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Critical Literacy and Cognitive Processes: A Documentary Analysis of Their Relationship In Digital Contexts

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ABSTRACT: Critical literacy within digital contexts has been a central topic of academic debate, especially with the exponential growth of Generative Artificial Intelligence (GAI). This emerging technology presents challenges and opportunities in the development of academic texts, as is the case with the ethical and cognitive comprehension issues. The purpose of this article was to analyze in depth the influence of different GAIs (Deepseek, ChatGPT, and Gemini) on improving academic texts, evaluating their role as tools to support critical literacy and exploring the cognitive processes involved in their use. This study is qualitative in nature and employs a case study based on a theoretical-practical analysis. The instructional prototypes of the GAIs were fed with a limited database on critical literacy and a specific prompt that allowed them to provide feedback on different types of texts. The results indicate that the various GAIs managed to position themselves as tools capable of guiding the development of critical literacy and even enhancing it. The models exhibited a tendency to be repetitive and to prioritize certain actions related to specific cognitive processes. This repetitiveness, if unaddressed, risks fostering mechanical engagement rather than genuine critical reflection, thereby limiting the development of autonomous critical thinking in students. Clear differences in the quality and focus of the feedback among each of the GAIs were identified, suggesting plausible explanations for how they are used in different cognitive functions. It is concluded that GAI is a promising mediating agent in the development of critical literacy, but its impact on cognitive processes (such as reflection or critical thinking) directly depends on its instructional design and the intrinsic characteristics of each model.

Keywords: Critical Literacy, Generative Artificial Intelligence, Cognitive Processes.

INTRODUCTION

Critical literacy is not defined as a mechanical, neutral, or technical task, but as a social, political, and ideological practice (Cassany, 2005). This involves managing the ideology of discourse,

recognizing that none is completely objective. It is crucial to place the discourse within its sociocultural context. Additionally, it requires becoming aware of the act of reading to interpret the world, not just the words. Among other key elements, this encourages us to continually question and compare information (Aguilar Trejo et al., 2013). Likewise, in the context of Generative Artificial Intelligence (AI), digital literacies or digital literacy skills (Vargas, 2015) are also relevant. Some authors argue that these require more use due to the greater amount of information, diversity of sources, and the unreliability of some of them.

In this context, it is helpful to analyze what new literacies are involved in the communicative processes of university students. As Castañeda-Castaño (2025) explains, critical literacy was analyzed on WhatsApp, where individuals used images (memes) to communicate and understand social phenomena within their immediate sociocultural context. This analysis highlighted skills such as contrasting information, verifying its accuracy, and conducting critical analysis.

Gemini is one of the most useful AI in the academic context, but it is not the only one. This study examines the elements of critical literacy related to the use of Gemini, specifically the feedback and reflective questions it proposes when creating academic texts. The goal is to map the cognitive processes that arise and how they are engaged when inserting a scholarly text and improving it based on Gemini itself. It is important to note that the AI was trained on a limited database drawn from the literature on critical literacy to create an instructional prompt that would enable it to provide feedback on different types of texts.

Studies like those by Madunic and Sovulj (2024) have demonstrated the usefulness of AI in carrying out instructional work to develop literacy with academic texts. However, Gemini has distinct features, despite belonging to the same branch of generative AI.

Literacy encompasses fundamental cognitive skills such as sustained attention, recognition of graphemes, phonemes, and patterns, as well as temporary retention, information manipulation, decoding, and semantic comprehension. It is crucial to view it as a higher-order cognitive skill that involves multiple elements. Thus, cognition and literacy are closely related, where critical and analytical thinking, metacognition, and new literacies in the digital age are part of the current debate in academic and scientific circles. Digital literacy, therefore, is a concept that has evolved as the internet, ICTs, and Web 2.0 have advanced rapidly (Casanovas, Capdevila, and Ciro, 2019).

Digital literacy serves multiple purposes across various social practices in which people use language; that is, it is not limited to understanding, transforming, and exchanging information via technological devices. Key elements for understanding it include representation, language, production, audience, and integration (Sánchez, 2021).

Among these key elements are also specific competencies, such as communicative, technological, and device-specific skills. On the other hand, delving deeper into the topic, the concept of academic digital literacy emerges as an interesting construct in the current debate. It is defined as the ability to effectively search for information, appropriately utilize and manipulate that data, and assertively communicate the results. This involves selecting, evaluating, interpreting, classifying, and using information (Aguilar, Ramírez, and López, 2013).

