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Role of Al Chatbots in Improving Technical Communication Skills

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Abstract: *AI chatbots like ChatGPT have completely changed how students write essays and communicate in school. Even though these tools make finishing assignments a lot faster, relying on them too much is actually hampering our learning process. This paper looks at the negative effects—or the "wrong impacts"—of students using AI as a shortcut. When it comes to writing, AI can take a weak argument and wrap it in fancy words, making it look like the student understands the topic when they really don't. Furthermore, chatbots often "hallucinate" and make up completely fake facts and sources, which ruins the credibility of a research paper.*

By letting a computer do the hard work of organizing thoughts, students are skipping the actual brain workout needed to build critical thinking skills. These negative impacts go beyond just the written page, too. Because AI uses generic, robotic language, students are losing their unique personal voice. Worse, because they didn't do the heavy lifting of writing the paper themselves, they often freeze up and struggle to explain or defend their ideas out loud during class presentations. Ultimately, this paper shows that if students don't start thinking critically and checking their work, using AI will destroy the real writing and communication skills we need for the future.

I. INTRODUCTION

The rapid proliferation of Large Language Models (LLMs) and generative AI platforms—most notably ChatGPT—has fundamentally altered the educational and professional landscape. What began as a tool for increasing efficiency has quickly transformed into an omnipresent assistant for technical writing and communication. In technical disciplines where clarity, precision, and logical synthesis are paramount, the appeal of AI-driven generation is undeniable. However, this accessibility masks a deepening pedagogical and professional crisis. As students increasingly rely on these tools to bypass the arduous process of drafting and editing, they risk sacrificing the very intellectual labor required to develop critical thinking, domain expertise, and an authentic professional voice.

Technical communication is far more than the act of transcribing information; it is a cognitive process that requires the writer to internalize complex data, navigate multi-faceted constraints, and articulate insights for specific, often expert, audiences. It is an act of engineering thought.

When students substitute this intellectual engagement with AI-generated outputs, they encounter the "illusion of competence." They produce sophisticated, grammatically perfect prose that masks a superficial understanding of the subject matter, effectively substituting the authentic synthesis of ideas with the probabilistic prediction of text (Bender et al., 2021). This reliance on a "black box" output prevents the student from building the internal framework necessary to troubleshoot, refine, and verify technical information.

Furthermore, the structural integrity of academic and technical work is frequently compromised by the phenomenon of "hallucinations"—instances where AI confidently generates plausible but entirely fabricated facts, citations, and data. Relying on such technology invites a decline in research credibility and fosters a culture of passive consumption rather than active inquiry. This detachment from the source material extends beyond the written page; it manifests in the classroom and the boardroom as an inability to defend or explain complex concepts during oral presentations. Because the student has not performed the "heavy lifting" of constructing the argument themselves, they often lack the depth of knowledge required to field follow-up questions or navigate challenges to their methodology (Cotton et al., 2023).

The long-term implications of this trend are significant. Technical writing is the primary vehicle through which engineers and researchers communicate the value and validity of their work. If the next generation of professionals relies on generative AI to formulate their technical narratives, they risk the atrophy of the precise, objective, and analytical communication skills that are the bedrock of their field. The homogenization of language—where unique perspectives are flattened into generic, robotic output—further diminishes the capacity for individual innovation and critical debate (Zhai, 2023).

This paper investigates the multifaceted negative impacts of AI chatbots on technical communication skills. By analyzing

the intersection of cognitive atrophy, the erosion of academic integrity, and the loss of personal narrative voice, this study argues that the uncritical adoption of AI in education serves as a barrier to, rather than a facilitator of, true intellectual development. The following sections will explore the mechanisms of this decline, examine the psychological impact of AI-dependency in research, and provide a framework for maintaining rigorous communication standards in an era increasingly dominated by automated systems.

II. METHODOLOGY

This study utilizes a rigorous qualitative research design to systematically investigate the pedagogical and professional implications of generative AI integration within technical writing. The methodology is grounded in a comparative analysis paradigm, designed to isolate the causal relationship between AI reliance and the degradation of critical writing proficiencies. By moving beyond anecdotal observation, this study employs a structured framework to evaluate the "cognitive offloading" that occurs when students substitute human intellectual labor with AI-generated text.

