Multimodal Technologies and Interaction

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Systematic Review

Systematic Review of Artificial Intelligence in Education: Trends, Benefits, and Challenges

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Abstract

Artificial intelligence (AI) is changing how we teach and learn, generating excitement and concern about its potential to transform education. To contribute to the debate, this systematic literature review examines current research trends (publication year, country of study, publication journal, education level, education field, and AI type), as well as the benefits and challenges of integrating AI into education. This review analyzed 155 peer-reviewed empirical studies published between 2015 and 2025. The review reveals a significant increase in research activity since 2022, reflecting the impact of generative AI tools, such as ChatGPT. Studies highlight a range of benefits, including enhanced learning outcomes, personalized instruction, and increased student motivation. However, there are challenges to overcome, such as students' ethical use of AI, teachers' resistance to using AI systems, and the digital dependency these systems can generate. These findings show AI's potential to enhance education; however, its success depends on careful implementation and collaboration among educators, researchers, and policymakers to ensure meaningful and equitable outcomes.

Keywords: artificial intelligence; educational environments; educational technology; systematic literature review

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1. Introduction

Artificial intelligence (AI) is transforming education. Defined as the ability of machines to acquire knowledge and make decisions using algorithms [1], AI emulates human cognitive processes [2,3]. In educational contexts, AI is a branch of computer science that can perform tasks such as reasoning, decision-making, and learning, which are traditionally associated with human intelligence [4,5].

Educational environments, on the other hand, include the physical, social, and technological contexts in which learning occurs [6]. These environments influence students' acquisition of skills and knowledge through elements such as infrastructure, teaching resources, and community participation. Zysberg and Schwabsky [7] described the educational environment as a reflection of society, fostering citizenship and community, while Tetzlaff et al. [8] emphasized its dynamic and adaptive characteristics. The interaction between societal values and contextual adaptability is particularly crucial in the era of AI, as educational environments must now integrate intelligent systems to enhance personalization, accessibility, and the overall learning experience [9].

The role of AI in education can be analyzed from two key theoretical perspectives: constructivism and connectivism. Constructivism views learning as an active process in which

students build knowledge through interaction with their environment and collaboration with others [10]. AI aligns with this perspective by offering adaptive and interactive environments that promote experiential and autonomous learning [11]. Similarly, Connectivism emphasizes that knowledge is distributed across networks and that learning occurs by navigating these connections [12]. AI acts as a critical node within these networks, facilitating access to diverse sources of information and promoting collaboration [13]. Together, these frameworks highlight AI's potential to enhance knowledge construction and connectivity in educational environments.

Although AI holds transformative potential, its integration into education presents challenges, including the need to adapt to pedagogical models, develop new student competencies, overcome teacher resistance, and address ethical, social, and technical concerns. Sperling et al. [14] suggest that AI can profoundly reshape education by reconfiguring teaching methods, learning processes, and teacher professional development. Therefore, preparing learners and educators to thrive in an increasingly automated world remains an urgent priority.

AI has been present in education for decades [15], including a wide range of systems and techniques such as rule-based algorithms, machine learning models, expert systems, intelligent tutoring systems, and generative AI. The release of ChatGPT and subsequent similar generative AI systems, such as DeepSeek, Claude, Gemini, and Copilot, has marked a milestone in education, ushering in what might be called the post-ChatGPT era. While this review acknowledges the growing interest in generative AI, its primary focus is on the broader landscape of AI in education. It examines how various forms of AI have been implemented and what empirical evidence exists regarding their benefits and challenges.

Given this context, it is crucial to understand how educational institutions are currently implementing AI. Although several reviews have explored AI's role in education, most are limited to pre-ChatGPT publications or narrow scopes focused on specific applications, user groups, pedagogical models, or types of AI systems. A more up-to-date and comprehensive synthesis is needed to reflect recent developments and capture the diversity of AI applications across educational levels and disciplines. This systematic review addresses that need by examining the following research questions:

(1) What trends characterize the current research on AI in educational environments?

This question examines trends in publication year, the country where the study was conducted, the journal in which the study was published, the educational level at which the study was implemented, the educational field involved in the study, and the type of artificial intelligence system implemented in the study. Understanding these trends provides valuable insights into regional disparities, research priorities, and areas where AI adoption in education is lagging. These trends generate patterns that could guide future research and policy decisions.

(2) What cognitive, personal, and social benefits are associated with AI in education?

This refers to the reported advantages related to cognitive (e.g., enhanced learning), personal (e.g., increased motivation), and social (e.g., improved communication skills) outcomes for students, as well as benefits reported by educators (e.g., task optimization). This analysis is important because it identifies how AI can support student development and improve teaching practices. Understanding these impacts can help educators and policymakers prioritize AI tools that align with educational goals.

(3) What challenges hinder the effective integration of AI into educational environments?

Challenges refer to difficulties, disadvantages, or opportunities for improvement that students, educators, and the educational environment face. These challenges include digital dependency, ethical concerns, technical barriers, and resistance from educators and

institutions. Overcoming these challenges helps ensure that AI adoption is inclusive, equitable, and effective. Conversely, if these challenges are not addressed, the transformative potential of AI in education may remain unrealized, which could either perpetuate existing inequalities or create new ones.

This review offers a timely and evidence-based overview of AI in education. It highlights its transformative potential while addressing the barriers that must be overcome to maximize its impact. Through the proposed research questions, this study aims to provide a roadmap for maximizing the use of AI to create more equitable and impactful educational experiences.

