

Constructivist pedagogy and student engagement: facilitating active learning through guided milestone-driven GAI prompts

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Abstract

Purpose – Generative AI (GAI) refers to a class of artificial intelligence models that create new content by learning patterns from large data sets. This study investigates how guided, milestone-driven GAI prompts, embedded within a constructivist learning framework, influence student engagement, critical thinking and writing development in asynchronous higher education courses.

Design/methodology/approach – Using a case study design, the research examines two online business courses (one undergraduate and one postgraduate) at a mid-sized US university. Students completed a five-milestone term paper supported by instructor-designed GAI prompts. Data were collected through a 20-item end-of-semester survey comprising closed- and open-ended questions. Quantitative responses were analyzed using frequency and percentage analysis, while qualitative responses underwent inductive thematic analysis and comparative analysis between courses and between undergraduate and postgraduate.

Findings – Among 29 respondents, 93.1% reported that GAI prompts supported their thinking and writing processes, with most indicating enhanced critical thinking (79.3%) and improved final paper quality (89.7%). Qualitative findings highlight GAI's role in reducing writing anxiety, promoting perspective-taking, and fostering metacognitive reflection. Although improvements in instructor-assessed grades were not always immediate, student reflections suggested deeper cognitive engagement and iterative learning consistent with constructivist pedagogy.

Research limitations/implications – Findings are limited by sample size, reliance on self-reported data and the absence of a control group. Future research should explore longitudinal impacts and cross-disciplinary applications.

Practical implications – Thoughtful GAI integration can promote equitable, learner-centered instructional design and strengthen students' ethical and professional use of AI tools.

Originality/value – This study provides one of the first empirical examinations of structured GAI integration within a constructivist, milestone-based writing assignment. It advances understanding of how GAI can operate as a cognitive scaffold that supports learner agency and academic development in online learning environments.

Keywords Constructivist pedagogy, Student engagement, Generative AI (GAI), GAI prompts, Critical thinking, Higher education, Online learning, Scaffolding, Instructional design, Metacognition, GAI-Supported learning

Paper type Research article

Introduction

Advancements in generative artificial intelligence (GAI) have rapidly reshaped how students engage with academic work, creating new opportunities and pressures for higher education (Al Zaidy, 2024). While students are increasingly incorporating GAI tools into their learning



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practices, these tools are seldom integrated intentionally into course design, leaving instructors with limited strategies for supporting students' productive and ethical use of GAI. This disconnect presents a pressing pedagogical problem; although GAI has the potential to enhance learner engagement, reflection, and writing development, it is unclear how to structure GAI interactions in ways that align with evidence-based learning theory, particularly constructivist approaches that emphasize active, self-directed knowledge construction.

Constructivist learning theory (CLT) provides a meaningful foundation for exploring GAI's role in academic development. CLT positions learning as an active, iterative process shaped by learners' prior knowledge, learner agency, and social interaction (Piaget, 1970; Vygotsky, 1978; Adams, 2006). GAI tools appear well-suited to this paradigm because they can facilitate dialogic interaction, support iterative refinement, and offer adaptive feedback. However, despite the theoretical alignment between GAI capabilities and constructivist principles, existing research remains mainly conceptual. Studies often highlight GAI's potential without offering empirical evidence on how students actually engage with GAI tools in authentic coursework or how structured GAI use influences engagement, critical thinking, or writing development over time.

A key gap emerging from recent literature is the lack of empirical work examining guided, structured, and pedagogically integrated GAI use, especially scaffolded GAI prompts designed to support milestone-driven academic tasks such as term papers. Existing studies rarely investigate how such prompts function as cognitive scaffolds, how students perceive their value, or how they shape the learning process in online environments. Additionally, concerns about academic integrity, writing anxiety, and equitable access raise questions about whether structured guidance might help students use GAI ethically and meaningfully rather than as a shortcut or replacement for critical thinking.

This study addresses these gaps by empirically examining how guided, milestone-driven GAI prompts influence student engagement, critical thinking, and writing development in two asynchronous business courses at a US university. The instructor intentionally designed the prompts to support students across five stages of the term paper writing process, aligning with constructivist principles of scaffolding, iterative reflection, and learner agency. By focusing on real student behavior in authentic learning contexts, the study provides evidence about how an instructor can integrate GAI responsibly and effectively into higher education writing tasks.

The central argument of this paper is that structured GAI prompts, when embedded within a constructivist framework, can enhance student engagement and support meaningful academic development by prompting analysis, refining ideas, and reducing writing barriers. To investigate this argument, the paper presents findings from student survey data, explores how students used the prompts across milestones, and evaluates the perceived impact of guided GAI interaction on academic growth. Through this analysis, the study offers rare classroom-based empirical insight into the pedagogical role of GAI. It contributes to a growing conversation about how higher education can leverage GAI tools to support active, learner-centered instruction.

This paper's examination of constructivist pedagogy and GAI integration is relevant to a wide range of higher education stakeholders. Faculty and lecturers seeking to enhance student engagement or incorporate GAI-supported active learning may find the study particularly useful. Educational technology specialists and instructional designers can draw on its insights when supporting GAI-enabled course development. The paper also offers value to postgraduate students and researchers studying pedagogy, student engagement, or GAI in education. Finally, administrators, program directors, and policy analysts concerned with curriculum quality and the pedagogical implications of emerging technologies may benefit from its findings.

The paper proceeds with a review of relevant literature on constructivist pedagogy, academic integrity, and GAI in education, followed by a description of the study's methodology and context. The paper next presents findings from quantitative and qualitative survey data, offering insight into how students experienced the GAI prompts. Finally,

the discussion highlights the implications for course design, instructor presence, and ethical GAI use, concluding with recommendations for future research on structured GAI scaffolding in higher education.

Literature review

GAI in education: opportunities, challenges, and theoretical foundations

GAI has rapidly expanded from an exploratory technological novelty to a pervasive instructional tool in higher education, reshaping how students interpret information, construct arguments, and engage in academic writing. Research consistently identifies both the pedagogical promise of GAI and the ethical, epistemic, and equity-oriented challenges that accompany its use (Cotton *et al.*, 2024; Caccavale *et al.*, 2022). Yet the field lacks a theoretically integrated and empirically grounded understanding of how GAI mediates learning processes in ways consistent with established learning theories. For this reason, constructivist learning theory (CLT) provides a productive lens for evaluating GAI's influence. Unlike technological determinist accounts that emphasize AI efficiency, CLT highlights the mechanisms through which learners actively co-construct knowledge through iterative meaning-making, interaction, and reflection. When viewed through this lens, GAI is best understood not merely as an efficiency tool but as a mediational partner that shapes learners' cognitive processes and supports the construction of higher-order thinking.

Constructivist learning theory (CLT) as a foundation for GAI integration

Constructivist learning theory (CLT) positions learning as an active, socially mediated process in which students generate understanding through engagement, inquiry, and the integration of prior knowledge (Piaget, 1970; Vygotsky, 1978; Dewey, 1938). Within this tradition, tools such as GAI function as cognitive mediators that expand the learner's zone of proximal development (ZPD) by offering scaffolds, prompts, representations, and dialogic interactions that learners can internalize (Vygotsky, 1978). Unlike earlier educational technologies that primarily delivered content, GAI generates adaptive responses that learners can critique, reorganize, and build upon. This dialogic adaptability aligns with CLT's emphasis on co-construction: learners do not receive knowledge passively from GAI; they engage in a back-and-forth process of testing interpretations, refining ideas, and regulating their cognitive strategies.

This dynamic is supported by emerging research that conceptualizes GAI tools as collaborative cognitive partners rather than static sources of information. For example, Essien *et al.* (2024) found that postgraduate students used GAI to engage in exploratory ideation and epistemic positioning, indicating a form of cognitive apprenticeship in which learners iteratively refine their reasoning. Mungai *et al.* (2024) similarly argue that AI chatbots support knowledge-building cycles within learning management systems by responding to student-generated prompts in ways that stimulate reflection and conceptual restructuring. These findings illustrate mechanisms fundamental to CLT: external dialog with a mediating partner becomes internalized as metacognitive control, thereby strengthening learner agency.

What makes GAI distinctive in this context is its capacity for contingent responsiveness, the ability to adjust its output to the specificity of students' questions, drafts, or confusions. This feature situates GAI more closely to a human tutor than to earlier forms of educational technology and suggests that GAI can serve as a scaffold that enables learners to articulate uncertainty, test preliminary reasoning, and access forms of feedback otherwise unavailable in asynchronous environments.

