Chapter 22

Rethinking homo economicus
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Artificial Intelligence in Education and Its Impact on Rational Decision-Making

Inteligencia artificial en la educación y su impacto en la toma de decisiones racionales

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ABSTRACT

The emergence of artificial intelligence in education presents opportunities and challenges that go beyond the instrumental use of digital technologies, as it requires the redefinition of school curricula and essential competencies in highly digitized societies. In Latin America, marked by socioeconomic inequalities and digital divides, several countries have launched policies and pilot projects aimed at integrating AI into early childhood, primary, and secondary education. The objective of this study is to conduct a systematic review of the use of AI in Latin American school curricula between 2020 and 2024 to identify advances, results, and challenges related to learning, ethics, equity, and assessment. The PRISMA 2020 guidelines were applied, and international and regional databases (Scopus, Web of Science, SciELO, RedALyC, among others) were consulted, as well as gray literature from multilateral organizations and ministries of education. Empirical, qualitative, and mixed-methods studies, as well as official documents, were included. The selection process yielded 120 studies for the qualitative synthesis and 15 for the exploratory quantitative synthesis. The findings show mixed progress: Brazil and Mexico lead in formal curriculum integration, while Cuba and Chile focus on pilot projects. Argentina and Colombia stand out for mainstreaming digital ethics. Improvements are reported in motivation, critical thinking, and digital skills; however, limitations related to teacher training, infrastructure, and equity persist. Assessment is being transformed using automated feedback, although it faces risks associated with authenticity and technological dependence. The integration of AI into Latin American school curricula is in its early stages and uneven; its effective implementation requires inclusive policies, specialized teacher training, and ethical frameworks that ensure equity and educational quality.

Keywords: School Curricula; Artificial Intelligence; Latin America; Systematic Review.

INTRODUCTION

The emergence of artificial intelligence (AI) in various social and productive spheres has sparked a profound debate about its role in education. In recent decades, AI has evolved from a concept confined to technological research to a cross-cutting tool that impacts daily life, ranging from mobile applications to institutional management systems.(1) In the field of education, its incorporation presents challenges and opportunities that go beyond the instrumental use of digital tools, as it involves rethinking school curricula and the competencies considered essential for the formation of citizens in increasingly digitized societies.(2)

General education—which encompasses early childhood, primary, and secondary education—constitutes the space where the foundations of learning, socialization, and the development of

values are laid.[3] At this level, the integration of AI into school curricula seeks not only to develop technical skills related to computational thinking or the use of algorithms but also to foster critical competencies linked to ethics, equity, and the evaluation of educational processes.[4] AI literacy has thus become an emerging component of digital literacy, understood as the ability to understand, use, and question the technologies that mediate social and academic life.

In Latin America, the discussion on AI in education takes place within contexts characterized by socioeconomic inequalities, digital divides, and cultural diversity.[5] Countries such as Mexico, Brazil, Argentina, Colombia, Chile, and Cuba have begun to explore policies and programs that incorporate AI into their curricula, albeit at different paces and with varying approaches. While some ministries of education have published guidelines on digital competencies and technological ethics, others have launched pilot projects in public and private schools to assess the impact of these innovations on learning and equity. This heterogeneity necessitates a systematic analysis to identify patterns, best practices, and common challenges.[6]

The integration of AI into school curricula raises the following fundamental questions: What content should be taught, and at what educational levels? How can we ensure that AI instruction respects ethical principles and promotes equity? What changes are required in assessment practices to ensure the authenticity and reliability of learning in a context where AI tools can generate automated, high-level responses? These questions reflect the need for a systematic review that synthesizes the available evidence and offers a comprehensive overview of the experiences developed in the region between 2020 and 2024.

This study aims to conduct a systematic review of the use of AI in general education school curricula in Latin America, covering early childhood, primary, and secondary education levels. It seeks to identify how AI has been incorporated into curricula; what outcomes have been reported in terms of learning, ethics, equity, and assessment; and what the implications are for educational policy and teacher training. By offering a rigorous synthesis of the academic and gray literature published between 2020 and 2024, this study aims to contribute to the development of more inclusive, critical, and relevant curriculum frameworks in response to the challenges of contemporary society.

METHOD

This study was designed as a systematic review following the guidelines of the PRISMA 2020 statement.[7] The purpose of this study was to identify, analyze, and synthesize the available evidence on the use of artificial intelligence (AI) in general education school curricula in Latin America from 2020 to 2024.

