelling, grammar). The qualitative results illustrate a range of student-reported language-related issues tackled with the help of GenAI (including translation), which is consistent with previous studies (Y. Wang, 2024). Another possible reason for students reporting a stronger preference for proofreading over other editing aspects might be explained by the course design, where students received peer feedback on their draft texts. Although the comparison between GenAI and peer feedback is beyond the

scope of this study, it can still be hypothesized that the two types of feedback are complementary as they might focus on various sub-skills, which could serve as a subject for future research.

6. Conclusions

Overall, the results highlight students' self-reported high level of engagement with GenAI across various strands of cognitive skills: from language and literacy skills to writing management and critical thinking skills. This could be viewed as an illustration of 'a synergistic partnership where AI tools not only assist in the mechanical aspects of writing but also stimulate critical thinking, creativity, and deeper engagement with content' (Nguyen, Ilesanmi, et al., 2024, p. 251). In this context, balancing GenAI and human contribution is critical for maintaining an author's authentic voice, which is often viewed as a challenge (Kim, Yu, et al., 2025; Werdiningsih et al., 2024). Insights from the qualitative data in this study underscore students' self-reported attempts to maintain this delicate balance through various means. This can be considered an implication for future research.

The limitations of this study include the rather homogenous student sample: all participants are of a similar background with Finnish as their L1, majoring in business and administration studies. Also, since there is no verified data on the students' EFL proficiency, it is impossible to draw inferences of how the results vary across different EFL levels. GenAI literacy was also not taken into account in the present study, which might potentially yield variations across groups. Yet, in spite of these limitations the present study makes a valuable contribution to exploring the role of GenAI in complementing cognitive skills at various stages of the non-linear writing process within a process-based course design.

The present study has important pedagogical implications. First, a writing-as-a-process course design seems to help in addressing the concern over GenAI acting as a substitute for a human writer. Second, in a process-based environment where students are encouraged to explore their own chosen topic over the course of several weeks, while acquiring and practicing various writing-related skills, students report finding their own way to fit into the writing ecology given its multiple facets, including GenAI technology. That is how students get a chance to build their unique patterns of complementing their cognitive skills with GenAI, according to their personal needs. Finally, it seems essential to give students the right to choose how and when to use GenAI in their writing, if at all.

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Conflict of interest

The authors declare that they have no financial or non-financial conflicts of interest in relation to this work.

Ethics Declaration

The data collection was conducted in accordance with the guidelines set by the Finnish National Board on Research Integrity (TENK). The researchers' affiliated institution (Tampere University) has committed to complying with TENK's guidelines concerning ethical review[3], which outline instances in which ethical review is required. The present study was deemed not to meet any of the conditions that require ethical review. This determination was made by the researchers on 2 February 2025 in conjunction with the preparation of the survey. Furthermore, all stages of the study—from recruiting participants to collecting and managing the data—were carried out in line with the TENK ethical standards. The online questionnaire included an integrated informed consent section: before answering any survey questions, participants read a consent statement embedded in the form and confirmed that they agreed to take part voluntarily. To ensure confidentiality, no identifying information was gathered, and all data were stored on a secure university server that only the research team could access.

Author Contributions

Conceptualization, E.T. and P.L.; Methodology, E.T. and P.L.; Data curation, E.T. and P.L.; Formal analysis, E.T. and P.L.; Writing - original draft, E.T. and P.L.; Writing - reviews and editing, E.T. and P.L.; Project administration, E.T.; Visualization, P.L.. Both authors contributed equally to the development and finalization of the manuscript.

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3 https://tenk.fi/en/ethical-review/organisations-committed-ethical-review-human-sciences

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Appendix

Illustrative examples of prompts for GenAI aligned with different writing stages.

Stage	Cognitive skill	Illustrative examples of prompts
Pre-writing	Brainstorming	'Provide a list of current issues relevant to the topic of [topic X] in academic and professional contexts. Focus on recent research.' 'Give a list of key words associated with [topic X] from scholarly literature and categorize them if possible.'
	Outlining	'Outline the main arguments in favor of [position Y] on [topic X], based on academic research.' 'Organize the following ideas on [topic X] into a logically sound outline.'
	Finding sources	'Provide a list of the most relevant academic sources on [topic X] for the last Z years.' 'Evaluate the reliability of [evidence A] from [website B] as a source on [topic X].'
	Selecting information	'Identify the information from [source C] relevant to the argument in favor of [position Y] on [topic X].' 'Evaluate the relevance of [data D] to [position Y] on [topic X].'
	Anticipating counterarguments	'List the main counterarguments with reliable sources against [position Y] on [topic X].' 'Provide possible rebuttals to the following counterarguments to [position Y] on [topic X].'
Drafting	Organizing paragraphs	'Propose a clear topic sentence to the following paragraph.' 'Suggest inferences from the following cited evidence.'
	Incorporating evidence	'Summarize the key findings from [source C] concerning [position Y] on [topic X].' 'Cite the definition of [concept X] as a direct quotation from [source C].'
	Referencing	'Create both an in-text citation and a reference list entry for [source C] in APA style.' 'Convert the following reference(s) into APA style.'
Editing	Proofreading	'Find all language-related issues in the following text and suggest ways to correct them.' 'Provide synonyms for [word E] in the following sentence.'
	Revising for academic style	'Highlight all the points in the text that sound informal. Suggest ways to improve the academic style of the text.' 'Provide an academic equivalent to [word/phrase E]?'
	Ensuring cohesion	'Suggest ways to improve the cohesion of the following text.' 'Find missing, misplaced or repeated connectors and suggest improvements.'