Human-AI Collaborative Writing: Pedagogies for Using LLMs to Improve the Ideation and Revision Process in Academic Writing

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Abstract

This paper explores effective human-AI collaboration in academic writing using Large Language Models (LLMs). Focusing on the two critical stages of ideation and revision, the article argues that higher education institutions must develop specific pedagogical strategies to guide students in leveraging the benefits of LLMs while mitigating risks such as academic integrity issues, over-reliance, and bias. The core of these strategies is to emphasize the primacy of human agency, critical thinking, and ethical responsibility. The ultimate goal is to transform AI from a potential pitfall into a powerful tool that enhances scholarly skills and depth of thought, rather than being used as a simple text generator.

Keywords Human-AI Collaboration; Academic Writing; Large Language Models (LLMs); Pedagogy; Critical Thinking

1 Introduction: The Evolving Landscape of Academic Writing with LLMs

1.1 Contextualizing the Rise of LLMs in Academic Settings

The landscape of higher education and academic practice is undergoing a profound transformation, largely driven by the rapid emergence and diffusion of Generative Artificial Intelligence (GenAI) tools, particularly Large Language Models (LLMs) such as ChatGPT. The increasing ubiquity of tools like ChatGPT, Sudowrite, and Chibi in academic environments signals a paradigm shift in how scholarly work is approached and produced. This evolution is characterized by a "breathtaking pace," compelling a societal acknowledgment that GenAI is not a fleeting trend but a lasting technological integration. The "transformative potential" of these tools in education is widely recognized, promising new avenues for learning and knowledge creation.

This swift integration of LLMs into the academic sphere necessitates a proactive, rather than merely reactive, stance from educators, institutions, and researchers. The call to "join them" if "you can't beat them," as articulated by Tseng and Warschauer, underscores the importance of developing pedagogical frameworks that guide the use of these powerful tools constructively. The alternative—allowing unguided or ill-informed adoption—risks undermining core academic values and skills. Thus, the onus is on the academic community to understand, critically evaluate, and strategically shape the role of LLMs in education.

1.2 Overview of Opportunities and Challenges in Academic Writing

The advent of LLMs in academic writing presents a complex duality of significant opportunities and formidable challenges. On one hand, these tools offer a suite of potential benefits that can enhance the writing process for students and researchers alike. These include increased productivity, robust language support encompassing grammar correction, improved phrasing, and even translation capabilities. LLMs can provide immediate feedback, a feature particularly valuable in large classroom settings or for independent learners. Furthermore, they have demonstrated utility in various academic tasks such as generating computer code, suggesting research ideas, and assisting with

preliminary literature reviews. For non-native English speakers, LLMs can be particularly beneficial in refining grammar and phrasing, with some users reporting their translation capabilities as superior to traditional tools. The potential to enhance cohesion, precision, clarity, creativity, and fluency in written work is a significant draw, alongside improvements in accuracy and structural organization of texts.

Conversely, the integration of LLMs is fraught with challenges that raise serious concerns within the academic community. Issues of academic integrity, including plagiarism and the authenticity of student work, are paramount. The ease with which LLMs can generate text may lead to an over-reliance on these tools, potentially diminishing students' critical thinking capacities, creative expression, and fundamental writing skills. The accuracy of LLM-generated content is another major concern; these models are known to "hallucinate" or produce factually incorrect information, and their outputs can reflect biases embedded in their vast training datasets. Such biases can include gender and racial prejudices, leading to the generation of content that is unrepresentative or misleading. The potential for ethical misconduct, such as the submission of entirely AI-generated assignments, further complicates their use. It is also important to note that despite their advancements, the capabilities of current LLMs remain limited in supporting the nuanced demands of high-quality scientific writing without substantial human intervention and critical engagement.

The speed of LLM development and adoption, coupled with their potential to fundamentally alter core academic skills like critical thinking and the very act of authorship, suggests that the stakes are higher and the need for pedagogical response more urgent than with previous educational technologies. The challenges are not merely technical imperfections but are deeply intertwined with student learning behaviors, such as over-reliance and plagiarism, and the foundational tenets of academic work, including originality and intellectual ownership. This urgency is not just about managing a new tool, but about safeguarding and evolving fundamental academic practices and literacies. Pedagogical innovation, therefore, is not an optional addendum but a critical necessity to guide this integration constructively. Moreover, the definition of "academic writing support" is expanding. Traditionally, support tools focused on mechanics; LLMs now assist with higher-order cognitive tasks such as ideation, outlining, drafting, and complex revision. This shift can reposition the human author from a primary creator to an editor or supervisor of AI-generated drafts, fundamentally altering the concept of authorship and raising profound questions about intellectual contribution and originality that pedagogical approaches must address.

1.3   Thesis Statement

This paper argues that to effectively harness the multifaceted benefits of LLMs while concurrently mitigating their inherent risks in academic writing, higher education institutions must urgently develop and implement specific, critically-informed pedagogies. These pedagogies must be meticulously designed to foster effective human-AI collaboration throughout the crucial ideation and revision stages of the academic writing process. A central tenet of such pedagogical approaches is the emphasis on human agency, the cultivation of critical thinking skills, and the instillation of ethical responsibility in students. The mere availability and technical capacity of LLMs are insufficient for their productive integration into academic workflows; robust pedagogical scaffolding is paramount for transforming these tools from potential pitfalls into powerful aids for scholarly communication and intellectual development.

