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BETWEEN ALGORITHMS AND KNOWLEDGE: ARTIFICIAL INTELLIGENCE IN TEACHER EDUCATION IN HIGHER EDUCATION

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REVISÃO INTEGRATIVA DA LITERATURA

ABSTRACT

Introduction: The advancement of artificial intelligence (AI) technologies, particularly generative tools such as ChatGPT, has profoundly impacted educational processes. In the context of teacher education, these impacts go beyond the technical use of AI and raise discussions around epistemology, ethics, and pedagogical culture. Objective: To analyze the scientific literature on the use of artificial intelligence in the education of higher education teachers, with an emphasis on the pedagogical, ethical, and cultural implications associated with its integration. Method: This is an Integrative Literature Review, developed based on the PICo strategy: P (higher education teachers), I (use of artificial intelligence in teacher education), Co (educational contexts). The search was conducted in the SciELO, LILACS, PubMed, Web of Science, and Scopus databases, covering the period from 2019 to 2025. After applying the eligibility criteria and analyzing the data using the PRISMA model, 12 articles were included in the final corpus and systematized in a summary table, with evidence levels classified according to the Joanna Briggs Institute. Results: The selected studies highlight the growing interest in AI in teacher education over the past three years, with a predominance of qualitative approaches and publications from Latin America, Western Europe, and North America. The literature emphasizes both innovative educational experiences and concerns about the instrumentalization of teaching, the superficiality of pedagogical mediation, and the ethical risks of uncritical AI usage. Discussion: The analysis reveals a tension between two approaches: one that promotes AI as an automation tool, and another that advocates for its critical and ethical mediation, valuing the teacher's role as author and educator. These findings underscore the urgency of policies and continuing education programs that incorporate AI with pedagogical intentionality. Final considerations: The presence of AI in teacher education demands not only technical skills but also ethical discernment, critical reflection, and commitment to emancipatory educational practices. This study contributes to expanding the debate and supporting professional development strategies

aligned with the complexities of contemporary teaching.

Keywords: artificial intelligence; teacher education; higher education.

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1- INTRODUCTION

In recent decades, higher education has undergone a period of intense transformation, driven by technological advances, social changes, and increasingly complex demands regarding the role of the university professor. In this context, teacher education becomes a field of tension between traditionally established knowledge and new demands imposed by a dynamic, digital, and hyperconnected world (Sarzi; Ramos; Lucas, 2024). The COVID-19 pandemic intensified these challenges, shifting the focus to technology-mediated pedagogical strategies and requiring educators to develop competencies that go beyond subject-matter expertise, such as adaptability, critical thinking, digital literacy, and communicational sensitivity (Singun, 2025).

The emergence and rapid dissemination of generative artificial intelligence (GAI), particularly tools like ChatGPT, have introduced new dilemmas and possibilities to pedagogical practice. The presence of AI in academic routines not only challenges conventional models of teaching and assessment but also urges educators to (re)think their approaches to teaching, evaluating, and engaging with knowledge (Qian, 2025). In the context of teacher education, these challenges become even more significant: how can we prepare teachers to act with discernment, ethics, and creativity in a scenario where access to information is automated and authorship becomes diluted? The debate goes beyond the technical dimension and extends into the realms of epistemology, didactics, and professional identity (Francis; Jones; Smith, 2025; Burneo-Arteaga et al., 2025).

Within this scenario, teacher education in higher education must be understood as a continuous process that involves the articulation of academic knowledge, teaching experience, and reflective practice. When critically and pedagogically integrated, the use of AI can serve as a tool for expanding the didactic repertoire and transforming teaching and learning processes (Ren; Wu, 2025; Xia; Weng; Ouyang et al., 2024). However, its uncritical adoption may also reinforce reproductive models, deepen inequalities, or render essential competencies obsolete. Thus, understanding how the scientific literature has addressed the incorporation of artificial intelligence into teacher education becomes essential for outlining ethical, methodological, and pedagogical horizons (Ruano-Borbalan, 2025).

In this regard, the present study aims to analyze national and international scientific literature on the use of artificial intelligence in teacher education in higher education, with an emphasis on its pedagogical, ethical, and formative impacts. This is an integrative literature review, which seeks to map trends, identify gaps, and offer support for more critical and sensitive practices in the use of AI in educational contexts.

2- METHOD

This study is an Integrative Literature Review (ILR), a comprehensive methodological approach that enables the gathering, critical evaluation, and synthesis of findings from studies with different designs, thus fostering a deeper understanding of a specific phenomenon. Grounded in the principles of Evidence-Based Practice, this methodology facilitates the generation of knowledge with both theoretical and practical applicability, contributing to the enhancement of teacher education and the development of policies and strategies in the educational field (Lemes et al., 2021; Ganong, 1987).