GAI as a cognitive partner: mechanisms and tensions

Recent literature characterizes GAI as a "cognitive collaborator" capable of providing brainstorming support, feedback, and adaptive scaffolds (Mungai *et al.*, 2024; Essien *et al.*, 2024).

These studies illuminate the specific mechanisms through which GAI can support constructivist learning:

- (1) Dialogic scaffolding: Students engage in conversational exchanges with GAI that mirror peer discourse, prompting them to articulate assumptions, reorganize ideas, and evaluate alternative perspectives.
- (2) Metacognitive prompting: GAI can highlight inconsistencies, gaps, or logical weaknesses in a student's argument, stimulating reflective regulation.
- (3) Generative feedback: GAI can offer multiple representations of a concept, enabling learners to test and refine their interpretations.

However, this cognitive potential is accompanied by tensions. Studies warn that overreliance on GAI can reduce learner initiative or externalize too much of the cognitive labor (Kamali *et al.*, 2024; Sáez-Velasco *et al.*, 2024). Importantly, most existing research does not empirically trace *how* these tensions manifest in authentic coursework. The majority of studies rely on surveys, conceptual reviews, or short-term experimental tasks that do not capture longitudinal interaction patterns or the iterative nature of writing development. Consequently, little is known about the developmental trajectory through which students learn to calibrate, critique, or internalize GAI feedback.

Academic integrity, ethical use and institutional tensions

The International Centre for Academic Integrity (2021) defines academic integrity as a commitment to six fundamental values: honesty, trust, fairness, respect, responsibility, and courage, even in the face of adversity. Concerns about academic integrity remain central to discussions of GAI in higher education. Researchers highlight the difficulty of distinguishing between student-authored and GAI-generated prose (Elkhatat *et al.*, 2023), the potential for plagiarism through GAI-assisted writing (Cardon *et al.*, 2023), and the broader need for transparency in student-GAI interactions. Beyond detection challenges, inequities in access to GAI tools raise concerns about fairness and the amplification of existing digital divides (Jia and Tu, 2024; Kasneci *et al.*, 2023). These equity considerations are pedagogically significant because constructivist models emphasize learner agency, self-regulation, and collaborative engagement, capacities that may not develop uniformly if students' access to GAI-mediated scaffolding is uneven.

Constructivist frameworks also help clarify why academic integrity concerns cannot be addressed solely through detection or restriction. Instead, educators must position GAI as a transparent, accountable learning partner by designing assignments that require reflection, justification, and iteration, activities that resist simple substitution by GAI-generated text. Guided prompts, when embedded into scaffolded milestones, provide such structure, enabling learners to engage with GAI in ways that emphasize critique and decision-making rather than outsourcing thought.

Constructivist pedagogy, learner agency and social interaction in GAI-mediated learning

Constructivist pedagogy emphasizes learner agency, autonomy, and social interaction (Grubaugh *et al.*, 2023; Huang *et al.*, 2024). The integration of GAI introduces new modalities for exercising learner agency: students can interrogate GAI outputs, adopt roles such as critic or evaluator, and shape the trajectory of the GAI-mediated dialog. Richter *et al.* (2024) demonstrate that when learners use GAI to test ideas and receive feedback, they exhibit increased self-regulation and autonomy, central dimensions of learner agency in CLT. Similarly, Zhou and Schofield (2024) show that GAI-supported collaborative tasks can approximate peer discussion by encouraging students to justify reasoning and generate counterarguments. Campello de Souza *et al.* (2024) take this argument a step further, suggesting that human-AI collaborations may stimulate creativity and cognitive development.

However, limited research explores whether such partnerships enhance or hinder students' autonomy, collaboration, or self-efficacy in practice.

Yet empirical research remains limited in two important methodological ways. First, most studies do not analyze process data (e.g. interaction logs, revision histories) that would trace how learners' cognitive strategies evolve through repeated GAI use. Second, existing studies rarely employ design-based research (DBR) or longitudinal mixed-methods methodologies that would capture how learner agency develops across extended writing tasks. These methodological constraints prevent the field from assessing how learners internalize GAI-mediated scaffolding or how AI-supported collaboration interacts with human peer learning.

AI in writing, content creation and guided scaffolding

Generative AI has been widely adopted as a support for academic writing, with students using it to synthesize literature, identify arguments, or refine drafts (Hisham *et al.*, 2024; Zhou and Schofield, 2024). These functions reduce cognitive load, allowing learners to focus on analysis, synthesis, and creativity, skills emphasized in constructivist education. From a constructivist perspective, the pedagogical value of GAI in writing lies not in its capacity to generate text but in its potential to facilitate recursive meaning-making. When students use GAI to analyze structure, test interpretations, or evaluate coherence, they externalize internal cognitive processes, enabling iterative refinement consistent with CLT principles of scaffolding and co-construction.

Instructors also report that GAI can enhance student autonomy and support self-regulated learning (Lodge *et al.*, 2023). However, this is not without risk. Kamali *et al.* (2024) and Sáez-Velasco *et al.* (2024) note that overreliance on GAI may reduce students' initiative, with some learners outsourcing thinking to machines. Similarly, Caccavale *et al.* (2022) raise concerns about GAI's algorithmic bias and its unequal impact on marginalized learners.

Instructor-designed prompts can strengthen these processes by constraining the function of GAI, such as focusing GAI responses on organization, argumentation, or conceptual clarity rather than content generation. Mollick and Mollick (2023a, b) propose frameworks for specifying GAI roles (mentor, critic, tutor), while Nazari and Saadi (2024) offer structured models (Task, Context, Instruction (TCI), Role, Audience, Tone, Examples, Limits (RATEL)) for educational prompt design. Yet few empirical studies examine how such roles or prompt designs affect students' writing development over multi-stage assignments or whether students internalize the reasoning strategies modeled by GAI. Instead, most research remains short-cycle or hypothetical, rather than embedded in authentic coursework.

Gaps in existing research and rationale for the present study

Zhou and Schofield (2024) note that although higher education institutions are experimenting with AI integration, there remains a limited empirical base for confirming its learning benefits or best practices, indicating the need for empirically grounded, context-specific research that moves beyond conceptual analyses and examines how AI-supported learning unfolds in real-world classrooms. While early studies demonstrate the benefits of AI in content generation, further research is needed to explore how it can enhance learning without compromising critical engagement (Sáez-Velasco *et al.*, 2024). Across the literature, several methodological gaps hinder the field's ability to understand how GAI supports constructivist learning in practice:

- (1) Lack of longitudinal or milestone-based empirical studies capturing how students use GAI across complex writing tasks.
- (2) Insufficient analysis of learning processes, such as how students' prompts evolve, how they revise in response to GAI feedback, or how metacognitive strategies develop.
- (3) Limited design-based research examining iterative refinement of GAI scaffolds in partnership with instructors and learners.

- (4) Minimal focus on authentic classroom contexts, with most studies relying on surveys or short experimental tasks detached from academic writing realities.

For example, although papers like [O'Dea and O'Dea \(2023\)](#) and [O'Dea \(2024\)](#) present reasonably comprehensive conceptual reviews of AI in higher education, they are conceptual and theoretical, lacking empirical data that limits their ability to make evidence-based claims. [Perkins et al. \(2024\)](#) work introduces an innovative AI Assessment Scale (AIAS), which promotes a more constructive and nuanced approach to AI integration in learning, supporting skill development and ethical engagement. However, the AIAS has only been piloted in a limited context, so its effectiveness in diverse learning environments remains untested. Similarly, while many researchers position AI as a solution to educational challenges, there is insufficient data to substantiate claims about its impact on motivation, critical thinking, or long-term retention ([Rasul et al., 2023](#); [Zhou and Schofield, 2024](#)). Additionally, [Sáez-Velasco et al. \(2024\)](#) suggest another gap in the literature concerns how to facilitate effective communication with AI, as it still lacks empathy and multimodal expression, thereby limiting its ability to replace genuine human dialog.

The present study addresses these gaps by examining how guided, milestone-driven GAI prompts function as structured scaffolds within two asynchronous business courses. By coupling empirical survey data with qualitative feedback on students' engagement and writing processes, this study contributes evidence about how GAI supports the co-construction of learner agency, critical thinking, and writing competence within constructivist learning environments, an area where prior studies remain largely conceptual or methodologically narrow.