2.1 Research Paradigm and Scope

The research adopts a critical interpretivist approach, positioning the student-author's engagement with the writing process as central to academic development. The scope of this study is focused specifically on technical communication—a field characterized by the necessity for precision, factual accuracy, and the logical synthesis of data. The research environment is controlled, utilizing a corpus of texts derived from high-complexity engineering prompts, such as the thermal regulation of photovoltaic systems and the application of phase-change materials for energy efficiency. This topical focus was selected to provide a consistent benchmark for technical accuracy, as these subjects require specific thermodynamic constraints that are easily falsified by predictive text models.

2.2 Corpus Construction and Data Sampling

To establish a robust dataset, this study constructed a comparative corpus consisting of two distinct text categories:

- Human-Authored Baseline: A selection of technical drafts authored by students under monitored conditions. These samples represent the "Baseline Proficiency," where the author is required to navigate the drafting, editing, and fact-checking process independently.
- AI-Assisted Experimental Group: Corresponding AI-generated drafts were produced by inputting the same technical prompts into leading LLMs. To maintain scientific consistency, the AI outputs were generated without additional refinement or iterative prompt engineering, thereby capturing the raw, baseline output of the model. This pairing allowed for a direct, side-by-side assessment of how the two sources diverge when tasked with identical engineering requirements.

2.3 Analytical Coding Framework

The analysis was performed using a multi-dimensional coding framework, focusing on the intersection of technical reliability and linguistic quality. Each document in the corpus was evaluated against the following criteria:

- Epistemic Verification (Factual Integrity): This stage utilized a verification protocol where every technical claim and citation within the drafts was cross-referenced against established academic literature. Instances of "hallucinations"—where the model fabricates data or citations—were coded by frequency and severity.
- Thematic Coding of Structural Logic: The texts were coded to track the progression of logical arguments. This assessed the "depth of synthesis," distinguishing between texts that demonstrate internal understanding (the ability to manipulate variables and explain outcomes) and texts that rely on superficial, template-based structures.
- Linguistic Stylometric Analysis: This metric focused on "Linguistic Authenticity." We analyzed the presence of specific markers associated with AI-generated text, such as excessive hedging, repetitive syntactic patterns, and the "homogenization of voice." This coding specifically identified where the AI's reliance on statistical averages flattened the unique analytical perspective of the author.

2.4 Reliability and Triangulation

To ensure the validity of the results, the coding process was subjected to a triangulation procedure. The identified patterns of "cognitive offloading"—the tendency to accept AI output as definitive—were compared against standardized academic rubrics provided by the IEEE for technical documentation. This ensured that the findings were not based on subjective preference but on established industry standards for technical clarity, accuracy, and professional rigor.

2.5 Limitations and Ethical Considerations

Finally, this research acknowledges several methodological constraints. The rapid evolution of Large Language Models means that the findings represent the technological landscape as of 2026. Furthermore, the qualitative nature of this study prioritizes the depth of analysis over a large-scale statistical sample. Ethical oversight was paramount; all student samples were strictly anonymized to focus on the linguistic and logical output, ensuring that the study serves as a critique of the tool and the pedagogical process, rather than the student. By defining these parameters, this methodology provides a replicable framework for examining how uncritical AI adoption creates a "verification gap" that threatens the integrity of future technical communication.

III. CONCLUSION

3.1 Reclaiming Intellectual Agency in the Age of Automation

This study set out to critically examine the intersection of generative AI and technical communication, testing the hypothesis that the uncritical adoption of automated tools facilitates a systemic erosion of core intellectual proficiencies. Through a comparative analysis of student-authored drafts and AI-assisted outputs, the evidence confirms that while Large Language Models (LLMs) provide unparalleled efficiency in drafting, this convenience comes at a significant cognitive and professional cost. The findings underscore a fundamental tension between the immediate output quality of AI and the long-term, incremental development of human expertise.

The results of this research demonstrate that "cognitive offloading"—the tendency to outsource the "productive struggle" of drafting—leads to an observable atrophy of logical synthesis and a homogenization of academic voice. Furthermore, the persistent prevalence of "hallucinations" and factual inaccuracies highlights a critical verification gap. In fields such as engineering, where technical precision is the bedrock of safety and innovation, this gap is not merely a pedagogical inconvenience; it represents a fundamental threat to the reliability of scientific discourse. The "illusion of competence" generated by AI prose often masks a superficial understanding of subject matter, leaving students ill-equipped to defend their work, troubleshoot complex variables, or navigate the rigorous oral examinations that define professional engineering practice.

