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Systematic Review

Artificial Intelligence in Education: From Instrumental Adoption to Human-Centered Pedagogical Ecologies

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Abstract

The rapid expansion of artificial intelligence in the educational field has configured a broad, dynamic, and constantly evolving research domain. Nevertheless, there remains a need to systematically analyze the evolution of its pedagogical approaches and to identify the conceptual dimensions that structure recent scientific production. For this purpose, a systematic literature review was conducted following the PRISMA protocol, based on searches in Web of Science and Scopus. The final corpus consisted of 235 articles, analyzed using bibliometric and semantic techniques in R, including bibliometrix, tidyverse, and ggplot2, complemented by co-occurrence maps developed with VOSviewer. The thematic classification was carried out through an inductive analysis based on clusters and emerging patterns. The results reveal a progressive transition from technocentric approaches toward more complex and integrative pedagogical perspectives. The semantic analysis made it possible to identify four structuring dimensions of the field: critical, ethical, literacy-oriented, and humanistic. Recent literature also shows a growing emphasis on teacher education, academic integrity, and cognitive coexistence between humans and intelligent systems. These findings indicate that artificial intelligence not only introduces technological innovations but is also reconfiguring the epistemological and pedagogical foundations of contemporary education, demanding conceptual frameworks capable of articulating its ethical, cognitive, and formative implications.

Keywords: AI literacy; AI education; AI pedagogy; artificial intelligence

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Academic Editor: Yu-Cheng Wang

Received: 13 May 2026
Revised: 16 June 2026
Accepted: 17 June 2026
Published: 22 June 2026

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1. Introduction

In educational training processes, the symbolic adoption of artificial intelligence has become an increasingly visible phenomenon [1]. Although institutional discourse and technological implementation projects present artificial intelligence as a sign of educational innovation [2], its incorporation into learning often remains at a superficial level [3]. In this way, artificial intelligence becomes a representation of digital competitiveness rather than a tool capable of transforming pedagogical practices or fostering critical thinking [4,5].

This situation is generating a pedagogical illusion of artificial intelligence, manifested when discourse promises intelligent, personalized, and equitable education [6], without empirical evidence supporting such claims [7,8]. In some cases, artificial intelligence tools are integrated for educational administration purposes [9], without improving fundamental

elements of the learning process, such as deep understanding, creativity, and students' metacognitive skills [10]. This gap between discourse and reality constitutes one of the main paradoxes of contemporary educational digital transformation [11,12].

Symbolic adoption and pedagogical illusion reveal a common pattern: the displacement of focus from learning toward compliance related to the implementation of artificial intelligence in educational institutions [13]. As a result, universities become immersed in a process of simulated innovation, where the educational value of this tool is measured by its visibility in training activities rather than by its actual impact [14]. This invites reconsideration of the real contributions of artificial intelligence to the emergence of pedagogies capable of transforming learning processes [15].

Based on the above, the present systematic literature review aims to identify the pedagogical contributions that have emerged from the adoption of artificial intelligence in educational institutions and to construct a classification of these contributions. As shown in Figure 1, the study starts from the tension between institutional discourse on artificial intelligence and its actual incorporation into educational practices. In this model, symbolic adoption and pedagogical illusion operate as interpretive entry points for understanding why AI is often presented as a sign of innovation, personalization, equity, and digital competitiveness, even when its use does not necessarily transform learning processes. These tensions lead to the need for an interpretive reorientation that examines AI not only as a technological tool but as a phenomenon with pedagogical, epistemic, ethical, and institutional implications.

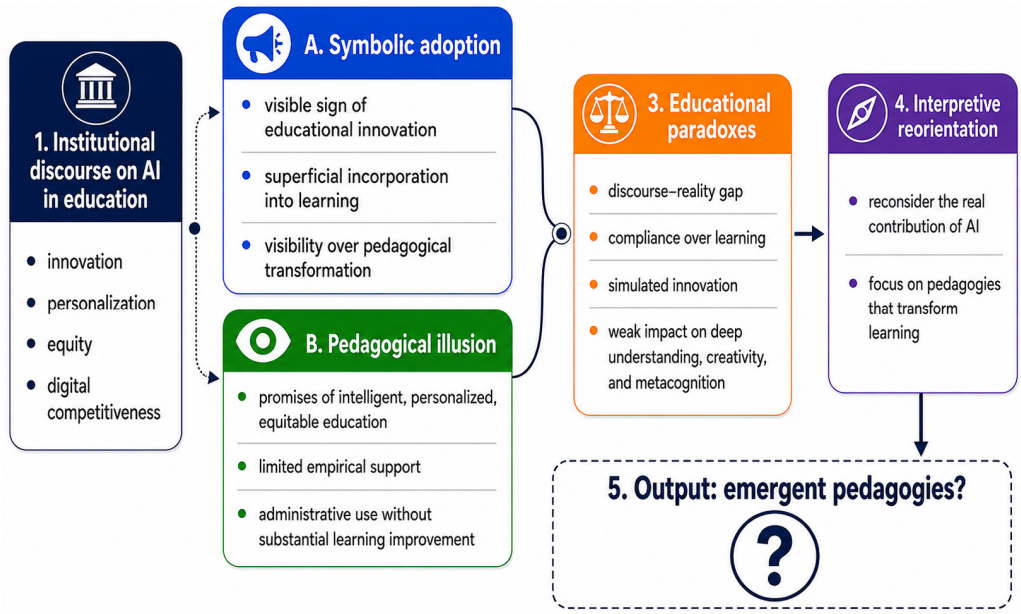


Figure 1. Interpretative model in AI in Education and emergent pedagogies.

The study seeks to answer the following research question: How has artificial intelligence evolved and been conceptualized in the international scientific literature on education, and what pedagogical dimensions emerge from this academic production? To address this question, three specific objectives are proposed: first, to analyze the temporal and thematic evolution of scientific production; second, to identify the contributions of the most impactful studies; and third, to classify the emerging pedagogical dimensions derived from the adoption of artificial intelligence.

Tensions Regarding the Use of Artificial Intelligence in Education

During the last decade, the adoption of artificial intelligence in education has experienced unprecedented expansion. Some studies indicate that more than eighty conceptual, ethical, and normative frameworks have been developed to guide its development, regulation, and responsible use [16]. This multiplicity of reference frameworks reflects global interest in establishing consensus around a technology with transversal impact, but it also evidences conceptual and empirical fragmentation that hinders its coherent integration into educational processes. An example of this is the Digital Competence Framework for Citizens, DigComp 2.2, published by the European Commission, which incorporates more than 250 examples integrating interaction with artificial intelligence-driven systems, personal data management, and the fight against disinformation. Although it promises to ensure that citizens acquire critical thinking skills, digital security, and data management abilities, national policies have adopted the framework, while educational systems have not yet translated it into concrete curricular practices [17].

The Framework for Ethical AI at the United Nations aims to guide the responsible use of artificial intelligence in social contexts [18]. It emphasizes that education plays a key role in ensuring that technology contributes to social wellbeing rather than reproducing structural inequalities. However, it has been argued that in many countries, unequal access to digital infrastructure and the lack of artificial intelligence literacy policies are creating a gap between the Global North and the Global South [19]. This disparity is particularly visible in Latin America, where scientific production related to the use of artificial intelligence in educational contexts remains limited compared to Europe and Asia [20].

Likewise, the Guidance for Generative AI in Education and Research [19] emphasizes the urgency of adopting a humanistic approach in response to the advancement of artificial intelligence, stating that artificial intelligence should not replace human intelligence but rather enhance it. However, the document recognizes that most countries lack the regulatory frameworks and institutional capacities necessary to apply this principle, indicating a gap between regulatory discourse and educational reality. In classrooms, spontaneous uses of artificial intelligence often occur without pedagogical mediation [21], exacerbating inequalities and risks of technological dependence [22].

The European Union has addressed this issue through the AI Act, which guides the ethical and secure use of artificial intelligence [23]. Article 4 establishes the obligation to ensure artificial intelligence literacy; however, institutional readiness to comply with this requirement remains insufficient [24]. Evidence of this can be found in the TALIS 2024 report, which indicates that only one out of three teachers use artificial intelligence in professional practice, while seven out of ten express concerns about risks related to plagiarism and the loss of fundamental cognitive skills among students [25].

In this context, the AI Literacy Framework proposes artificial intelligence literacy as a key competence for the twenty-first century, arguing that students must understand, manage, create, and design with artificial intelligence in an ethically responsible manner. Nevertheless, draft findings reveal a significant gap: more than 49 percent of young people between the ages of 17 and 27 struggle to identify the limitations and errors of artificial intelligence, and 74 percent believe that school does not prepare them for a future labour market mediated by these technologies.

Furthermore, the Ethical Guidelines on the Use of Artificial Intelligence and Data in Education and Training for Educators [26] complement the principles of the AI Act by providing practical guidance for teachers. These guidelines emphasize the importance of promoting understanding of the potential and risks of artificial intelligence, as well as ensuring transparent data use in learning environments. As previously noted, reality

reveals a significant gap: most teachers lack the training and institutional support needed to understand the ethical principles promoted by these guidelines [27].