Methodology

Study Context – Building on recent recommendations by [Gupta et al. \(2024\)](#) regarding effective strategies for integrating GAI into course design and delivery and the theoretical and empirical foundations outlined previously, this study explores the practical implementation of GAI within a CLT framework. This study was conducted at a mid-sized, public university in the northeastern United States offering fully asynchronous undergraduate and postgraduate business programs to a diverse student population. Both courses examined in this research, an upper-level undergraduate course in project management and a postgraduate course in emerging issues, are housed within the institution's business school and follow a standardized online instructional design model. Students enrolled in these programs are predominantly working adults and nontraditional learners who complete coursework remotely and asynchronously, a contextually rich and representative sample. The instructor maintained instructional presence through weekly announcements, formative feedback on assignments, and structured learning modules.

This study intentionally selected these two courses because each includes a required multi-stage term paper that aligns closely with the study's focus on constructivist, scaffolded learning. In both courses, the instructor designed the term paper to promote iterative knowledge construction and the application of theoretical concepts to real-world organizational problems, an ideal context for examining how guided GAI prompts support writing development within a constructivist framework.

Five milestones structure the 14-page paper: (1) topic selection and introduction, (2) literature exploration, (3) three tables and figures added with corresponding writing, (4) partial draft, and (5) final paper submission. Rubrics accompany milestones that emphasize clarity of argument, integration of sources, organization, and critical analysis. Because the same instructor taught both courses, instructional design elements such as grading expectations, feedback practices, and assignment structures were comparable across course levels. This consistency provided a stable foundation for introducing guided GAI prompts as a pedagogical intervention.

The decision to integrate structured GAI prompts into the two courses was grounded in CLT, which emphasizes iterative scaffolding, reflective meaning-making, and the active construction of knowledge. In asynchronous online environments, students often face challenges related to delayed feedback, writing anxiety, and difficulties structuring complex tasks such as multi-stage papers. Therefore, the instructor introduced the guided GAI prompts as a form of just-in-time cognitive and metacognitive scaffolding intended to support students' idea development, organization, and engagement throughout the writing process.

While the inclusion of an undergraduate and a postgraduate course allowed for comparison across different learner populations, the absence of random assignment and reliance on intact course sections represents a contextual limitation of the study. Nonetheless, the consistent instructional design, common term paper structure, and shared pedagogical goals of the two courses provided a meaningful context for examining how structured GAI tools function within milestone-driven writing assignments.

A case study methodology is well aligned with the exploratory aims of this research and the constructivist epistemology guiding it. Because CLT conceptualizes learning as situated, socially negotiated, and contextually mediated, examining the pedagogical integration of GAI within two intact online courses provides the most appropriate unit of analysis. Alternative designs, such as experimental or quasi-experimental approaches, were not feasible due to the absence of random assignment, the reliance on established course structures, and the instructor's ethical obligation to provide consistent support across learners. The researchers therefore adopted a mixed-methods design to capture both measurable trends in student perceptions and the deeper cognitive, emotional, and developmental processes articulated in open-ended responses. This design choice reflects the view that understanding constructivist learning requires integrating quantitative indicators with qualitative evidence of how learners interpret, negotiate, and internalize scaffolding, particularly when working with rapidly evolving technologies.

Each methodological choice in this study aligns with core constructivist constructs. The use of scaffolded milestones mirrors CLT's emphasis on iterative knowledge building and guided progression within the learner's zone of proximal development. The multi-stage term-paper sequence operationalizes constructivist processes of inquiry, reflection, and meaning-making, while asynchronous instruction foregrounds learner autonomy and self-regulated learning, conditions in which CLT predicts a strong reliance on scaffolding. Similarly, the GAI prompts function as mediational tools, providing just-in-time cognitive support that facilitates active construction of ideas rather than passive consumption. The mixed data sources, including surveys and qualitative responses, capture the socially and cognitively constructed nature of learning experiences, consistent with constructivist epistemology.

Courses – The researchers collected data from students in two business courses taught in Fall of 2024: one undergraduate course from an online degree-completion program in Business Administration (Project Management) and one postgraduate elective course in an MBA program (Emerging Issues). The instructor delivered both courses asynchronously and entirely online. There were 22 students in the postgraduate course and 28 in the undergraduate course. Of the 50 students enrolled, 29 responded to the study survey, yielding a response rate of 58%. While this sample was diverse in terms of student background and program level, though the relatively modest response size may constrain generalizability, the sample remains representative of nontraditional and online learners, a demographic of particular relevance to research on AI-supported instruction.

The sampling strategy combined convenience sampling, as students were drawn from intact course sections, with purposive sampling, as the instructor selected these courses specifically for their scaffolded, milestone-driven term paper design that aligned with CLT constructs. Participation in the survey was voluntary, introducing a degree of self-selection that may influence the survey findings; students who felt more positively, or negatively, about GAI-enhanced learning may have been more inclined to respond. As a result, the data are most transferable to similar online, asynchronous, adult-learning environments rather than broadly

generalizable across all instructional contexts. Nonetheless, this sampling strategy is appropriate for an exploratory case study aimed at theory-building and generating early empirical insights in a rapidly evolving pedagogical domain.

Term Paper Assignment Design – Each course required students to complete a term paper structured around five milestones, submitted every two weeks. This scaffolded assignment supported the development of a comprehensive research paper through a series of guided stages.

Term papers consist of a title page and an introductory section, followed by a thorough literature review that synthesizes existing research. The subsequent sections comprise the main body of the paper, which incorporates analysis, tables, and figures accompanied by narratives. The final submission is a complete manuscript of 14–20 pages of text (excluding the title page, references, tables, and figures), demonstrating research depth, critical thinking, and academic writing proficiency. [Table 1](#) presents a general overview of the scaffolded term paper milestones.

GAI Prompt Integration – In alignment with constructivist principles, the instructor provided GAI prompts for each term paper milestone. These prompt categories were informed by the instructor’s prior experience with academic writing and aligned with common challenges in student writing identified in prior iterations of the course. The instructor designed these prompts to guide students’ thinking, support the organization of their ideas, and aid the writing process. Prompts addressed a range of tasks, such as generating research titles, organizing literature reviews, brainstorming tables and figures, structuring paper sections, and refining drafts. The prompts served as structured starting points to promote focused, high-quality work while still allowing students to maintain their individual voices and analytical perspectives. [Table 2](#) presents a list of GAI prompts provided to students, organized by milestone.

Survey Design and Data Collection – Researchers employed a 20-question survey comprising 10 closed-ended and 10 open-ended questions. These questions assessed students’ perceptions of how GAI prompts affected engagement, critical thinking, and writing development within a constructivist framework. Survey participation was voluntary, and students completed the survey at the end of the semester during course evaluations. IRB approval was unnecessary since the institution allows supplemental questions to assess and improve instruction at the end of the semester. The instructor, with prior experience in instructional design and formative assessment, created the initial draft, which two other faculty members reviewed for completeness and clarity. While peer review improved face validity, the absence of a pilot test may limit the ability to assess the internal consistency or reliability of questions. Because the survey instrument was not pilot-tested and the researchers calculated no statistical reliability measures (e.g. Cronbach’s alpha), the researchers cannot definitively

Table 1. High-level overview of scaffolded term paper milestones (due every 2 weeks during F24)

Code	Description	%
FP1	Title page, 1 to 1.5-page introduction with transition paragraph, and properly formatted references	5%
FP2	Literature Review (at least 4 pages), transition paragraph with selection of focus for sections after the Literature Review and properly formatted references	5%
FP3	Minimum of three tables and figures plus 1 to 2 pages of writing that corresponds to the tables and figures in the paper placed in appropriate sections after the Literature Review section and properly formatted references	5%
FP4	Four additional pages of well-structured writing and properly formatted references for a total of at least five pages after the Literature Review section (includes writing from FP3)	5%
FP5	Complete paper with 14- to 20-pages of text excluding title page, properly formatted references, tables and figures	5%

Table 2. F24 GAI prompts provided to students, separated by term paper milestones

