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REVIEW

New literacy in the age of AI: pedagogical frameworks, ethics, and the transformation of academic writing

La nueva alfabetización en la era de la IA: marcos pedagógicos, ética y la transformación de la escritura académica

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ABSTRACT

The widespread emergence of Generative Artificial Intelligence (GAI), driven by Large Language Models (LLMs), has fundamentally transformed the writing and research ecosystem in higher education. This paper analyzes the urgent need to move beyond reactive management (focused on cheating detection) to a proactive approach focused on AI Literacy. The analysis assesses the pedagogical foundations, practical skills, and ethical challenges arising from the integration of GAI into writing processes. Pedagogically, the AI-TPACK and SAMR frameworks are explored, concluding that effective integration requires redefining learning tasks to foster co-creation and Self-Regulated Learning (SRL), as these factors positively predict academic performance and digital well-being. Practically, this paper examines Prompt Engineering as an essential metacognitive skill, demonstrating that advanced techniques (such as Chain-of-Thought and ReAct) are crucial for structuring users' critical thinking. Ethically, it discusses the imperative of algorithmic transparency and the mitigation of biases (gender, confirmation bias) inherent in AI models. Conclusions converge on the need for faculty to assume a new role as designers of co-creation environments, requiring explicit declaration of AI use and promoting critical evaluation of its output as the new standard of academic integrity.

Keywords: Generative Artificial Intelligence; AI Literacy; Writing Pedagogy; Academic Integrity; Prompt Engineering; TPACK; Algorithmic Bias.

RESUMEN

La irrupción generalizada de la Inteligencia Artificial Generativa (IAG), impulsada por los Grandes Modelos de Lenguaje (LLMs), ha transformado fundamentalmente el ecosistema de la escritura y la investigación en la educación superior. El presente trabajo analiza la necesidad urgente de trascender la gestión reactiva (enfocada en la detección de trampas) para establecer un enfoque proactivo centrado en la Alfabetización en IA (*AI Literacy*). El análisis evalúa los fundamentos pedagógicos, las habilidades prácticas y los desafíos éticos derivados de la integración de la IAG en los procesos de escritura. Pedagógicamente, se exploran los marcos AI-TPACK y SAMR, concluyendo que la integración efectiva requiere redefinir las tareas de aprendizaje para fomentar la co-creación y el Aprendizaje Autorregulado (SRL), ya que estos factores predicen positivamente el rendimiento académico y el bienestar digital. Prácticamente, se examina la Ingeniería de Prompts como una habilidad metacognitiva esencial, demostrando que las técnicas avanzadas (como *Chain-of-Thought y ReAct*) son cruciales para estructurar el pensamiento crítico del usuario. Éticamente, se discute la imperativa de la transparencia

algorítmica y la mitigación de sesgos (de género, de confirmación) inherentes a los modelos de IAG. Las conclusiones convergen en la necesidad de que el profesorado asuma un nuevo rol como diseñador de entornos de co-creación, exigiendo una declaración explícita del uso de la IA y promoviendo la evaluación crítica de su *output* como la nueva norma de integridad académica.

Palabras clave: Artificial Generativa; Alfabetización En IA; Pedagogía De La Escritura; Integridad Académica; *Prompt Engineering*; TPACK; Sesgo Algorítmico.

INTRODUCTION

The emergence of Generative Artificial Intelligence (GAI) tools, particularly large language models (LLMs), has caused unprecedented disruption in higher education and academic writing instruction. By analyzing vast amounts of data, these models generate strings of words that are most likely in response to a user request.[1] Although the resulting text may be coherent and fast, it also generates an "average composite" that reflects the linguistic conventions and biases present in its training data.

This ability of GAI to produce text quickly has had a direct impact on traditional university writing and research practices.[2] GAI is replacing cognitive and research activities that students performed autonomously until recently.[2] This phenomenon has generated a profound crisis regarding the definition of "authorship" and the authenticity of intellectual work, forcing institutions and faculty to reevaluate not only assessment methods but also the fundamental objectives of teaching writing.

The initial response of many teachers was rejection, motivated by the risk that the tool would replace human work and eliminate research habits.[2] However, a position of total prohibition has proven unrealistic.[3] The real pedagogical dilemma lies in how to ensure that AI is seen as an agent of profound transformation in learning, and not just as a shortcut. The challenge is not to avoid technology, but to teach students to use it effectively for learning, the latter being one of the goals of education.