2   Conceptualizing Human–AI Collaboration in Academic Writing

2.1   Defining Collaborative Roles: Beyond Automation to Synergistic Partnerships

The integration of Artificial Intelligence into the fabric of academic writing is fundamentally reshaping traditional notions of authorship and the writing process itself. What was once predominantly viewed as a solitary, human-driven cognitive and creative endeavor is evolving into a more complex and often ambiguous interplay between human intellect and AI capabilities. In this new paradigm, the human author's role is shifting from that of sole creator to one of a collaborator, curator, or even supervisor of AI-assisted content generation.[1]

Effective human-AI collaboration in academic writing transcends the mere automation of tasks. It moves towards a model of synergistic partnership where AI tools augment and extend human capabilities rather than simply replacing them. In such a partnership, AI can assist in diverse aspects of the writing process, including content generation, structural organization, creative input, and even analytical contributions.[1] However, the critical element is that human agency remains central. The human author acts as the "arbiter"[1] or "supervisor", making crucial decisions about the direction of the work, the selection and refinement of AI suggestions, and the overall intellectual integrity of

the final product. The aim is to leverage AI to free up cognitive resources that can then be redirected towards higher-order thinking, critical analysis, and more nuanced rhetorical considerations, provided this is done strategically.

2.2 Exploring Frameworks for Productive Human–AI Interaction

Several conceptual frameworks are emerging to help understand and guide productive human–AI interaction in writing. One notable model is the Multidimensional Framework proposed by Adebayo et al. (as inferred from 1, with primary details in). This framework offers a more nuanced perspective than a simple linear scale of AI involvement (ranging from "none" to "complete"). It conceptualizes human–AI collaboration along several distinct axes: first, Content Generation, where AI tools can generate text to varying degrees, from offering suggestions to drafting substantial portions, while the human author critically evaluates and decides on the incorporation of this AI-generated content; second, Structural Assistance, where AI can assist in organizing ideas, ensuring coherence, suggesting logical progressions, and identifying structural weaknesses, with the human writer retaining control over the implementation of these suggestions to align with their argumentative and rhetorical goals; third, Creative Input, where AI can propose stylistic revisions, alternative phrasings, or even generative creative elements, as the human author guides the overall tone, voice, and creative direction; and fourth, Analytical Contribution, where AI tools can aid in data analysis, offer critical feedback, or generate interpretive insights, which the human author interprets within the broader intellectual context of the work.

This multidimensional approach emphasizes that AI's role is primarily assistive, augmenting human capabilities without supplanting human agency and intellectual ownership.[1]

Another important direction is the development of Human-in-the-Loop Models, exemplified by projects like XtraGPT. These models explicitly advocate for hybrid workflows where human authors maintain primary control over the creative and intellectual aspects of writing, such as generating core ideas and initial drafts. LLMs then function as targeted, context-aware assistants, providing revisions based on explicit instructions and specific writing goals (e.g., "improve clarity of this paragraph," "strengthen the motivation in this section"). The XtraGPT model, for instance, is built upon "controllable post training" to enhance its ability to follow nuanced instructions and maintain contextual consistency within the document. Similarly, initiatives like Stanford's CoAuthor project aim to illustrate and foster productive collaborative practices, demonstrating how AI can enhance and support student effort rather than merely replacing it. These models underscore a shift towards more interactive and controllable AI writing support.

2.3 The Importance of Human Agency and Critical Thinking in the Collaborative Process

Regardless of the sophistication of AI tools, human agency, critical thinking, rhetorical awareness, and independent writing skills remain indispensable in the academic writing process. There is a legitimate concern that uncritical or excessive use of AI tools could lead to a diminishment of these crucial human faculties. Therefore, a core component of any pedagogy for human–AI collaborative writing must be the cultivation of students' ability to critically evaluate AI-generated outputs.

LLMs are known to produce content that may be untrue, biased, irrelevant, or contextually inappropriate. They can "hallucinate" information, generate responses that conflict with previous statements, or deviate from input prompts. Furthermore, LLMs can inherit and perpetuate biases present in their training data, such as gender or racial biases, or misrepresent the importance of historical events based on the volume of written accounts in their training corpus. They may also produce inaccurate programming code or even fabricate bibliographic citations, rendering their outputs unreliable without thorough human scrutiny.

Consequently, students must be explicitly taught to approach AI-generated content with a critical lens. The human writer bears the ultimate responsibility for refining AI suggestions, ensuring that any incorporated material aligns with their own authorial intent, meets scholarly standards, and upholds ethical and intellectual accountability.[1] This involves not just proofreading for errors, but engaging in a deeper critical analysis of the AI's contribution, questioning its assumptions, verifying its claims, and ensuring that the student's own voice and intellectual contribution remain paramount.

The argument that AI can reduce cognitive load is more nuanced than it initially appears and depends significantly on the pedagogical framing of AI use. While AI tools might indeed scaffold certain aspects of the writing process, potentially "freeing cognitive load for higher-order thinking", there is an equally valid concern that they might encourage students to "bypass crucial developmental steps" or foster "over-reliance". The integration of AI

does not automatically lead to a beneficial reduction in cognitive load. If students passively accept AI-generated text without critical engagement, the cognitive effort required for essential learning processes—such as deep comprehension, critical analysis, and thoughtful revision—may actually decrease, leading to what has been termed detrimental "cognitive offloading". Therefore, pedagogical strategies must guide students to reinvest any cognitive capacity freed by AI into more demanding higher-order tasks, such as the critical evaluation of AI outputs, the complex synthesis of information from multiple sources (including AI), and sophisticated rhetorical decision-making. Without such guidance, the promise of reduced cognitive load may not translate into enhanced learning or improved writing quality.