This type of literacy is characterized by interaction with information to solve problems, so that owning portable digital devices is not directly proportional to mastery of them. In other words, it is possible to use technological devices incessantly; however, this does not guarantee mastery of the literacy skills needed to acquire, transform, and communicate information.

Studies such as López (2022) emphasize that new generations are immersed in a digital environment where hypertext reading has become an everyday activity. However, there are also indications of a disconnect between digital practices and academic demands. That is, they consider that truly academic writing should be predominantly traditional textual, which sometimes leads to a lack of integration of multimodal skills proposed by Cassany, (2019), potentially limiting creativity when developing formal texts.

The idea that there is a disconnect between digital literacy practices in informal contexts and the demands of the academic world has been central to debate for several decades. However, López (2022) and Aguilar, Ramírez, and López (2013) propose an alternative in which formal education enables the use of more diverse practices, such as sophisticated, interactive, and multimodal genres. In this way, the gap could be reduced in terms of creative expression and greater freedom for subjective expression.

Amid the challenges outlined in the previous diagram, the role of the teacher becomes even more critical in addressing this phenomenon. In a world where AI-generated content is increasingly used in universities, teachers have the opportunity to promote critical thinking, model its use, and set an example of ethical use (Cantamutto, 2014).

Academic digital literacy can be strengthened through mediation and scaffolding—guiding students through the complex amount of information they encounter and building bridges between prior knowledge and their mental schemas, which allow them to reinvent and reframe their digital experiences.

One of the key elements of the teacher's role is humanizing the process. It is important to remember, as mentioned at the beginning of the text, that literacy and cognition, together with education, are constantly seeking to help students find meaning in their experiences and, through reading and language, develop critical thinking that enables them to recognize and understand their reality. This is how the formation of well-rounded, creative individuals capable of debating and questioning what they read becomes a vital activity for educational institutions.

The core problem addressed by the research revolves around the complex interaction between critical literacy and the exponential growth of Generative Artificial Intelligence (GAI) in digital and academic contexts. Specifically, the challenge lies in understanding how different GAIs (DeepSeek, ChatGPT, and Gemini) influence the development and enhancement of scholarly texts, and critically, what cognitive processes are involved when students use these tools for feedback. There is a noted tension between GAI's potential to guide critical literacy development and an observed tendency for the models to be repetitive or to prioritize specific cognitive processes, raising questions about the quality and focus of the feedback provided. Furthermore, a

significant disconnect is debated: the gap between students' informal digital literacy practices and the formal demands of the academic world.

The purpose of this article was to analyze in depth the influence of different GAI (Deepseek, ChatGPT, and Gemini) on improving academic texts. The research aimed to evaluate the role of these GAIs as tools to support critical literacy and to explore the cognitive processes involved in their use. This included examining the specific feedback and reflective questions Gemini proposed for creating and improving academic texts. The ultimate goal was to map the cognitive processes that arise and how they are engaged when inserting a scholarly text and improving it based on the AI's suggestions.

Despite the extensive literature linking critical literacy with digital environments, a clear research gap and inherent tension still exist: the absence of a thorough comparative analysis of how the specific architectures of different GAIs (DeepSeek, ChatGPT, and Gemini) influence and shape core cognitive processes—such as metacognition and inference—during academic text production. While these tools have the potential to support critical literacy, they also tend to be repetitive and focus on certain processes, raising important questions about the quality and focus of the feedback they provide. Therefore, this study is necessary to map these cognitive processes and assess each GAI's role as a pedagogical scaffold, rather than just a substitute, to help educators and students use artificial intelligence responsibly and reflectively.

Despite the growing body of work on critical literacy and digital environments, there is still a lack of comparative analyzes of how different GAI architectures (DeepSeek, ChatGPT, and Gemini) shape cognitive processes through feedback. This study addresses this gap by regularly comparing their epistemological stances and feedback designs in relation to critical literacy.