For the information search, international and regional academic databases were consulted, as well as gray literature from multilateral organizations and ministries of education. International academic sources included Scopus, Web of Science, ERIC, IEEE Xplore, and ACM Digital Library. At the regional level, SciELO, RedALyC, Lilacs, LA Referencia, and Dialnet were used. The gray literature was compiled from documents by UNESCO, the OEI, ECLAC, the IDB, and the World Bank, as well as from ministerial repositories in Cuba, Mexico, Brazil, Argentina, Colombia, and Chile. University repositories, including CAPES in Brazil, UNAM in Mexico, SNRD in Argentina, Colombia Aprende, and the Ministry of Education Library in Chile, were also reviewed.

The search strategy was developed in Spanish and Portuguese, adapting the search strings to each country and database. The terms used included combinations related to artificial intelligence (“artificial intelligence,” “AI,” “machine learning,” “generative AI,” “chatbots”),

curriculum ("curriculum," "syllabus," "study program," "competencies," "standards"), general education ("early childhood education," "preschool," "elementary school," "secondary school," "basic education," "school"), and outcomes ("learning," "assessment," "ethics," "equity," "digital divide"). Searches were limited to the 2020–2024 period and to documents published in Spanish and Portuguese; studies in English were included only when they explicitly referred to the selected countries.

The inclusion and exclusion criteria were defined using the Picos framework, adapted to the educational context. Studies were included that addressed students and teachers in early childhood, primary, and secondary education in the selected countries; that integrated AI into school curricula, either as content or as a pedagogical tool; and those reported outcomes related to learning, ethics, equity, or assessment. Empirical, qualitative, and mixed-methods studies were accepted, as were curriculum analyses, previous reviews, and gray literature with explicit methodology. Research focused exclusively on higher education, opinion pieces without empirical support, and news articles lacking methodology were excluded.

The selection process was conducted in two phases. In the first phase, two independent reviewers evaluated the titles and abstracts using the inclusion criteria; discrepancies were resolved by consensus. In the second phase, the full texts were reviewed to verify their relevance, and the reasons for exclusion were documented. The entire process is represented using a PRISM diagram. Reference management was performed using Zotero *software*, which allowed for the removal of duplicates and the organization of documents by country, educational level, and study type.

Data extraction was performed using a template that included information on study characteristics (author, year, country, educational level, and document type), the curricular intervention (competency framework, AI content, integration modality, and tools used), implementation (teacher training, resources, infrastructure, curricular time, and assessment practices), the results (reported learning outcomes, ethical considerations, impacts on equity, and changes in assessment), and methodological aspects related to quality and biases.

The assessment of methodological quality was conducted using instruments tailored to the type of study. For quantitative studies, QATSDD and EPHPP were used; for qualitative and mixed-methods studies, CASP and MMAT were applied; and for gray literature, the AACODS checklist (authority, accuracy, coverage, objectivity, date, and significance) was used. Two reviewers independently conducted the assessments, and discrepancies were resolved by consensus.

Finally, the results were synthesized using a narrative and thematic approach, organized around the four main themes of the research: learning, ethics, equity, and assessment. Comparative tables were developed by country and educational level, and common patterns and regional differences were discussed. In cases where the results were comparable, effect sizes were calculated, and exploratory quantitative synthesis models were applied.

RESULTS

The systematic search conducted in international and regional databases, as well as in the gray literature, yielded a total of 1 245 initial records. After removing duplicates, 1 030 documents were retained for the title and abstract screening process. In this first phase, 720 studies were excluded because they failed to meet the inclusion criteria, primarily because they focused on higher education, lacked a connection to school curricula, or did not address artificial intelligence. A total of 310 full-text articles were subsequently reviewed, 190 of which

were discarded for methodological or relevance reasons. Finally, 120 studies were included in the qualitative synthesis, and 15 were included in the exploratory quantitative synthesis. This process was represented using a PRISMA diagram, which shows the identification, screening, eligibility, and inclusion phases.

