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Data availability
This article is of a theoretical nature; consequently, there are no quantitative or qualitative data that may be available.

Recibido: 09/06/25
Aceptado: 08/09/25

Artificial intelligence and contemporary scientific production: epistemologies, mediations and knowledge disputes[1]

Inteligencia artificial y la producción científica contemporánea: epistemologías, mediaciones y disputas por el saber

Inteligência artificial e a produção científica contemporânea: epistemologias, mediações e disputas pelo saber

Abstract
This article examines the role of artificial intelligence (AI) in the production of scientific knowledge from a critical perspective. It explores how AI reshapes research methods, authorship, scientific communication, and teacher education, distinguishing between traditional AI and generative AI. It addresses technical advances as well as risks such as algorithmic bias, epistemic exclusion, and discursive homogenization. Recent regulatory frameworks and the role of prompt design in research are also discussed. The paper advocates for ethical, transparent, and plural governance to ensure equity in science and higher education.
Keywords: *artificial intelligence, scientific production, epistemology, scientific communication, higher education.*

Resumen
Este artículo analiza el papel de la inteligencia artificial (IA) en la producción de conocimiento científico desde una perspectiva crítica. Se examina cómo la IA transforma los métodos de investigación, la autoría, la comunicación científica y la formación docente, diferenciando entre IA tradicional e IA generativa. Se abordan tanto los avances técnicos como los riesgos de sesgos algorítmicos, exclusión epistémica y homogeneización del discurso. Asimismo, se discuten marcos normativos recientes y el rol del diseño de prompts en la investigación. El trabajo aboga por una gobernanza ética, transparente y plural, capaz de garantizar equidad en la ciencia y en la educación superior.
Palabras clave: *inteligencia artificial, producción científica, epistemología, comunicación científica, educación superior.*

1 Artículo aprobado por el equipo editor: Diego Amarilla, José Matías Nuñez y Nancy Peré.

Resumo

Este artigo examina o papel da inteligência artificial (IA) na produção do conhecimento científico a partir de uma perspectiva crítica. Analisa como a IA remodela métodos de pesquisa, autoria, comunicação científica e formação docente, diferenciando entre IA tradicional e IA generativa. São discutidos os avanços técnicos, assim como riscos de viés algorítmico, exclusão epistêmica e homogeneização discursiva. Além disso, apresentam-se marcos normativos recentes e o papel do design de prompts na pesquisa. O trabalho defende uma governança ética, transparente e plural, que assegure equidade na ciência e na educação superior.

Palavras-chave: inteligência artificial, produção científica, epistemologia, comunicação científica, educação superior.

1. Introduction

The presence of artificial intelligence (AI) in scientific production represents, beyond a technical evolution, a paradigmatic inflection in the way knowledge is conceived and systematized. From the automation of repetitive tasks to the generation of hypotheses through predictive models, AI has become a central mediator in contemporary research processes. In this article, **traditional AI** refers to rule-based systems, supervised learning, and search algorithms, whereas **generative AI (GAI)** refers to large language models and deep neural networks capable of autonomously producing texts, images, or inferences. Gallent-Torres et al. (2023) emphasize that generative AI has profoundly transformed higher education by generating new opportunities while also intensifying debates on ethics and academic integrity. This conceptual distinction is crucial for understanding the scope of the examples discussed throughout the paper.

Machine learning algorithms and neural networks have transformed fundamental stages of research, from data collection and analysis to the elaboration of more accurate inferences. Tools such as Google Socratic and Microsoft Math Solver, which integrate optical recognition and deep learning, illustrate the impact of AI on scientific practice in school and higher education. In biomedicine, algorithms accelerate antibody discovery and predict molecular interactions, optimizing the development of treatments with substantial social impact (Alves, 2023). These advances reveal a shift in the logic of scientific production: from an exclusively human endeavor to a co-authorship with intelligent systems, which reconfigures traditional notions of authorship and specialization.

Nevertheless, the incorporation of AI into scientific practice is not without dilemmas. Algorithmic opacity remains one of the main obstacles to its epistemic legitimacy: it is difficult to fully trust decisions whose criteria remain invisible, which undermines the auditability of results and, ultimately, the reliability of research. As Gallent-Torres et al. (2023) note, while integration in higher education offers numerous opportunities, it also poses significant challenges related to the reliability of information, transparency of sources, and data privacy. These risks are aggravated when supposedly «neutral» algorithms replicate biases embedded in training data, effectively naturalizing social inequalities under the guise of technical objectivity (Alamu et al., 2020). Moreover, the use of AI in the automatic writing of academic articles and abstracts, while functional, raises concerns about the trivialization of scientific production and the homogenization of discourse. In light of this ambivalence between progress and risk, the central purposes of this article are explicitly defined as follows:

a) to analyze AI as a tool in scientific and educational knowledge production,
b) to examine its ethical and epistemological dilemmas,
c) to discuss recent regulatory frameworks and challenges of transparency,
d) to explore its implications for interdisciplinarity and teacher education.