Although these frameworks converge in promoting a human-centered, transparent, and rights-based approach to artificial intelligence, the distance between their promises and classroom realities remains considerable [28]. While they present a coherent narrative regarding opportunities such as inclusion, efficiency, and the strengthening of human agency, empirical evidence reveals structural gaps in their implementation, including insufficient teacher training, technological adoption without pedagogical impact evaluation, and growing dependence on automated systems at the expense of critical thinking [29].

2. Materials and Methods

The PRISMA method was used [30]. The search period covered January 2005 to December 2025. The complete search strategy, eligibility criteria, data curation procedure, and supporting bibliographic information are provided in the Supplementary Materials. The process was structured in the following stages: (1) formulation of the research questions; (2) identification of the scientific production; (3) screening and selection of documents according to the established criteria; (4) construction and refinement of the bibliographic database; and (5) systematic and thematic analysis of the final corpus. The questions guiding this study were as follows:

Q1. What have been the main thematic trends characterizing international research on artificial intelligence in education?

Q2. What thematic clusters structure scientific production specifically focused on the relationship between artificial intelligence and pedagogy?

Q3. How has research on artificial intelligence and pedagogy evolved over time in terms of thematic centrality and density?

Q4. What are the conceptual and pedagogical contributions of the studies with the greatest international impact in the field of artificial intelligence and education?

Q5. How can the emerging pedagogical dimensions derived from the literature on artificial intelligence in education be systematically classified?

2.1. Identification and Search of Scientific Production

Web of Science and Scopus databases were used. The search strategy was structured through the following Boolean operation: ("artificial intelligence" OR AI OR "machine learning" OR "generative AI" OR "large language model*") AND (education OR pedagogy OR pedagog* OR "education" OR university OR "instructional design" OR "educational technolog*") in order to encompass the main conceptual variants related to artificial intelligence and its integration into educational contexts. Three specific inclusion criteria were applied: (a) documents had to correspond to articles in their final published version; (b) they had to be directly linked to the educational field; and (c) they had to explicitly incorporate, in the title, abstract, or keywords, a pedagogical focus.

Once the initial set of records was assembled, a systematic mapping process was conducted to verify their relevance and confirm compliance with the established criteria. Figure 2 illustrates the selection process followed in the study. The following were excluded: (a) duplicate documents across databases; (b) publications in languages other than English and Spanish; (c) works not belonging to the field of education sciences or areas directly related to pedagogy and educational training; and (d) documents such as editorials, reviews, and technical notes. Because the corpus included heterogeneous study designs, they were assessed according to four criteria: (a) peer-reviewed final published article status, (b) explicit relevance to the educational field and to pedagogy, (c) sufficient methodological or conceptual clarity to permit reliable classification and analysis, and (d) availability

of an abstract and bibliographic metadata robust enough for bibliometric and semantic processing. Accordingly, editorials, technical notes, opinion pieces, duplicate records, studies without a clear pedagogical focus, and documents lacking sufficient analytical or methodological information were excluded at this stage.

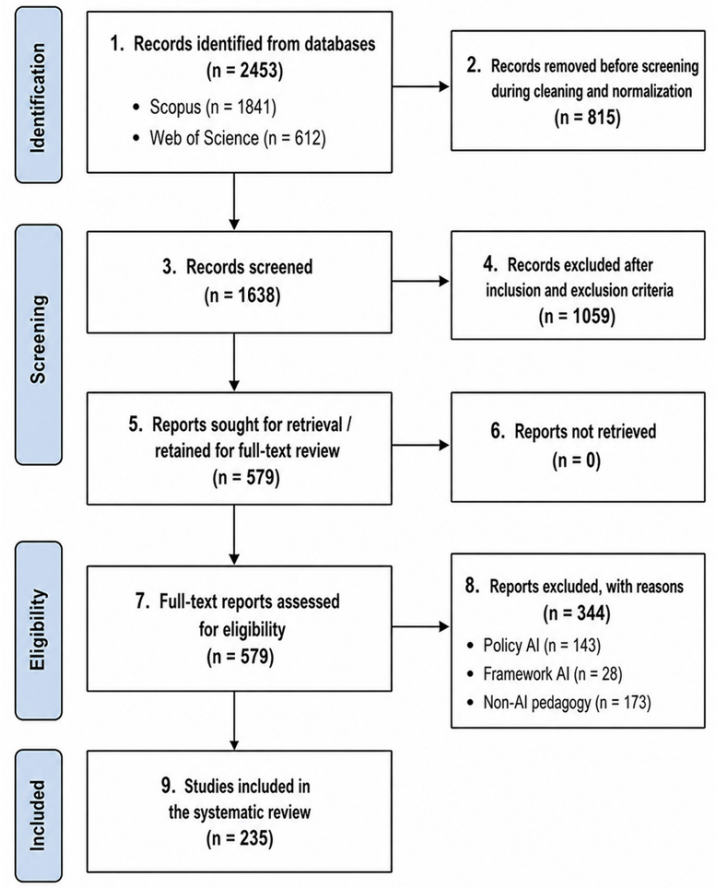


Figure 2. Identification and curation of scientific production.

All authors participated in the different phases of corpus cleaning, screening, eligibility assessment, and thematic analysis. In the first stage, two authors independently reviewed the records identified in Scopus and Web of Science, applying the previously defined inclusion and exclusion criteria. Subsequently, the results of this review were cross-checked by the full research team in order to verify the relevance of the selected documents, the consistency of the bibliographic database, and the correspondence between the semantic clusters and the emerging pedagogical dimensions. Discrepancies arising during screening, document exclusion, or the interpretive assignment of categories were resolved through collective discussion among all authors until consensus was reached. When differences in interpretation emerged, the title, abstract, keywords, and, when necessary, the full text of the document were reviewed again, always prioritizing coherence with the research question, the eligibility criteria, and the pedagogical focus of the study.

2.2. Databases and Analysis of Scientific Output

The result was the selection of 235 scientific publications [31]. To analyze them, two complementary databases were constructed. The first consisted of a plain text file in CSV format with the following fields: (1) author or authors; (2) title of the work; (3) year of publication; (4) source information including journal name, volume, issue, pages, DOI, abstract, and keywords; and (5) country. Based on this initial matrix, a second database was generated in .RIS format to facilitate the automatic extraction of references in APA

style using Zotero software 9.0.5. To analyze the scientific output, the bibliometrix, dplyr, ggplot2, and tidyverse libraries of the R software 2026.01.1-403 were used. VOSviewer software 1.6.20 was also employed to identify co-occurrence relationships among terms and to group them according to their semantic proximity.

2.3. Organization of the Results

An inductive analysis was conducted to identify emerging connections without relying on preconceived categories. For this purpose, the qualitative interpretive phase was guided by Braun and Clarke's Reflexive Thematic Analysis [32], which enabled a systematic and recursive examination of the semantic structures identified through bibliometric mapping. In this process, the clusters generated through VOSviewer were treated as analytical entry points rather than as definitive themes. Thus, the software did not directly generate the four final dimensions; instead, it identified multiple semantic microclusters and co-occurrence patterns that were subsequently reviewed, compared, and interpretively grouped. Through this process, conceptual regularities were observed and progressively organized into four major dimensions: critical, ethical, literacy-oriented, and humanistic.

3. Results

3.1. Q1. What Have Been the Main Thematic Trends Characterizing International Research on Artificial Intelligence in Education?

Figure 3 shows that during its initial phase from 2019 to 2021, the emphasis on terms such as virtual reality, computer-aided instruction, and educational measurement reflects a literacy-oriented logic focused on understanding digital tools and their basic functionality. Beginning in 2022, the emergence of topics such as learning analytics, deep learning, and self-efficacy indicates a more pedagogical and critical shift, in which artificial intelligence starts to be analyzed as a cognitive device influencing learning processes beyond its instrumental dimension. The turning point from 2023 to 2025, marked by the emergence of ChatGPT, generative AI, large language models, and prompt engineering, intensifies concerns regarding academic integrity and teacher education, aligning with ethical discussions that problematize authorship, transparency, and responsibility in artificial intelligence-mediated environments.

Figure 4 shows that between 2023 and 2025, the field of artificial intelligence in education has been structured around interconnected thematic clusters that reflect the rapid expansion of generative models and their pedagogical, ethical, and technological implications. Artificial intelligence and ChatGPT emerge as the highest density centers, articulating the network and demonstrating their dominant role as thematic axes that have reorganized scientific production. Around them, a pedagogical cluster can be observed composed of terms such as student, curriculum, creativity, and innovation, indicating a growing concern about the impact of artificial intelligence on learning processes, student agency, and the redesign of educational experiences.

A second cluster brings together concepts such as academic integrity, privacy, writing, and responsible AI, signaling that the proliferation of generative models has intensified discussions about academic integrity and transparent use practices. Likewise, the co-occurrence of language models, learning analytics, chatbots, contrastive learning, and AI systems shows that the development of intelligent pedagogical systems continues to advance in parallel with pedagogical reflection. The temporal gradient reveals the recent emergence of keywords associated with AI policy, AI equity, cognitive load, and teacher education, evidencing a shift toward regulation, educational justice, and teacher preparation as emerging priorities.