The review process followed the stages systematized by Ganong (1987) and updated by Lemes et al. (2021), namely: (1) identification of the research problem, (2) definition of eligibility criteria, (3) search strategy across databases, (4) selection and evaluation of the included studies, (5) categorization, analysis, and synthesis of findings, and (6) presentation of results. The guiding research question was constructed based on the PICo strategy (Stern; Jordan; McArthur, 2014), considering: P (higher education teachers), I (use of artificial intelligence in the teacher education process), and Co (context of initial or continuing education of university professors). Accordingly, the following research question was established: how has the scientific literature addressed the use of artificial intelligence in teacher education in higher education, and what are the pedagogical, ethical, and formative impacts of this integration?

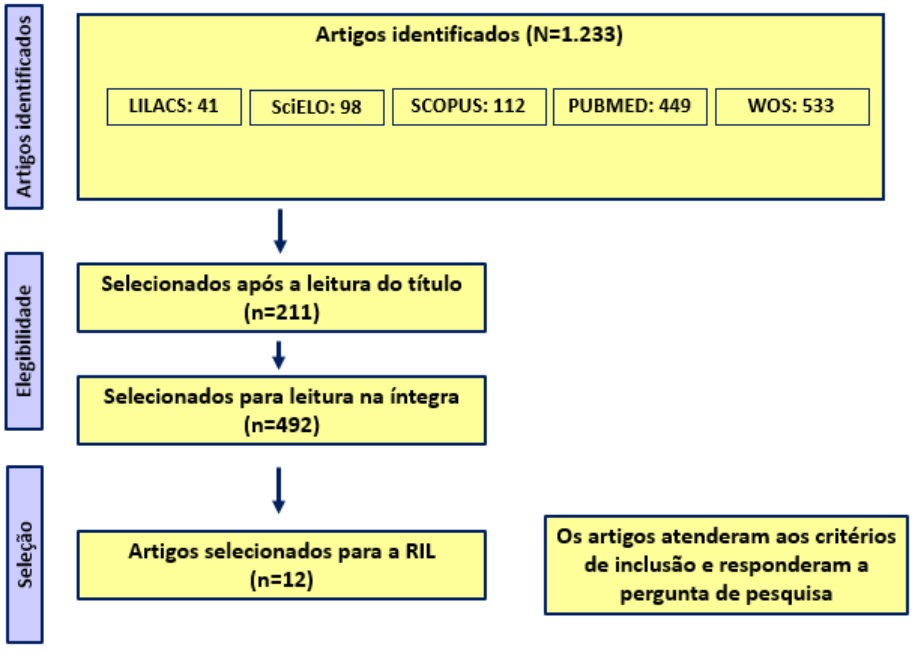
The search for studies was conducted using controlled vocabularies from the Health Sciences Descriptors (DeCS) and the Medical Subject Headings (MeSH), as well as free terms related to the research topic. The following descriptors were used, combined by Boolean operators (AND and OR): “Artificial Intelligence” OR “Inteligência Artificial”, “Higher Education Teaching” OR “Docência no Ensino Superior”, “Teacher Training” OR

"Formação de Professores" OR "Faculty Development", "Educational Technology" OR "Tecnologias Educacionais", "Higher Education" OR "Ensino Superior", "Teaching Competencies" OR "Competências Docentes", and "ChatGPT" OR "Generative AI". The selected databases for data collection were: Scientific Electronic Library Online (SciELO), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Scopus, Web of Science, and PubMed.

We included scientific articles published between 2019 and 2025, in Portuguese, English, or Spanish, available in full text, that directly addressed the relationship between artificial intelligence and university teacher education, whether in the context of initial training, continuing education, or professional development. We excluded non-integrative reviews, institutional documents, theses and dissertations, studies focusing exclusively on basic or technical education, studies solely focused on students, and publications addressing AI only as an administrative or academic management tool.

The screening of studies was based on title and abstract reading, in accordance with the previously defined criteria. Potentially eligible texts were read in full to confirm thematic relevance and methodological quality. The process of identification, screening, eligibility, and inclusion of articles followed the recommendations of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), with data represented in an explanatory flowchart (Moher et al., 2009).