These objectives guide the reflection toward the need for governance mechanisms that ensure diversity, transparency, and epistemic justice in the age of artificial intelligence.

2. AI as a tool in the production of scientific knowledge

Artificial intelligence has progressively become embedded in the various stages of scientific knowledge production, ranging from the early phases of data collection to advanced analytical procedures. Its applications can be grouped into three broad categories. First, there are educational support tools, such as Google Socratic or Microsoft Math Solver, which combine optical recognition with deep learning to assist students and teachers in solving mathematical and scientific problems. These resources exemplify how AI contributes to lowering barriers to access and sup-

porting learning processes within higher education.

A second category comprises academic research tools designed to optimize the management, classification, and analysis of information. Platforms such as Atlas.ti with GPT integration, ChatPDF, or Scite.ai illustrate how researchers can accelerate literature review, content analysis, and citation tracking. These systems are increasingly important for handling large volumes of academic texts and for identifying connections across dispersed bodies of knowledge. It is also important to recognize the distinctions between free and paid versions of these tools. While free access contributes to the democratization of knowledge, premium versions often provide more advanced features, creating asymmetries of access that must be critically examined in the context of equity in higher education.

Finally, there are generative AI models that function as multipurpose engines, most notably ChatGPT and other large language models. As Gallent-Torres et al. (2023) argue, these systems are transforming the way students and researchers approach teaching, learning, and assessment by enabling the rapid generation of text, summaries, and other academic content. Their integration into higher education environments not only introduces efficiencies, but also provokes new debates about ethics, reliability, and academic integrity.

Taken together, these categories illustrate that AI is no longer a peripheral support, but a constitutive element of contemporary knowledge production. The evolution from task automation to the creation of new hypotheses and discursive outputs signals a shift from a human-centered model of science toward one that increasingly involves collaboration between humans and intelligent systems. This shift, however, calls for a critical understanding of the boundaries of these technologies, especially given the risks of bias, opacity, and misuse that accompany their adoption.

3. Ethics and transparency in the use of AI in science

The rapid integration of artificial intelligence into scientific research has intensified debates on ethics and transparency. One of the most pressing challenges is **algorithmic opacity**. Most AI systems, especially those based on deep learning, function as highly complex architectures whose internal decision-making processes remain inaccessible to users. As Alves (2023) argues, this opacity undermines the auditability of results, thereby weakening the credibility of AI-assisted research. When decisions cannot be explained or verified, trust in scientific outcomes is inevitably compromised.

A second ethical dilemma relates to **algorithmic bias**. Since AI systems are trained on large datasets, they tend to reproduce the inequalities embedded in those data. In the field of education, Bruno (2020) highlights how automated systems risk reinforcing pre-existing patterns of exclusion, thereby aggravating structural inequalities. Similarly, Alamu et al. (2020) demonstrate that the apparent neutrality of algorithms can mask systemic distortions that privilege certain perspectives while marginalizing others. This issue is particularly relevant in contexts of epistemic justice, where the challenge lies in ensuring that multiple ways of producing knowledge are not overshadowed by a narrow, homogenizing technological logic.

The expansion of **generative AI** intensifies these challenges. Gallent-Torres et al. (2023) stress that while GAI offers opportunities for innovation in teaching and research, it simultaneously raises critical concerns related to reliability, data privacy, and academic integrity. In higher education, the ability of these models to generate coherent but unverifiable content creates risks of plagiarism, authorship impersonation, and the trivialization of academic writing. These concerns point to the need for clearer boundaries regarding originality and responsibility in the production of scientific knowledge.

In addition to these epistemological dilemmas, the debate must also consider **emerging regulatory frameworks**. The UNESCO's *Recommendation on the Ethics of Artificial Intelligence* (2021) underscores the principles of inclusivity, transparency, and reduction of digital divides as central to the responsible adoption of AI in education and research. More recently, UNESCO's quick start guides (2023) emphasize the ethical risks posed by generative systems and provide strategies for universities to manage their integration responsibly. In parallel, the European Union has advanced in the *Artificial Intelligence Act*, a comprehensive legal framework aimed at classifying AI systems by risk level and ensuring compliance with standards of safety, transparency, and accountability. These developments reflect a growing global awareness of the necessity to regulate AI in ways that safeguard academic and social integrity.