Given this scenario, there is a critical need for a comprehensive framework to guide the integration of AAI into academic writing, overcoming technophobic views or moral panic. The purpose of this text is to provide such a framework, articulating the integration of IAG from three interconnected perspectives: Pedagogical, Practical, and Ethical. The central argument of this work is that new literacy requires students to become critical designers of their interaction with AI, mastering interaction techniques, understanding algorithmic limitations, and assuming ultimate responsibility for authorship.

METHOD

The methodological design adopted for this study is a Qualitative Analysis Based on Systematic Literature Review. Given the complexity and rapid evolution of the phenomenon of IAG in education, this design was selected to combine a review of the theoretical literature with an analysis of the most recent empirical evidence.[4]

The study is essayistic and reflective in nature, with the aim of constructing an integrated analytical framework. The intention is to move from a mere description of the tools to the construction of a prescriptive guide to orient curriculum designers and teachers. The level of depth is analytical and comparative. To structure the understanding of IAG integration, three established conceptual frameworks in educational technology have been adopted and adapted, complemented by variables specific to the AI era:

1. TPACK Framework (*Technology, Pedagogy, and Content Knowledge*): The model is used as a lens to analyze the harmony between technological knowledge (TK),

pedagogical knowledge (PK), and content knowledge (CK). The AI-TPACK approach adapts this framework, highlighting the need for educators to modify their pedagogical approaches to include AI, ensuring that technology enriches and does not overshadow human-centered teaching.[5]

2. SAMR Model (*Substitution, Augmentation, Modification, Redefinition*): This four-level taxonomy is used to assess the impact of technology on learning experiences. The analysis seeks to promote movement from improvement (Substitution and Augmentation) to Transformation levels (Modification and Redefinition), which are crucial for the development of critical thinking.[6]

3. *AI* Literacy and Self-Regulated Learning (SRL): *AI Literacy* and SRL are explicitly included as key competencies. Research has shown that both positively and significantly predict writing performance and digital well-being in AI-assisted contexts.

Information sources were selected by searching academic databases (Dialnet, Scielo, NCBI) and university repositories, using key descriptors such as "generative AI academic writing," "*AI literacy*," "*prompt engineering*," and "algorithmic bias."

Literature was selected that met the following criteria:

- Empirical Evidence and Case Studies: Articles documenting real experiences of AI integration in university writing courses.[2]
- Rigorous Ethical Analysis: Academic reviews on algorithmic biases and the reliability of references generated by LLMs.[7]
- Institutional Policy Documents: Academic integrity guides and guidelines from leading universities.

An inherent limitation is the speed at which IAG technology is advancing, which requires any pedagogical framework to be dynamic and adaptable. Furthermore, most of the available empirical literature is in its infancy, which means that some conclusions are based on theoretical projections about the transformation of the teaching role.[3]

DEVELOPMENT

Pedagogical Foundations: Redefining AI Literacy for Writing

AI Literacy as an Essential Skill for Autonomy

AI literacy is not simply the ability to use a *chatbot*, but a set of fundamental resources and skills for deciphering, understanding, and critically using the *outputs* and signals generated by AI.[1] In the context of academic writing, this literacy involves understanding how LLMs work, recognizing that the results are probable language patterns based on training data,[1] and knowing how to interact with them to enhance learning, rather than delegating it entirely.

Recent research has established a crucial connection between *AI Literacy* and Self-Regulated Learning (SRL). Results from studies with university students in AI-assisted environments indicate that both competencies positively and significantly predict writing performance and digital well-being. Specifically, SRL has a stronger effect on writing performance than mere technological literacy.

SRL is the student's ability to set goals, plan, monitor, and evaluate their own learning process. Fostering SRL is an indispensable pedagogical strategy to mitigate the risk of technological dependence that AIAG could generate in students.[2] By developing SRL, students acquire the ability to assess when and how AI assistance is appropriate and when autonomous cognitive effort should take precedence. Student autonomy should be the main objective of the process, so that IAG is a tool that accelerates the learning process without replacing the ability to think.