Figure 1. Flowchart of the study selection process included in this Integrative Review



Adapted from: Moher et al., 2009

The data collection stage was systematized through the construction of a summary table containing the following information: article title and journal name, main author and year of publication, country of origin and language, research method and level of evidence, as well as the overall objective of the study. The classification of evidence levels followed the guidelines of the Joanna Briggs Institute (JBI), as described by Lockwood et al. (2020), namely: Level I – evidence from meta-analyses, randomized controlled trials; Level II – evidence from experimental studies; Level III – evidence from quasi-experimental studies; Level IV – evidence from descriptive investigations or studies with a quantitative/qualitative approach; Level V – evidence from case reports or experience-based accounts; and Level VI – evidence based on expert opinion (Lockwood et al., 2020).

3- RESULTS

After applying the inclusion and exclusion criteria and completing the screening process in accordance with the PRISMA protocol, 12 articles were selected to compose the corpus of this integrative review. The publications span the years 2019 to 2025, with a predominance in the last three years, indicating the growing interest of the scientific community in the topic. Most studies are qualitative or descriptive in nature, with Level IV evidence according to the Joanna Briggs Institute classification.

Regarding the areas of publication, the studies are predominantly situated in the fields of Education, Communication, Digital Technologies, and Applied Social Sciences, reflecting the cross-cutting nature of the debate on AI and teacher education. The studies were published in journals within the fields of Education, Human Sciences, and Applied Technologies, with contributions originating mainly from Latin America, Western Europe, North America, East Asia, and Oceania, revealing a global and transversal approach to the phenomenon.

A diversity of application contexts was observed, encompassing both initial teacher education programs and in-service faculty development strategies. Notably, the studies analyzed institutional guidelines, didactic uses of ChatGPT, critical digital literacy, counter-hegemonic epistemologies, and the ethical implications of generative AI.

The analysis of the selected studies enabled the organization of findings into two core analytical categories, which will be discussed in the following section: (1) Pedagogical potentials and limitations of artificial intelligence in teacher education; and

(2) Ethical, epistemic, and identity-related challenges in the integration of AI in higher education.

These categories reflect the complexity of the object of study and the multiplicity of approaches present in the literature, offering insight into both instrumental uses of AI and its deeper implications for university teaching. Table 1 below presents a synthesis of the included studies, highlighting the article title and main author, journal and year of publication, country and language, study type and level of evidence, as well as key findings and implications for teacher education.

Table 1 – Characterization of the studies included in the Integrative Literature Review

Title and main author	Journal and year of publication	Country and language	Type of study and level of evidence	Implications for teacher education
ChatGPT and generative AI: possibilities for its contribution to lesson planning, critical thinking and openness in teacher education. Van Den Berg, G.	Education Sciences; 2023.	Netherlands; English.	Qualitative study; Level of evidence IV.	AI supported lesson planning and fostered critical thinking; highlights the need to assess its limitations and biases.
Opportunities and risks involved in using ChatGPT to create first grade science lesson plans. Powell, W.	PLOS ONE; 2024.	USA and Philippines; English.	Qualitative study; Level of evidence IV.	ChatGPT facilitated 5E model-based lesson planning but presented inconsistencies and false data; underscores the need for critical teacher mediation and verification skills.
Artificial intelligence in higher education: The impact of need satisfaction and self-regulated learning on AI literacy. Wang, K.	Education and Information Technologies; 2025.	China; English.	Quantitative study; Level of evidence IV.	Psychological needs (autonomy, competence, relationships) and self-regulation strategies are positively linked to AI literacy, stressing supportive learning environments in AI-integrated courses.
Primazia da Dimensão Utilitária e Recuo Crítico: Inteligência Artificial Generativa e os Valores em Disputa na Ciência. Azevedo, N. H.	Ensaio: Pesquisa em Educação em Ciências; 2025.	Brazil; Portuguese.	Case report; Level of evidence V.	Highlights the risks of uncritical use of generative AI in science education; calls for ethical-political foundations in teacher training to foster critical and epistemologically aware practices.