METHOD

The literature review was initially conducted by searching for articles in indexed journals using keywords such as critical literacy, Artificial Intelligence, cognition, cognitive processes, and digital literacies. The search was conducted in English and Spanish across databases including Scopus, Web of Science, ProQuest, EBSCO, and ScienceDirect. Subsequently, the information was categorized using Iramuteq (Alarcón, 2022; Solso, 2001; Wolf, 2007).

The conceptualization of critical literacy has been evolving, starting with its distinction from traditional literacy, then viewed as a social practice shaped by historical, ideological, political, and cultural factors, and today, it is seen as an essential tool for navigating complex digital environments, such as internet use, digital social networks, and the use of generative AI. Casanny (2006, 2008) notes that literacy is not only about mere decoding but about the profound ability to understand, interpret, and manage biases and intentions behind discourse. This perspective aligns with the New Literacy Studies (NLS), which have gained significant weight and importance in current debates (Hernández Zamora, 2019).

In the era of generative AI, the ability to read between the lines has become a key skill for discerning the intentions and potential biases of models such as DeepSeek, ChatGPT, and Gemini (Castañeda-Castaño, 2025). In this sense, critical literacy is redefined as an active mediation practice that enables individuals to compare and evaluate information produced by cutting-edge tools, thereby preventing the uncritical reproduction of prompt results (Castañeda-Castaño, 2025; Massip et al., 2021).

The role of generative AI in promoting critical literacy is emerging as a promising research field, but it also poses evident challenges. On one hand, studies such as those by Madunić and Sovulj (2024) and Eager and Brunton (2023) have shown that tools like ChatGPT can serve as valuable assistants in instructional design and the creation of educational materials for literacy courses, by speeding up the production of initial drafts and curricular structures (Eager & Brunton, 2023). On the other hand, this allows educators to focus on validating and adapting content to specific contexts, acting more as 'editors' rather than creators from scratch (Lalonde, 2023). On the other hand, Castañeda-Castaño's (2025) research suggests that although these technologies facilitate literacy, their use by students remains passive and unreflective, highlighting the need for pedagogical training that integrates critical evaluation of sources and ethical use of these tools (Benhumea & Velasco, 2021). Despite the efficiency advantages, AI tends to be repetitive and may lack the necessary conceptual complexity for in-depth critical analysis, which requires human intervention to elevate the quality of academic texts (Madunić & Sovulj, 2024).

The relationship between critical literacy and cognitive processes has been explored from various perspectives, underscoring the need to go beyond linear information-processing models and embrace more holistic, distributed approaches. Sandoval-Ruiz's (2025) work introduces the concepts of 'geometrization' and 'linguistic patterns' as methods for modeling cognitive composition and meaning decoding, suggesting that reading and writing can be approached from a nonlinear perspective that optimizes memory and inference (Sandoval-Ruiz, 2025). Vargas (2015) and Botelho and Vargas (2021) delve into the 'inferential plane' of reading, arguing that inference is a central cognitive process that can be managed through metacognitive strategies. This implies that, to interact critically with AI like DeepSeek, users must not only understand the literal text but also be aware of how they construct their own meanings based on prior knowledge and the information provided (Botelho & Vargas, 2021). This metacognitive approach is essential for developing a 'critical reading' of AI, not naturalizing the meanings produced by them and reflecting on the reality they construct (Freire, 2004).

A recurring challenge in research is the gap between students' informal digital literacy practices and the demands of the academic world (López Gil, 2022a). While students are immersed in digital environments and are proficient in 'hypertext reading," they often fail to integrate these skills into the production of formal academic texts (López Gil, 2022b). This is partly because formal education tends to favor a view of writing as a 'motor skill' or a 'mechanized process,' rather than a social and cultural activity (Hernández Zamora, 2016; Peña Galeano & Quintero Saavedra, 2016). This disconnect is amplified with the advent of generative AI, as students may rely on these tools to perform tasks that should strengthen their critical skills (Madunić & Sovulj, 2024). Therefore, teachers' objective is to build bridges between vernacular literate practices and academic ones,

using AI as a mediator to foster reflection and creativity, rather than allowing its use as a simple substitute for critical thinking (Casanovas Catalá et al., 2019; Gamboa Suárez et al., 2016).