2. Related Work

Several systematic review studies have examined the applications and integration of AI in educational settings. Next, we describe the most influential comprehensive reviews in recent years, based on the number of citations they have received.

Chen et al. [16] provided a comprehensive synthesis of AI's evolution and applications in educational settings, making it a foundational contribution to the field. The study categorizes AI applications as adaptive learning systems, intelligent tutoring systems, and learner analytics. The study also highlights the growing importance of learner analytics in identifying patterns in student behavior, predicting academic success, and informing pedagogical strategies. Despite the promising potential of these technologies, the authors highlight important challenges, including issues of scalability, data privacy, and algorithmic biases, which may exacerbate inequities if not addressed effectively. The authors advocate for interdisciplinary collaboration and ethical considerations to guide the development and integration of AI, ensuring it aligns with educational goals and promotes equitable access.

The review by Zhai et al. [17] categorized educational AI research into three dimensions: development (e.g., intelligent tutoring systems and adaptive learning models), extraction (e.g., feedback and reasoning), and application (e.g., immersive learning and gamification). The authors highlighted key trends, such as the integration of deep learning and neuroscience, while addressing challenges like algorithmic biases, teacher resistance, and ethical concerns. Their findings emphasize the need for interdisciplinary collaboration to align AI technologies with pedagogical goals. The study provides valuable insights into how AI can be used to enhance learning outcomes, optimize teaching strategies, and support educational equity.

Chiu et al. [18] examined the scattered nature of research in educational AI and proposed a framework that categorizes AI applications into four key domains: learning, teaching, assessment, and administration. The study also identified various roles of AI technologies, their impact on learning outcomes, and associated challenges. Despite its strengths in organizing existing research, the study did not explore practical solutions to bridge research gaps or address implementation issues in real-world settings. The authors called for in-depth investigations into how AI affects students and teachers, providing valuable guidance for future research.

Dimitriadou and Lanitis [19] critically assessed the integration of AI and emerging technologies in smart classrooms. The study illustrated how smart classrooms have evolved with advanced technologies, improving classroom management and supporting in-person and remote learning. Using strengths, weaknesses, opportunities, and threats analysis, the authors highlighted the potential benefits of AI in enhancing learning environments. They also emphasized the challenges of implementation, such as technical complexities and cost barriers. While the study provided valuable insights, it primarily focuses on smart classroom environments, leaving gaps in understanding how AI affects the broader educational landscape.

Saputra et al. [20] systematically analyzed the opportunities, challenges, threats, and obstacles of integrating AI in education. The study identified opportunities for improvement, including enhanced delivery of educational materials, refined assessment processes, streamlined management systems, and evidence-based policymaking. However, challenges include limited pedagogical and educational frameworks and low technological literacy among educators. Threats such as personal data security concerns, ethical dilemmas, and obstacles, including high implementation costs, inadequate teacher training, and slow curriculum adaptation, are also highlighted. While the study provides a broad overview, it lacks specific examples or actionable strategies to address these challenges in diverse educational contexts.

Finally, Wang et al. [21] conducted a detailed review of how AI has been used in classroom discourse over the past decade. The study examined how AI tools have been implemented to analyze teacher-student interactions, student collaboration, and whole-class discussions in both physical and online classrooms. The findings reveal that AI has a positive influence on learning outcomes, emotional engagement, and classroom dynamics. For instance, AI technologies have been used to analyze teacher questioning patterns, student speech acts, and collaborative dialogue, offering insights to improve teaching and learning practices. However, the review also emphasizes the need to address challenges, such as the ethical use of AI and its long-term impact.

While these reviews offer valuable contributions, the studies they analyzed cover research conducted up to 2022. Therefore, they do not address the vast changes that have been posed by technologies such as ChatGPT, Gemini, Copilot, and DeepSeek, among others. These tools have rapidly redefined educational practices by introducing new possibilities for teaching, learning, and assessment [22]. Therefore, it is imperative to examine how educators and students are adopting these technologies and address the ethical concerns, pedagogical shifts, or long-term implications associated with their use. More recent studies have partially addressed this issue by analyzing applications from the post-ChatGPT era. Nonetheless, they have focused on specific applications [23,24], target users [14,25], education levels [26,27], education fields [28,29], AI tools [30,31], or pedagogical approaches [32,33]. This poses the need for a comprehensive study that systematically analyzes trends and the influence of AI in educational environments.

This study addresses these gaps by conducting a systematic literature review focused on three key aspects: (1) emerging trends in AI-focused educational research; (2) the benefits of AI for cognitive, personal, and social dimensions of learning; and (3) the challenges and ethical tensions associated with AI adoption. Through this approach, the review contributes to a deeper and more nuanced understanding of how AI is reshaping educational environments worldwide.

3. Methods

This systematic review adopted the PRISMA statement approach [34] and followed the recommendations of Kitchenham and Charters [35]. Specifically, the authors proposed a three-step process to ensure an effective review: Planning (preparation of the review protocol), Conducting (review itself) and Reporting (publication of the results). Below, we describe the process carried out in each stage.

3.1. Planning the Review

The primary goal of this stage is to establish the strategy for the review process. It involved three key activities: defining the research questions, establishing the research objectives, and developing the research protocol. The introduction section contains details about the first two activities. Therefore, this section focuses on the research protocol

that guided the identification and selection of the studies for analysis. This protocol was developed internally by the research team during the planning stage and registered on the Open Science Framework (OSF) platform.