Furthermore, effective human-AI collaboration necessitates the development of a new form of "meta-literacy"—the ability to strategically manage and orchestrate AI's contributions to the writing process. The multidimensional framework[1] and models like XtraGPT imply that the human writer is not merely a passive recipient of AI assistance but an active director of it. This involves understanding the AI's capabilities and limitations, skillfully crafting prompts that elicit desired responses (a process akin to "coding in English" that requires sophisticated writing, editing, and critical thinking skills), critically assessing the AI's outputs, and making informed decisions about how, when, and to what extent AI-generated content should be integrated. This meta-literacy is a higher-level cognitive skill that extends beyond basic tool usage and must be explicitly taught as part of a comprehensive writing pedagogy in the age of AI.

3   Pedagogical Strategies for LLM–Assisted Ideation in Academic Writing

3.1   Leveraging LLMs for Brainstorming, Topic Exploration, and Research Question Formulation

The ideation phase of academic writing, often characterized by the daunting "blank page," can be significantly supported by the strategic use of LLMs. These AI tools can serve as valuable assistants for brainstorming, exploring various facets of a potential topic, and formulating initial research questions. Reports indicate that suggesting research ideas and aiding in brainstorming are among the popular applications of LLMs by researchers and students. For instance, a student might find ChatGPT "awesome for brainstorming ideas", using it to generate a range of possibilities that can then be refined.

A key pedagogical approach is to guide students to use LLMs as a dynamic starting point or a catalyst for thought, rather than a definitive source of ideas. For example, students can input a broad subject area and prompt the LLM to generate a list of sub-topics, potential research questions, related concepts, or even arguments for and against a particular stance. This can help overcome initial writer's block, broaden perspectives, and uncover avenues of inquiry that the student might not have initially considered.

Specific pedagogical activities can be designed to structure this process, such as "Topic Deconstruction," where students begin with a general theme or a broad assignment prompt and use a series of targeted LLM prompts to break this theme down into narrower, more manageable, and researchable sub-topics in an iterative interaction; the "Question Generation Challenge," in which students provide an LLM with a chosen sub-topic and instruct it to generate a diverse set of potential research questions, which they then critically evaluate for clarity, feasibility, academic relevance, and originality before refining the most promising ones or synthesizing elements from several to craft their own; and "Conceptual Mind-Mapping with AI," which allows students to use LLMs to explore connections between different concepts related to their topic by, for instance, prompting an LLM with "What are the key concepts related to [topic X] and how do they interact?" to yield a preliminary map of ideas that they can then critically examine, expand, and organize.

These activities encourage students to see LLMs not as providers of final answers, but as interactive tools that can augment their own thinking processes during the crucial early stages of academic writing.

3.2   The Role of Effective Prompt Engineering in Stimulating Creative and Critical Idea Generation

The quality and utility of the ideas generated by LLMs are heavily dependent on the quality of the prompts provided by the user. Effective prompt engineering—the art and science of crafting and refining specific, detailed instructions for generative AI—is therefore crucial for stimulating creative and critical idea generation.[2] It is a process that involves more than just asking a question; it requires a thoughtful approach to communicating one's needs to the AI model.

Pedagogical strategies must include explicit instruction on various prompt engineering techniques. Several frameworks can be introduced to students. One is the Rhetorical Approach (Bauer[2]), which encourages students to define their rhetorical situation for the AI, including the main claim, intended audience, context, desired ethos, pathos, logos, arrangement, and style requirements. Another is the C.R.E.A.T.E. Framework (Birss[2]), an acronym guiding users to structure prompts by defining: (a) Character, the role the AI should assume; (b) Request, a clear and specific definition of the task; (c) Examples, providing samples of desired outputs; (d) Additions, refining the task with specific viewpoints; (e) Type of Output, specifying the format; and (f) Extras, any further relevant information. A third option is the Structured Approach (Cummings[2]), which advocates for a formula including a role and a goal for the AI, necessary context, a clearly defined task with detailed expectations, and any reference content. Finally, there is the Goal-Format-Warnings-Context Framework (Brockman,), a practical framework involving: (a) Goal, clearly defining the desired output; (b) Response Format, specifying the structure; (c) Warnings, indicating pitfalls to avoid; and (d) Context, providing background information.

Crucially, students should be taught that prompt engineering is often an iterative process. The first prompt may not yield the best results. They should be encouraged to refine their prompts, experiment with different phrasing, and resubmit their requests to guide the LLM towards more useful and insightful ideation support. This iterative refinement is key to unlocking the full potential of LLMs as brainstorming partners. This focus on prompt engineering as a critical skill underscores that it is not merely a technical input method but a sophisticated rhetorical and critical thinking exercise. Liberal arts skills such as clear writing, precise editing, and analytical thinking are fundamental to crafting effective prompts. To elicit genuinely useful and nuanced ideas from an LLM, students must strategically define their inquiry, consider their eventual audience and purpose, and frame their requests thoughtfully—all core components of advanced rhetorical practice.