Investigating the higher education institutions' guidelines and policies regarding the use of generative AI in teaching, learning, research, and administration. An, Y.	International Journal of Educational Technology in Higher Education; .2025	USA; English.	Descriptive study; Level of evidence IV.	Mapped AI-related guidelines in 94% of top US universities; identified key topics like integration, security, and integrity; suggests institutional strategies for critical teacher development.
Reporting the potential risk of using AI in higher education: Subjective perspectives of educators. Pikhart, M.	Computers in Human Behavior Reports; 2025.	Czech Republic and Iraq; English.	Qualitative study; Level of evidence IV.	Educators raised concerns over ethics, autonomy, and trust; study reinforces the need for culturally sensitive, ethical-pedagogical training for AI use in higher education.
Educational pathways for enhancing algorithmic transparency: a discussion based on the phenomenological reduction method. Lu, X.	AI & Society; 2025.	United Kingdom and China; English.	Quantitative study; Level of evidence IV.	Proposes a phenomenological educational model to enhance "cognitive transparency" in AI systems through critical reflection, intuitive understanding, and empathetic listening.
Reflection-AI: artificial intelligence or algorithmic instruction problem? Kim, O.	Frontiers in Communication; 2025.	South Korea; English.	Qualitative study; Level of evidence IV.	Reframes the 'AI problem' as pedagogical standardization; advocates for reflexive pedagogy grounded in feminist epistemologies and qualitative methods to foster ethical, creative classroom use.
Educación inclusiva con inteligencia artificial: personalización	Multidisciplinary Latin American Journal; 2025.	Ecuador; Spanish.	Systematic review study; Level of evidence I.	Explores AI's role in curricular personalization for students with special needs;

curricular para estudiantes con necesidades educativas especiales. Vasco-Delgado, J.C.				emphasizes teacher preparation for ethical, inclusive, and adaptive practices in the Ecuadorian context.
Cognitive imperialism in artificial intelligence: counteracting bias with indigenous epistemologies. Ofosu-Asare, Y.	AI & Society; 2025.	Australia; English.	Qualitative study; Level of evidence IV.	Suggests a participatory framework to include Indigenous epistemologies in AI development; stresses pedagogical reflection on bias and the promotion of epistemic justice in teacher education.
Unveiling the shadows: Beyond the hype of AI in education. Al-Zahrani, A. M.	Heliyon; 2024.	Saudi Arabia; English.	Descriptive study; Level of evidence IV.	Identified 10 educational AI risk dimensions; advocates for teacher training strategies that balance innovation with ethical responsibility.
Artificial Intelligence in Teaching and Teacher Professional Development: A Systematic Review. Tan, X.	Computers and Education: Artificial Intelligence; 2025.	China; English.	Systematic review study; Level of evidence I.	Analyzed 95 studies; found limited focus on teacher training (35%); emphasizes the need for continued education strategies addressing ethical and pedagogical aspects of educational AI.

Source: Authors' own elaboration.

4- DISCUSSION

The emergence of Artificial Intelligence (AI) as a tool in educational settings

challenges not only pedagogical practices but also the very foundations that underpin the teaching profession. In the field of teacher education, this scenario disrupts traditional models, calls for the reconstruction of professional knowledge, and requires the development of new epistemological, ethical, and technological competencies. The reviewed literature reveals both the vitality and complexity of this debate, with studies alternately emphasizing the practical benefits of AI in higher education and warning against uncritical and decontextualized adoption.

The analysis of the 12 selected studies enabled the construction of two interpretive categories. The first addresses the pedagogical potentials and limitations of AI as an educational tool, focusing on its impact on teaching and assessment practices. The second category explores the ethical, epistemic, and identity-related challenges that arise from AI integration in university contexts, including reflections on authorship, critical thinking, and teacher autonomy. Both categories highlight the need for robust, critical, and context-aware pedagogical mediation, especially in teacher training programs and continuing education initiatives.

4.1 Pedagogical Potentials and Limitations of Artificial Intelligence in Teacher Education

The reviewed studies emphasize that AI, particularly its generative branch, has been explored as a valuable ally in lesson planning, curriculum organization, and the development of more dynamic assessment strategies. Experience reports indicate that tools like ChatGPT have been used to support lesson scripting, the creation of teaching materials, and interactive simulations, fostering student engagement and autonomous learning (Van Den Berg; Du Plessis, 2023; Powell; Courchesne, 2024). These practices reflect a redefinition of the teacher's role, shifting from a knowledge transmitter to a knowledge mediator and curator (Wang; Cui; Yuan, 2025).

However, the literature also highlights important limitations. In many contexts, AI use remains instrumental and detached from pedagogical foundations, reinforcing technocratic logics and impoverishing the educational process. Studies point to the lack of clear institutional guidelines and the scarcity of specific training for educators to deal with the dilemmas posed by AI (An; Yu; James, 2025). In teacher education programs,

for instance, there are still few initiatives that critically address the role of these technologies in shaping ethical, civic, and critical teacher profiles (Pikhart; Al-Obaydi, 2025).

Another recurring concern involves the superficiality of interactions promoted by AI systems, which, although efficient in generating content, often lack pedagogical intentionality. There is a risk of algorithmic logic overtaking pedagogical logic, replacing reflection with automation and reducing teaching to a series of technical tasks (Lu; Yang, 2025). These limitations demand that AI integration be approached with discernment, planning, and reflective monitoring, lest its transformative potential be diminished (Kim, 2025).