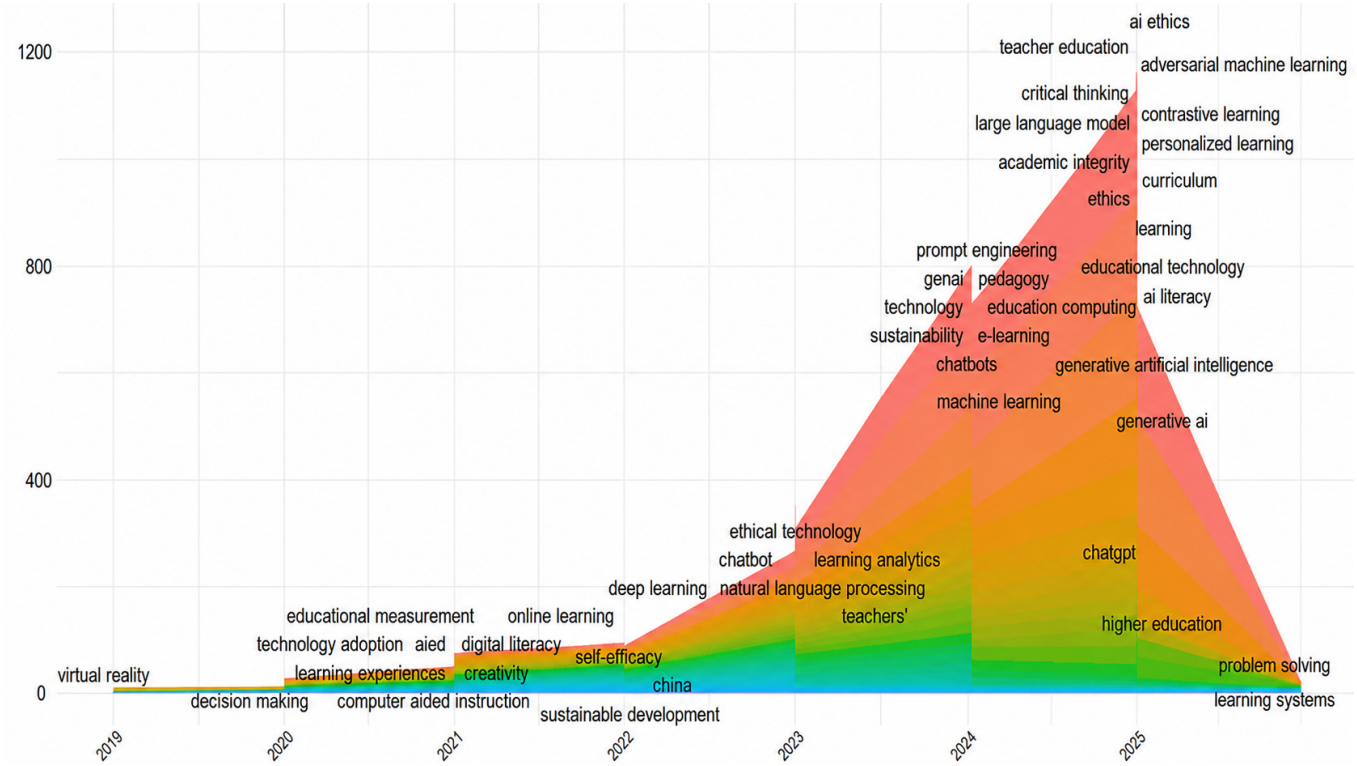


Figure 3. Thematic evolution based on keyword analysis.

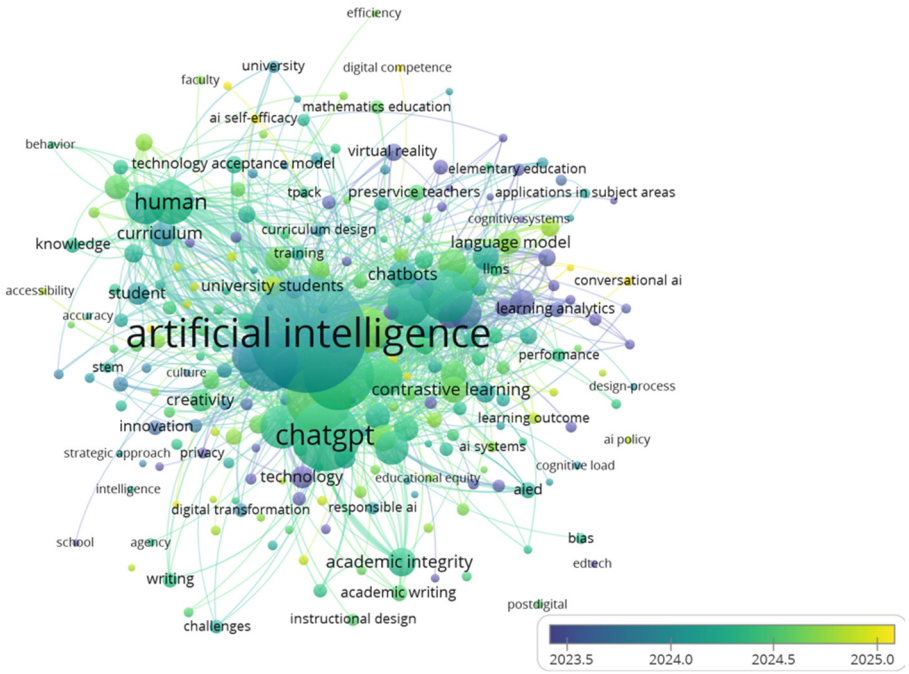


Figure 4. Keyword co-occurrence map.

3.2. Q2. What Thematic Clusters Structure Scientific Production Specifically Focused on the Relationship Between Artificial Intelligence and Pedagogy?

A co-occurrence map of keywords was developed. In Figure 5, terms such as ethical technology, ethical considerations, critical thinking, and artificial intelligence in education can be observed forming a cluster where concerns about conditions of inequality converge with questioning of the epistemological assumptions that underpin the use of artificial intelligence in educational contexts. In another cluster, words such as students,

curricula, learning systems, engineering education, e-learning, and AI literacy appear, indicating a growing emphasis on the competencies required to understand, interpret, and critically engage with intelligent systems, both from the perspective of students and from curricular redesign.

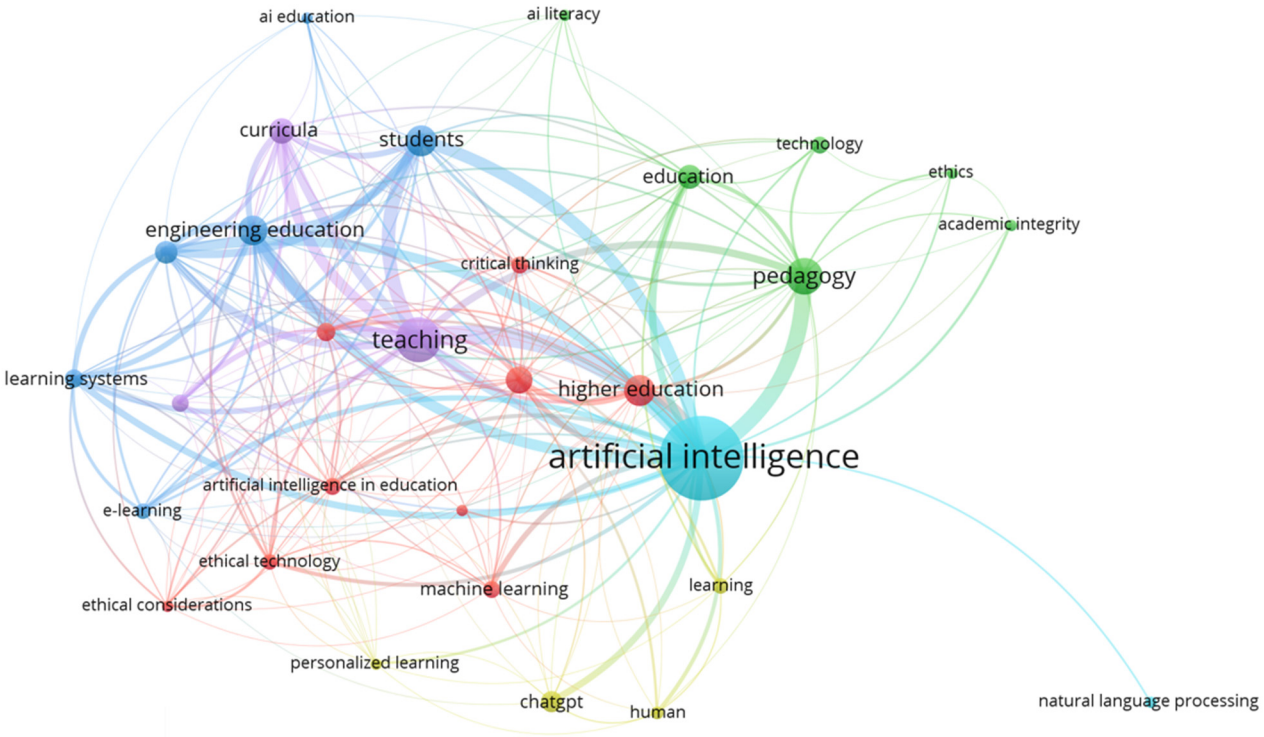


Figure 5. Map of co-occurrence keywords (AI pedagogy).