3.3   Developing Critical AI Literacy: Guiding Students to Evaluate and Refine AI–Generated Ideas

While LLMs can be powerful tools for ideation, it is paramount to develop students' critical AI literacy. This involves emphasizing that AI tools offer assistance, not a replacement for human thought and intellectual labor. Human writing, at its core, is a powerful mode of inquiry, learning, and communication that machines cannot and should not supplant.

Instruction must focus on teaching students to critically evaluate AI-generated ideas for accuracy, potential bias, relevance to their specific academic context, and overall depth. LLMs can produce plausible-sounding but incorrect information ("hallucinations"), reflect societal biases from their training data, or offer generic suggestions that lack specificity or originality. Pedagogical activities can be designed to highlight these limitations. For example, students could be asked to compare AI-generated poetry with human-authored poetry to discuss notions of predictability versus genuine creativity, or to have an LLM generate discussion questions for an academic article they have already read, then critically analyze the AI's questions for vagueness, inaccuracies, or superficiality.

A crucial component of critical AI literacy in the ideation phase is guiding students to corroborate and refine AI-generated suggestions. This aligns with the "corroborate" step in the Tseng & Warschauer pedagogical framework. Students should be encouraged to cross-reference AI-generated ideas with scholarly sources, fact-check any claims, and critically assess the suitability of the suggestions for their academic work. Reflective use of AI is also key; students should be prompted to think critically about how their own prompting strategies, rhetorical choices, and ethical judgments shape the ideation process when using AI tools. The "blank page" problem, a common source of anxiety for writers, can indeed be mitigated by the rapid idea generation capabilities of LLMs. However, this initial output often requires significant "critical sculpting" by the student. The pedagogical value, therefore, lies not merely in using LLMs to fill the void, but in equipping students with the skills to rigorously evaluate, select, refine, challenge, and elaborate upon these AI-generated starting points. This necessitates a two-step ideation pedagogy: AI-assisted generation followed by intensive, human-led critical refinement and development, ensuring that substantial human intellectual engagement accompanies any use of AI.

4   Pedagogical Approaches for LLM–Enhanced Revision in Academic Writing

4.1   Utilizing LLMs for Structural, Stylistic, Grammatical, and Coherence Improvements

The revision stage of academic writing, crucial for refining arguments and enhancing clarity, can be significantly supported by LLMs. AI writing assistants such as Grammarly and ChatGPT are capable of providing real-time feed-

back on a wide array of textual elements, including grammar, syntax, style, clarity, engagement, coherence, and overall structure. Research indicates that GenAI tools can enhance the cohesion, precision, and clarity of academic writing. They are adept at identifying and correcting grammatical errors, improving sentence structure, and suggesting more appropriate vocabulary. Studies have shown measurable improvements in students' writing in terms of accuracy, structural organization, and style when using such tools.

Beyond granular corrections, LLMs can assist with more substantial revisions. They can be prompted to rephrase sentences or entire paragraphs for better flow or to suit a different audience, summarize lengthy sections of text to check for conciseness, and offer suggestions for restructuring arguments or improving the logical organization of a paper. Tools like QuillBot are noted for their ability to summarize findings and rephrase text for enhanced clarity. Furthermore, specialized models are being developed with revision in mind. For example, XtraGPT is designed to provide context-aware, instruction-guided revisions at the section level of academic papers, allowing users to target specific goals such as improving the clarity of a particular argument or strengthening the motivational framing of a research problem.

A practical pedagogical approach involves introducing students to a range of AI tools, highlighting their specific strengths and optimal use cases for different revision tasks. For instance, Grammarly might be recommended for detailed grammatical and mechanical checks, while ChatGPT or more specialized models like XtraGPT could be employed for feedback on broader stylistic concerns, argumentative coherence, or structural organization. Students should be taught to select the appropriate tool based on their specific revision needs at different points in the writing process.

4.2 Teaching Students to Critically Assess, Selectively Integrate, and Build Upon AI-Generated Revision Suggestions

While LLMs offer powerful revision capabilities, it is imperative that students develop the critical capacity to assess, selectively integrate, and build upon AI-generated suggestions, rather than passively accepting them. AI feedback is not infallible; it can be generic, miss contextual nuances, misunderstand the author's intent, or even introduce errors. LLM-based revisions might sometimes involve the "overuse of generic language" or offer "superficial edits" that do not address the core intent of the revision. AI feedback is not always completely accurate and can overlook subtle aspects of writing style or argumentation.[3]

Therefore, pedagogy must focus on empowering students to act as discerning "gatekeepers" of AI suggestions. They need to make informed decisions about which suggestions to accept, which to reject, and which to modify to better suit their purpose and voice. Research suggests that higher-performing students tend to actively engage with and refine AI-generated content, whereas lower-performing students may rely on it more passively, limiting deeper learning.

Several pedagogical activities can foster this critical engagement, such as "AI Feedback Triangulation," where students obtain revision suggestions from an LLM, a peer reviewer, and the instructor, then compare the feedback to make their own informed revision choices; "Justify Your Revision Choices," which requires students to document and explain why they accepted or rejected specific AI suggestions; "Track Changes Analysis," where students use an LLM with changes tracked and then critically analyze them; and "AI as a 'Critical Friend'," which teaches students to prompt the LLM to identify potential weaknesses in an argument rather than just asking for corrections.