The search for relevant studies was conducted in two primary sources: academic databases and prior systematic reviews. Database search was performed across Web of Science, Scopus, and Taylor & Francis. Web of Science and Scopus were selected due to their broad coverage of high-quality, peer-reviewed literature in education, technology, and interdisciplinary fields. Similarly, Taylor & Francis was included as a complementary source because it hosts several leading journals in educational technology and AI in education, ensuring a comprehensive retrieval of relevant empirical studies.

We used the following search string across all three databases: ("artificial intelligence" OR "AI" OR "machine learning" OR "generative artificial intelligence") AND ("education" OR "learning" OR "teaching" OR "training") AND ("empirical study" OR "empirical research" OR "experimental study" OR "case study"). The review included studies from the past decade to ensure a focus on the current state of the field. As recommended by Chiu et al. [18], we restricted the search to categories related to educational research. This process was completed on 1 July 2025, resulting in 3406 potential studies.

In addition to database search, we conducted backward citation searching by reviewing the reference lists of relevant prior systematic reviews [14,16–19,26,36,37]. This approach, which is recommended in systematic review methodology to enhance the completeness of study identification [38], allowed us to identify 435 potential studies for inclusion in the final analysis.

After removing 1838 duplicate entries, the second and third authors screened the remaining studies $(n = 2003)$ based on their titles, abstracts, and keywords. This process excluded 1432 studies for being unrelated to education, unrelated to AI, non-empirical, conference papers, work-in-progress papers, reviews, meta-analyses, or non-peer-reviewed. The remaining 571 studies were then evaluated against the inclusion criteria, as presented in Table 1.

Table 1. Inclusion/Exclusion criteria.

Studies Were Included if They:	Studies Were Excluded if They:
• Focused on the application, integration, or impact of AI in educational contexts;	• Did not explicitly address AI or its applications in education;
• Were empirical research employing experimental, quasi-experimental, or other data-driven research methods;	• Were secondary sources (e.g., reviews, opinion papers, meta-analyses);
• Were published in peer-reviewed journals;	• Were conference papers, theses, dissertations, or work-in-progress;
• Provided data related to the research questions.	• Lacked methodological detail (e.g., missing or unclear design, sample, data collection, or analysis).

Occasional discrepancies in this process were resolved through consensus. If the second and third authors disagreed on any specific paper, the first author reviewed the paper and made the final decision to maintain consistency and rigor. After applying the inclusion/exclusion criteria, 155 studies remained for the final analysis (see Figure 1).