A third cluster includes terms such as academic integrity, ethics, and personalized learning, confirming discussions about authorship, privacy, and institutional responsibility in the educational use of generative models. A final cluster is articulated through the connection among artificial intelligence, pedagogy, human, learning, and technology, suggesting that artificial intelligence is not conceived merely as a tool but as an enabler that allows humans and machines to co-construct pedagogical practices.

Subsequently, a co-occurrence map of abstracts was developed, which indicated the presence of a thematic structure organized into four dimensions. Figure 6 shows that the first dimension has a critical orientation, manifested in a cluster where terms such as ethical concern, importance, instructor, and AI tool converge. This semantic space reveals the tensions generated by artificial intelligence regarding authorship, the teaching role, and the capacity of generative models to influence power dynamics within the classroom.

Second, a cluster related to literacy emerges, represented by words such as knowledge, experience, AI literacy, practice, and curriculum. This indicates that a significant portion of the literature is oriented toward the development of digital competencies and toward understanding the functioning, potential, and limitations of artificial intelligence, both among teachers and students.

Third, terms such as assessment, impact, effectiveness, and ethical concern are associated with an ethical dimension linked to institutional responsibility and the risks related to its use, emphasizing issues such as transparency, equity, and reliability. A dense interconnection among genAI, ChatGPT, learner, human, development, and innovation becomes visible, suggesting the presence of a dimension related to the interweaving of humans, intelligent systems, and forms of learning.

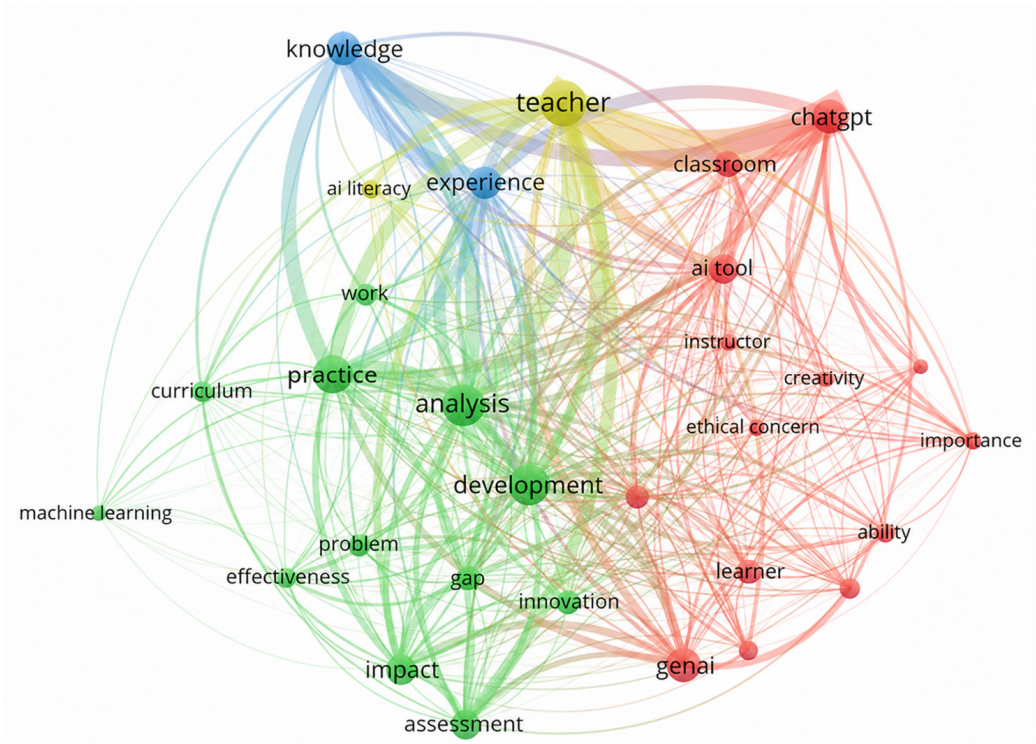


Figure 6. Thematic evolution of abstracts (AI pedagogy).

3.3. Q3. How Has Research on Artificial Intelligence and Pedagogy Evolved over Time in Terms of Thematic Centrality and Density?

Figure 7 shows a clear transition from an instrumental and technicist approach toward a denser and more pedagogically oriented thematic ecosystem. In the early years from 2005 to 2018, terms such as computing, programming, classes, and teaching reflect a field centered on digital tools and basic practices of informatization. Between 2019 and 2021, the network began to articulate around concepts such as pedagogy, innovation, decision, framework, and educators, evidencing a shift toward discussions on educational design, institutional impacts, and early ethical reflections.

From 2022 onward, and especially after the emergence of generative artificial intelligence, semantic density increases abruptly. Words such as AI literacy, ethical concerns, generative design, development, and teaching suggest that research no longer conceives artificial intelligence solely as technology but as a structure that reorganizes learning, assessment, and teaching practices.

In 2024 and 2025, the image shows a condensation of terms into four coherent clusters aligned with four dimensions: critical, ethical, literacy-oriented, and humanistic. These clusters converge around concerns related to governance, pedagogical practices, equity, assisted creativity, algorithmic transparency, and curricular design. This confirms the evolution from a phase of technical exploration toward a paradigm in which artificial intelligence, particularly generative artificial intelligence, reconfigures the way knowledge is produced, validated, and taught.

Figure 8 provides a semantic positioning of the final corpus through a text mining procedure applied to the abstracts. The vocabulary was structured around the four pedagogical dimensions identified in the review: critical, ethical, literacy-oriented, and humanistic. Relative prevalence was calculated as the percentile rank of the normalized frequency of dimension-related terms, whereas relative association was estimated as the percentile rank of the co-occurrence strength between those terms and the semantic core of each category. The quadrant boundaries were established from the median percentile values of both axes,

enabling a comparative interpretation of how each pedagogical dimension is semantically articulated across the corpus.

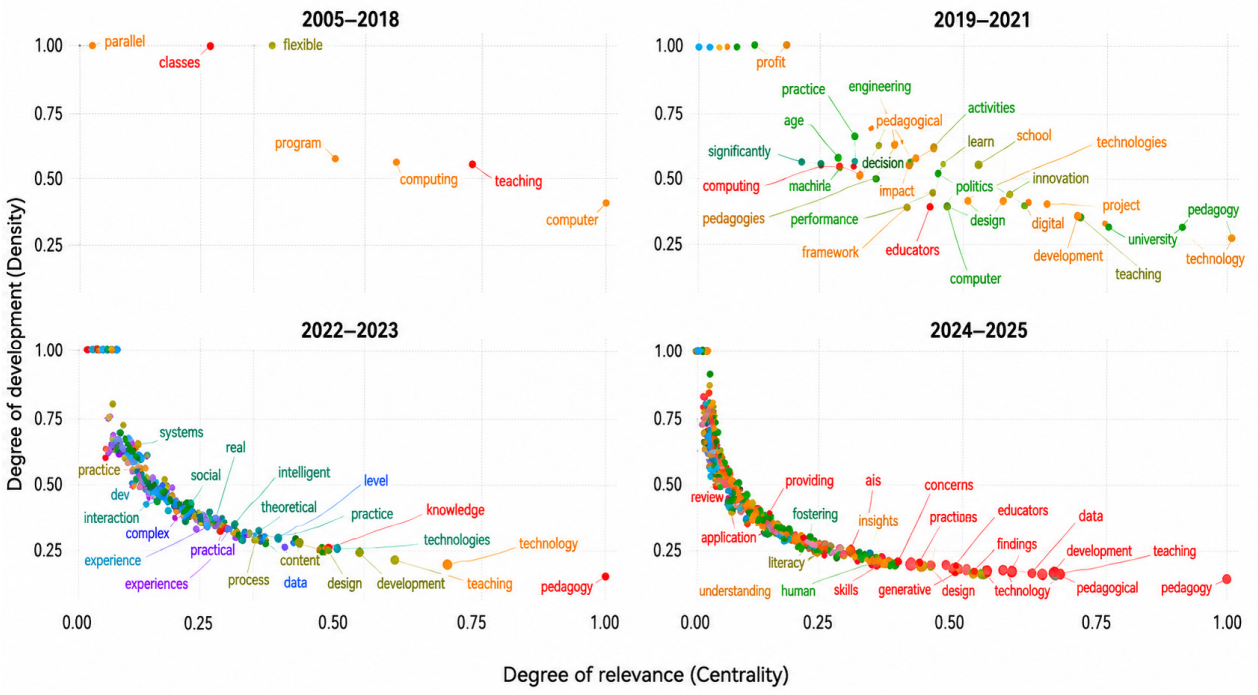


Figure 7. Degree of relevance vs. centrality of keywords by periods in the IA-pedagogy relationship.