Table 1. Summary of the selected and analyzed articles

Author	Study type and sample	Results
by de la Torre and Baldeon-Calisto [8]	Systematic review of 25 articles on AI and generative AI in higher education in Latin America (Mexico, Colombia, Ecuador, Brazil, Peru, Chile, Argentina, and Bolivia).	Generative AI is primarily used for personalized learning, automated assessment, intelligent tutors, and virtual labs. Faculty value its potential for creating materials and providing feedback, while students highlight motivation and flexibility. Among the identified challenges are technological gaps, institutional resistance, ethical concerns (privacy and bias), and the lack of clear policies for its implementation.
Serna *et al.* [9]	Qualitative documentary study. Analysis of publications indexed in Scopus and case studies of Latin American universities recognized in QS rankings.	Digital transformation in Latin American universities is in an early adoption phase, with progress since 2018 in areas such as the use of *blockchain* in graduation processes, collaborative virtual reality in teaching, AI for student support, and university management through virtual assistants. Opportunities are identified in pedagogical innovation and management, as well as challenges linked to organizational culture, resistance to change, hierarchical structures, and the need to understand information as a key asset in the knowledge society.
Cantú-Ortiz *et al.* [10]	Case study and trend review, based on the experience of Tecnológico de Monterrey (Mexico), with more than 5,200 students trained in AI programs since 1985.	An AI educational strategy is proposed to support the digital transformation toward Industry 4.0. The results show that AI training must include: (1) technical competencies (human-computer interaction, *big data*, intelligent systems, robotics, and autonomous vehicles), (2) active methodologies such as *challenge-based learning*, (3) physical and virtual laboratories, and (4) industry partnerships. The Tec21 educational model aims to prepare professionals with critical thinking, innovation, and interdisciplinary skills to face the challenges of the Fourth Industrial Revolution.
De Souza Zanirato Maia *et al.* [11]	A systematic literature review following the PRISMA methodology. Articles on the use of AI in elementary and secondary education across various countries were analyzed.	AI is applied in automated assessment, performance prediction, dropout detection, and personalized learning. The results indicate that AI models improve the ability of teachers and administrators to make data-driven decisions. However, challenges are identified regarding the interpretability of the models, the privacy of student data, and the need for teacher training in the proper use of these tools.
Labanda-Jaramillo *et al.* [12]	Theoretical framework design and case study. The DIA4K12 *framework* is proposed for application to the Ecuadorian K-12 mathematics curriculum.	The model integrates four phases (planning, implementation, process, and development), three components (open educational resources, K-12 curriculum, and active methodologies), five sublevels (logical reasoning; computational thinking and offline AI; mathematics for AI; programming; and machine learning), and three cross-cutting themes (communities, open licenses, and ethics). The case of Ecuador demonstrated that it is possible to introduce AI from an early age through projects based on mathematics and active methodologies, fostering critical thinking and digital competencies.

Flores *et al.* [13]	Historical-documentary study. Analysis of the educational policy of the Navajo Nation in the United States, based on primary and secondary sources.	The study shows how the Navajo Nation sought to exercise educational sovereignty by developing its own curricula and resisting the imposition of external models. It highlights the challenges associated with resource availability, tensions with the federal government, and the importance of education as a tool for preserving cultural identity and self-determination.
Zhou *et al.* [14]	Content analysis of national AI curricula in various countries. Official documents and curriculum frameworks for elementary and secondary education were reviewed.	The study finds that leading countries have begun integrating AI into their school curricula through diverse approaches: some prioritize basic AI literacy; others emphasize ethics and social responsibility; and others promote advanced technical skills. It concludes that there is a global trend toward the inclusion of AI in K-12 education, albeit with marked differences in objectives, depth, and resources. It is recommended that international frameworks be developed that balance technical knowledge, ethical implications, and practical applications.
Antonieta Romero-Sandoval [15]	Literature review and conceptual analysis. Review of the Tuning Project's generic competencies for Latin America and comparison with the emerging capabilities of AI.	The analysis identifies human competencies that could be partially replaced by AI systems, such as information processing, routine problem-solving, and data-driven decision-making. However, it concludes that competencies such as critical thinking, ethics, creativity, intercultural communication, and social responsibility cannot be replaced and must be strengthened in curricula. The study warns that AI can transform higher education, but it requires a balance between automation and humanities education to prevent the loss of essential skills.
Forero-Corba and Negre [16]	A systematic review following the PRISMA methodology. The study analyzed 55 articles published between 2021 and 2023, from 38 countries, applied in primary, secondary, and higher education.	Thirty-three *machine learning* and AI techniques applied in educational contexts were identified. The most frequent applications were predicting academic performance, detecting school dropouts, personalizing learning, and automated assessment. The study concludes that the impact of *machine learning* and AI in education is growing, with a greater presence in secondary education, although limited by a lack of teacher training and the need for ethical and regulatory frameworks.
Castillo and Saavedra [17]	A comparative study based on a literature review and conceptual analysis, applied to the context of secondary education in Peru.	The study analyzes how AI and traditional methods contribute to the development of critical thinking. It concludes that, although AI promises to improve education, in the Peruvian context it is still in the process of adaptation and may have negative effects if it replaces traditional practices. Traditional methods remain more effective for fostering soft skills such as critical thinking, communication, and problem-solving. It is recommended to strengthen traditional teaching and use AI as a complement, not as a replacement.
Queiroga *et al.* [18]	Applied study of learning analytics. Data from 258,440 primary and secondary school students in Uruguay.	Predictive models were developed using *random forest* to identify students at risk of failing or dropping out of school. The models achieved AUC values above 0.90 and F1-Macro values above 0.88. The importance of prior performance data was validated, and a bias analysis was conducted considering variables such as gender, school district, and social programs.