These activities aim to shift students from being passive recipients of AI feedback to active, critical agents in their own revision processes. This critical engagement is vital because over-reliance on LLMs for revision risks stifling the development of "editorial judgment"—a crucial academic skill. Revision is not merely about error correction; it is a complex cognitive process through which writers learn to critically assess their own work for clarity, coherence, logical consistency, and stylistic appropriateness. If students habitually and uncritically accept AI suggestions, they may bypass the very cognitive processes that foster this internal editor. Pedagogies must therefore actively cultivate this judgment by requiring students to evaluate, question, and justify their use of AI-generated revisions, ensuring that AI informs human editorial decisions rather than dictating them.

4.3 The Significance of Iterative Prompting and Sustained Human Oversight in the Revision Loop

Effective revision with LLMs is rarely a one-shot process. Instead, it often involves an iterative loop of prompting, receiving feedback, evaluating that feedback, making human-led revisions, and then potentially re-prompting the AI with more refined instructions or on a revised draft. Students need to understand that, similar to the ideation

phase, the initial AI-generated revision suggestions may not be perfect. They may need to experiment with different prompts, provide more context, or specify their revision goals more clearly to guide the AI towards more useful and targeted feedback. This move from "good enough prompting to agentic iterative prompting" is a key aspect of developing sophisticated human–AI collaboration skills.

Sustained human oversight is critical throughout this iterative revision loop.[4] The student must continuously evaluate the AI's contributions to ensure they align with their own authorial voice, the core argument of the paper, and the specific requirements of the academic task. Human judgment is necessary to address contextual limitations of AI, critically analyze its suggestions, and fact-check any information it provides. Without this constant human engagement, there is a risk that the AI could lead the writing astray or that the student's unique perspective could be diluted.

Pedagogical approaches should model and encourage this cyclical process. First, the student produces a draft. Second, the student prompts an LLM for specific types of revision feedback. Third, the student critically evaluates the AI's suggestions. Fourth, the student makes informed revisions to the draft, incorporating, modifying, or rejecting AI suggestions. Fifth, if further AI assistance is needed, the student refines their prompts or provides the revised section to the AI for another round of feedback. Finally, the student makes final revisions, taking full ownership of the text.

This iterative and human-supervised approach helps maintain the student's control over the writing process while leveraging the AI's capacity to identify potential areas for improvement. The locus of "revision skill" may subtly shift when LLMs are involved. Traditionally, revision skill primarily involved the student directly executing all re-writing, re-structuring, and re-phrasing. With advanced LLMs, students can increasingly instruct the AI to perform some of these actions (e.g., "rephrase this paragraph for a more formal tone," "identify and correct any inconsistencies in the argument in this section"). This implies that the student's skill set expands from solely generative revision to include strong diagnostic abilities (identifying what needs revision), directive capabilities (formulating effective instructions for the AI), and curatorial judgment (evaluating and integrating the AI's output). This does not necessarily signify a reduction in skill but rather an evolution towards a different, arguably more complex, skillset that combines analytical, critical, and managerial competencies. Pedagogies must recognize and actively cultivate this evolving set of revision skills.

5   Holistic Pedagogical Models for Integrating Ideation and Revision with LLMs

5.1   The Tseng & Warschauer Framework and its Evolution

A significant contribution to the pedagogy of AI in language learning, with direct relevance to academic writing, is the framework developed by Tseng and Warschauer. Initially proposed primarily for second language (L2) learners grappling with AI writing tools like ChatGPT, this five-part pedagogical framework emphasizes a structured approach to effective partnership with AI. The original components are: (1) Understand, where students must first develop a foundational understanding of LLMs; (2) Access, ensuring that students have equitable access to the necessary AI tools; (3) Prompt, giving explicit instruction in prompt engineering; (4) Corroborate, a critical step involving guiding students to verify and critically evaluate the information provided by AI; and (5) Incorporate, helping students learn how to meaningfully and ethically integrate AI assistance into their own work.

This framework acknowledges both the immediate and long-term contexts in which students must learn to use these tools. More recent work by Tseng and colleagues has seen an evolution and refinement of this initial framework, placing even greater emphasis on human cognition and metacognition within the collaborative process. This evolved perspective highlights three steps: (1) Think First, encouraging students to engage in their own initial thinking before turning to AI tools; (2) Agentic Iterative Prompting, shifting the focus from basic prompting to a more strategic, iterative, and student-driven interaction with the AI; and (3) Reflect, a crucial concluding step where students reflect on their use of AI throughout the writing process.

This evolution underscores a pedagogical shift towards ensuring that human cognition precedes, guides, and critically follows any interaction with AI, thereby fostering a more mindful and agentic approach to human–AI collaboration.

5.2   Adapting Principles from Frameworks like CRAFT for Broader Academic Writing Support

While some pedagogical frameworks are developed with specific contexts like L2 learning or literature reviews in mind, their underlying principles can often be adapted for broader academic writing support, including the ideation and revision processes. The CRAFT Framework (Collecting, Reviewing, Analyzing, Framing, and Tailoring), for example, was initially designed to enhance proficiency in conducting AI-augmented literature reviews.[5] However, its core stages and systematic integration of AI tools offer valuable insights for general academic writing pedagogy. The stages can be reinterpreted, including Collecting (relevant to Ideation), which aligns with using LLMs for brainstorming and exploring initial ideas[5]; Reviewing (relevant to Ideation and Revision), which can translate to using AI to find relevant background information or identify potential sources[5]; Analyzing (relevant to Ideation and Revision), where LLMs can assist in analyzing drafted text for logical consistency[5]; Framing (relevant to Revision), where LLMs can help students structure their arguments or create outlines[5]; and Tailoring (relevant to Revision), which is directly applicable to the final stages of revising any academic paper for linguistic precision and stylistic appropriateness.[5]

The CRAFT framework's emphasis on a structured approach, the systematic integration of various AI tools at different stages of a research-intensive task, and its dual goals of streamlining workflows while upholding academic integrity provide a useful model. Adapting such principles can help educators design a holistic approach to LLM use that supports students systematically through both the creative and critical phases of writing.