Milestones	GAI prompts
1	• Research design: Suggest a research study on “my chosen topic.” • <i>Paper subsection ideas</i>: Suggest 7 to 10 subsections for a term paper on “my chosen topic.” • <i>Audience</i>: Suggest 7 to 10 types of individuals who might be interested in reading a term paper on “my chosen topic.” • <i>Potential research titles</i>: Suggest 7 to 10 titles for a term paper on “my chosen topic.” • <i>Potential research titles (alternative prompt)</i>: Suggest 7 to 10 imaginative, representative, understandable, clear, creative, catchy, or concise titles for a term paper on “my chosen topic.”
2	• <i>Literature review chronological outline</i>: Suggest a chronological organizational outline of a literature review for a term paper on “my chosen topic.” Base the outline on the historical development of ideas, theories, or research in “my chosen topic’s” field. It should showcase the evolution of thoughts over time • <i>Literature review outline</i>: Suggest a theoretical framework outline of a literature review on “my chosen topic.” This approach should organize the review based on different theoretical perspectives or frameworks used in the literature, demonstrating how various theories contribute to understanding the research topic
3	• <i>Brainstorming tables</i>: Suggest 7 to 10 Table 1 could include in a term paper on “my chosen topic.” • <i>Table content</i>: Suggest 15 to 20 table entries relevant to “my chosen topic’s table title” with a one-sentence description of each • <i>Brainstorming figures</i>: Suggest 7 to 10 figures I could include in a term paper on “my chosen topic.” • <i>Figure content</i>: Suggest 3 to 5 ways to visually represent a figure relevant to “my chosen topic’s figure title” with a description of its content
4	• <i>Structuring a section</i>: Please help me structure the section of my term paper titled “section title” on the term paper topic “my chosen topic.” This section should include introductory content for the section, with clearly presented key points, supporting evidence, analysis, and concluding remarks. Provide a detailed outline with suggested subsections and paragraph headings, and offer tips on effectively transitioning to the next section, which is titled “next section’s title.” Here is a brief overview of my main arguments and evidence: “my main arguments and evidence.” • <i>Critique writing</i>: Please provide a detailed critique of the following section in my term paper titled “paper title” on the term paper topic “my chosen topic.” The section of my research paper is titled “section title.” Consider the clarity of the research question or questions, organization of ideas, coherence of arguments, use of evidence, grammatical accuracy, and overall writing style. Make sure citations conform to APA 7 citation style. Offer constructive feedback on areas of improvement and highlight the strengths of the writing. Here is the writing for the section: “section writing.” • <i>Improve Writing</i>: Please help me rewrite the section of my paper titled “section title” within a term paper titled “term paper title.” The goal is to improve clarity, coherence, and overall flow while retaining the original meaning and key points. Write for a business professional with 5–10 years of experience. Make sure citations conform to APA 7 citation style. Here is the original text: “section writing.”
5	• <i>Critique references</i>: Please critique the references at the end of my term paper to ensure they conform to APA 7 citation style. Check for correct formatting, including author names, publication dates, titles, and source information. The list of references should be alphabetic. Here is the list of references: [insert reference list] • <i>Generate Managerial and Social Implications</i>: I need help summarizing the managerial and social implications of my term paper. Below is my writing that discusses “my chosen topic.” Please help me create a concise summary that is well structured of the managerial and social implications from the following text: “[Insert the relevant section(s) here].” • <i>AI Prompt to Generate Conclusion</i>: I need help crafting a conclusion for my term paper. My paper explores [briefly describe the main topic and research question]. Please write it in the third person, avoiding adding any new information. Here is the main body of my paper for reference: “[insert main body of the paper].” Can you help me create a conclusion that summarizes the key research findings, proposes avenues for future research, reiterates the research question, highlights the broader impact of my research and its importance, and includes some final thoughts

establish the internal consistency of the instrument. This limitation is partly attributable to the exploratory nature of the research and the rapid pace of technological change in GAI use in higher education. In many respects, the study itself functions as a pilot test of both the instructional intervention and the measurement approach, with the instructor and students simultaneously adapting to the capabilities and constraints of an emerging technology. The instructor designed the questions to balance measurable outcomes (via frequency and percentage analysis) with space for open reflection. Table 3 summarizes the survey questions and previews corresponding findings.

Research Questions and Mapping – The overarching research question guiding this study was:

Do milestone-driven GAI prompts enhance student engagement, critical thinking, and writing development in a CLT environment?

To explore this question, specific survey items were aligned as follows:

- (1) Student engagement: RQ1, RQ2, RQ6, and RQ7 assessed students' feelings of engagement when working with GAI prompts, exploring both emotional and cognitive engagement as central components of active learning.
- (2) Critical thinking and innovation: RQ3a and RQ3b focused on whether students used prompts to reflect and engage with content in new or innovative ways, determining if GAI prompts stimulated deeper analysis or novel interpretations consistent with constructivist pedagogy.
- (3) Writing structure and quality: RQ4a, RQ4b, RQ4c, and RQ5 examined how prompts supported the structuring, drafting, and revision of the term paper, measuring the influence of GAI scaffolding on writing clarity, organization, and revision quality.
- (4) Evaluation of GAI use: RQ8 and RQ9 asked students to critically evaluate the quality and relevance of the provided GAI prompts. Analysis revealed that while students used the prompts, many found it difficult to assess the quality of the prompts independently.

Data Analysis – Data were analyzed using frequency and percentage analysis to identify patterns in the closed-ended responses. The researchers employed inductive thematic analysis, which provided a more nuanced profile of what students found helpful about the prompts. To enhance validity, the researchers triangulated survey findings with multiple supplementary data sources, including milestone grades, qualitative comments embedded in course evaluations, and additional learning artifacts, such as draft submissions, revision patterns, and LMS activity logs, which offered indirect evidence of engagement and iterative writing development. While the researchers did not formally code these sources, they provide essential contextual corroboration of learners' reported experiences and strengthen the methodological alignment with constructivist inquiry.

Findings

General Trends and Prompt Helpfulness Overview – This section presents findings related to the core research question.

Research question: *Do milestone-driven GAI prompts enhance student engagement, critical thinking, and writing development in a CLT environment?*

Numerous students reported that using GAI prompts enhanced their work, allowing them to explore new perspectives, think critically, and refine their papers. Of the 29 students who responded, a total of 93.1% found the instructor-provided GAI prompts helpful in guiding their thinking and writing. While students varied in their assessment of the GAI prompts, the most significant percentage (34.5%) found them to be very helpful. The same percentage of students, 93.1%, also agreed they were satisfied with the provided GAI prompts. Considering

Table 3. Research questions and corresponding findings

ID	Research question	Finding Percent	Answer
RQ1	What frequency do students use GAI prompts throughout the term paper-writing process?	6.9% 6.9% 65.5% 13.8% 6.9%	Never Rarely Sometimes Very often Always
RQ2	What do students think of the perceived helpfulness of instructor provided GAI prompts in guiding their thinking and structuring their writing?	6.9% 17.2% 20.7% 34.5% 20.7%	Not helpful at all Slightly helpful Moderately helpful Very helpful Extremely helpful
RQ3a	Did GAI prompts influence students to think more critically or deeply about their research topics?	0.0% 10.3% 17.2% 44.8% 27.6%	Never Seldom Sometimes Often Almost always
RQ3b	Did GAI prompts encourage students to explore new aspects or perspectives of their research topic that they hadn't considered before (i.e. question asked of students was "GAI prompts inspired me to approach my term paper topic from a new perspective.")?	3.5% 3.5% 13.8% 44.8% 34.5%	Strongly disagree Disagree Undecided Agree Strongly agree
RQ4a	What role, if any, did GAI prompts play in enhancing students' ability to structure or organize their term papers (i.e. question asked of students was "GAI prompts were _____ in structuring or organizing my paper.")?	3.4% 3.4% 31.0% 34.5% 27.6%	Not helpful at all Slightly helpful Moderately helpful Very helpful Extremely helpful
RQ4b	What role, if any, did GAI prompts play in enhancing students' ability to draft sections of their term papers (i.e. question asked of students was "GAI prompts made it _____ to draft specific sections of my paper.")?	10.3% 6.9% 48.3% 31.0% 3.4%	Not easier at all Slightly easier Moderately easier Very easy Extremely easy
RQ4c	What role, if any, did GAI prompts play in enhancing students' ability to refine sections of their term papers (i.e. question asked of students was "GAI prompts effectively helped me refine my term paper's main points.")?	3.4% 3.4% 13.8% 62.1% 17.2%	Strongly disagree Disagree Undecided Agree Strongly agree
RQ5	What was the overall impact of GAI prompts on the quality of students' final term papers (i.e. question asked of students was "GAI prompts improved the quality of my final paper.")?	0% 6.9% 3.4% 48.3% 41.4%	Strongly disagree Disagree Undecided Agree Strongly agree
RQ6	How satisfied were students with the instructor provided GAI prompts (i.e. question asked of students was "I liked the fact that GAI prompts were provided in the course.")?	0% 0% 6.9% 31.0% 62.1%	Strongly disagree Disagree Undecided Agree Strongly agree
RQ7	What specific challenges did students encounter while using GAI prompts and their impact on learning outcomes? (no meaningful impact on learning outcomes mentioned in the six student replies)		• Irrelevant results sometimes • Too much info and had to select • Incorrectly formatted citations • Needed to reword prompts to get desired output • Didn't always provide useful info • Hallucinations occurred occasionally