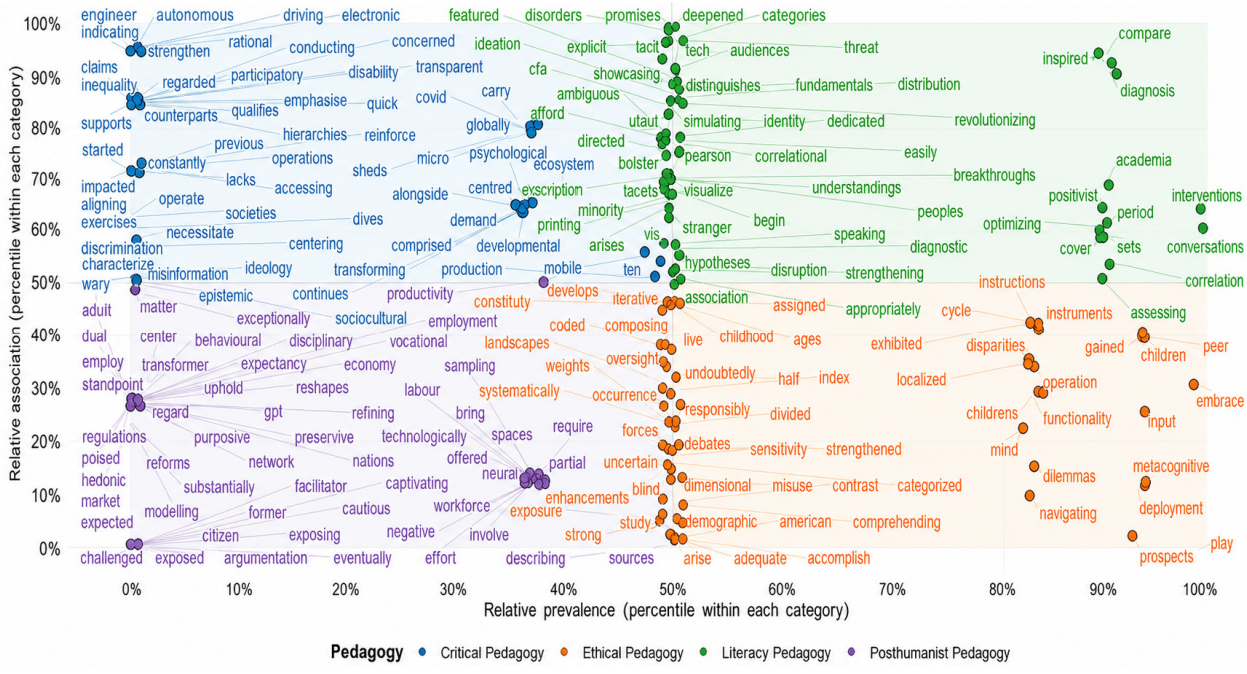


Figure 8. Abstract categorization map (AI pedagogy).

From this perspective, the critical quadrant reveals a discourse strongly shaped by terms such as inequality, discrimination, accessing, participatory, and transforming, suggesting that this strand of the literature does not approach artificial intelligence as a neutral innovation but rather as a sociotechnical phenomenon entangled with structural asymmetries, exclusion, and struggles over educational participation. By contrast, the ethical quadrant, represented by terms such as responsibility, dilemmas, privacy, metacognition,

functionalities, and appropriateness, points to a normative discourse concerned with regulating the conditions under which AI may be pedagogically integrated, particularly in relation to academic integrity, responsible use, and the governance of risk.

The literacy-oriented quadrant, represented in green, clusters terms such as understanding, hypotheses, distinguishing, processes, diagnosis, and interventions, indicating that a substantial segment of the literature frames AI through the development of interpretive, evaluative, and applied competencies. This semantic concentration suggests that AI literacy is being conceptualized not merely as technical familiarity, but as a cognitive and pedagogical capacity to engage critically with complex information processes and decision-making environments. In turn, the humanistic quadrant, represented in purple, brings together terms such as sociocultural, epistemic, co evolving, spaces, operations, and technologically mediated, thereby reflecting a discourse that repositions education as a relational and hybrid ecosystem in which humans and intelligent systems participate in the co-construction of knowledge. Taken together, these four quadrants do more than classify recurrent terminology. They reveal distinct pedagogical imaginaries through which the field interprets the role of artificial intelligence in education: as a site of critique, a domain of ethical regulation, a space for literacy formation, and a humanistic arena for rethinking the boundaries between agency, knowledge, and technological mediation.

3.4. Q4. What Are the Conceptual and Pedagogical Contributions of the Studies with the Greatest International Impact in the Field of Artificial Intelligence and Education?

The 20 most cited scientific products were examined (see Table 1). The analysis shows that the most cited literature does not present artificial intelligence as a single educational innovation but as a heterogeneous pedagogical field organized around five major concerns: the epistemic reliability of AI-generated knowledge, the personalization of learning, the redesign of curriculum and assessment, the governance of educational risk, and the need to preserve human agency in increasingly automated learning ecologies.

The most cited study in the corpus, Cooper [33], illustrates the centrality acquired by generative artificial intelligence in educational debate after the public emergence of ChatGPT, wherein the abstract frames ChatGPT not merely as a teaching aid but as an object of epistemological inquiry within science education. The study explores how ChatGPT responds to science education questions, how educators might incorporate it into science pedagogy, and how the tool itself can be used reflectively in research. Its main contribution lies in revealing the ambivalence of generative AI: while its outputs often align with relevant research themes and may support pedagogical planning, the system can also position itself as an apparent epistemic authority. This is pedagogically significant because it shifts the discussion from whether AI can generate useful content to whether learners and educators are prepared to evaluate the quality, limits, and authority of that content.

A second group of highly cited works focuses on AI as a mechanism for personalization and the construction of adaptive learning pathways. Tapalova and Zhiyenbayeva [34] conceptualize AIEd as a set of technologies that includes chatbots, expert systems, intelligent mentors, agents, machine learning, personalized educational systems, and virtual learning environments. Their contribution is relevant because the abstract connects AI with the possibility of responding to individual student needs and professional competence development.

The corpus also reveals a strong philosophical and pedagogical concern with the nature of knowledge in AI mediated education. Cope et al. [35] move beyond the instrumental use of artificial intelligence and examine the limits and possibilities of machine intelligence in learning ecologies. Their contribution is central because it treats AI not as a neutral tool added to conventional education, but as part of a broader transformation in how knowledge is represented, assessed, and produced.

Table 1. Top 20 most cited works in the AI-education-pedagogy relationship.

N	Title	Authors	Cites
1	Examining Science Education in ChatGPT: An Exploratory Study of Generative Artificial Intelligence	Cooper [33]	797
2	Artificial Intelligence in Education: AIEd for Personalised Learning Pathways	Tapalova & Zhiyenbayeva [34]	312
3	Artificial intelligence for education: Knowledge and its assessment in AI-enabled learning ecologies	Cope et al. [35]	307
4	Artificial Intelligence education for young children: Why, what, and how in curriculum design and implementation	Yang [36]	274
5	Nursing education in the age of artificial intelligence powered Chatbots (AI-Chatbots): Are we ready yet?	Tam et al. [37]	122
6	Learning to work with the black box: Pedagogy for a world with artificial intelligence	Bearman & Ajjawi [38]	114
7	Affordances and challenges of artificial intelligence in K-12 education: a systematic review	Crompton et al. [39]	110
8	Using Generative Artificial Intelligence Tools to Explain and Enhance Experiential Learning for Authentic Assessment	Salinas-Navarro et al. [40]	103
9	How should we change teaching and assessment in response to increasingly powerful generative Artificial Intelligence? Outcomes of the ChatGPT teacher survey	Bower et al. [41]	98
10	Artificial Intelligence Alone Will Not Democratise Education: On Educational Inequality, Techno-Solutionism and Inclusive Tools	Bulathwela et al. [42]	96
11	Artificial intelligence in business curriculum: The pedagogy and learning outcomes	Xu & Babaian [43]	92
12	Impact of artificial intelligence in special need education to promote inclusive pedagogy	Garg & Sharma [44]	91
13	Artificial intelligence-enabled prediction model of student academic performance in online engineering education	Jiao et al. [45]	88
14	Higher Education's Generative Artificial Intelligence Paradox: The Meaning of Chatbot Mania	Rudolph et al. [46]	70
15	Entrepreneurship education in the era of generative artificial intelligence	Bell & Bell [47]	63
16	Teaching introductory artificial intelligence using a simple agent framework	Pantic et al. [48]	62
17	A systematic review of artificial intelligence technologies used for story writing	Fang et al. [49]	48
18	Faculty members' use of artificial intelligence to grade student papers: a case of implications	Kumar [50]	46
19	Is Artificial Intelligence Really the Next Big Thing in Learning and Teaching in Higher Education? A Conceptual Paper	O'Dea & O'Dea [51]	46
20	A Risk Framework for Human-centered Artificial Intelligence in Education: Based on Literature Review and Delphi–AHP Method	Li & Gu [52]	44

AI literacy appears as another organizing axis in the top cited production. Yang [36] addresses AI education for young children and argues that AI literacy should be considered an organic component of early childhood curriculum rather than a specialized technical topic reserved for later stages of education. This expands the scope of AI pedagogy by asking why AI should be introduced early, what conceptual subset is appropriate for young learners, and how children can engage meaningfully with fundamental AI ideas.