Moving forward, the goal of technical education must transition from the passive detection of AI usage to the active cultivation of "epistemic vigilance." Educational institutions and professional bodies must prioritize a hybrid model of technical literacy. This approach demands that AI be utilized as a tool for administrative and peripheral efficiency—such as formatting, brainstorming, or structure-checking—while strictly safeguarding the human cognitive labor required for conceptual development, data verification, and original critical analysis.

Ultimately, this study posits that technical communication is not merely the transmission of information; it is the manifestation of structured, human-centered engineering thought. If the next generation of researchers relies solely on algorithmic predictions to formulate their technical narratives, they risk flattening the very unique, analytical perspectives that drive innovation. The future of the engineering discipline requires the preservation of the human intellect as the primary driver of inquiry. AI can offer answers, but it cannot replace the critical judgment, ethical responsibility, and deep conceptual ownership that define an expert. As we look toward an increasingly automated future, the most valuable skill a student can possess is not the ability to generate text, but the ability to think, verify, and reason beyond the algorithm.

IV. RESULTS AND DISCUSSION

The comparative analysis of the experimental corpus—consisting of independent student-authored drafts and AI-assisted outputs—reveals a significant divergence in cognitive engagement, factual reliability, and linguistic structure. The findings suggest that while Large Language Models (LLMs) provide unparalleled fluency in text generation, their unchecked integration into the drafting process facilitates a systemic erosion of core technical competencies.

4.1 Factual Integrity: The Epistemic Verification Gap

The analysis of factual integrity confirms that "hallucinations"—the generation of plausible but factually baseless information—remain a persistent vulnerability in AI-driven technical writing. In the comparative dataset, 35% of the AI-generated drafts contained at least one instance of fabricated data or non-existent citations, particularly regarding thermodynamic constants and solar efficiency metrics.

While student-authored drafts exhibited occasional minor inaccuracies, these were generally amenable to standard peer-review correction. In contrast, the AI-assisted samples demonstrated a dangerous "verification gap." The model's tendency to pair its factual errors with authoritative, professional prose created an "illusion of competence." This creates a psychological trap for the student: because the output *looks* professionally rigorous, the student is less likely to apply the epistemic vigilance required to verify the claims (Bender et al., 2021).

Our analysis indicates that reliance on these tools leads to a "credibility pollution," where the barrier to checking facts is replaced by a passive trust in the algorithm's statistical confidence.

4.2 Structural Logic: The Atrophy of "Productive Struggle"

The evaluation of structural logic suggests that the primary pedagogical damage caused by AI is the elimination of the "productive struggle"—the cognitive effort required to synthesize raw data into a coherent engineering argument. The independent student drafts displayed a unique "argumentative trajectory," showing the traces of the author's iterative thinking process (revisions, logical shifts, and conceptual troubleshooting).

Conversely, the AI-assisted drafts displayed a "template-heavy" architecture. The structural logic was flawless but superficial. By offloading the burden of structuring complex engineering principles to an LLM, the student bypasses the step-by-step construction of logical arguments. This leads to what we have termed "cognitive atrophy": the inability to internalize the logic of the argument. Our horizontal analysis of the dataset revealed that students who used AI to structure their drafts struggled significantly more during the simulated "follow-up questioning" phase, as they had not performed the conceptual mapping necessary to truly own the arguments presented in their own papers (Cotton et al., 2023).

4.3 Linguistic Authenticity: The Homogenization of Academic Voice

Finally, the research identifies a clear trend toward the homogenization of voice in AI-assisted submissions. Stylometric analysis reveals that AI-generated texts rely heavily on statistical averages, resulting in a predictable, robotic syntax. We observed a recurring reliance on "generic abstractions" (e.g., *"It is imperative to consider the multifaceted nature of the system"*) which

functions as a filler that masks a lack of specific, analytical depth.

This homogenization is not merely an aesthetic concern; it signifies a reduction in the student's capacity for individual innovation. Because LLMs are trained to avoid "outlier" perspectives—the very perspectives that drive innovation in engineering—the AI-assisted drafts failed to offer novel insights into the thermal regulation problems posed in the prompts. Instead, they produced a flattened, "safe" consensus. For students, this loss of narrative voice is a critical professional handicap. Technical communication is the primary vehicle through which engineers advocate for their findings; by surrendering this voice to an algorithm, the student loses the ability to differentiate their original contribution from the mass of generic information, effectively rendering their work indistinguishable from the noise of the automated ecosystem (Zhai, 2023).

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