The integration of generative AI in higher education requires a reconfiguration of pedagogical practice that addresses both 'digital literacy' and 'feedback literacy' (Rivera Ceseña et al., 2025; Winstone et al., 2022). Rivera Ceseña et al. (2025) point out that 'feedback literacy' is a set of knowledge and skills that enable students to interpret and effectively use feedback, a process that becomes crucial when the "feedback' comes from an AI system. In this sense, generative AI can offer instant, personalized feedback that, if used correctly, can enhance students' self-regulation and improve their learning (Carless & Winstone, 2023; Dawson et al., 2024). However, the proliferation of these tools also brings ethical and pedagogical risks, such as overconfidence in AI, lack of proper attribution, and the reproduction of biases (Madunić & Sovulj, 2024; Rudolph et al., 2023). Therefore, the debate should not focus on whether they should be used or not, but on how to integrate them responsibly, fostering a 'cognitive policy' of invention rather than reproduction (Kastrup, 2012). This requires collaboration among library professionals, educators, and technology developers to ensure these tools are transparent, reliable, and truly serve to empower students in an increasingly digital world (Pride et al., 2023).

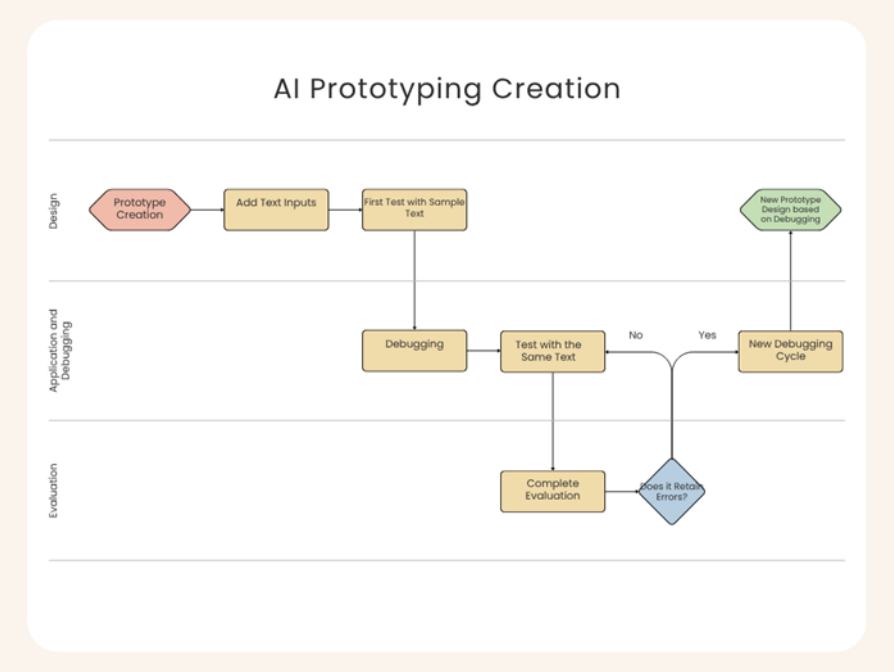
The analytical corpus derived from the AI feedback prototypes was processed using a multi-stage qualitative approach to ensure both rigor and transparency. Category establishment was primarily conducted through a thematic content analysis of the AI responses, focusing on patterns related to the literature review and the research questions. The initial categorization of the seven key categories (e.g., underlying literacy model, focus of feedback, metacognitive component) emerged from a deductive framework informed by key theoretical concepts (such as situated literacy and cognitive processes). It was refined inductively based on the specific content generated by DeepSeek, ChatGPT, and Gemini.

Furthermore, the initial data gathered from the literature review were systematically categorized and analyzed using the software Iramuteq. This program facilitated the statistical analysis of textual data (lexical analysis), which helped validate the conceptual framework, ensuring that the defined categories were strongly supported by the existing literature and consistently present across the different AI responses. This combined approach of deductive theory and inductive lexical analysis served as the measure of reliability, lending methodological credibility to the categorization and subsequent interpretation of the results.

Three generative AIs were selected: DeepSeek, ChatGPT, and Gemini, because their accessibility on different mobile devices and operating systems has made them some of the most used by the student community. Additionally, they share similar features, as they can be fed text files that allow them to analyze and respond based on that information.

For this, prototypes of feedback and critical literacy analysis for academic texts were created as follows:

Figure 1. Own Celaboration.



Each AI was fed more than 39 scientific articles from the literature review. Each article is related to critical literacy in academic texts; likewise, the same prompts were used, and the debugging cycle was followed for each prototype.