Ensuring ethical and transparent use of AI in science therefore demands more than technical solutions. It requires the consolidation of **research practices grounded in academic integrity**, including disclosure of AI use in publications, careful verification of AI-generated content, and the establishment of institutional protocols for data governance. Moreover, it necessitates an engagement with plural epistemologies, resisting the tendency to universalize technological

approaches at the expense of diversity in knowledge production.

In conclusion, the dilemmas of ethics and transparency surrounding AI highlight both the promise and the risks of its incorporation into scientific practice. Addressing these issues involves combining robust regulatory frameworks with institutional policies and pedagogical strategies that foster critical engagement. Only through such a multidimensional approach can AI be integrated into science in a manner that is both innovative and socially just.

4. AI, interdisciplinarity, and new paradigms in scientific knowledge

Artificial intelligence is not only a technical tool, but also a phenomenon that challenges established paradigms of scientific knowledge. The traditional model of scientific inquiry has been grounded in the formulation of hypotheses, empirical testing, and peer validation. With the incorporation of machine learning and generative models, however, this sequence is being reconfigured. Algorithms are capable of identifying patterns and generating predictions even before explicit hypotheses are articulated, which suggests a profound epistemological shift in how science operates.

Thomas Kuhn's (1970/2011) reflections on paradigm shifts help to illuminate this transformation. For Kuhn, moments of scientific revolution occur when anomalies within an established framework accumulate to the point of demanding a new conceptual order. The emergence of AI may be understood in this light: it introduces new logics of inquiry that destabilize the «normal science» of hypothesis-driven research. Rather than merely accelerating existing practices, AI opens the possibility of alternative ways of producing knowledge. Lyra (2024) reinforces this perspective by arguing that the epistemic role of AI systems extends beyond efficiency, fostering hybrid forms of reasoning where human interpretation and algorithmic processing coalesce in the generation of new knowledge.

This reconfiguration also demands an **interdisciplinary orientation**. The complexity of AI cannot be fully understood or applied from a single disciplinary perspective. Instead, it requires insights from computer science, philosophy, sociology, education, law, among others. Gallent-Torres et al. (2023) underscore that the transformative role of generative AI in higher education cannot be disentangled from questions of ethics, academic integrity, and governance. Such a multidimensional analysis points to the necessity of building bridges across disciplines to grasp both the opportunities and risks of AI in knowledge production.

Interdisciplinarity, however, should not be reduced to a pragmatic collaboration among disciplines, but must also be seen as an epistemic stance that recognizes the limits of reductionist approaches. In educational contexts, this implies fostering curricula that integrate critical perspectives from the humanities and social sciences with the technical capabilities of AI. Doing so can mitigate the risk of epistemic homogenization and ensure that diverse traditions of knowledge contribute to shaping the future of science.

In sum, the rise of AI signals not only the incorporation of new technologies into research, but also a paradigmatic transition. This transition challenges the conventional linear model of scientific inquiry and calls for interdisciplinary strategies that safeguard epistemic diversity while acknowledging the disruptive potential of algorithmic systems.

5. AI and knowledge production in educational research

The field of educational research has been particularly affected by the expansion of artificial intelligence, not only in the form of new tools, but also in the redefinition of its methodological approaches. AI systems are increasingly used to analyze large datasets from educational assessments, institutional platforms, and digital learning environments. These applications allow researchers to detect patterns in student performance, identify risks of dropout, and design adaptive learning trajectories. Albino and Valente (2023) note that such uses demonstrate the potential of AI to enhance large-scale evaluations, but also expose the limitations of relying on automated systems to interpret complex social realities.

In Brazil, Bruno (2020) highlights how the use of algorithmic systems in national assessments such as SAEB[2] risks reinforcing structural inequalities rather than overcoming them. By privileging standardized indicators and overlooking contextual dimensions, automated analyses may obscure the voices of marginalized groups and reproduce mechanisms of exclusion. These findings are consistent with broader critiques of algorithmic bias in education, where the promise of neutrality often conceals the reproduction of social hierarchies. Generative AI further complicates the epistemological landscape of educational research. Beyond facilitating text analysis or coding qualitative

2 Acronym in Portuguese for Basic Education Assessment System.

data, generative models are now being explored as partners in the co-construction of research narratives. This challenges conventional notions of authorship and raises new questions about methodological transparency. As Gallent-Torres, et al. (2023) point out, the use of generative AI in academic environments brings significant opportunities, but simultaneously requires clear guidelines to safeguard integrity and reliability.