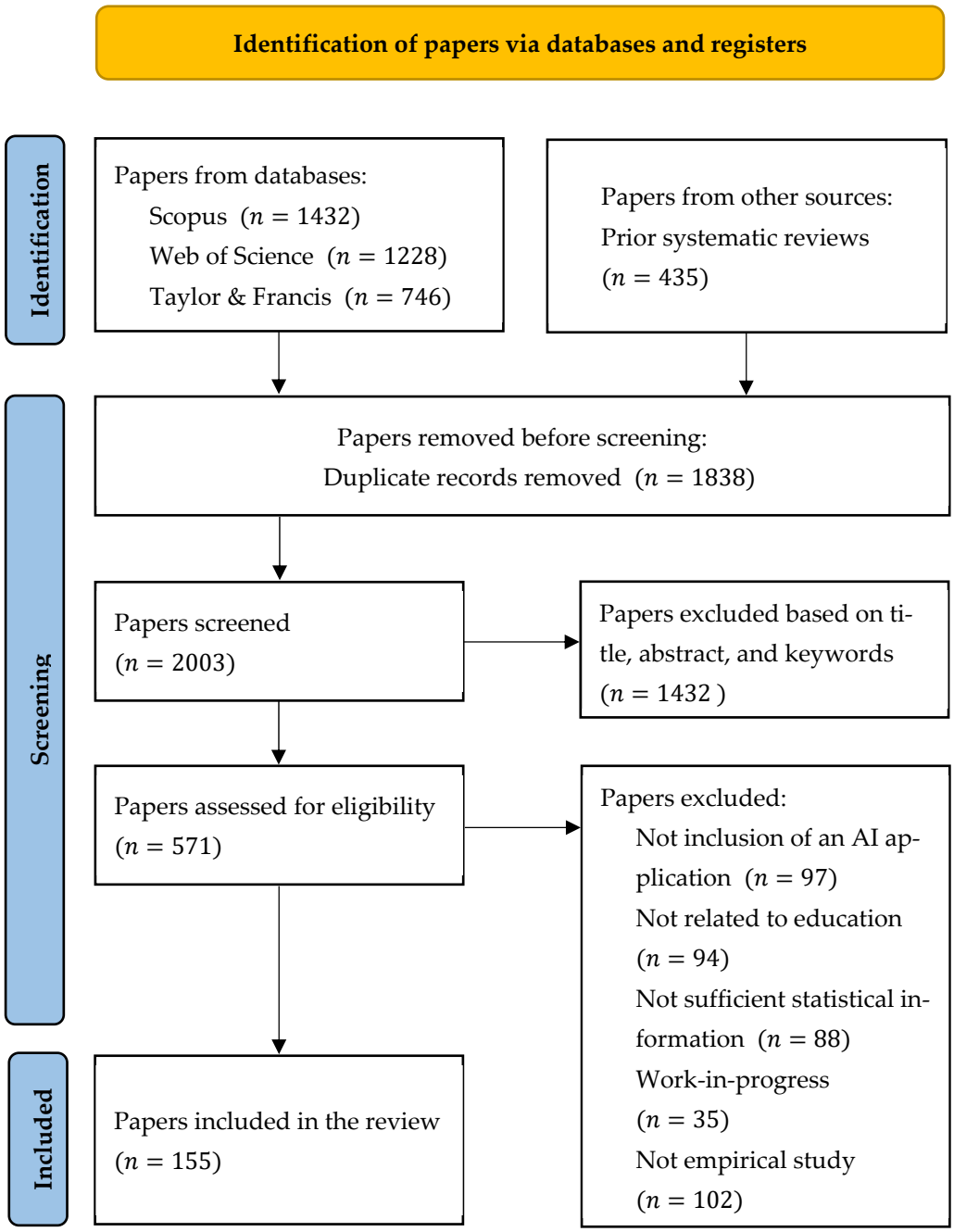

Figure 1. PRISMA diagram of the document selection process.

3.2. Conducting the Review

A standardized data extraction form was developed by the research team to ensure consistency in coding and interpretation. Although the form was not formally piloted, it was collaboratively refined during the initial phase of data extraction. The final version is available as online Supplementary Materials (Table S1). The following information was extracted from each study: Title, authors, publication year, country of the study, publication journal, education level, education field, AI type, reported benefits, and reported challenges.

Thematic analysis was conducted using an inductive coding approach, without the use of qualitative analysis software. The second and third authors independently coded the extracted qualitative data manually using Microsoft Excel. The themes were identified through iterative comparison, and disagreements were resolved in consultation with the

first author. Cohen's Kappa coefficient was calculated to evaluate intercoder reliability. This value was 0.89, indicating almost perfect agreement [39].

3.3. Reporting the Review

The final stage of this systematic review involved synthesizing the extracted data and presenting the findings in a clear and structured manner. The results were organized around the research questions, namely trends, benefits, and challenges of AI in educational contexts. Quantitative data, such as the distribution of studies according to the described categories (year, country, journal, education level, and education field), were summarized in tables and figures for clarity. Similarly, qualitative findings were categorized into thematic sections for thorough analysis.

Before synthesizing the findings, we carefully reviewed all extracted data to ensure they were complete and consistent. In cases where certain descriptive details, such as the country of origin, were not explicitly provided, we used the first author's affiliation as a proxy. Similarly, in cases of multi-country collaborations, each country was included. To support meaningful comparisons across studies, we standardized education levels and subject areas using the International Standard Classification of Education (ISCED). Quantitative variables such as publication year, country, education field, and AI type were organized into summary tables for trend analysis. For qualitative aspects like reported benefits and challenges, we applied an open coding process, followed by thematic grouping. Since our synthesis was descriptive and thematic in nature, there was no need to perform statistical conversions or impute missing summary statistics.

The review also includes a discussion section that contextualizes the findings within the existing literature, identifying gaps, trends, and areas for future research. Finally, the study provides actionable recommendations for educators, policymakers, and researchers, aiming to support the effective integration of AI in education.

4. Results and Discussion

This section presents the findings of the review in response to the research questions. In addition to reporting findings, the discussion highlights how this study contributes to the field by providing a broader and deeper understanding of how AI is being used in educational settings, the benefits it offers, and the challenges that must be addressed to ensure its meaningful integration. Unlike previous literature reviews that offer high-level overviews, this study provides a nuanced and context-specific analysis across various dimensions, including educational levels, fields, countries, AI types, evolution over time, and journal distribution. This specificity allows stakeholders to identify research gaps and design more targeted interventions. We provide the full list of the reviewed studies and the outcomes for each analyzed variable in the Supplementary Materials.

4.1. Trends Characterizing the Current Research on AI in Education

Identifying research trends helps us understand the current state of AI in education and reveals where scholarly and institutional attention is most concentrated. We examined five key dimensions: publication year, country of study, publication journal, educational level, education field, and AI type. Below, we present the trends according to each topic.

4.1.1. Publication Year

We classified the studies based on their year of publication to track the evolution of interest in AI in education over time. Figure 2 does not include studies from 2025, as the final search was limited to publications available up to the middle of the year.

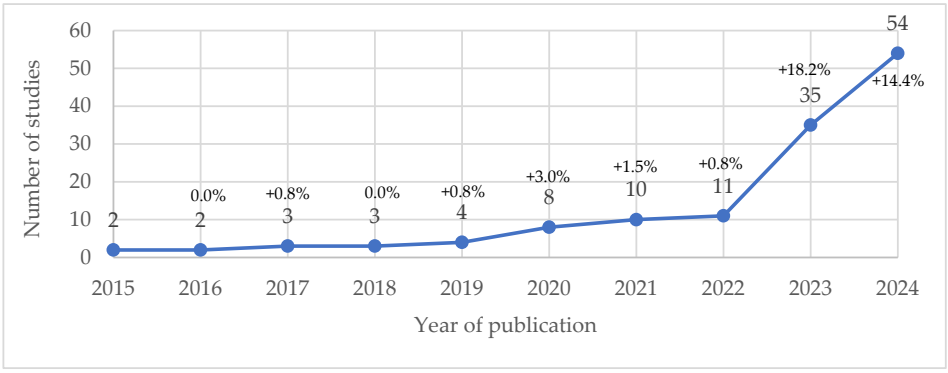

Figure 2. Evolution over time.

This analysis reveals a marked increase in research in 2023. This spike likely correlates with the widespread release and adoption of generative AI tools, such as ChatGPT, which induced academic interest and application development [40,41].