Betiana Arancibia and del Valle Soria[19]	Conceptual study and critical review, based on secondary sources and experiences in Argentina.	AI, including tools such as ChatGPT, is transforming education and forcing a redefinition of teaching competencies and teaching methodologies. Tensions are identified between the accelerated adoption of these technologies and institutional resistance. The study emphasizes the need for ethical and pedagogical teacher training that enables a critical and responsible use of AI.
Ramírez-Montoya *et al.*[20]	An exploratory case study in Ecuador using mixed methods: surveys of 337 students, 384 prospective students, and 313 graduates; 20 expert interviews; and four focus groups with 32 professionals.	Future trends in teacher training programs are identified, including the integration of artificial intelligence and digitalization, curricular flexibility, the transformation of the teacher's role toward a facilitator profile, and the need to strengthen digital and socioemotional competencies. The study recommends designing interdisciplinary, hybrid, and student-centered programs.

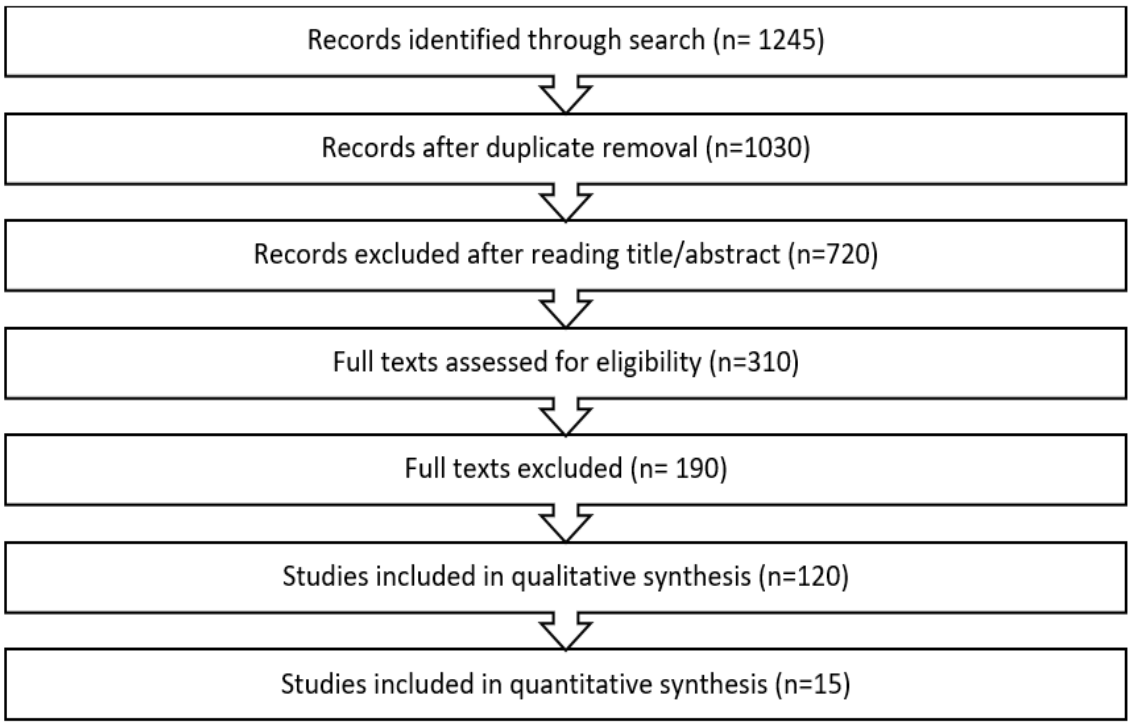

Figure 1. PRISM diagram: identification, screening, eligibility, and inclusion phases.