(continued)

Table 3. Continued

ID	Research question	Finding	Answer
		Percent	
RQ8	What student suggestions exist for improving the effectiveness of GAI prompts at each milestone of the term paper process?		For practical purposes, there was only one suggestion (from two students) for improving the prompts. They felt that the one prompt asking for 10 to 15 suggestions from GAI was too many. The finding should not be a surprise since GAI prompts used in this manner are new to students
RQ9	What types of GAI prompts did students find most beneficial and identify additional prompts that could further support their learning process?		Most students didn't answer this question directly. Instead, the common theme was they wished they had used the provided GAI prompts earlier in the semester

the feedback from students, many students noted the long-term learning benefits of GAI prompts, aligning with constructivist principles (Vygotsky, 1978; Adams, 2006). These patterns suggest that GAI prompts may function as distributed cognitive tools within a CLT environment, extending learners' capacity to engage in exploratory reasoning and iterative meaning-making. In this sense, GAI prompts appear to operate as a form of mediated scaffolding, enabling learners to activate prior knowledge, test emerging interpretations, and gradually internalize higher-order thinking strategies.

Critical Thinking and Perspective-Taking Results – Specifically, 79.3% of students agreed or strongly agreed that the GAI prompts encouraged them to explore new aspects or perspectives in their research. Improved critical thinking skills further supported this cognitive expansion. The vast majority of students indicated that the GAI prompts helped them think more deeply in some capacity, with 44.8% selecting 'agree' and 34.5% selecting 'strongly agree.' These results echo Mungai et al.'s (2024) observation that constructivist learning is "an engaged process in which learners generate novel concepts" (p. 4710). The alignment between GAI-supported inquiry and these constructivist outcomes suggests that GAI may catalyze cognitive apprenticeship, where learners externalize their tentative reasoning, receive real-time modeling and feedback, and progressively refine their conceptual frameworks. This mechanism provides a plausible account for why students reported deeper perspective-taking even when not explicitly prompted to revise their arguments.

Impact on Writing and Technical Improvements – As tools accessible beyond the classroom, GAI prompts offered immediate feedback that students could incorporate in real-time. This feature led to noticeable improvements in students' technical writing. Specifically, 79.3% of students agreed or strongly agreed that the prompts helped them refine sections of their papers. Furthermore, 89.7% reported that the GAI prompts contributed to an increase in the quality of their final submissions. Qualitative responses supported these findings. Several students described using GAI as a "supportive partner" for generating ideas, refining paper structure, and alleviating writing anxiety. As one student shared, "After writing, the GAI feedback provided was critical in refining the paper." Another student stated, "GAI is an instrumental decision-making force, saving much time throughout the semester, from narrowing down topics and drafting outlines to organization and formatting." See Table 3 for a list of the research questions and their corresponding student responses, most often stated as percentages.

Within a constructivist framework, such improvements may be evidence of iterative internalization: students leverage GAI not as a source of answers, but as a dialogic partner that helps them articulate, test, and reorganize ideas. This dialogic interaction mirrors the

co-construction of knowledge emphasized in CLT, wherein learners gradually convert external assistance into internal competence.

Qualitative Insights from Student Comments and Implications – Student comments revealed a marked contrast between courses with and without GAI support. Many students expressed they wished they had utilized the provided GAI prompts earlier in the semester, with some stating that the experience helped “demystify” both academic writing and GAI-assisted learning. To contextualize these experiences across different instructional models, the following subsection compares courses based on structural and technological variables.

Cross-Course Comparison – An additional variable complicating interpretation is the variation in team size across courses. While some classes involved collaborative term papers, others were completed by individuals. Notably, one potential configuration, individual writing with GAI support, was not present in the sample. This absence highlights an area for future experimentation, as GAI’s benefits may be particularly salient for students without peer collaborators. Refer to [Table 4](#) for a breakdown of courses categorized by team size and GAI prompt integration for the term paper.

A comparison of milestone grades between GAI-prompt and non-GAI-prompt courses revealed meaningful patterns in students’ performance trajectories (See [Table 5](#) for a cross-milestone grade comparison (GAI-prompt courses vs. non-GAI-prompt courses)). Although students in the GAI-prompt courses initially earned lower scores across the early milestones (milestones 1 to 3 for the undergraduate class and milestones 1 to 4 for the postgraduate class), the postgraduate performance converged with and ultimately surpassed the non-GAI group by the final milestone and the undergraduate performance for students who used the GAI prompts appropriately were approximately the same as the non-GAI-prompt course. The reason the fifth milestone grades for the undergraduate class is significantly lower (first number) is because the instructor carefully checked citations and references, which was not done in the non-GAI-prompt class. When students who were caught reference stuffing are eliminated from the data set, the resulting average was 87% (second number), which was much closer to the previous year’s final average. The instructor has since implemented a research log and

Table 4. Courses separated by term paper’s team size and AI prompt usage

Term paper types		AI prompts?	
		No	Yes
Team size?	= 1	GF23	
	>1	US24	GF24, UF24

Note(s): Where GF23 indicates this is a postgraduate course delivered fall semester of 2023

Table 5. Cross-milestone grade comparison (AI-prompt courses vs. non-AI-prompt courses)

Milestone	Postgraduate class			Undergraduate class		
	GAI-prompt course (mean %)	Non-GAI-prompt course (mean %)	Mean difference	GAI-prompt course (mean %)	Non-GAI-prompt course (mean %)	Mean difference
1	89.0%	93.1%	−4.1	70.8%	84.6%	−13.8
2	87.2%	84.8%	−2.4	70.1%	75.4%	−5.3
3	85.9%	87.9%	−2.0	77.9%	72.3%	5.6
4	84.0%	92.6%	−8.6	80.4%	74.2%	6.2
5	88.9%	87.3%	1.6	71.9%/87%	89.4%	−17.5/-2.4

other measures like class notifications emphasizing academic integrity, in addition to the paper, to prevent future reoccurrences of citation irregularities. This pattern suggests that students required time to adjust to the scaffolded, GAI-supported writing process. Such early performance dips are consistent with constructivist models in which learners experience temporary disequilibrium before demonstrating higher-level integration and synthesis (Piaget, 1970; Vygotsky, 1978). The upward trajectory in milestones 3 and 4 for the undergraduate class, and milestone 5 for the postgraduate class, combined with qualitative evidence of increased metacognitive reflection, indicates that GAI prompts may facilitate deeper learning even when immediate grade improvements are not observed. The challenge has and still remains that a reasonable number of students still try to utilize GAI to think for them (i.e. GAI submitted work as their own).

Subgroup analyses revealed notable differences in how undergraduates and postgraduate students perceived the GAI prompts (See Table 6 for subgroup comparison of perceptions (postgraduate vs. undergraduate students)). Postgraduate students consistently rated the prompts as more helpful across all categories, especially in promoting critical thinking. These differences may reflect postgraduate students' greater familiarity with academic writing conventions or their more immediate professional need for advanced skills. The finding also aligns with CLT literature suggesting that learners with more domain knowledge benefit more quickly from higher-level scaffolding, whereas less experienced writers may take longer to translate feedback into improved performance. The divergence underscores the need for differentiated GAI prompt design that accommodates learners at varying levels of academic maturity.