The steady growth into 2024 suggests that AI is transitioning from an emergent innovation to a core element of educational research and practice. This reflects a paradigm shift rather than a temporary spike, reinforcing findings from recent reviews that describe AI as an increasingly integral component of pedagogical design, personalized learning, and assessment strategies [11,32,42].

Most studies examined short-term interventions; however, the growing use of AI in diverse educational contexts suggests the need for further research that explores its long-term integration. To support this evolution, future work should be guided by robust theoretical frameworks and informed by emerging policy discussions on ethical and effective implementation. Without such guidance, there is a risk that AI may be applied inconsistently or inequitably as its adoption increases [43,44].

4.1.2. Country of the Study

We classified the papers according to the country in which the research was conducted. The analysis of this variable is important, as it helps academics and researchers to establish connections with other authors and organizations, thereby contributing to the development of the field. Figure 3 illustrates the geographic distribution of studies, with a focus on countries that contribute more than 2% of the total publications.

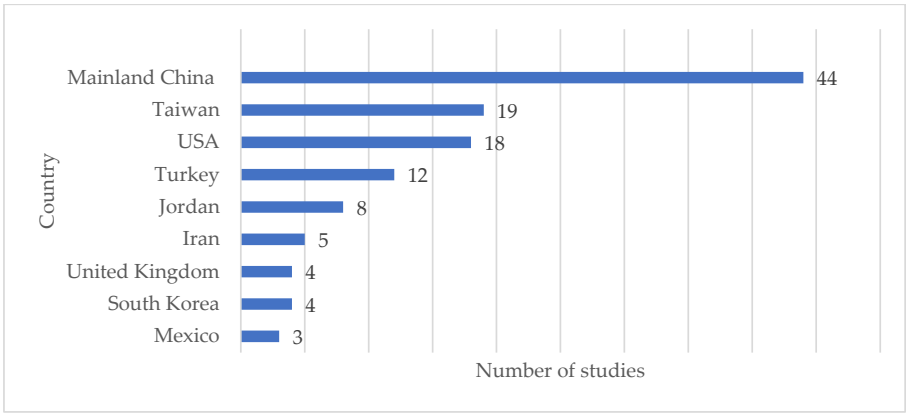

Figure 3. Distribution by country of the study.

The studies were conducted in 35 countries from all inhabited continents. Asian nations, particularly China and Taiwan, along with the United States, dominate the field. Conversely, the relative absence of contributions from regions such as Latin America and

Africa is a cause for concern. This imbalance may stem from structural challenges, such as limited research funding, unequal access to AI tools, or publication barriers faced by scholars in the Global South [45]. As a result, the current body of literature risks overrepresenting educational priorities, pedagogical models, and technological infrastructures from high-income or tech-dominant countries.

The uneven geographic representation raises concerns about whether AI tools can effectively meet the diverse needs of educational systems worldwide. Educational systems differ widely in terms of language, infrastructure, curricula, and student needs. Without including diverse educational contexts, it is difficult to ensure that AI solutions are adaptable, ethical, and relevant on a global scale [46,47].

Therefore, this study reinforces the need for a more inclusive research agenda that actively supports the participation of underrepresented regions. Promoting transnational research partnerships, open-access publishing, and equitable funding mechanisms may help democratize the development and evaluation of AI tools in education.

4.1.3. Publication Journal

This analysis offers insights into the journals that have consistently demonstrated the greatest sustained interest in integrating AI within educational contexts. Identifying these journals is valuable for researchers seeking high-impact channels for dissemination, as well as for understanding where scholarly discourse on this topic is most actively developing. To maintain clarity and relevance, Figure 4 includes only those journals that published at least 2% of the reviewed studies.

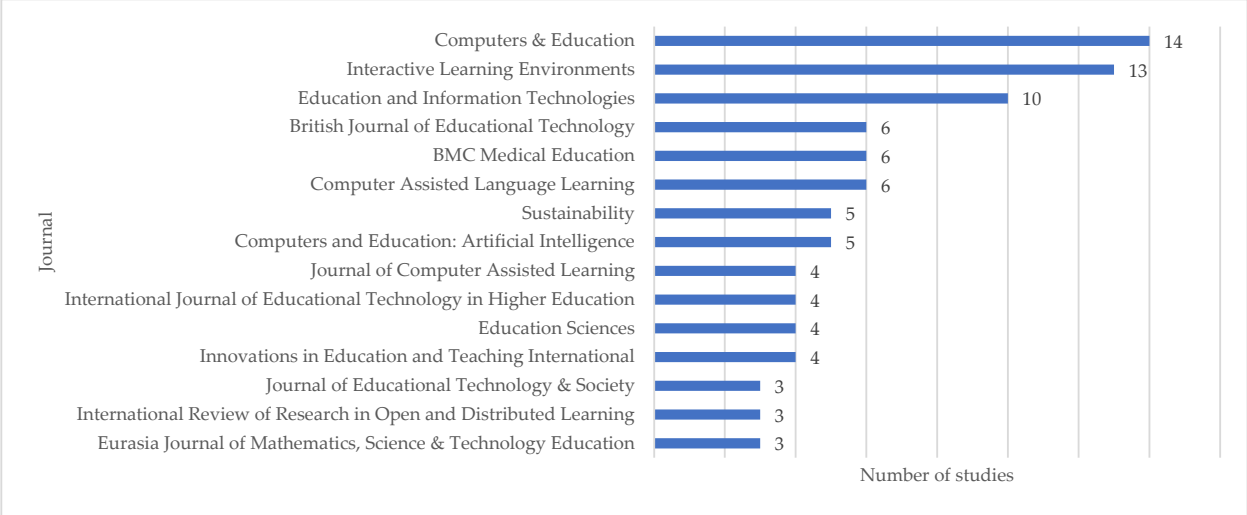

Figure 4. Distribution by journal of publication.