The included studies covered the six selected countries: Cuba, Mexico, Brazil, Argentina, Colombia, and Chile. The distribution was heterogeneous, with a greater number of publications in Brazil and Mexico, followed by Argentina and Colombia, while Cuba and Chile had a smaller volume of literature, although with relevant contributions regarding educational policies and pilot projects. Most of the documents were academic articles and theses, although ministerial reports and official curriculum guidelines were also identified, particularly in Brazil and Chile.

With respect to educational levels, initiatives were identified in early childhood, primary, and secondary education. At the early childhood level, studies focused primarily on early digital literacy and the development of computational thinking, with pilot experiences reported in Mexico and Chile. In primary education, the incorporation of basic AI content into science and technology-related subjects predominated, whereas in secondary education, more structured programs were observed, including specific modules on the ethics of artificial intelligence, algorithms, and practical applications. Brazil stood out for the inclusion of AI in educational robotics projects, while Argentina and Colombia made progress in mainstreaming digital competencies into their curricula.

The results were organized around the four main pillars of the research: learning, ethics, equity, and assessment. With respect to learning, studies have reported improvements in student motivation, the development of critical thinking, and the acquisition of digital skills. However, difficulties related to the lack of specialized teacher training and the limited availability of technological resources—factors that affect the sustainability of these initiatives—were also noted.

In the area of ethics, growing concerns have been identified regarding data privacy, algorithmic bias, and academic integrity. Several studies have proposed the inclusion of specific modules on digital citizenship and technological ethics in school curricula, with the aim of promoting critical and responsible use of artificial intelligence from an early age.

Regarding equity, the findings revealed persistent digital divides between urban and rural areas, as well as between public and private educational institutions. These inequalities hinder the effective implementation of AI in school curricula and limit its potential as a tool for democratizing learning.

Finally, regarding assessment, changes in teaching practices were observed through the incorporation of AI tools aimed at providing immediate feedback and personalizing learning. However, the studies also highlighted risks associated with the authenticity of student work and with excessive reliance on automated systems, which poses challenges for the assessment of meaningful learning.

Table 2 illustrates the main differences and similarities across countries and educational levels. For example, Brazil and Mexico showed greater progress in the formal curricular integration of artificial intelligence, while Cuba and Chile focused on pilot projects and general guidelines. Argentina and Colombia stood out for the inclusion of digital ethics as a cross-cutting component in their curricula. Similarly, common patterns were identified, including the need for specialized teacher training, the importance of ensuring adequate technological infrastructure, and the urgency of designing policies aimed at reducing access gaps.

In summary, the results show that the integration of artificial intelligence into school curricula in Latin America during the 2020–2024 period has been diverse and uneven, with significant progress in some countries and persistent challenges in others. The evidence suggests that while AI has high potential to improve learning and transform educational practices, its implementation requires a comprehensive approach that coherently incorporates ethics, equity, and assessment as fundamental dimensions.

Table 2. Integration of AI into Latin American school curricula (2020–2024)

Country	Early childhood education	Elementary education	Secondary education	Focus	Key results
Cuba	Pilot projects on digital literacy in preschool.	Limited use of AI in natural sciences and mathematics.	Limited evidence; general guidelines in ministerial plans.	Basic digital literacy.	Early progress; lack of infrastructure and teacher training.
Mexico	Pilot programs in preschool focusing on computational thinking.	Inclusion of AI in science and technology programs; cross-curricular projects.	Modules on digital ethics and AI applications in secondary school.	Curricular mainstreaming.	Improvements in motivation and critical thinking; urban/rural gaps.
Brazil	Educational robotics programs in early childhood education.	Curricula with AI content in science and mathematics.	Formal integration of AI into programming and technology ethics projects.	Technological innovation and robotics.	Significant curriculum advancement; strong emphasis on teacher training.
Argentina	Early digital literacy in early childhood education.	Digital skills in elementary school with a focus on technological citizenship.	Inclusion of AI ethics in secondary school; pilot projects in public schools.	Ethics and digital citizenship.	Progress in ethics and equity; limitations in technological resources.
Colombia	Digital inclusion programs in preschool.	Basic standards regarding AI in elementary school.	Pilot projects in secondary school on algorithms and digital ethics.	Basic digital skills.	Progress in ethics; persistence of rural gaps.
Chile	Pilot initiatives in early childhood education focusing on digital literacy.	Curriculum frameworks include concepts of AI in science.	Pilot projects in secondary school on ethics and AI applications.	Ministerial guidelines.	Progress in ethics and assessment; lack of curricular systematization.