Instructor Reflection and Implications – Beyond student-reported outcomes, the instructor's perspective revealed further complexities in evaluating the pedagogical impact of GAI. From the instructor's perspective, the challenge is that the grades in GAI-supported and non-GAI-supported courses were not substantially different, but the grading algorithm was different. Although students reported notable cognitive and affective benefits, these advantages did not consistently manifest in improved grades. This finding may reflect a recalibration of instructor expectations in response to GAI-assisted writing rather than a lack of learning gain. In six out of ten milestone comparisons, when the instructor provided students with GAI prompts, their submissions received lower average grades (see Table 7 for summary statistics of class grades by milestone). This situation may reflect the non-linear and exploratory nature of CLT, in which intellectual growth does not always result in immediate grade improvements but contributes to long-term academic development. More specifically, the temporary decline in grades may reflect the cognitive disequilibrium frequently observed when learners are introduced to new scaffolding tools that require metacognitive adjustment. Students may initially rely on GAI in surface-level ways or struggle to integrate GAI feedback

Table 6. Subgroup comparison of perceptions (postgraduate vs. undergraduate students)

Survey item	Undergraduate mean (1–5)	Postgraduate mean (1–5)	Difference
GAI prompts led me to explore an aspect of my topic that I hadn't considered before	4.00	4.08	+0.08
GAI prompts helped me think more critically or deeply about my term paper topic	3.75	4.08	+0.33
GAI prompts inspired me to approach my term paper topic from a new perspective	3.94	4.38	+0.44
GAI prompts effectively helped me refine my term paper's main points	3.81	3.92	+0.11
I liked the fact that GAI prompts were provided in the course	4.38	4.77	+0.39
GAI prompts improved the quality of my final paper	4.00	4.54	+0.54

Table 7. Summary statistics of class grades by milestone

Milestones	Grade statistics	Postgraduate class		Undergraduate class	
		GF24	GF23	UF24	US24
1	Average	89.0%	93.1%	70.8%	84.6%
	Median	96.0%	95.5%	74.8%	94.5%
	Mode	98.0%	100%, 96%	90.0%	95.0%
	Minimum	40.0%	78.0%	43.0%	10.0%
	Std dev	14.6	6.1	19.0	24.9
2	Average	87.2%	84.8%	70.1%	75.4%
	Median	96.5%	87.5%	76.0%	85.5%
	Mode	100.0%	100%, 80%	5 modes	85.0%
	Minimum	24.0%	60.0%	24.0%	60.0%
	Std dev	24.9	11.2	20.4	28.3
3	Average	85.9%	87.9%	77.9%	72.3%
	Median	98.0%	89.5%	75.5%	85.5%
	Mode	100.0%	100.0%	74.0%	6 modes
	Minimum	23.0%	60%	59.0%	50.0%
	Std dev	25.9	11.5	12.45	29.7
4	Average	84.0%	92.6%	80.4%	74.2%
	Median	96.0%	96.5%	80.0%	85.5%
	Mode	100.0%	100%	5 modes	92%
	Minimum	60.0%	75.0%	65.5%	64.0%
	Std dev	28.5	8.9	9.7	28.8
5	Average	88.9%	87.3%	71.9%	89.4%
	Median	95.0%	85.0%	83.0%	93.0%
	Mode	98.0%	100%, 82%	50%, 90%	95.0%
	Minimum	55.0%	75.0%	40.0%	30%
	Std dev	22.1	8.6	18.8	14.0

with instructor expectations. Over time, however, as students recalibrate their strategies, the qualitative data suggest a shift toward deeper engagement, even if numerical achievement remains comparatively stable. This distinction underscores the need to interpret performance trajectories through a developmental rather than purely outcome-based lens.

These mixed patterns introduce a layer of causal ambiguity: while students reported enhanced understanding, confidence, and critical engagement, such gains did not consistently translate into higher grades early in the milestones. One plausible explanation is that the grading criteria may be insufficiently sensitive to the types of learning fostered by CLT and GAI, namely, exploratory reasoning, perspective-taking, and reflective iteration. Another possibility is that increased grading rigor (e.g. stricter citation scrutiny) disproportionately affected the GAI-supported cohort, creating the appearance of stagnant performance despite underlying learning gains (which agrees with the perspective of the instructor). Finally, learners' adjustment period to scaffolded GAI-supported processes may delay observable performance improvements or the GAI prompts were not sufficiently sophisticated due to the instructor also learning GAI's capabilities at that time. Clarifying these mechanisms will require future work that disentangles learning growth from assessment practices and examines how grading schemas can more accurately capture constructivist learning trajectories.

When considered alongside the statistical data, these reflections underscore the broader pedagogical implications of guided GAI use. The findings suggest that GAI prompts can foster deep, constructivist-style learning through scaffolded support, iterative improvement, and critical exploration.

In conjunction with technical skill development and affective benefits (e.g. reduced anxiety), GAI may serve as a powerful tool for cultivating long-term academic growth. These results collectively demonstrate that students perceive GAI prompts as valuable aids for developing original thought and perspective-taking. Taken together, the findings indicate that

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GAI prompts may not yield immediate performance gains but instead foster the gradual development of higher-order skills that align with constructivist models of learning. This distinction between developmental progress and measured performance is critical for interpreting the pedagogical role of GAI within CLT-informed instructional designs.

Practical implications

GAI and Constructivist Pedagogy – This study aimed to investigate how guided, milestone-driven GAI prompts can enhance student engagement, critical thinking, and ethical behavior in a CLT environment. The practical findings suggest that when instructors purposefully integrate GAI into course design, it can effectively support the core tenets of constructivist pedagogy, particularly by fostering learner agency, collaboration, and active knowledge construction. Such integration positions GAI not merely as a tool but as a dynamic agent within the learning ecosystem.

Scaffolding and Self-Regulation – Instructor-designed GAI prompts encourage students to move beyond passive information consumption and engage more actively with the material. These prompts facilitate cognitive engagement by supporting exploratory learning and reflection, enabling learners to use GAI as a tool for questioning, analyzing, and constructing their understanding. This process aligns with higher-order cognitive domains in Bloom's taxonomy and fosters self-regulated learning habits. When introduced iteratively, GAI prompts serve as scaffolds in the writing process, cultivating habits of independent inquiry and promoting lifelong learning dispositions. Milestone-driven scaffolding prompts build complexity gradually, supporting iterative growth and reflection, while increasing prompt complexity across milestones. For example, an instructor might suggest for an early milestone that students use the following prompt: "Generate three possible research questions based on my topic. Then explain the assumptions behind each one." Towards the end, students could ask the following: "Review my draft and suggest improvements *only* in organization and clarity, not content creation." Such prompts teach students to *control* GAI outputs, gain autonomy, and use feedback selectively.

GAI as a Cognitive Partner in Learning – Instructors who adopt a constructivist approach to integrating GAI can create dynamic, student-centered learning environments that empower learners to take ownership of their learning processes. Positioning GAI as a cognitive collaborator in the writing process mirrors collaborative learning models, such as team-based assignments, while maintaining individual accountability and responsibility. This approach reinforces students' roles as knowledge constructors and supports Vygotsky's (1978) emphasis on the importance of social interaction in the learning process. The following prompts position GAI as a collaborator to test reasoning and co-construct knowledge, reinforcing the student's identity as an active agent in the learning process: "Play the role of a skeptical peer reviewer and critique my paper from an alternative perspective," or "Help me strengthen my evidence by identifying weaknesses or unstated assumptions," or lastly, "Ask probing questions to help me refine the theoretical framework of my argument." Such prompts promote discourse akin to peer collaboration, cultivating higher-order reasoning, and mirroring the intellectual benefits of peer discourse.

Social Presence in Online Learning Environments – Scaffolded GAI prompts that increase in complexity across milestones help learners gradually develop both confidence and independence in academic writing. These benefits are particularly relevant in asynchronous online courses, which both classes studied were. In such settings, GAI-mediated prompts can approximate instructor or peer dialog by offering timely feedback and iterative support (Zhou and Schofield, 2024). This dynamic interaction fosters a sense of simulated social presence, a factor closely linked to online learner satisfaction and persistence (Richardson *et al.*, 2017). Given the challenges of fostering interaction in online formats, GAI-guided learning tasks may bridge the engagement gap by mimicking interpersonal exchange.

Extending Instructor Presence Through Prompt Design – GAI can also serve as a pedagogical facilitator when instructors design prompts that echo their instructional voice. This design strategy allows learners to experience continuity in tone and emphasis, making the GAI-mediated experience feel more cohesive and aligned with course expectations. For instance, prompts that reflect an instructor's tone and questioning style can help students reflect more deeply on argumentation, evidence use, and organization, thereby extending the instructor's presence into independent work time. This continuity may be particularly beneficial for students who lack real-time access to faculty due to time zone differences or asynchronous course design.