The reviewed studies were published across 37 different indexed journals, indicating a broad and diverse interest in AI in education. This diversity suggests that the topic transcends traditional disciplinary boundaries, attracting attention from both educational technology specialists and researchers in broader pedagogical and computational domains [37]. *Computers & Education* emerged as the most prominent journal, highlighting its established role as a leading platform for empirical and theoretical contributions in the field of technology-enhanced learning. Following closely, *Interactive Learning Environments* and *Education and Information Technologies* also stand out as prominent publication venues. These journals not only reflect the academic community's sustained interest in the intersection of AI and education but also serve as influential platforms for disseminating high-impact research that forms current and future developments in the field.

The concentration of publications in these high-impact journals highlights the growing academic recognition of AI's transformative potential in education. At the same time, the presence of studies in a wide range of journals suggests that interest in this topic is expanding across diverse subfields, including learning analytics, personalized learning, and intelligent tutoring systems.

4.1.4. Education Level

This trend refers to the academic level of the students participating in the interventions. We coded each study following the International Standard Classification of Education (ISCED), formulated by UNESCO [48]. This classification allowed a more precise categorization of the studies, facilitating a better understanding of how AI is implemented at different educational levels. Consequently, this study adopts four educational levels: Primary Education (Includes early childhood education), Secondary Education, Higher Education (includes Post-secondary, Tertiary, and postgraduate education), and Teachers (includes In-service and Pre-service teachers). If a study included students from different levels, each level was coded as the education level (see Figure 5).

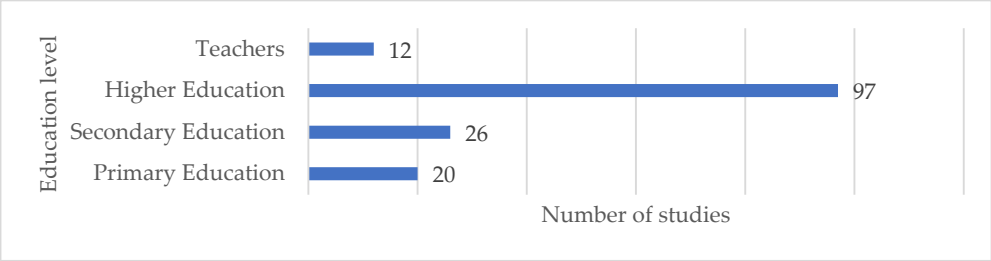

Figure 5. Distribution by level of education.

Most studies focused on higher education. In contrast, the number of studies conducted at the primary, secondary, and teacher education levels was notably lower and relatively evenly distributed. Only one study included students from postgraduate programs (i.e., Master's or Doctoral programs); therefore, we included it in the higher education category. The predominance of higher education in AI-related research aligns with prior reviews in the field of educational technology, which attribute this trend to the increased availability of digital infrastructure, funding mechanisms, and institutional autonomy in universities [36]. Universities often serve as testing grounds for new technologies due to the presence of research expertise, ethical oversight, and a student population that may be more comfortable engaging with experimental digital tools [49].

On the other hand, the relatively low number of studies at the primary and secondary levels may be influenced by a range of barriers, including ethical concerns related to minors, curricular rigidity, limited technical infrastructure in schools, and the perceived risks associated with deploying emerging technologies in early education [50,51]. Additionally, implementing AI in these contexts often requires adaptations to pedagogy and content, which may dissuade rapid experimentation.

The underrepresentation of teacher education is particularly noteworthy. Despite the growing discourse on the potential of AI to support teacher professional development through intelligent tutoring systems, AI-driven feedback, and adaptive teaching simulations, empirical research on this topic remains scarce [14,52]. Given that teachers play a central role in mediating the integration of AI into classrooms, this gap underlines a critical area for future research.

4.1.5. Education Field

This trend refers to the content area that each study focused on. We coded each study following the International Standard Classification of Education (ISCED), formulated by UNESCO [48]. This classification is used to define broad groups and educational fields rather than specific subjects. Accordingly, this study established nine educational levels: Science Education (including Biology, Mathematics, Physics, and Chemistry); Information and Communication Technologies; Social Sciences; Engineering (including Construction); Medicine (including Nursing, Health, and Welfare); Education (including Teacher training and Education Science); Services (including Physical Education and Culinary); and Humanities (including Arts). Although ISCED formally includes language learning within the field of Humanities, we treated it as a separate category due to the high volume of language-related studies in our review. This allowed for a more granular analysis of trends in this particularly active area of research (see Figure 6).