5.3   Designing Learning Activities that Foster a Reflective and Strategic Approach to Using LLMs Across the Writing Process

Effective pedagogical models for human-AI writing are not merely about teaching students which buttons to press; they are about fostering an iterative, reflective, and strategic engagement with these tools. This means that the AI interaction should ideally be framed by crucial human cognitive acts—initial human-led thinking and planning, strategic guidance of the AI, critical evaluation and integration of its output, and finally, metacognitive reflection on the entire collaborative process. This "human–first, human–last" principle ensures that AI serves as an augmentation of human learning and expression, rather than dictating or diminishing it.

Learning activities should be designed to embody this principle. This can include activities like Process-Oriented Assignments, shifting the assessment focus to the entire writing process by having students submit "AI interaction logs"; Reflective Writing Tasks, incorporating assignments where students explicitly analyze how their use of LLMs impacted their thinking processes; AI-Assisted Peer Review Workshops, where students use AI-generated feedback as a starting point for a more nuanced peer review discussion; and Documented Decision-Making, requiring students to annotate their drafts to indicate where and why they chose to incorporate AI suggestions.

It is also important to recognize that holistic frameworks must be adaptable. Academic writing conventions vary significantly across disciplines, and students will enter classrooms with diverse levels of AI literacy, access to tools, and specific learning needs. Therefore, while general models provide a valuable foundation, their implementation must be flexible and sensitive to these contextual factors. A rigid, one-size-fits-all pedagogical model for LLM integration is unlikely to be effective across the varied landscape of higher education.

To provide a clearer overview of the various pedagogical models discussed, Table 1 offers a comparative analysis.

6   Addressing Ethical Considerations and Cultivating Academic Integrity

The integration of LLMs into academic writing brings to the forefront a host of complex ethical considerations that demand careful pedagogical and institutional attention. Navigating these challenges effectively is crucial for maintaining the integrity of academic work and fostering a responsible learning environment.

6.1   Navigating Challenges of Plagiarism, Authenticity, Over–reliance, and Bias

Key challenges include Plagiarism and Authenticity, as LLMs fundamentally challenge traditional understandings of plagiarism by generating text that is not the student's own intellectual product[4]; Over–reliance, a pervasive concern that excessive dependence on AI tools could diminish students' own writing and critical thinking skills[3]; Bias, since LLMs trained on vast datasets often reflect existing societal biases related to gender, race, and culture, which can be perpetuated in their outputs[4]; and Accuracy and Reliability, as LLMs are prone to "hallucinations" and can generate factually incorrect information, requiring rigorous fact-checking.[4]

Table 1: Comparative Analysis of Pedagogical Frameworks for Human–AI Collaborative Academic Writing

Feature	Tseng & Warschauer (Original)	Tseng & Warschauer (Evolved)	Adapted CRAFT Principles	Multidimensional Collaboration Model[1]	XtraGPT Human-in-the-Loop
Core Principles/Focus	Effective partnership with AI for L2 learners.	Human cognition first, agentic AI use, metacognition.	Systematic AI integration for research tasks, efficiency, academic integrity.	Nuanced understanding of varied AI contributions, shared effort.	Controllable, instruction-guided AI assistance for scientific revision, human creative control.
Key Stages/Components	Understand, Access, Prompt, Corroborate, Incorporate.	Think First, Agentic Iterative Prompting, Reflect.	Collecting, Reviewing, Analyzing, Framing, Tailoring (adapted for general writing).	Axes: Content Generation, Structural Assistance, Creative Input, Analytical Contribution.	Human drafts, AI revises based on explicit instructions and goals.
Emphasis on Ideation	Moderate (via Prompting, Understanding).	High (Think First, Agentic Prompting).	High (Adapted Collecting, Analyzing).	Moderate (Content Generation, Creative Input).	Low (focus is primarily on revision of human-drafted content).
Emphasis on Revision	Moderate (via Corroborate, Incorporate).	High (Agentic Prompting, Reflect).	High (Adapted Analyzing, Framing, Tailoring).	Moderate (Structural Assistance, Analytical Contribution).	Very High (core focus of the model).
Role of Human Agency	Central in evaluation and incorporation.	Paramount: initiates, guides, reflects.	Directive at each stage, responsible for critical evaluation.	Arbiter and supervisor, retains control over intent and final product.	Retains creative control, generates initial content, directs AI revisions.
Role of AI	Supportive tool for language and idea generation.	Interactive partner guided by human agent.	Tool to streamline tasks, enhance retrieval, analysis, and refinement at different stages.	Assistant across multiple dimensions of writing.	Targeted assistant for context-aware, instruction-based revisions.
Key Pedagogical Implication/Strength	Structured approach for learners new to AI.	Emphasizes metacognition and human-centered AI use.	Provides a systematic workflow for integrating AI across complex writing tasks.	Offers a comprehensive lens for understanding diverse AI roles and human–AI interplay.	Demonstrates potential for highly specific and controllable AI revision support in technical fields.