The incorporation of AI into educational research also reveals the necessity of **critical digital literacy**. Researchers and educators need to develop competencies to interrogate the origins of data, evaluate algorithmic outputs, and identify possible distortions. Without such competencies, there is a risk of uncritically adopting AI-generated results as objective truths, thereby undermining the epistemological rigor of educational inquiry.

In short, AI reshapes educational research by introducing new tools for data analysis and knowledge generation, while also amplifying old challenges related to equity, context, and methodological rigor. Addressing these tensions requires both technical expertise and critical engagement with the social, cultural, and political dimensions of education.

6. Teacher education, curriculum, and epistemic justice in the age of AI

The integration of artificial intelligence into higher education has direct implications for teacher education and curriculum design. As digital technologies become central to pedagogical practice, teachers are increasingly required not only to master technical tools, but also to critically understand their ethical, epistemological, and cultural impacts. This transformation redefines the skills needed for professional development and challenges the traditional boundaries of pedagogical knowledge.

One emerging dimension of teacher education in this context is **prompt design**. The effectiveness of generative AI systems depends significantly on the ability of users to formulate precise, contextualized, and critical prompts. Albino and Valente (2023) argue that such skills represent a new form of digital literacy, shaping how educators and students interact with intelligent systems. Far from being a purely technical competence, prompt design requires pedagogical intentionality, since the way questions are framed can determine whether AI reinforces standardization or opens space for creativity and critical thinking.

Another critical issue relates to the reconfiguration of **authorship and collaboration**. The rise of AI-assisted academic writing invites reflection on the possibility of dialogical co-authorship between humans and intelligent systems. While Alves (2023) warns that the automation of writing may risk trivializing academic production, Gallent-Torres et al. (2023) highlight that the pedagogical use of generative AI can encourage innovative forms of collaboration if accompanied by explicit ethical and methodological guidelines. This shift requires rethinking how originality, creativity, and responsibility are taught and evaluated in higher education.

The discussion also intersects with the broader concern of **epistemic justice**. Bruno (2020) emphasizes that the use of algorithmic systems in education may reinforce structural inequities if not critically mediated. Conversely, Lyra (2024) suggests that ethical frameworks for AI can contribute to expanding epistemic plurality by ensuring that diverse knowledge traditions are represented in technological design and application. In this sense, curriculum design must not only integrate AI as a tool, but also promote critical perspectives that challenge hegemonic narratives and foster inclusivity.

Teacher education in the age of AI, therefore, cannot be limited to technical adaptation. It must embrace a critical pedagogy that prepares educators to interrogate the socio-political contexts of AI, design prompts that foster creativity, and engage with intelligent systems as partners in, rather than substitutes for, human knowledge production. By doing so, education can become a space of cognitive justice, where AI contributes to, rather than undermines, the democratic and plural construction of knowledge.

7. Final considerations

The growing presence of artificial intelligence in scientific production marks not only a technological transformation, but also an epistemological turning point. By accelerating research processes, supporting interdisciplinary connections, and enabling new forms of authorship, AI expands the horizons of knowledge creation. At the same time, it introduces ethical dilemmas, risks of bias, and challenges of transparency that directly affect the legitimacy of science and education.

Throughout this article, it has been argued that AI functions simultaneously as an opportunity and a risk. As Alves (2023) and Albino and Valente (2023) demonstrate, AI tools optimize analysis and expand access to information, but they also demand critical mediation. Bruno (2020) shows how algorithmic systems may reproduce structural inequalities, while Gallent-Torres et al. (2023) highlight the need to safeguard academic integrity in contexts shaped by generative AI. Lyra (2024) and Kuhn (1970/2011) contribute to framing these changes as part of broader paradigm shifts,

where scientific knowledge is redefined by the coexistence of human and algorithmic reasoning.

The reflection developed here adopts a critical epistemological perspective grounded in the principles of epistemic justice and cognitive plurality. This implies recognizing that algorithms are not neutral and that their design, training, and application embed values and power relations. For this reason, the governance of AI in science and education must be informed by frameworks such as those proposed by UNESCO (2021, 2023) and the European Commission (2024), which emphasize transparency, inclusivity, and accountability.

Integrating AI into higher education and research thus requires more than regulation or technical training. It demands a pedagogical and epistemological commitment to diversity, equity, and responsibility. Only by embracing a critical approach can AI serve as a tool for expanding knowledge rather than narrowing it, fostering democratic and plural science that remains faithful to its ethical and social purposes.

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Authorship contribution

All the authors have contributed equally to the preparation of the article.

Data availability

This article is of a theoretical nature; consequently, there are no quantitative or qualitative data that may be available.