The ethical and governance dimension is also visible in studies that examine the opportunities and risks of AI adoption in specific educational fields. Tam et al. [37] discuss AI chatbots in nursing education and identify both potential benefits and risks. Course material development, administrative support, personalized self-paced learning, and problem-

based learning are presented as possible benefits, whereas plagiarism, over reliance, and limitations to critical thinking appear as central concerns.

Bearman and Ajjawi [38] deepen the epistemological discussion by defining AI through a relational perspective in which computational artifacts provide judgments whose internal logic cannot always be fully traced. Their notion of learning to work with the black box is especially important because it reframes pedagogy: rather than assuming that all AI systems must become fully transparent to be useful, education must prepare learners to interact critically with opaque systems, judge when to trust them, and recognize the conditions under which their outputs may be partial, biased, or unreliable.

However, the personalization narrative associated with AI is not purely technical. When read alongside the systematic review by Crompton et al. [39], which identifies affordances and challenges of AIEd in K-12 contexts, it becomes clear that personalization must be interpreted through pedagogical, institutional, and equity lenses. AI may support gaming, diagnosis, adaptive feedback, and content learning, but its educational value depends on the context of implementation, teacher mediation, and the capacity to address negative perceptions, limited access, and insufficient preparation.

A further line of contribution concerns the redesign of teaching, assessment, and authentic learning in response to generative AI. Salinas-Navarro et al. [40] argue that GenAI requires learning environments capable of addressing academic integrity while also strengthening experiential learning and authentic assessment. Their abstract is significant because it does not reduce AI to a threat to be controlled. Instead, it proposes that GenAI can enhance higher order learning when integrated into active learning designs and constructive alignment. Bower et al. [41] complement this argument through a large-scale mixed methods study on how educators believe teaching and assessment should change in response to generative AI. Their results indicate that many teachers perceive generative AI as having a major impact on education, which implies that institutional adaptation cannot be limited to prohibition or detection. Pedagogical change requires rethinking the design of tasks, the evidence used to evaluate learning, and the kinds of cognitive work expected from students.

Another important contribution of the most cited corpus is the critique of techno solutionism and the democratization discourse surrounding educational AI. Bulathwela et al. [42] explicitly challenge the assumption that AI alone can democratize education. Their abstract argues that although AI can support personalized curricula and new teaching practices, unequal access, the digital divide, and preexisting social inequalities may produce the opposite effect: a large-scale expansion of AI that widens educational inequality.

The transversal nature of AI literacy is further reinforced by studies focused on non-technical and disciplinary audiences. Xu and Babaian [43] approach AI education from the perspective of business curricula, where the challenge is to design learning experiences for learners who do not necessarily have a technical background. This confirms that AI literacy is no longer restricted to computer science; instead, it includes conceptual understanding, contextual application, critical interpretation, and the ability to participate in professional environments transformed by intelligent systems.

The inclusive potential of AI is examined by Garg and Sharma [44], who analyze AI in special needs education and inclusive pedagogy. Their work emphasizes the potential of AI to support learners with visual, hearing, mobility, and intellectual disabilities, but it also shows that inclusion depends on how technologies are embedded in institutional and pedagogical practices. Therefore, the most cited literature does not support a naïve optimism about AI. Rather, it suggests that democratization requires accessibility, inclusive design, teacher preparation, and critical attention to social inequality.

The influence of AI on disciplinary and professional education is also evident. Jiao et al. [45] developed an AI enabled prediction model of student academic performance in online engineering education, using learning process and summative data to address the difficulty of predicting academic achievement. This contribution reflects a data driven orientation within the corpus, where AI is valued for identifying patterns, supporting decision making, and improving educational diagnosis.

Several highly cited studies reveal how generative AI is reshaping disciplinary practices and professional preparation. Rudolph et al. [46] add a contemporary critical view by describing the paradox of generative AI in higher education, where pedagogical promise coexists with hype, technological dependency, and the influence of educational technology business groups. Bell and Bell [47] analyze entrepreneurship education in the era of generative AI, highlighting its potential to influence pedagogy, assessment, and students' preparation for future entrepreneurial opportunities. Pantic et al. [48], one of the earliest studies in the top 20, provides a historical contrast by presenting a simple agent framework for teaching introductory AI through a constructivist, real world-oriented approach. Fang et al. [49] examine AI technologies used for story writing and show that AI is transforming literacy practices, authorship, and creative production.

However, the expansion of AI in education must also be interpreted with caution. O'Dea and O'Dea [50] question whether AI is truly the next major transformation in higher education and note the lack of robust evidence on its pedagogical impact. This conceptual caution is especially relevant when contrasted with data driven and generative approaches, because AI may increase analytic capacity or content generation, but this does not automatically imply deeper learning, better teaching, or stronger educational justice.

The governance dimension becomes especially explicit in studies that examine assessment, institutional responsibility, and risk. Kumar [51] examines the use of AI to grade student papers and exposes a dilemma between efficiency, consistency, and feedback quality on one side, and cost, privacy, legality, ethics, and professional implications for faculty on the other. Li and Gu [52] provide a broader governance contribution by proposing a human centered AI risk framework in education. Their abstract identifies risks such as misunderstanding human centered AI, misusing AI resources, and mismatching AI pedagogy. These studies show that the ethical problem is not confined to individual student misconduct; it also involves institutional responsibility, data governance, assessment design, faculty labor, and the alignment between AI systems and pedagogical purposes.

The top 20 most cited scientific products in the selected corpus show that the international discussion on artificial intelligence and pedagogy has evolved from technical implementation toward a more complex educational agenda. The abstracts reveal that AI is simultaneously understood as a learning support system, a curricular object, a risk environment, a tool for inclusion, a challenge to academic integrity, and a catalyst for rethinking assessment and human agency. This confirms that the most influential production in the corpus does not revolve around adoption alone. Its main contribution is to redefine the pedagogical question itself: the central issue is not whether artificial intelligence should be used in education, but under what epistemic, ethical, curricular, and institutional conditions its use can contribute to meaningful, equitable, and human centered learning.

3.5. Q5. How Can the Emerging Pedagogical Dimensions Derived from the Literature on Artificial Intelligence in Education Be Systematically Classified?

This section was developed through a second analytical reading of the corpus, aimed at deepening the interpretation of the scientific outputs included in the review. Although some studies could be associated with more than one category, each work was assigned to the dimension that most clearly reflected its dominant conceptual and pedagogical

contribution. This decision was made to preserve analytical clarity and avoid unnecessary repetition. The resulting classification can be seen in Table 2.

Table 2. Distribution of scientific products according to the emerging pedagogical dimensions.

Dimension	Scientific Products
Critical dimension	[42,44,53–77]
Ethical dimension	[33,38,40,46,50,52,78–105]
Humanistic dimension	[106–143]
Literacy-oriented dimension	[34–37,39,41,43,45,47–49,51,144–267]

Critical dimension

The critical dimension is defined by studies that do not treat artificial intelligence as a neutral educational innovation, but as a sociotechnical system embedded in power relations, institutional priorities, and unequal conditions of access. From this perspective, AI is not only a set of tools for improving efficiency. It is also a mechanism through which educational privatization, platform dependency, datafication, and new forms of symbolic authority may be intensified. Saltman [53], for example, situates AI within broader processes of public education privatization and warns that digital technologies can erode democratic education when they are governed by market logics rather than public pedagogical values. Lee et al. [54] show that youth can investigate AI through media production and ethics-centered pedagogy, which allows students to move from distrust or uncertainty toward a more explicit understanding of how AI participates in their lives. Hodgson et al. [55] extend this critique to social work education by showing that AI transforms not only teaching practices, but also the professional identities, values, and forms of judgment that students must develop for future digital work environments.

The abstracts also show that critique is increasingly connected to inclusion, sustainability, and cross-cultural participation. Yang et al. [56] analyze the global development of AI courses and identify challenges related to the sustainable organization of AI education. Yim [57] demonstrates that arts-based approaches can expand AI literacy in primary education by addressing age and gender barriers that may otherwise be reinforced by technically narrow pedagogies. Stuchlikova and Weis [58] argue that AI-rich learning environments can overwhelm students with information unless they are supported in moving from information access to conceptual insight. Toscano et al. [59] present generative AI as a possible scaffold for critical thinking in architecture, engineering, and construction education, whereas Lubbe et al. [60] connect generative AI, Bloom's taxonomy, and critical thinking as a triad for redesigning assessment toward higher-order cognitive skills.

A further group within the critical dimension emphasizes the pedagogical conditions required to prevent AI from reproducing educational asymmetries. Bo et al. [61] examine AI in translation education through the lens of sustainable development, connecting technological transformation with equitable language learning opportunities. Alqarni [62] contributes to this dimension by developing a teacher-specific scale for AI-critical pedagogy, which indicates that critical integration requires measurable pedagogical capacities, not only positive attitudes toward innovation. Konstantinidis [63] deepens this line of analysis by arguing that dominant metaphors such as tool or tutor can obscure the statistical and ideological nature of AI systems. Asghar et al. [64] link AI literacy, collaborative knowledge practices, and inclusive leadership development across multiple national contexts, while Adigun and Ojomo [65] argue that AI may support inclusive education only when it is accompanied by accessible infrastructure, teacher preparation, and adapted curricula. Finally, Chakraborty and Galatro [66] frame the AI gap between the Global North and the Global South as an educational equity issue that affects who benefits from AI-enabled pedagogies.