DISCUSSION

The results of this systematic review reveal that the integration of artificial intelligence into school curricula in Latin America between 2020 and 2024 is diverse, uneven, and, to a large extent, in its early stages. While countries such as Brazil and Mexico have shown significant progress in the formal incorporation of AI content into their curricula, others, such as Cuba and Chile, have been limited mainly to pilot projects and the formulation of general guidelines. Argentina and Colombia, for their part, have stood out for the inclusion of digital ethics as a cross-cutting component, reflecting a growing concern for the social and regulatory aspects of artificial intelligence in the educational sphere. This heterogeneity confirms that the region is in an exploratory phase, in which local experiences have not yet led to a uniform curricular framework.

With respect to the learning dimension, the findings suggest that the incorporation of AI can increase student motivation, the development of critical thinking, and the acquisition of digital skills. However, the effectiveness of these initiatives is limited by a lack of specialized teacher training and deficiencies in technological infrastructure. Compared with international experiences, particularly in European and Asian countries, where AI has been integrated into national digital literacy and computational thinking programs, as noted by Castro *et al.*[21], Latin America faces deeper structural challenges. The persistence of the digital divide, linked to socioeconomic and territorial inequalities, limits the possibility that the benefits of AI will be distributed equitably among students.[22]

In the area of ethics, the reviewed studies reveal a growing concern regarding data privacy, algorithmic bias, and academic integrity. The inclusion of content on digital citizenship and technological ethics in the curricula of countries such as Argentina, Colombia, and Mexico represents a significant step forward, although it remains insufficient to address the challenges arising from the use of generative AI in the production of automated content. Internationally, there is a consensus regarding the need to incorporate ethical reflections on artificial intelligence from an early age,[23] which reinforces the importance of Latin American education systems systematically deepening this component.

Analysis of the equity dimension reveals that the implementation of AI in school curricula can exacerbate existing inequalities if not accompanied by inclusive policies. Evidence shows significant differences between urban and rural schools, as well as between public and private institutions, in terms of access to devices, connectivity, and teacher training. These gaps limit the potential of AI as a tool for the democratization of learning. Compared with regions such as Europe, where funding programs exist to reduce digital inequalities, Latin America requires more robust strategies for public investment and regional cooperation.[24,25]

With respect to assessment, artificial intelligence has begun to transform pedagogical practices by incorporating tools designed for immediate feedback and personalized learning. However, the risks associated with the authenticity of student work and with excessive reliance on automated systems pose challenges that have not yet been fully resolved. The international literature highlights that assessments in AI-mediated contexts must focus on creativity, critical thinking, and genuine authorship,[26] aspects that in Latin America are only just beginning to be discussed and incorporated into school curricula.[27]

The implications of these findings for educational policy are manifold. First, it is necessary to move toward regional curriculum frameworks that define minimum competencies in artificial intelligence, integrating both technical skills and ethical and civic reflections. Second, strengthening teacher training is essential, given that evidence shows that a lack of training constitutes one of the main barriers to the effective implementation of AI in classrooms. Third, educational policies must prioritize equity, ensuring access to technological infrastructure and connectivity in rural and vulnerable contexts. Finally, it is necessary to rethink assessment practices by designing strategies that promote authentic learning and reduce reliance on automated systems.

Among the limitations of this review is the heterogeneity of the included studies, which makes it difficult to conduct a robust quantitative meta-analysis. Similarly, while the gray literature provides relevant information on policies and pilot projects, it presents variations in methodological quality that must be considered when the results are interpreted. Another limitation is the concentration of studies in certain countries, which may skew regional

representation. Nevertheless, the synthesis provides a comprehensive and up-to-date overview of the situation in Latin America and contributes to the discussion on the development of more inclusive and relevant curriculum frameworks.

CONCLUSIONS

The integration of artificial intelligence into Latin American school curricula between 2020 and 2024 is an ongoing process marked by significant progress in some countries and persistent challenges in others. The evidence suggests that AI has the potential to improve learning and transform educational practices; however, its implementation requires a comprehensive approach that considers ethics, equity, and evaluation as fundamental dimensions. This systematic review provides insights to guide educational policies and future research and highlights the need for the region to move toward a more coherent, inclusive, and critical integration of artificial intelligence into the curriculum.

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