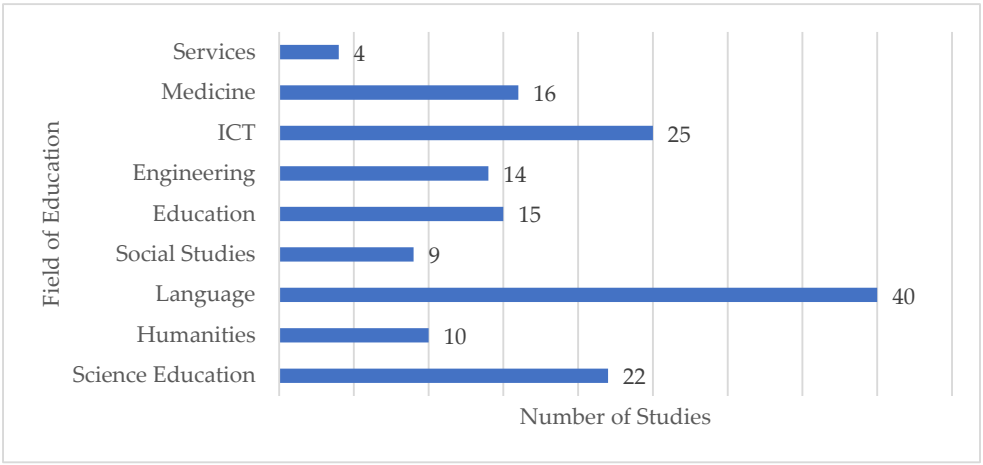

Figure 6. Distribution by field of education.

There is a strong dominance of language learning, followed by ICT and science education. The prominence of language-related studies reflects a growing interest in the application of AI for personalized and adaptive instruction, particularly through technologies such as intelligent tutoring systems, generative AI, automated feedback tools, and speech recognition [53,54]. These tools offer solutions to language learning challenges, such as vocabulary acquisition, grammar correction, and pronunciation feedback, which may explain their popularity among researchers.

The substantial representation of ICT aligns with prior literature that identifies a natural synergy between AI and computer science education [55]. Studies in this area often involve teaching students about AI itself or using AI to support algorithmic thinking, coding instruction, or learning analytics [56]. This trend is not surprising given that many AI applications originate within ICT-related fields and are often conducted by technically proficient educators or within computing departments.

In contrast, fields such as social sciences, services, and humanities (excluding language learning) remain underrepresented. These gaps point to potential missed opportunities for innovation. For example, in social sciences, AI could support discourse analysis, critical thinking, and simulations of societal dynamics. Similarly, in physical education, culinary studies, and creative disciplines, AI has been explored in a limited capacity, despite its potential to augment experiential and multimodal learning [37].

The education field itself, including teacher training and pedagogy, also showed limited representation. This is notable given the central role of educators in mediating the implementation of AI tools. Research focusing on AI-supported professional development,

pedagogical decision-making, and classroom orchestration remains scarce and suggests greater attention [52].

4.1.6. Type of AI

This variable was examined to identify the AI type that was implemented in each study. In the absence of a similar one in the literature, we propose a taxonomy that includes the AI types most commonly used in educational contexts. Table 2 presents these categories along with a brief description and the number and percentage of studies that implemented each type.

Table 2. Types of AI systems implemented in the studies.

Category	Description	*f*	%
Rule-Based and Expert Systems	Apply predefined rules or expert knowledge bases to make decisions or provide guidance, without adaptive learning.	9	5.8
Machine Learning Models	Learn from data to improve predictions, including deep learning, computer vision, and recommender systems.	22	14.2
Generative AI	Generate new content (text, images, audio, etc.) based on learned patterns from training data.	47	30.3
Conversational and NLP Agents	Understand, process, and respond to human language in interactive ways, without generative capabilities.	30	19.4
Intelligent Tutoring Systems	Provide adaptive, personalized instruction and feedback, simulating a one-on-one human tutor.	16	10.3
Embodied and Immersive Systems	Provide learning experiences through physical robots, augmented/virtual reality, or simulation-based environments.	14	9.0
Hybrid/Other	Combine multiple approaches or do not fit into other categories.	13	8.4
Not Available	Cannot be determined by available study details.	4	2.6

The analysis shows that Generative AI was the most implemented type, followed by Conversational and NLP Agents, and Machine Learning Models. This aligns with recent literature indicating a surge in generative AI adoption in education due to its versatility in producing personalized content and feedback [40,41]. The prevalence of Conversational and NLP Agents reflects sustained interest in dialogue-based learning tools for language acquisition and tutoring, consistent with prior findings on chatbot-mediated instruction [29]. Meanwhile, Embodied and Immersive Systems and Intelligent Tutoring Systems remain less frequent, despite strong evidence of their effectiveness in fostering engagement and deep learning [32]. The relatively small portion of Rule-Based & Expert Systems reflects a shift from static, deterministic systems toward adaptive and data-driven approaches. Notably, 2.6% of studies lacked sufficient details to classify AI type, highlighting gaps in reporting standards.

4.2. Benefits Associated with AI in Education

The benefits associated with the use of AI in education were identified through a comprehensive review of the results, discussion, and conclusion sections of each study. This process allowed us to identify 22 different types of benefits. Subsequently, we organized them into four categories: cognitive, personal, social, and those reported by the teachers (see Table 3).

Table 3. Description of the benefits associated with AI in educational environments.