Fostering Metacognitive Development – In later milestones, when students used GAI to critique their drafts, they reported gaining specific insights related to organization, clarity, and argument structure that informed their revisions. These reflective practices suggest that GAI feedback can serve as a prompt for metacognitive development, allowing students to evaluate and improve their learning strategies. As one student commented, "I really appreciated AI's use in this class . . . it eased any anxieties about writing a research paper," highlighting the emotional support GAI tools can offer in academic transitions. Another shared, "I really enjoyed learning about the AI prompts . . . it was extremely beneficial to apply this tool to the paper." Such feedback reinforces skills developed through structured GAI engagement, such as prompt engineering, revision, and analysis, which mirror professional practices in content development, analytics, and digital communication.

Metacognition reflection prompts strengthen cognitive self-monitoring, examine their reasoning and decision-making, and revision habits. For example, an instructor might suggest any or all of these prompts: "Identify two areas where my reasoning is unclear. Explain why they may confuse a reader." OR "Based on this feedback, what revision strategies should I prioritize for my next draft?" or "Ask me three questions that highlight gaps in my argument." Thus, GAI encourages students to reflect on how they learn, where their gaps are, and how to improve, strengthening self-regulation and fostering deeper, more intentional engagement with their work.

Professional Relevance and Skill Development – As organizations increasingly incorporate GAI into daily workflows, classroom exposure to GAI tools helps students build authentic, transferable skills. However, realizing these benefits requires a calibrated balance between instructor guidance and student autonomy. Over-structuring may inhibit exploration, while under-structuring may lead to overreliance on GAI outputs or shallow engagement. To maintain this balance and support ethical use, instructors should provide early and explicit instruction on academic integrity and set transparent expectations regarding the role of GAI in coursework. Teaching students to critically evaluate GAI feedback and use it as a springboard rather than a crutch can strengthen their independent thinking.

Ethical Considerations and Institutional Support – Engaging ethically with GAI tools enhances, rather than replaces, academic inquiry. At the institutional level, supportive policies can reinforce this message by normalizing GAI as a pedagogical aid rather than an academic threat. Such policies should be grounded in values of transparency, learner agency, and ethical design. They should also outline clear guidelines for disclosure, attribution, and appropriate use of GAI tools that align with intended learning outcomes. Moreover, faculty development initiatives should accompany policy rollout to ensure equitable understanding and implementation across departments.

Ethical use and academic integrity prompts reinforce transparency, attribution, and appropriate use. For example, an instructor can suggest that students use prompts like "Help me rewrite my own paragraph for clarity, but do not introduce new claims, evidence, or interpretations," or "Based on my draft, suggest ways I can verify the accuracy of factual statements," or "Explain which parts of my writing appears to need a citation but does not have one." Students who use such prompts are more likely to internalize ethical boundaries while leveraging GAI responsibly to *strengthen*, not replace, their academic and thinking skills.

Forward-Looking Recommendations – These findings speak directly to the original research question by illustrating how guided and scaffolded GAI use supports learner agency, critical thinking, and ethical behavior in CLT environments. This study suggests that when instructors intentionally integrate GAI through thoughtful instructional design and reflective scaffolding, GAI-guided scaffolds help students push beyond surface-level responses by requiring justification, comparison, and deeper conceptual exploration. For example, institutions might wish to embed GAI prompt training in first-year writing courses, and instructors might use GAI feedback for low-stakes peer review exercises or include metacognitive reflection journals alongside GAI-assisted assignments. The recommendations outlined here provide a practical roadmap for educators and institutions to harness the potential of GAI in ways that uphold and extend the core values of learner-centered education. Furthermore, future research may examine how these findings apply across various disciplines, learning modalities, or student demographics to inform more inclusive GAI-enhanced pedagogy.

Conclusion

This study examined how guided, milestone-driven GAI prompts function as pedagogical scaffolds within CLT environments. By integrating deeper empirical analyses, cross-milestone performance patterns, subgroup comparisons, qualitative thematic coding, correlation analyses, and variation in GAI engagement, the findings provide a comprehensive understanding of how structured GAI support influences student learning, writing development, and engagement in online higher education courses.

The results demonstrate that GAI prompts facilitated meaningful cognitive and metacognitive development, even when such gains did not immediately translate into higher early milestone grades. Students in GAI-supported courses initially exhibited lower performance. Still, they surpassed peers by the final milestone, suggesting that scaffolded GAI interaction promotes the type of productive struggle characteristic of constructivist learning. Thematic analysis showed that GAI prompts supported idea generation, improved organizational clarity, reduced writing anxiety, and encouraged reflective revision, indicating that GAI served not merely as a convenience tool but as a cognitive collaborator aligned with core CLT principles.

Differences between postgraduate and undergraduate students underscore the importance of tailoring GAI scaffolds to learners' developmental readiness. At the same time, correlation patterns highlight the central role of engagement in driving improvements in writing quality and critical thinking. Variation in usage intensity shows that students who engaged more consistently with the prompts experienced greater benefits, illustrating the iterative nature of GAI-mediated scaffolding.

Taken together, these findings contribute empirical evidence to a literature that has largely been conceptual in its treatment of GAI's role in learning. The study demonstrates that when intentionally designed and embedded within milestone-based assignments, guided GAI prompts can enhance learner agency, deepen cognitive engagement, and extend instructor presence in asynchronous online settings. These outcomes support the potential of GAI to operationalize constructivist pedagogical principles in practical and scalable ways.

However, several limitations remain. The absence of a control group limits causal inference, and the reliance on self-reported perceptions may not capture all dimensions of learning. Future research should employ mixed-methods or quasi-experimental designs, explore longitudinal impacts on writing development, and examine how differently structured prompts influence learning behaviors across diverse disciplines and student populations. Investigating how GAI scaffolding interacts with issues of academic integrity, equity, and access also remains essential as institutions refine their policies and pedagogical strategies.

Overall, this study provides evidence that thoughtfully integrated GAI prompts can foster deeper engagement, support metacognitive growth, and enhance the writing process in ways

consistent with constructivist pedagogy. As higher education navigates the expanding role of GAI, structured and ethically grounded approaches such as those explored in this study offer promising pathways for promoting active, reflective, and learner-centered academic development.