Curricular Transformation Frameworks: From SAMR to AI-TPACK

The effective pedagogical integration of AI in writing must be evaluated through models that measure the depth of learning transformation. The SAMR Model offers a useful taxonomy for this purpose, differentiating between simple *enhancement* and transformation of learning.[6]

Application of the SAMR Model to Writing

Classroom experience has revealed a significant risk in applying the initial levels of SAMR:

- Substitution (S) and Augmentation (A): These initial levels refer to the use of AI for direct and repetitive tasks, such as grammar correction, information gathering, or simple paraphrasing.[2] Classroom experiences have shown that AI at this stage replaces cognitive and investigative activities that students used to do themselves, such as searching for information or the initial structuring of a text.[2] Teachers express great concern, as AI at this level automates repetitive tasks and risks limiting students' critical and creative skills.[2]
- Modification (M) and Redefinition (R): Real transformation is achieved at these higher levels.[6] Modification involves significantly redesigning the task, and Redefinition (R) involves creating projects that were previously inconceivable.[6] For example, IAG can be used to generate scenario simulations or create opposing viewpoints to a thesis, forcing the student to strengthen their original argument. Moving toward Redefinition promotes the development of critical thinking and self-regulation skills by requiring students to reimagine the task using technology.[6]

The AI-TPACK Framework for Teacher Integration

For teachers to guide this transformation (M and R), the **AI-TPACK** framework is essential (Lakhe Shrestha, et al, 2025). This model emphasizes that the successful integration of AI depends on maintaining a harmonious balance between technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK).[5]

The AI-TPACK framework requires teachers to have:

1. Technological Knowledge (TK): Not only knowing how to use the tools, but understanding their fundamentals and limitations.
2. Pedagogical Knowledge (PK): Knowing how AI can facilitate the learning process without supplanting the central role of the teacher.
3. Content Knowledge (CK): Ensuring that AI does not introduce inaccurate or biased information, which is a constant risk.

This balance is crucial to avoid overregulation or mistrust by teachers, instead fostering collaboration and student autonomy.[5] Technology, pedagogy, and content must converge to ensure that AIAG tools are aligned with learning objectives.[6]

The New Role of Teachers: Drivers of Competencies and Designers of Critical Tasks

The new role of teachers must abandon the idea that using AI is inherently "cheating" and instead focus on providing tools that enable students to be autonomous and critical thinkers. Teachers become drivers of skills development in the face of AI.[3]

To mitigate the risk of cognitive substitution, teachers must design tasks that require original thinking. It is imperative to propose activities that require personal reflection, ethical positioning, connection with real experiences, or collaborative work, rather than requesting summaries or syntheses of information that can be easily delegated to AI.[8]

In this new paradigm, it is essential to prioritize the evaluation of processes over the exclusive evaluation of the final product. This involves evaluating the student's meta-writing (how they planned the task), the design of the *prompts* used (as a reflection of their thought

structure), and critical reflection on the *output* generated. This approach aligns with the idea that AI can be a study partner, but the ultimate responsibility for intellectual authorship must rest with the student.[2]

Below is a summary of the SAMR model taxonomy applied to writing:

Table 1. Taxonomy of the SAMR model

SAMR Level	Impact on Writing Task	Example of IAG Use	Pedagogical Impact (Risk/ Benefit)
Substitution (S)	The technology replaces the previous tool.	Use of IAG to correct grammatical errors or paraphrase a paragraph.	High risk of cognitive substitution.[2]
Augmentation (A)	Technology improves the previous tool.	Use of AI to search for information or generate a basic index structure.	Improves efficiency but limits creativity and independent research.[2]
Modification (M)	Technology significantly redesigns the task.	Use of IAG to generate arguments opposed to the student's original thesis and restructure the text.	Encourages critical thinking and argumentative reevaluation.[6]
Redefinition (R)	Technology enables the creation of tasks that were previously impossible.	Use of IAG to design simulations or personalized tutors for peer review.	Maximum development of SRL and AI Literacy.

Practical Integration: Prompt Engineering and Writing Strategies

Prompt Engineering: From Basic Instruction to Metacognitive Skill

Prompt engineering is defined as the art of refining inputs (words, phrases, formats) to optimize the output of AI models. In academic writing, this skill is essential, as the quality of the generated text is directly proportional to the complexity and specificity of the instruction provided.[9]

Mastering Prompt Engineering becomes a metacognitive skill. When students learn to design advanced prompts, they are required to clearly articulate their goal, context, desired format, and ethical or content constraints. This needs to structure the requirement forces the user to think critically about the steps needed to solve a problem before interacting with the AI.

The C.R.E.A.T.E. framework (Character, Request, Examples, Additions, Type of Outpt, Extras) provides a useful structure for formulating prompts in complex academic tasks. This framework ensures that the student engages in detailed conceptual planning, a critical skill required in writing reports and research papers.