6.2   Pedagogies for Promoting Transparency, Responsible AI Use, and Proper Attribution

Addressing these ethical challenges requires proactive pedagogical interventions. One is Critical AI Literacy, which involves teaching students not just how to use AI tools, but also how they work and their inherent limitations.[6] Another is Ethical Education and Clear Boundaries, wherein academic institutions must define and communicate a clear code of ethics regarding the use of AI in academic work.[4] Furthermore, Process-Oriented Assessment can encourage responsible AI use by focusing on the writing process rather than solely on the final product.[4] Finally, clear Attribution Practices must be developed and taught for when the use of AI tools for substantial contributions is deemed permissible.[4]

The traditional concept of academic integrity, often centered on detecting the plagiarism of human-authored text using tools like Turnitin, is being fundamentally challenged by LLMs that generate novel, non-plagiarized text.[4] The core issue shifts from "copying" to "outsourcing cognition" or misrepresenting AI-generated work as one's own intellectual effort. Consequently, the pedagogical and institutional response must evolve from a primary focus on detection and punishment towards a more formative approach centered on cultivating "ethical AI usefulness." This involves proactively teaching students when and how it is appropriate, beneficial, and ethically sound to use AI as a supportive tool, and, just as importantly, when its use undermines learning objectives or constitutes academic misconduct. The aim should be to guide students towards responsible and transparent AI use, rather than implementing outright bans, which are often impractical and may hinder the development of essential future skills.

Furthermore, addressing the challenge of AI bias in student work requires more than simple warnings. Pedagogies must actively foster "critical algorithmic awareness"—a nuanced understanding of how biases are embedded in AI systems and how they can manifest in AI-generated outputs. This involves teaching students to: critically question the presumed neutrality of AI-generated content; actively seek out diverse perspectives and information sources beyond the LLM to corroborate, contextualize, and counterbalance potential biases (aligning with the "Corroborate" principle); and reflect on how their own prompting strategies and implicit assumptions might influence the biases surfaced by the AI. This approach moves beyond purely technical instruction to a critical engagement with the socio-technical nature of AI and its products.

6.3   Institutional Roles in Establishing Clear Guidelines and Support

Individual educators cannot address these complex ethical issues in isolation. Institutions play a vital role in creating an environment that supports the responsible and ethical use of AI in academic writing. This includes Policy Development, where institutions must establish clear, transparent, and adaptable policies regarding AI use; providing Training and Resources for both students and faculty on the ethical and effective use of AI tools[4]; Fostering Dialogue and Trust by creating a climate of open discussion about AI policies and practices; Addressing Equity to mitigate disparities in access to high-quality AI tools and digital literacy[4]; and Supporting Faculty by giving them the academic freedom to design their own syllabus policies appropriate to their specific courses.

By taking a proactive and collaborative approach, involving all stakeholders, higher education institutions can help navigate the ethical complexities of LLMs and foster a culture of academic integrity in the age of AI.

7   Future Directions and Implications for Higher Education

The integration of LLMs into academic writing is not a static endpoint but an ongoing process of evolution and adaptation. Understanding the future trajectories of this integration and its broader implications for higher education is crucial for preparing students, educators, and institutions for the challenges and opportunities that lie ahead.

7.1   The Evolving Role of Educators: From Instructors to Facilitators of Human–AI Writing Practices

The rise of sophisticated AI tools necessitates a significant evolution in the role of educators. Traditionally, educators have often been seen as primary transmitters of knowledge and arbiters of skill. In an AI-integrated environment, this role is likely to shift towards that of a facilitator, guide, and mentor who helps students navigate the complexities of human–AI collaboration in learning and writing. Educators will need to develop nuanced pedagogical approaches that incorporate AI as a collaborative partner rather than viewing it solely as a threat or a shortcut. This involves designing learning experiences that actively foster critical AI literacy, promote ethical awareness, and develop students' skills in effective human–AI interaction.

This shift requires educators to become adept not only at using AI tools themselves but also at understanding their pedagogical implications. Teacher training and ongoing professional development will be essential to equip educators with the knowledge and skills to guide students in leveraging AI for enhanced learning while mitigating risks such as over-reliance and the erosion of critical thinking. The focus will be less on dictating information and more on cultivating students' abilities to ask critical questions, evaluate diverse sources (including AI-generated content), synthesize information, and communicate effectively in an increasingly complex information landscape.

7.2   Necessary Shifts in Curriculum Design and Assessment Methods

The capabilities of LLMs demand fundamental shifts in curriculum design and assessment methods across higher education. This involves Curriculum Integration, where AI literacy should be incorporated into curricula across various disciplines, and Evolving Assessment Practices, as traditional methods are highly vulnerable to being completed by LLMs.[4] This "assessment crisis" necessitates a move towards more robust and AI-resistant assessment strategies. These may include an increased emphasis on in-class assignments, oral defenses, and presentations[4]; assessments that focus on the writing process as much as the final product, such as evaluating students' documented interactions with AI tools[4]; and designing assignments that require higher-order thinking skills that current LLMs struggle to replicate authentically, such as complex problem-solving or personal reflection.[4]

The challenge posed by LLMs to traditional assessment can be reframed as an opportunity to re-evaluate pedagogical goals and diversify assessment practices towards more authentic, engaging, and meaningful learning experiences. If an LLM can adequately complete an assignment, it may indicate that the learning objectives or the assessment itself were insufficiently focused on developing deeper, transferable cognitive skills. The need to design AI-resistant assessments can thus be a catalyst for pedagogical reform, pushing educators to prioritize tasks that require genuine critical thinking, problem-solving, creativity, and personal voice—qualities that define robust human intellect and are less susceptible to being outsourced to AI.