Initial analysis prompt:

1. **Initial Response Evaluation**
   Prompt 1.1: Clarity of the thesis.
   "Using the initial Prompt 1.1, review the AI responses. Did they accurately identify the main thesis? If not, give me three possible reasons why the AI might have failed in its analysis. Are the suggested structures logical and applicable?"

   Prompt 1.2: Relevance of the Academic Tone.
   "Based on Prompt 1.2, analyze whether the AI truly adjusted its suggestions to the context of a specialized audience. Did the AI suggest changes that improved the academic tone, or did it limit itself to general formatting suggestions? What were the most notable differences in responses among the different AIs?".

2. **Deepening Critical Analysis**
   Prompt 2.1: Quality of Source Recommendations.
   "Review the AI responses to Prompt 2.1. Are the recommended types of sources varied and relevant to the essay topic? Did the AI provide the sources directly, or did it adhere to the instruction to only suggest types of sources? Describe the level of detail in the justification the AI gave for each recommendation."

Prompt 2.2: Identification of Biases and Reflective Questions.
"Analyze the AI responses to Prompt 2.2. Were they able to identify subtle biases in the text? Are the reflective questions they generated genuinely challenging for critical thinking, or are they superficial? Compare the quality of the questions among Deepseek, ChatGPT, and cevvi Coordinación Altos. Which AI offered the deepest questions?".

3. **Refinement of Feedback**
Prompt 3.1: Coherence of the Conclusion.
"Using Prompt 3.1, examine the suggestions to improve the conclusion. Did the AI maintain coherence with the rest of the essay, or did it propose unrelated ideas? Are the AI's proposals detailed enough for a student to implement?"

Prompt 3.2: Effectiveness of Guided Self-Assessment.
"Finally, with Prompt 3.2, evaluate the AI's ability to summarize the necessary changes. Was the AI able to synthesize its own suggestions clearly and concisely? Is the summary they provided useful for a student to perform a self-assessment? What differences did you notice in how each AI presented the summary?"

RESULT AND DISCUSSION

The management and systematization of the analytical corpus were carried out based on seven categories, which are:

- The "underlying literacy model," that is, whether the AI positions itself with respect to the traditional view's assumption of individual skill or situated and sociocultural literacy.
- Focus of Feedback, where it concentrates on the final product or on the process.
- Type of Feedback, is it direct towards correction or indirect with questions and suggestions?
- Metacognitive component. Whether it fosters self-reflection, review, and planning.
- Critical component, that is, whether it stimulates critical thinking and reflection on the ideology of the text.
- Interactivity, given that it can have characteristics of a unidirectional system or of a system that allows dialogue.
- Scope of feedback, determining whether it relates only to the text or considers other elements such as the context, the author, and the audience.

Prototype 1. Gemini:

Gemini's reasoning has the main characteristic of having a more holistic approach. The primary structure chosen by the AI was a flowchart that guides the student through a reflective process of continually improving their own written work. Additionally, the core code that defines it is situated literacy—ideological and critical—since it is not limited to grammar or the structure of the product

but also emphasizes that the essay addresses literacy from a social practice, influenced by elements such as context, culture, and power relations.

Regarding the feedback, Gemini not only values the product but also offers instructions to improve the writing process. It is through intertextuality and dialogue with authors that a deeper relationship is promoted. This feedback is based on key questions that serve as triggers for reflection. Clear examples include: Does the thesis go beyond the basic definition? Or does the essay present the ideology of the discourses? The above demonstrates that it evaluates literacy through a more Socratic method, in which reflection, through self-questioning, leads to the improvement of complex products.

Another identified element was the metacognitive component, which carries significant weight within the analytical corpus, as it provides students with insights into their writing process at the end of their reasoning. Key elements include learning, planning, monitoring, and evaluation. The adoption of the critical literacy model enhances this prototype's Socratic feedback, prioritizing reflection over correction. Lastly, the focus on the process relates to metacognition, one of the categories with the most significant weight in the analysis.

Prototype 2. ChatGPT.

In ChatGPT's reasoning, it is more of a linear, binary sequence. However, the main elements of critical literacy are addressed, they are reduced to a verification process, limiting the depth of analysis for each text. The study of the categories showed that this AI's model of critical literacy is of a sociocultural and functional type. It aligns more with a traditional model, where, to analyze an essay, a series of requirements must be met, rather than using a reflective lens.