Advanced Techniques for Research Writing

For high-level research and analysis tasks, prompt engineering techniques must go beyond simple instruction. Advanced methodologies allow users to influence the behavior of LLMs to optimize accuracy and complex problem solving.

- *Chain-of-Thought (CoT) and ReAct*: The Chain-of-Thought (CoT) technique, and its variants such as ReAct (Reasoning and Acting), are essential. CoT encourages AI to simulate intermediate reasoning steps before offering the final answer. This is crucial for tasks that require justification and complex analysis. ReAct combines reasoning with action. A *prompt* can be used to instruct the AI: "Analyze the following climate data and identify key trends. Based on your analysis, explain the concept of climate change, its causes, and its effects."
- This approach forces the model to "think" critically about the data (reasoning) before proceeding to the explanation (action), which elevates the quality of *the* academic *output* by relying on structured logic.

- *Flow Engineering* (Multi-Step Process Design): *Flow Engineering* consists of designing a reflective multi-step process that the AI must follow to complete a task. This technique is valuable for constructing complex arguments, as the student externalizes their methodological design to the AI and then validates it. For example: "Design a 4-step process for constructing arguments, beginning with the identification of evidence, the development of counterarguments, the validation of sources, and final reflection."

Specific Use Cases for Cognitive Assistance

AGI can perform valuable cognitive assistance roles that improve efficiency without replacing creativity or student intervention.

- AI as a Human Writing Advisor: Textual assistance provided by AI, such as style or consistency correction, resembles the intervention of a human writing advisor.[2] This validates the use of AI in the editing and polishing phase of drafts, allowing the student to focus on substantive content and argumentation.
- Creation of Self-Learning Resources: A practical application that promotes autonomy is the use of AI to enable students to create their own self-learning resources. Students can generate personalized study guides or reading guides specific to a subject. This requires the student to know how to instruct the AI to meet their specific needs, directly promoting SRL competence.

Ethical Implications and Academic Integrity Challenges

The Reliability Crisis: Algorithmic Bias and Transparency

The most significant ethical challenge is the inherent lack of ideological neutrality of AGI[3] and the crisis of reliability that this generates. AGI feeds on data that reflects biases rooted in society.[1]

- Algorithmic Bias and Gender Bias: Algorithmic biases are systematic deviations that can manifest themselves in the model's responses.[7] A key example is gender bias, which is present in the data used to train the algorithm.[10] These biases can perpetuate stereotypes through the use of generic masculine pronouns or the association of certain professions with a specific gender, which negatively influences the presentation of information and compromises the perception of fairness.[10]
- Confirmation Bias and Lack of Evidence: Another crucial problem is confirmation bias. AGI may tend to seek information that confirms its pre-existing beliefs.[7] This tendency is exacerbated by the fact that many models do not differentiate the type of information according to its level of evidence, mixing academic and non-academic sources.[7]
- The Attribution Problem (*Hallucinations*): IAG lacks the ability to generate accurate and complete citations and references, a phenomenon known as "hallucinations".[10] This makes human verification mandatory and underscores the need to ensure the interpretability and transparency of AI, understanding how and why certain content is generated.

University Policies and Academic Integrity Management

Responsible integration of IAG requires clear guidelines to prevent unauthorized use from being considered academic misconduct. Leading university policies seek to balance the promotion of learning with the maintenance of integrity:

- Mandatory Transparency: Leading university policies agree that the use of IAG in summative assessments must be explicitly acknowledged.
- Focus on Demonstrating Expertise: There is debate surrounding a total ban. Some experts argue that the use of AI for brainstorming or ideation should be prohibited, as

this is precisely where part of human creative work lies. Integrity policy should focus on demonstrating human expertise and knowledge, not on total rejection.

Encouraging Responsible Authorship and Critical Thinking

The primary ethical requirement is not the detection of GAI, but rather the demonstration that the student has applied critical scrutiny to their *output*. This shifts the burden of academic integrity to demonstrating a critical engagement with the generated content.

To develop these skills, it is crucial that writing programs encourage critical thinking when evaluating AI-generated content. This includes analyzing the arguments that AI provides and the quality and veracity of the evidence it uses to support them. Mandatory transparency, through explicit disclosure of the use of AI in summative assessment work, becomes a minimum requirement for responsible authorship. Without this transparency, academia cannot evaluate the student's actual cognitive intervention.