Still, when critically and contextually integrated, AI can expand teachers' pedagogical repertoire, allowing for personalized learning, diversified assessment strategies, and stimulation of creativity (Vasco-Delgado et al., 2025). The literature highlights experiences in which AI contributed to the inclusion of students with learning difficulties through real-time adaptations, and to the reduction of inequalities in access to educational resources. These findings reinforce that the pedagogical potential of AI depends less on the technology itself and more on the political and formative intentionality guiding its use (Van Den Berg; Du Plessis, 2023; Wang; Cui; Yuan, 2025).

4.2 Ethical, Epistemic, and Identity-Related Challenges in the Integration of AI in Higher Education

The integration of artificial intelligence into teacher education is not a neutral process: it mobilizes values, worldviews, and epistemological positions. The analyzed studies warn of the risk of intellectual disengagement and the dilution of authorship, especially when teachers and students resort to AI without critical mediation (Azevedo; Santos, 2025). The ease of access to automated responses may weaken the development of autonomous thinking, compromising essential aspects of the educational process such as argumentation, authorship, and critical inquiry (Pikhart; Al-Obaydi, 2025; Kim, 2025).

Another challenge concerns the tension between technological innovation and epistemic justice. The literature indicates that AI continues to reproduce structural

biases, often rendering peripheral knowledge and traditional wisdoms invisible (Ofosu-Asare, 2025). In teacher education contexts, this can lead to standardized practices and the erasure of the diverse epistemologies that make up the educational landscape, particularly in Global South countries. Thus, uncritical AI use may exacerbate historical asymmetries in the access to, recognition of, and production of knowledge (Al-Zahrani et al., 2024).

Lastly, the presence of AI in academic routines prompts a reconfiguration of the university professor's professional identity. From being the central agent in the educational process, the teacher now shares space with intelligent systems that provide content, correct assignments, and interact with students (Ofosu-Asare, 2025; Lu; Yang, 2025). This symbolic shift often generates anxiety, insecurity, and resistance, especially among educators trained in more traditional models. The literature suggests that this transformation can only be constructive if accompanied by a robust pedagogical policy that considers the subjective and sociocultural dimensions of teaching (Kim, 2025; Lu; Yang, 2025).

In this regard, several authors argue that confronting these challenges requires not only technical training but also the promotion of collective spaces for dialogue, reflection, and critical engagement among educators. Rebuilding teacher identity in the age of AI depends on valuing formative experiences, ethical reflection, and the collaborative production of knowledge, breaking with hierarchical models and renewing the social commitment of university teaching (Tan et al., 2025; Kim, 2025).

5- FINAL CONSIDERATIONS

This study aimed to analyze, through an integrative literature review, how artificial intelligence has been incorporated into teacher education in higher education, emphasizing its potentials, limitations, and pedagogical, ethical, and identity-related implications. The findings indicate that although AI may be a promising tool for enhancing educational practices, facilitating lesson planning, diversifying assessment strategies, and expanding access to knowledge, its integration still occurs unequally and is often devoid of critical mediation in many of the experiences reported.

More than the adoption of a new technology, the presence of AI calls for a

reexamination of formative practices and the epistemologies that underpin teaching. The literature reviewed suggests that such transformation cannot be technocratic or merely instrumental, as this risks reinforcing automatism and obscuring plural ways of knowing. In this context, the need arises for institutional policies that combine ongoing training, dialogical spaces for collective reflection, and the construction of a pedagogical culture attuned to technological change, without relinquishing the humanizing intentionality of the educational process.

Although conducted with methodological rigor, this study presents limitations, particularly the predominance of qualitative and exploratory studies, which restrict the generalizability of findings. Moreover, the diversity of approaches and contexts in the selected articles poses challenges for analytical uniformity. Nonetheless, these limitations do not diminish the relevance of the investigation, as it offers a current and critical overview of a rapidly expanding phenomenon, contributing to the deepening of the debate on pedagogical uses of AI and its implications for teacher education.

In conclusion, the role of artificial intelligence in teacher education fundamentally depends on the pedagogical project that sustains it. When grounded in ethical, reflective, and collaborative principles, AI can serve as an ally in the construction of more responsive, critical, and innovative teaching practices. However, this alliance will only be fruitful if teaching continues to be understood as a social, situated, and intentional practice, capable of giving meaning to technology, promoting epistemic justice, and contributing to the integral education of individuals in complex and diverse contexts.

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