The feedback mainly focuses on the product; the dominant code of this AI concentrates on the goal, with questions such as: Is critical literacy recognized beyond decoding? Is an essential stance identified? Ultimately, the proposed flowchart culminates in an improved essay grounded in critical literacy, which demonstrates a greater concern for the product than for the student's development as a writer. That said, the feedback is direct and corrective, without fostering dialogue or allowing the student to engage in a constructivist approach.

Finally, the metacognitive component was one of the categories that, with this prototype, was nonexistent; no reflection or questioning of the process was included; it was not designed for self-regulation or self-assessment of learning, but rather for the evaluation of the product itself.

Prototype 3. DeepSeek.

DeepSeek was chosen for its reasoning more aligned with an intervention plan for learning; it is a model focused on strategies and tools to improve students' cognitive processes, with an emphasis on metacognition. Sociocultural and metacognitive literacy were the key characteristics of its operation, with contextualization codes and self-reflection positioned as a duo that enables students to understand how to improve their products.

Although it does not delve into ideology as Gemini does, it has a multi-level analysis—literal, inferential, and critical—that demonstrates an understanding of reading and writing as activities that require complexity and the evaluation of diverse perspectives. Unlike ChatGPT, the feedback focuses on the process, promoting intervention strategies such as reflective journals or critical rewrites to be applied with the student in question. The input, therefore, becomes indirect and suggestive, without offering specific corrections; instead, it provides a toolkit of support for the student, including pre-reading exercises, concept maps, and rubrics. Consequently, the metacognitive component is strong and has a significant weight in the flowchart and operation, as it utilizes the tools as mentioned above.

The results of this study show that the three analyzed artificial intelligences (DeepSeek, ChatGPT, and Gemini) adopt different epistemological approaches regarding critical literacy and the cognitive processes involved in the production of academic texts. Gemini stands out for a situated critical literacy model that links the ideological dimension of discourse with a reflective, metacognitive framework. In contrast, ChatGPT operates within a functional paradigm, focused on the product and on verifying the text's structure. DeepSeek, on the other hand, occupies an intermediate position, prioritizing planning and self-regulation of learning, with a metacognitive approach centered on the process. These differences not only reflect the nature of each architecture but also the level of cognitive depth that each model fosters in users.

From a cognitive perspective, the results indicate that interacting with generative AI systems involves different levels of processing: from selective attention and semantic understanding to higher-level operations such as inference, planning, and self-regulation. However, the quality of feedback depends not only on the AI's technical sophistication but also on its ability to foster reflective dialogue that places the individual at the center of the cognitive process. In this context, Socratic feedback practices in Gemini offer a promising framework for strengthening critical literacy, promoting a 'distributed cognition' in which the machine serves as a mediator of thought rather than replacing it.

This study also reinforces the importance of the ideas of Cassany, (2008) and Freire (2004), who argue that reading and writing are political and social actions that require recognizing the ideologies and power structures present in texts. Generative AI can strengthen this critical perspective, provided that its use occurs within a conscious pedagogical framework that encourages reflection on algorithmic biases, meaning-making, and the ethical responsibility of discourse. However, as Madunić and Sovulj (2024) warn, there is a risk that this could lead to the mechanization of critical thinking, in which users delegate the task of questioning to AI rather than actively engaging in the interpretive process.

The findings strongly support the socio-political aspect of literacy proposed by Cassany and Freire. Specifically, Gemini's situated model, which actively questions the ideology and power structures in texts, directly affirms the view of reading as a social and political act. In contrast, the functional, product-focused approach of ChatGPT, which overlooks this ideological aspect, presents a challenge to the NLS (New Literacy Studies) framework, suggesting a risk of re-mechanization where interpretation is entrusted to the algorithm rather than the user.