Below is a table summarizing the main ethical challenges and the required responses:

Table 2. Main ethical challenges

Ethical Challenge	Root Cause	Risk to Academic Writing	Required Response (*AI Literacy*)
Algorithmic Bias	Training data that reflects social biases.	Perpetuation of stereotypes (gender, ethnicity); lack of equity in information.	Critical analysis of *output* to identify biases and fallacies.
Hallucinations	AI generates probable language, but does not verify the accuracy of sources.	Inaccuracy, false references; compromise of research r reliability.	Mandatory human verification of all references and data
Substitution of authorship	Use of low levels of the SAMR model to delegate cognitive tasks	Plagiarism due to non-attribution; atrophy of autonomous skills (SRL).	Mandatory transparency and assessment focused on the *process* and *prompting*

FINAL CONSIDERATIONS

Recap and Synthesis: From Restriction to Critical Co-Creation

The integration of Generative Artificial Intelligence into academic writing marks a turning point that demands a paradigm shift, moving the focus from restriction to the development of advanced skills. The findings presented in this manuscript demonstrate that GAI is a powerful assistance tool that demands a rethinking of learning objectives (pedagogical), the elevation of *prompting* to a structural skill (practical), and rigorous management of reliability and algorithmic biases (ethical).

The key to success lies in the articulation of *AI Literacy* with Self-Regulated Learning (SRL). Evidence indicates that the development of student autonomy is crucial not only to avoid technological dependence but also to ensure quality performance and sustainable digital well-being in AI-enriched environments. The new literacy transcends traditional frameworks, positing an AI-CoACT (*Co-creation with AI)* model that views interaction not as delegation, but as a collaborative process overseen by critically trained human intelligence.[11]

Transformative Implications for Pedagogy

The pedagogical conclusions call for a radical transformation in curriculum design and the role of teachers:

1. Prompt Engineering as a Metacognitive Skill: Mastery of advanced techniques such as *Chain-of-Thought* or *Flow Engineering* must be integrated into the academic writing

curriculum. These techniques transform *prompting* from a mere technical trick into an exercise in metacognitive development, strengthening the student's ability to structure and justify their reasoning.

2. Transformation-Based Assessment (SAMR): Teachers should design tasks that consistently operate at the Modification (M) and Redefinition (R) levels of the SAMR model. This is achieved by prioritizing complexity, originality, and personal reflection,[8] over synthesis tasks, which can be delegated to AI. Assessment should focus on the process, *prompting*, and critical reflection on *the output,* not just the final product.[2]

3. Teacher Training in AI-TPACK: Teacher training programs should incorporate the AI-TPACK framework, ensuring that educators are equipped to harmonize technology (TK), pedagogy (PK), and content (CK).[5] This prevents the uncritical adoption of technology and ensures that AI is used to enrich, rather than impoverish, learning objectives.

The New Ethical Paradigm: Transparency and Bias Mitigation

From an ethical perspective, the IAG crisis is a crisis of reliability and transparency. Algorithms are not neutral,[3] and the existence of inherent biases and the propensity to generate inaccurate citations imposes a double obligation:[10]

1. Mandatory Transparency and Responsible Authorship: Institutional policies may require explicit disclosure of the use of AI in summative assessment work, aligning practice with the principles of integrity of leading universities around the world. This transparency is crucial for faculty to assess the degree of human cognitive intervention.

2. Bias Mitigation and Epistemological Verification: AI literacy should focus on the student's ability to identify, question, and mitigate algorithmic biases. This involves developing critical and epistemological scrutiny that evaluates the quality and veracity of the evidence provided by AI (Gallent- Torres, et al., 2023). Academic integrity is ultimately protected by requiring students to be competent as the "human filter" that validates knowledge.

Future Lines of Research

To consolidate New Literacy, future lines of research are identified:

- Longitudinal studies on the impact of IAG on creativity and original ideation skills, exploring whether *brainstorming* assistance leads to long-term dependency.
- Empirical research on the effectiveness of *Chain-of-Thought* and *Flow Engineering*-based methodologies for writing development in different academic domains, quantifying improvement in structure and argumentative complexity.
- Exploration of specific mechanisms for mitigating algorithmic biases in the training and use of language models adapted to Spanish-speaking educational and cultural contexts, thus promoting equity in the generation of academic content.

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DECLARATION OF USE OF ARTIFICIAL INTELLIGENCE

The author of this text declares the use of a generative artificial intelligence language model as a support tool to synthesize and reformulate the information extracted from the research documents in order to ensure the coherence and fluidity of the text.