Ethical dimension

The ethical dimension brings together studies that foreground responsibility, transparency, integrity, legality, and institutional governance. This dimension becomes especially prominent in the context of generative AI because fluent outputs can simulate authority while concealing fabrication, bias, plagiarism, or weak epistemic grounding. Moya and Eaton [78] examine recommendations for using generative AI with integrity through a scholarship of teaching and learning lens, showing that responsible use must be framed pedagogically rather than only through prohibition. Rajkhanna and Rabbiraj [79] show that legal education must adapt curricula to the changing role of AI in the legal profession. Kumar et al. [80] similarly argue that algorithmic writing technologies are reshaping the way academic integrity is conceptualized, requiring educators to rethink misconduct, authorship, detection, and student learning. Asad et al. [81] show that English writing pedagogy must address both the opportunities of ChatGPT and the risks associated with dependence, authorship, and uncritical adoption.

Other studies in this dimension reveal that ethical AI integration requires governance frameworks that operate across institutional, disciplinary, and technical levels. Virvou and Tsihrintzis [82] propose the FEPER framework by connecting efficiency, pedagogical requirements, and ethical requirements, including transparency, accuracy, trust, data privacy, and human oversight. Ogalo and Mtenzi [83] extend this concern to higher education in Kenya by emphasizing the ethical challenges created by large language models. Hassan [84] adds that the integration of AI with micro-credentials in open education also raises questions about assessment credibility, credential portability, and the governance of personalized learning. Alqahtani and Wafula [85] show that leading universities are already reshaping pedagogical strategies and policies around privacy, ethics, and implementation conditions.

The ethical dimension also appears in professional and disciplinary contexts where AI affects clinical preparation, personalized instruction, legal reasoning, and assessment. Ghimire and Qiu [86] explore nursing students' use of AI and show that learning benefits are inseparable from changing perceptions of traditional pedagogy and professional preparation. Han [87] connects personalized instruction and inclusive pedagogy with ethical concerns such as privacy, algorithmic bias, and the role of teachers. Khurramov et al. [88] analyze the ethical and legal implications of AI tools in science, mathematics, and legal pedagogy. Choiriyah et al. [89] focus on AI-driven assessment in faculties of education and identify a paradox between efficiency and the possible erosion of human-centered evaluation. Sabbaghan [90] broadens this discussion by showing how GenAI challenges authorship, originality, and transparency in academic knowledge production. Alli et al. [91] formulate a policy framework for generative AI in higher education institutions, emphasizing that adoption varies according to infrastructure, regulation, and access to resources. Together, these studies indicate that the ethical dimension is not an external add-on to AI pedagogy. It is one of the conditions that determines whether AI-supported education can be academically legitimate.

Literacy-oriented dimension

The literacy-oriented dimension concerns the competencies that teachers, students, and institutions need in order to understand, evaluate, and pedagogically use AI systems. The abstracts reviewed show that AI literacy is not limited to knowing how to operate tools. It includes conceptual understanding, critical evaluation, curricular design, disciplinary adaptation, and awareness of ethical consequences. Alnasib [144] shows that faculty readiness to integrate AI into teaching depends on identifiable factors that shape pedagogical adoption. Bender [145] frames awareness of ChatGPT and GenAI as an essential digital literacy for English education, while Dai et al. [146] demonstrate that analogy-based peda-

gogy can support AI understanding among upper primary students by connecting human and machine processes.

Teacher education is a central axis of this dimension. Acquah et al. [147] examine pre-service teachers' intention to use AI in lesson planning, showing that future teachers' beliefs and readiness are critical for instructional integration. Burriss and Leander [148] argue for critical post-humanist literacy as a way to understand everyday AI as part of contemporary reading, writing, and ethical life. Joubin [149] focuses on trustworthiness in humanities higher education, emphasizing that generative AI can support curiosity and questioning only when students learn how to interrogate AI-generated texts. Angel et al. [150] propose teacher training in AI use as a twenty-first-century challenge, while Chiu et al. [151] develop and validate a teacher AI competence self-efficacy scale that captures the need for safe, effective, and ethically aware AI-based education.

The literacy-oriented dimension also includes broader theoretical, professional, and institutional frameworks. Ren and Wu [152] identify teaching competencies and challenges in higher education through an intelligent TPACK perspective, and Chan and Tang [153] use a TPACK-based model to evaluate English teachers' AI readiness and training needs. Zou et al. [154] further systematize this field by proposing a framework for educators' pedagogic AI competence. Asal et al. [155] show that digital competence and AI readiness can reinforce pedagogical innovation among nurse educators. Saharuddin et al. [156] analyze teachers' TPACK in the use of AI for teaching, while Galan-Inigo et al. [157] compare AI competency frameworks and identify AI-related digital competencies as a fundamental component of teacher professionalization. Taken together, these contributions reveal that AI literacy functions as the bridge between critical awareness, ethical responsibility, and meaningful pedagogical design.

Humanistic dimension

The humanistic dimension repositions AI within relational, creative, affective, and sociocultural learning ecologies. It does not ask only what AI can automate, but how AI changes the ways learners imagine, create, communicate, feel, and co-construct knowledge. Urmeneta and Romero [106] describe creative applications of AI in education while warning that innovation must be understood through ethical and pedagogical nuance. Yan et al. [107] examine metaphorical conceptualizations of GenAI among Chinese university EFL learners, showing that students interpret AI through symbolic frames that shape their trust, expectations, and learning behavior. Vo [108] analyzes AI and virtual reality in design education, where consumer-ready technologies can support ideation and spatial experimentation for students without extensive computer science backgrounds.

A second humanistic strand focuses on co-construction, active learning, and constructivist transformation. Jin et al. [109] analyze knowledge co-construction among AI, novice teachers, and experienced teachers in an online professional learning community, showing that GenAI can become part of collaborative teacher learning when embedded in a community of practice. Ruiz Viruel et al. [110] examine project-based learning and teachers' perceptions, suggesting that AI can add value to active methodologies when it is aligned with learning quality. Pavlik [111] explicitly connects generative AI with constructivist learning theory, arguing that multimodal AI can transform student engagement when used as an interactive and multisensory resource. Shi and Shakibaei [112] show that AI-integrated speaking instruction can influence speaking skills, social-emotional competence, demotivation, and shyness, which means that AI may affect emotional conditions for language learning. Van den Berg [113] analyzes teachers' experiences in open distance learning and identifies successes, challenges, and strategies that make AI use a situated professional practice.

The humanistic dimension also includes affective, cultural, and professional identity concerns. Nunez-Valdes et al. [114] examine student perceptions of AI in professor training, revealing the need to understand familiarity, access, use frequency, and concerns about ethics and privacy. Sanchez Vera [115] theorizes AI as a form of critical algorithmic mediation that reshapes cultural transmission and symbolic power. Boutob et al. [116] study AI strategies for teaching and learning in higher education, while Kavitha et al. [117] connect instructional design and AI tools with student-centered learning. Lehfid et al. [118] show that teachers may perceive AI as both a collaborative tool and a possible threat to the preservation of teacher roles. Mendonca et al. [119] examine educators' perceptions of GenAI across disciplines, while Praveena and Anupama [120] describe the transformative potential of AI tutors and virtual assistants in English language instruction.

4. Discussion

The findings of this systematic review show that research on artificial intelligence in education is not merely expanding as a technological field, but is undergoing a conceptual and pedagogical classification. The results reveal a movement from early approaches centered on automation, prediction, personalization, learning analytics, and digital support toward a more complex debate on the epistemic, ethical, curricular, and human implications of AI in educational settings. This transition is especially relevant because it challenges the assumption that the presence of AI tools in classrooms, platforms, or institutional systems automatically produces pedagogical innovation. Instead, the evidence suggests that AI becomes educationally meaningful only when it is connected to intentional pedagogical design, critical reflection, institutional responsibility, literacy development, and a clear understanding of the human purposes of education.

A first point for discussion is the heterogeneity of the field. The corpus shows that AI in education cannot be treated as a single or homogeneous phenomenon. Earlier studies in the selected production focused on adaptive learning, student performance prediction, intelligent tutoring, computational instruction, and personalized learning pathways [34,45,48]. However, the emergence of generative AI has intensified concerns related to authorship, academic integrity, synthetic content, epistemic trust, automated feedback, and assessment redesign [33,37,40,41,46,50,51]. This distinction is important because different forms of AI generate different pedagogical problems. Predictive and adaptive systems primarily raise questions about data use, personalization, and learning trajectories, while generative AI raises additional concerns about knowledge production, originality, verification, and the boundaries between human and machine agency.

The critical dimension identified in the review shows that AI must be analyzed as a sociotechnical phenomenon rather than as a neutral instrument for improving educational efficiency. This dimension questions the techno-solutionist assumption that AI, by itself, can democratize education or solve structural problems of access, quality, and inclusion [42]. Several studies in this group warn that AI may reproduce educational inequalities when access to infrastructure, language resources, institutional support, and teacher preparation is unevenly distributed [53–66]. This is particularly relevant because the promise of personalization can obscure the fact that educational systems are already shaped by asymmetries of power, data, language, and technological capacity. From this perspective, critical AI pedagogy does not reject technological innovation, but asks under what conditions AI contributes to justice, participation, and meaningful learning, and under what conditions it reinforces dependency, exclusion, or privatized forms of educational governance.