The comparative analysis indicates that AI-mediated critical literacy creates new opportunities for understanding how cognitive processes are externalized in digital environments. For example, the structured, multi-level feedback from models like Gemini and DeepSeek externalizes the planning and monitoring stages of writing—normally internal and hidden mental processes—by making the AI's inferential 'reasoning' visible to students. This transparency enables researchers to observe, follow, and analyze metacognitive behavior in a measurable and clear way that differs greatly from traditional text analysis. Specifically, metacognition and inference are key for meaningful learning, while the system's interactivity is vital for self-regulation. Nonetheless, the growing trend toward standardization in feedback—such as with ChatGPT—emphasizes the necessity of developing more adaptable models that account for differences in context, discipline, and culture among users.

Finally, the findings point to new directions for further investigation. Among them are: the relationship between literacy for feedback (Rivera Ceseña et al., 2025) and metacognitive processes mediated by AI; the creation of ethical and epistemological frameworks to regulate the interaction between humans and machines in educational contexts; and the design of hybrid cognitive architectures that combine machine learning with situated critical literacy. Additionally, a promising field emerges to study how AI can contribute to the training of teachers as critical mediators, rather than merely passive consumers of technology. These trends invite a reconsideration of higher education as a space for cognitive co-construction, where artificial intelligence serves as a tool for the emancipation of thought rather than its automation.

The relationship among cognition, critical literacy, and generative artificial intelligence is a dynamic, constantly evolving field. This study demonstrates that AI can play an essential role in shaping well-rounded, self-regulated individuals, provided that its use is grounded in sound pedagogical principles and a deep understanding of the cognitive processes involved in academic reading and writing. Beyond being automatic correction tools, DeepSeek, ChatGPT, and Gemini act as cognitive mediators with varying levels of depth, where reflective feedback and the metacognitive component are key to improving learning quality.

The differential impact of the three AI systems (Gemini, DeepSeek, and ChatGPT) has significant implications for teaching and learning. First, educators need to move beyond viewing AI as a universal tool. The study shows that selecting an AI with a metacognitive focus (like DeepSeek or Gemini) is a pedagogical decision that directly influences the type of cognitive processes students engage in. Instructors are therefore encouraged to choose tools that explicitly promote reflection and self-regulation rather than those that merely prioritize correction.

Second, the findings underscore the crucial role of teacher mediation. Since ChatGPT's functional feedback risks fostering dependency and mechanical responses, teachers must serve as critical mediators. This role includes modeling how to question the AI's output, helping students identify algorithmic biases, and ensuring that the technology is used for cognitive co-construction rather than automation. Incorporating the Socratic, reflective framework of systems like Gemini into the curriculum can transform AI from a writing substitute into a partner for critical thinking.

Critical literacy with AI requires a paradigm shift in higher education. This change goes beyond simply adding technology and focuses on transforming the way educational actors understand the construction of knowledge in the digital age. AI can enhance critical thinking and creativity, but it

can also homogenize discourse if not accompanied by ethical, contextually grounded pedagogy. Therefore, the role of the teacher remains essential as a mediator between human reasoning and the algorithm, ensuring that technology contributes to improving understanding, reflection, and cognitive emancipation.

In this sense, the main contribution of this research is to demonstrate that feedback processes and cognitive scaffolding can be replicated, complemented, and enriched through generative AI, reflected automation is prioritized. Although critical thinking cannot be replaced, it can be expanded through technologically mediated interactions that promote introspection, doubt, and dialogue with texts.

Looking ahead, trends indicate the importance of developing critical digital literacy models that incorporate algorithmic ethics, cognitive transparency, and adaptability to context. New research areas should explore how AI can help design personalized learning environments that foster self-regulation, creativity, and complex thinking. Thus, 21st-century education will not only adopt technology but also become a space for cognitive co-creation, where human and artificial intelligence collaborate to build meaningful and socially transformative knowledge.

CONCLUSION

The central research question guiding this study sought to determine how different Generative Artificial Intelligences (DeepSeek, ChatGPT, and Gemini) influence the development of critical literacy and the cognitive processes involved in academic text production. The findings revealed that each system embodies a distinct epistemological stance toward literacy: Gemini promotes a situated and reflective model, ChatGPT emphasizes structural correction and textual coherence, while DeepSeek prioritizes metacognitive regulation and learning strategies. These contrasts demonstrate that the impact of AI on critical literacy is not uniform but dependent on its instructional design and the cognitive scaffolding it affords to users.