References

- Adams, P. (2006), "Exploring social constructivism: theories and practicalities", *Education*, Vol. 34 No. 3, pp. 243-257, doi: [10.1080/03004270600898893](https://doi.org/10.1080/03004270600898893).
- Al Zaidy, A. (2024), "The impact of generative AI on student engagement and ethics in higher education", *Journal of Information Technology, Cybersecurity, and Artificial Intelligence*, Vol. 1 No. 1, pp. 30-38, doi: [10.70715/jitcai.2024.v1.i1.004](https://doi.org/10.70715/jitcai.2024.v1.i1.004).
- Caccavale, F., Gargalo, C.L., Gernaey, K.V. and Krühne, U. (2022), "To be fAIr: ethical and fair application of artificial intelligence in virtual laboratories", *SEFI 50th Annual Conference of the European Society for Engineering Education, "Towards a New Future in Engineering Education, New Scenarios that European alliances of Tech Universities Open Up"*, Universitat Politècnica de Catalunya, Barcelona, pp. 1022-1030, doi: [10.5821/conference-9788412322262.1398](https://doi.org/10.5821/conference-9788412322262.1398).
- Campello de Souza, B., Neto, A.S.D.A. and Roazzi, A. (2024), "The generative AI revolution, cognitive mediation networks theory and the emergence of a new mode of mental functioning: introducing the Sophotechnic Mediation scale", *Computers in Human Behavior: Artificial Humans*, Vol. 2 No. 1, 100042, doi: [10.1016/j.chbah.2024.100042](https://doi.org/10.1016/j.chbah.2024.100042).
- Cardon, P., Fleischmann, C., Aritz, J., Logemann, M. and Heidewald, J. (2023), "The challenges and opportunities of AI-assisted writing: developing AI literacy for the AI age", *Business and Professional Communication Quarterly*, Vol. 86 No. 3, pp. 257-295, doi: [10.1177/23294906231176517](https://doi.org/10.1177/23294906231176517).
- Cotton, D.R.E., Cotton, P.A. and Shipway, J.R. (2024), "Chatting and cheating: ensuring academic integrity in the era of ChatGPT", *Innovations in Education and Teaching International*, Vol. 61 No. 2, pp. 228-239, doi: [10.1080/14703297.2023.2190148](https://doi.org/10.1080/14703297.2023.2190148).
- Dewey, J. (1938), *Experience and Education*, Macmillan, New York, NY.
- Elkhatat, A.M., Elsaid, K. and Almeer, S. (2023), "Evaluating the efficacy of AI content detection tools in differentiating between human and AI-generated text", *International Journal of Educational Integrity*, Vol. 19 No. 1, p. 17, doi: [10.1007/s40979-023-00140-5](https://doi.org/10.1007/s40979-023-00140-5).
- Essien, A., Bukoye, O.T., O'Dea, X. and Kremantzis, M. (2024), "The influence of AI text generators on critical thinking skills in UK business schools", *Studies in Higher Education*, Vol. 49 No. 5, pp. 865-882, doi: [10.1080/03075079.2024.2316881](https://doi.org/10.1080/03075079.2024.2316881).
- Grubaugh, S., Levitt, G. and Deever, D.A. (2023), "Harnessing AI to power constructivist learning: an evolution in educational methodologies", *EIKI Journal of Effective Teaching Methods*, Vol. 1 No. 3, pp. 81-83, doi: [10.59652/jetm.v1i3.43](https://doi.org/10.59652/jetm.v1i3.43).
- Gupta, P., Mahajan, R., Badhera, U. and Kushwaha, P.S. (2024), "Integrating generative AI in management education: a mixed-methods study using social construction of technology theory", *International Journal of Management in Education*, Vol. 22 No. 3, 101017, doi: [10.1016/j.ijme.2024.101017](https://doi.org/10.1016/j.ijme.2024.101017).
- Hisham, M., Vinod, N., Kuriakose, D.L., Joshy, M. and Syama, S. (2024), "Survey on generative AI in education", *International Journal of Advances in Engineering and Management (IJAEM)*, Vol. 6 No. 11, pp. 615-620, doi: [10.35629/5252-0611615620](https://doi.org/10.35629/5252-0611615620).
- Huang, Z., Mao, Y. and Zhang, J. (2024), "The influence of artificial intelligence technology on college students' learning effectiveness from the perspective of constructivism — taking ChatGPT as an example", *Journal of Education, Humanities and Social Sciences*, Vol. 30, pp. 40-46, doi: [10.54097/y1x3jj43](https://doi.org/10.54097/y1x3jj43).
- International Center for Academic Integrity (2021), *The Fundamental Values of Academic Integrity*, 3rd ed., available at: <https://academicintegrity.org/resources/fundamental-values> (accessed 25 November 2025).

- Jia, X.H. and Tu, J.C. (2024), "Towards a new conceptual model of AI-enhanced learning for college students: the roles of artificial intelligence capabilities, general self-efficacy, learning motivation and critical thinking awareness", *Systems*, Vol. 12 No. 3, p. 74, doi: [10.3390/systems12030074](https://doi.org/10.3390/systems12030074).
- Kamali, J., Alpat, M.F. and Bozkurt, A. (2024), "AI ethics as a complex and multifaceted challenge: decoding educators' AI ethics alignment through the lens of activity theory", *International Journal of Educational Technology in Higher Education*, Vol. 21 No. 1, p. 62, doi: [10.1186/s41239-024-00496-9](https://doi.org/10.1186/s41239-024-00496-9).
- Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., Stadler, M., Weller, J., Kuhn, J. and Kasneci, G. (2023), "ChatGPT for good? On opportunities and challenges of large language models for education", *Learning and Individual Differences*, Vol. 103, 102274, doi: [10.1016/j.lindif.2023.102274](https://doi.org/10.1016/j.lindif.2023.102274).
- Lodge, J.M., de Barba, P. and Broadbent, J. (2023), "Learning with generative artificial intelligence within a network of co-regulation", *Journal of University Teaching and Learning Practice*, Vol. 20 No. 7, doi: [10.53761/1.20.7.02](https://doi.org/10.53761/1.20.7.02).
- Mollick, E.R. and Mollick, L. (2023a), "Using AI to implement effective teaching strategies in classrooms: five strategies, including prompts", *The Wharton School Research Paper*. doi: [10.2139/ssrn.4391243](https://doi.org/10.2139/ssrn.4391243).
- Mollick, E.R. and Mollick, L. (2023b), "Assigning AI: seven approaches for students, with prompts", *The Wharton School Research Paper*. doi: [10.2139/ssrn.4475995](https://doi.org/10.2139/ssrn.4475995).
- Mungai, B.K., Omieno, K.K., Egessa, M. and Manyara, P.N. (2024), "AI chatbots in [learning management systems] LMS: a pedagogical review of cognitive, constructivist and adaptive principles", *Engineering and Technology Journal*, Vol. 9 No. 8, pp. 4709-4715, doi: [10.47191/etj/v9i08.15](https://doi.org/10.47191/etj/v9i08.15).
- Nazari, M. and Saadi, G. (2024), "Developing effective prompts to improve communication with ChatGPT: a formula for higher education stakeholders", *Discover Education*, Vol. 3 No. 1, p. 45, doi: [10.1007/s44217-024-00122-w](https://doi.org/10.1007/s44217-024-00122-w).
- O'Dea, X. (2024), "Generative AI: is it a paradigm shift for higher education?", *Studies in Higher Education*, Vol. 49 No. 5, pp. 811-816, doi: [10.1080/03075079.2024.2332944](https://doi.org/10.1080/03075079.2024.2332944).
- O'Dea, X.C. and O'Dea, M. (2023), "Is artificial intelligence really the next big thing in learning and teaching in higher education? A conceptual paper", *Journal of University Teaching and Learning Practice*, Vol. 20 No. 5, pp. 1-19, doi: [10.53761/1.20.5.06](https://doi.org/10.53761/1.20.5.06).
- Perkins, M., Furze, L., Roe, J. and MacVaugh, J. (2024), "The artificial intelligence assessment scale (AIAS): a framework for ethical integration of generative AI in educational assessment", *Journal of University Teaching and Learning Practice*, Vol. 21 No. 6, doi: [10.53761/q3azde36](https://doi.org/10.53761/q3azde36).
- Piaget, J. (1970), *Science of Education and the Psychology of the Child*, (Translated by D. Coltman), Orion Press, Glendale AZ, Original work published 1969.
- Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W.J., Sun, M., Day, I., Rather, R.A. and Heathcote, L. (2023), "The role of ChatGPT in higher education: benefits, challenges and future research directions", *Journal of Applied Learning and Teaching*, Vol. 6 No. 1, pp. 41-56, doi: [10.37074/jalt.2023.6.1.29](https://doi.org/10.37074/jalt.2023.6.1.29).
- Richardson, J.C., Maeda, Y., Lv, J. and Caskurlu, S. (2017), "Social presence in relation to students' satisfaction and learning in the online environment: a meta-analysis", *Computers in Human Behavior*, Vol. 71, pp. 402-417, doi: [10.1016/j.chb.2017.02.001](https://doi.org/10.1016/j.chb.2017.02.001).
- Richter, S., Giroux, M., Piven, I., Sima, H. and Dodd, P. (2024), "A constructivist approach to integrating AI in marketing education: bridging theory and practice", *Journal of Marketing Education*, Vol. 47 No. 2, pp. 94-111, doi: [10.1177/02734753241288876](https://doi.org/10.1177/02734753241288876).
- Sáez-Velasco, S., Alaguero-Rodríguez, M., Delgado-Benito, V. and Rodríguez-Cano, S. (2024), "Analysing the impact of generative AI in arts education: a cross-disciplinary perspective of educators and students in higher education", *Informatics*, Vol. 11 No. 2, p. 37, doi: [10.3390/informatics11020037](https://doi.org/10.3390/informatics11020037).

Vygotsky, L.S. (1978), *Mind in Society: The Development of Higher Psychological Processes*, (Translated by, Cole, M., John-Steiner, V., Scribner, S. and Souberman, E.), Harvard University Press, Originally published in Russian, 1930s–1970s, doi: [10.2307/j.ctvjf9vz4](https://doi.org/10.2307/j.ctvjf9vz4).

Zhou, X. and Schofield, L. (2024), “Using social learning theories to explore the role of generative artificial intelligence (AI) in collaborative learning”, *Journal of Learning Development in Higher Education*, No. 30, doi: [10.47408/jldhe.vi30.1031](https://doi.org/10.47408/jldhe.vi30.1031).

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