The ethical dimension complements this critique by showing that responsible AI integration cannot be reduced to individual user behavior. Although academic integrity, plagiarism, and fabricated information are recurrent concerns, the ethical problem is broader.

It includes transparency, accountability, data governance, privacy, evaluation validity, institutional policy, and the pedagogical consequences of delegating judgment to automated systems [37,50,52,78–91]. In this sense, the ethical dimension moves the debate beyond detection and prohibition. The central issue is not only whether students use AI inappropriately but whether institutions have developed clear frameworks for responsible use, whether teachers are prepared to redesign assessment, and whether students understand the limits of AI-generated outputs. This explains why studies on grading, chatbots, legal education, nursing education, and policy frameworks converge around the same concern: AI requires institutional safeguards capable of protecting learning, fairness, and academic responsibility [80,82,83,85,89,91].

The literacy-oriented dimension is the broadest area of the corpus, which indicates that the field is strongly oriented toward the development of competencies for understanding, evaluating, and using AI in educational contexts. This dimension includes studies on AI literacy, teacher readiness, pedagogical competence, curriculum design, adaptive learning, disciplinary applications, and professional training [34–37,39,41,43,45,47–49,51,144–157]. Its relevance lies in showing that access to AI tools is insufficient without interpretive and evaluative capacities. Students and teachers need to understand how AI systems operate, how their outputs are produced, what kinds of errors or biases may emerge, and how these tools can be integrated into learning without replacing reasoning, creativity, and disciplinary judgment. Therefore, AI literacy should not be interpreted as basic technical familiarity, but as a complex pedagogical competence that includes conceptual understanding, critical evaluation, ethical awareness, and the ability to design meaningful learning activities with AI.

The humanistic dimension expands the discussion by situating AI within relational and formative educational ecologies. In this group of studies, AI is not understood only as an instrument for efficiency but as a technology that reshapes agency, creativity, communication, professional identity, and the meaning of learning [106–120]. This perspective is important because it resists two reductionist positions: the idea that AI should simply replace or automate human tasks, and the idea that AI is external to educational relationships. Instead, the humanistic dimension suggests that AI becomes pedagogically significant when it is integrated into practices of co-construction, reflection, creativity, dialogue, and student-centered learning. Studies on project-based learning, teacher professional communities, language learning, design education, constructivist learning, and creative applications of AI show that the value of AI depends on how it mediates relationships among learners, teachers, knowledge, and contexts [106,109–111,115–120].

The analysis of the 20 most cited products reinforces this interpretation. These studies do not simply represent the most visible contributions in terms of citation impact; they also trace the conceptual evolution of the field. Cooper [33] shows how ChatGPT became an object of pedagogical and epistemic inquiry in science education. Tapalova and Zhiyenbayeva [34] illustrate the centrality of personalized learning pathways. Cope et al. [35] provide a broader theoretical view of AI-enabled learning ecologies, while Bearman and Ajjawi [38] highlight the need to prepare learners to work critically with opaque systems. Salinas-Navarro et al. [40] and Bower et al. [41] place generative AI within the redesign of authentic assessment and teaching practices, whereas Li and Gu [52] show the need for human-centered risk frameworks. Taken together, these works demonstrate that the most influential production in the corpus is not limited to celebrating AI adoption. Rather, it increasingly asks how AI transforms assessment, knowledge validation, inclusion, pedagogical agency, and institutional responsibility.

The distribution of the 235 scientific products across the four dimensions also reveals an important imbalance in the field. The literacy-oriented dimension concentrates the

largest number of studies, which suggests that the current international conversation is strongly focused on competencies, teacher preparation, curricular integration, and applied pedagogical design. By contrast, the critical and humanistic dimensions are smaller, but conceptually significant, because they address deeper questions about inequality, agency, relationality, cultural meaning, and the social purposes of education. This imbalance suggests that AI education research may still be more developed in relation to implementation and competence building than in relation to structural critique and humanistic theorization. Future research should therefore strengthen studies that connect AI literacy with justice, inclusion, cultural diversity, and the preservation of human agency.

5. Conclusions

The findings of this systematic review indicate that the field of artificial intelligence in education is undergoing a profound transformation. What initially appeared as the incorporation of digital tools into teaching and learning has evolved into a broader pedagogical debate about how intelligent systems reshape knowledge production, educational mediation, and the social organization of learning. In this transition, artificial intelligence no longer occupies a peripheral position. Rather, it has become a structuring force that challenges conventional assumptions about authorship, agency, evaluation, and the role of pedagogical practice in increasingly technologized environments. The literature reviewed shows that the field is moving away from an instrumental fascination with innovation and toward a more complex discussion of the ethical, cognitive, social, and epistemic implications of AI.

One of the main contributions of this study is the identification of four dimensions that currently organize the international conversation on artificial intelligence in education: a critical dimension that interrogates inequality, exclusion, and power asymmetries; an ethical dimension focused on responsibility, transparency, and academic integrity; a literacy-oriented dimension concerned with the development of competencies for understanding, evaluating, and using AI; and a humanistic dimension that rethinks education as a relational process co-shaped by humans and intelligent systems. Taken together, these dimensions provide an interpretive framework for understanding the pedagogical complexity of the current moment and for explaining why the educational significance of AI cannot be reduced to technical functionality alone.

However, these conclusions must be interpreted in light of the methodological boundaries of the review. The exclusive use of Web of Science and Scopus ensured an internationally visible and academically consolidated corpus, but it also introduced an epistemic and geographic bias that may shape the configuration of the four dimensions identified. For example, the critical dimension may reflect debates that are more visible in globally indexed scholarship, while underrepresenting decolonial, community-based, and regionally grounded critiques emerging from the Global South. The ethical dimension may emphasize concerns dominant in highly indexed academic environments, such as academic integrity, governance, and transparency, while giving less visibility to situated ethical problems related to infrastructural precarity, linguistic inequality, or uneven technological access.

Similarly, the literacy-oriented dimension may privilege formal competence-based models produced in well-resourced institutional contexts, whereas local pedagogical responses developed in less visible educational systems may remain marginal. The humanistic dimension may also be conditioned by theoretical vocabularies recognized in mainstream international publishing, which can favor Euro-American sociotechnical and post-humanist perspectives over alternative relational, communal, or culturally embedded understandings of education and technology. These examples show that the pedagogical

map generated by this review is analytically useful, but it should not be understood as neutral or exhaustive.

For this reason, the study not only identifies pedagogical trends in AI education but also reveals how knowledge about the field is filtered through the logics of international academic visibility. Future research should mitigate this indexing bias by expanding the documentary base beyond Web of Science and Scopus. This may include incorporating regional databases, multilingual scholarship, institutional reports, local case studies, and community-based educational experiences that are often excluded from dominant indexing systems. Such an expansion could challenge, refine, or redistribute the four pedagogical dimensions identified in this review, especially by making visible pedagogical experiences from the Global South and from educational contexts with different technological, linguistic, and institutional conditions.

This review suggests that education is facing a historical turning point. Artificial intelligence introduces not only new tools but also new tensions regarding knowledge, responsibility, participation, and human agency. Understanding this transformation requires critical, ethical, literacy-oriented, and humanistic perspectives capable of entering into dialogue with one another while also remaining attentive to the exclusions produced by the ways in which the field itself is mapped. In this sense, the present study offers both an interpretive framework and a methodological caution: the future of education will depend not only on how AI is pedagogically integrated but also on whose voices, contexts, and epistemologies are allowed to shape that conversation.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/info17060616/s1, Table S1: PRISMA 2020 checklist.

Author Contributions: Conceptualization, L.M.O.-C. and C.E.G.-R.; methodology, C.E.G.-R. and M.B.-F.; software, C.E.G.-R.; validation, D.R.-R., M.B.-F. and C.E.G.-R.; formal analysis, C.E.G.-R. and M.B.-F.; investigation, L.M.O.-C., D.R.-R. and C.E.G.-R.; data curation, M.B.-F. and C.E.G.-R.; writing-original draft preparation, D.R.-R. and C.E.G.-R.; writing-review and editing, L.M.O.-C., D.R.-R., M.B.-F. and C.E.G.-R.; supervision, C.E.G.-R.; project administration, C.E.G.-R.; funding acquisition, M.B.-F. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The bibliographic dataset supporting this systematic literature review has been deposited in Zenodo and is publicly available under the Creative Commons Attribution 4.0 International license, CC BY 4.0. The dataset can be accessed through the following DOI: https://doi.org/10.5281/zenodo.20710043.

Acknowledgments: The authors gratefully acknowledge the technical support provided by the WISE—Women in Smart Education: Complexity and AI Literacy Hub research group (PROY-INB-UBE-030) at the Universidad Bolivariana del Ecuador for the development of this study.

Conflicts of Interest: The authors declare no conflicts of interest.

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