From a cognitive perspective, the results show that generative AI can activate multiple mental processes—from selective attention and inferential reasoning to metacognitive planning and self-assessment. Gemini, for instance, encourages recursive questioning and reflective dialogue that strengthen critical thinking, whereas ChatGPT favors procedural verification. DeepSeek stands out for its emphasis on self-regulation, offering indirect feedback that guides students toward deeper understanding. Thus, the quality of cognitive engagement depends not merely on algorithmic sophistication but on the extent to which feedback mechanisms invite introspection and reinterpretation.

These findings highlight the pedagogical potential of generative AI as a mediating agent in higher education. When integrated responsibly, AI can promote distributed cognition, enabling learners to externalize reasoning, test interpretations, and refine their writing through dialogic feedback. However, this requires teachers to assume an active mediating role—interpreting AI suggestions, modeling critical evaluation, and ensuring that the technology supports rather than replaces

cognitive effort. Without this form of mediation, there is a danger of encouraging dependency and automated critical responses.

Another relevant implication concerns feedback literacy. The study suggests that the ability to interpret, evaluate, and act upon AI feedback is as crucial as traditional literacy skills. Developing students' feedback literacy entails teaching them to question algorithmic outputs, identify biases, and use suggestions as stimuli for higher-order thinking. This dimension becomes central to future frameworks that merge critical literacy, digital ethics, and metacognitive awareness in university instruction. Furthermore, the inclusion of reflective feedback loops could foster students' autonomy, supporting them in becoming active participants in the construction of their own learning processes.

Ethical and epistemological implications also arise from these findings. The proliferation of generative AI systems demands educational policies that address transparency, authorship, and cognitive autonomy. The automation of academic writing processes raises questions about the ownership of ideas and the nature of intellectual effort. Therefore, AI should be understood not as a neutral tool but as a cultural artifact that embodies particular ideologies and discursive patterns. Critical literacy, in this context, becomes the key mechanism through which users can decode these patterns, resist passivity, and assert their own agency in meaning-making.

Generative AI presents both a challenge and an opportunity for critical literacy in the digital age. It can expand cognitive abilities when integrated into teaching strategies that focus on reflection, self-regulation, and dialogue. This study confirms that feedback processes and cognitive scaffolding can be enhanced through AI interaction, provided that automation is approached thoughtfully. Future research should explore the development of adaptive feedback systems, hybrid cognitive architectures, and teacher training programs that position AI as a collaborator in knowledge creation rather than a replacement for human thought. This approach can transform education into a space where human and artificial intelligences work together to foster critical, creative, and socially meaningful understanding. Building on these findings, future studies should include empirical and longitudinal research(Zavala, 2009).

Generative AI represents both a challenge and an opportunity for critical literacy in the digital age. It can expand cognitive abilities when integrated into teaching strategies that focus on reflection, self-regulation, and dialogue. This study confirms that feedback processes and cognitive scaffolding can be enhanced through AI interaction, provided that automation is approached thoughtfully.

Future Research Directions

Building on these findings, future studies should include empirical and longitudinal research. Specifically, the focus should be on practical application and evidence gathering:

- Adaptive Systems: Design and test adaptive feedback systems in real classroom environments to evaluate their effect on student writing over an entire semester. Hybrid Architectures:

Develop and assess hybrid cognitive architectures that incorporate situated critical literacy alongside machine learning models. Teacher Training: Implement teacher training models that emphasize the teacher's role as a crucial mediator of AI-generated feedback, while measuring their effectiveness in promoting critical thinking and reducing student reliance.

These research efforts will produce the essential evidence needed to shift from theoretical debates about AI's potential to validated teaching practices.

Educational Policy Implications

The differing effects of GAI on cognitive processes and critical thinking require a transparent and proactive response from university policymakers. Policies must address not only plagiarism and academic integrity but also students' cognitive autonomy. This involves establishing concrete guidelines:

- Transparency: Mandating transparency about the data and ideological frameworks behind AI systems used in teaching.
- Curriculum: Incorporating digital ethics and critical literacy into curriculum standards across all fields.
- Responsible Use: Creating clear guidelines for the responsible selection and use of AI tools that emphasize self-regulation and thoughtful dialogue over just efficiency or automation.

Ultimately, policies should aim to transform the integration of AI into a space of cognitive co-creation, thereby strengthening human capacity to question, interpret, and exercise agency in meaning-making(Neisser, 1967; Pinker, 1997).

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