7.3   Identifying Research Gaps and Opportunities in Human-AI Writing Pedagogy

Despite the rapid proliferation of LLMs, research into their pedagogical application in academic writing is still in its nascent stages. Several critical research gaps and opportunities exist. There is a need for Long-Term Impact Studies on the effects of sustained LLM use on students' writing development. More Efficacy of Pedagogical Interventions studies are required to evaluate the effectiveness of different teaching strategies. Opportunities exist for the Development of Pedagogically-Informed AI Tools that better support specific educational goals. Further research is needed to understand and address issues of Equitable Access and Use across diverse student populations.[4] Finally, research should explore Discipline-Specific Pedagogies tailored to different academic fields.

The future of AI in writing education may hinge on developing "co-evolutionary" relationships between pedagogy and technology, rather than education merely adapting to technological advancements. While much current discourse focuses on how educational practices must change in response to LLMs, a more proactive and ultimately more fruitful approach involves educational research and pedagogical needs actively shaping the development and application of AI tools. Projects like XtraGPT, which designed LLMs specifically for instruction-guided scientific revision based on identified needs in academic writing, exemplify this. Progress will require a reciprocal dynamic where pedagogical insights inform AI development (e.g., building tools that explicitly scaffold particular writing processes or critical thinking skills) and, in turn, new AI capabilities open up novel pedagogical possibilities. This implies a need for much closer collaboration between educators, writing studies researchers, learning scientists, and AI developers.

8   Conclusion: Towards Synergistic Human-AI Writing Practices for Academic Excellence

The integration of Large Language Models into academic writing represents a watershed moment for higher education. These powerful tools offer unprecedented opportunities to support and enhance the writing process, yet they also introduce significant challenges related to academic integrity, the development of critical thinking, and the very definition of authorship. This paper has argued that navigating this complex terrain requires a deliberate and critical pedagogical response, focused on fostering synergistic human-AI collaborative writing practices.

8.1   Recap of Key Pedagogical Principles

Several key principles have emerged as foundational for the effective and ethical integration of LLMs into academic writing pedagogy. Central among these is the unwavering emphasis on human agency, critical thinking, and ethical awareness. LLMs should be positioned as tools to augment human intellect, not replace it. Students must be empowered to maintain control over their writing process, critically evaluate AI-generated content, and make informed decisions about its use.

Effective human-AI collaboration hinges on a set of core practices: strategic and iterative prompting to guide AI effectively; rigorous critical evaluation of AI outputs for accuracy, bias, and relevance; iterative refinement where human judgment directs the integration and modification of AI suggestions; and reflective practice where students metacognitively assess their learning and the impact of AI on their work. Holistic pedagogical frameworks, such as the evolved Tseng & Warschauer model or adaptations of the CRAFT principles, are essential for guiding students through both the ideation and revision stages of writing with LLMs, ensuring that human cognitive engagement remains central. The "human-first, human-last" approach—where human thinking initiates and concludes the engagement with AI—is paramount.

8.2   Vision for the Future of Academic Writing in an AI-Integrated Environment

The future of academic writing in an AI-integrated environment need not be one of diminished human capability or compromised integrity. Instead, it can be envisioned as a landscape where LLMs, when used thoughtfully, ethically, and under the guidance of robust pedagogical structures, can significantly enhance human intellect, foster deeper and more engaged learning with the writing process, and potentially support more equitable learning outcomes by providing personalized support. There is potential for AI to scaffold complex academic tasks and offer tailored feedback, particularly if educational needs drive tool development.

However, realizing this positive vision requires a shift in perspective. The ultimate goal of human-AI writing pedagogy should not be merely the production of better texts, but the cultivation of better thinkers and more empowered learners. While LLMs can undoubtedly assist in improving the surface quality of written output, the enduring focus of education must remain on the development of students' critical thinking, problem-solving abilities, rhetorical sophistication, ethical reasoning, and overall intellectual agency. The AI tool is a means to these more profound educational ends, not an end in itself.

Successfully navigating the human-AI writing future also calls for a culture of "critical optimism" and continuous adaptation within higher education. The discourse surrounding LLMs often oscillates between unbridled enthusiasm and profound apprehension. A more productive path forward involves embracing a stance of critical optimism: acknowledging the transformative potential of these technologies while remaining acutely aware of the challenges and proactively working to mitigate them through thoughtful pedagogy, evidence-based policy, and ongoing critical dialogue. The technological landscape is characterized by rapid and continuous evolution. Consequently, pedagogical approaches, assessment strategies, and institutional policies cannot afford to be static. They will require ongoing review, agile adaptation, and iterative refinement based on emerging research, the evolution of AI capabilities, and the changing needs of students and society. This implies a commitment to lifelong learning and adaptability, not only for students but for educators and institutions as a whole.

Ultimately, the journey of integrating LLMs into academic writing is an invitation to reaffirm the core values of higher education: the pursuit of knowledge, the development of critical intellect, and the cultivation of ethical and articulate communicators. By embracing innovative pedagogies centered on human-AI collaboration, higher education can strive to ensure that these powerful new technologies serve to enrich, rather than erode, these fundamental academic pursuits.

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