Category	Benefit	Description	*f*	%
Cognitive benefits	Learning gains	AI enhances learning gains by personalizing instruction and adapting to student needs.	102	65.8
	Personalized learning	AI-driven systems adapt to individual needs, improving effectiveness.	41	26.5
	Problem-solving	AI enhances problem-solving by providing real-time guidance, interactive simulations, and personalized challenges that foster critical thinking.	28	18.1
	Knowledge retention	AI improves knowledge retention through adaptive learning techniques, spaced repetition, and personalized student feedback.	23	14.8
	Digital literacy	AI enhances digital literacy by exposing students to technology-driven learning.	19	12.3
	Accessibility	AI provides inclusive, adaptive, and assistive learning solutions.	19	12.3
	Critical thinking	AI encourages critical thinking by analyzing data, presenting complex scenarios, and promoting evidence-based decision-making.	17	11.0
Personal benefits	Motivation	AI boosts motivation by providing engaging, interactive, and personalized learning experiences.	47	30.3
	Autonomy	AI promotes autonomy by enabling self-paced, independent, and personalized learning experiences.	30	19.4
	Enjoyment	AI enhances enjoyment by making learning interactive, engaging, and personalized.	27	17.4
	Attitude	AI fosters a positive attitude by creating a positive, supportive educational environment.	25	16.1
	Engagement	AI increases engagement through interactive lessons, gamification, and real-world applications.	24	15.5
	Creativity	AI fosters creativity by encouraging exploration, innovation, and problem-solving skills.	13	8.4
	Cognitive anxiety	AI reduces cognitive anxiety by offering support, guidance, and adaptive feedback.	12	7.7
	Cognitive load	AI reduces cognitive load by simplifying complex tasks and information processing.	8	5.2
Social benefits	Communication	AI improves communication skills through interactive tools, language practice, and feedback.	21	13.5
	Collaboration	AI enables group projects, shared digital workspaces, and real-time communication, enhancing teamwork and peer learning.	14	9.0
	Cultural awareness	Exposure to AI-driven diverse perspectives, global content, and inclusive learning materials enhances cultural awareness.	5	3.2
Teacher benefits	Task optimization	AI enhances task optimization by automating processes and improving efficiency.	20	12.9
	Professional growth	AI supports teachers' professional growth by offering personalized training and access to innovative teaching resources.	15	9.7
	Time reduction	AI reduces time by automating tasks and streamlining learning processes.	11	7.1
	Classroom management	AI improves classroom management by automating attendance, tracking behavior, and offering real-time insights for engagement.	7	4.5

The results reveal that AI in education is predominantly associated with cognitive and personal benefits, particularly enhancing learning gains and student motivation. These findings suggest that AI is widely perceived as a powerful tool for personalizing instruction, adapting to individual learning needs, and fostering student engagement. This aligns with previous studies, such as those by Strielkowski et al. [11] and Xu [57], which emphasize the transformative potential of AI in improving academic outcomes through adaptive learning environments.

Other frequently reported cognitive benefits include improvements in problem-solving, knowledge retention, and critical thinking. These outcomes reflect AI's potential to foster higher-order thinking through mechanisms such as real-time feedback, interactive simulations, and scaffolded learning experiences [58]. Additionally, benefits like digital literacy and accessibility demonstrate AI's role in equipping students with essential 21st-century skills and making learning more inclusive for diverse populations.

On the personal dimension, benefits such as increased motivation, autonomy, and engagement suggest that AI-supported environments often enhance students' affective and behavioral responses to learning. These findings align with research by Younas et al. [59] and Wang et al. [37], which have also found that intelligent tutoring systems and gamified

AI applications promote student interest and self-directed learning. However, affective outcomes like reduced cognitive anxiety and enhanced creativity are comparatively underreported, indicating that these areas remain underexplored in current implementations.

Social benefits such as improved communication and collaboration are less frequently documented. This gap supports critiques raised by Sethi and Jain [60] and Zheng et al. [61], who argue that many AI applications in education tend to prioritize individualized learning over collaborative and socio-emotional learning. The minimal attention to cultural awareness further suggests that the design of AI tools has not yet fully incorporated culturally responsive pedagogy or global competencies, which are increasingly relevant in today's interconnected educational landscape.

From the teacher's perspective, AI is most associated with task optimization, professional development, and time reduction. These results align with studies that demonstrate how AI can streamline administrative duties, generate personalized learning analytics, and support instructional planning [15,17]. However, the relatively limited attention to teacher-centered benefits points to a persistent gap in research and development. Given that teachers are essential mediators of AI adoption, more work is needed to empower educators with tools that enhance, not replace, their professional agency and pedagogical expertise.

Our classification of AI benefits into cognitive, personal, social, and teacher domains offers a more comprehensive framework than earlier reviews [16–21], which often focused narrowly on learning outcomes. This broader categorization reveals significant imbalances in how AI's potential is being used, particularly the relative neglect of social-emotional, collaborative, and teacher-related dimensions.

4.3. Challenges Associated with AI in Education

The challenges associated with integrating AI into education were identified by analyzing the results, discussion, and conclusions sections of each study. This process allowed us to identify 16 different types of challenges. Subsequently, we categorized them into four categories: cognitive, personal, social, and those reported by the teachers (see Table 4).

The results show a multifaceted range of challenges associated with integrating AI into educational environments, with personal and teacher-related concerns being the most frequently reported. Ethical concerns and teacher resistance emerged as the most prominent challenges, indicating that the human dimensions of AI adoption, such as privacy, bias, and user acceptance, remain critical barriers. Specifically, many educators resist adopting AI due to skepticism, lack of trust, fear of job displacement, or a reluctance to change their teaching methods. Studies show that teachers who are unfamiliar with AI often view it as a threat rather than a tool to enhance learning [62,63]. These findings are consistent with previous studies [64,65], which emphasize that trust, transparency, and ethical governance are foundational for the successful use of AI in education. Technical difficulties and low digital literacy among teachers further reflect infrastructural and competence-related barriers that may hinder the effective deployment of AI tools, reinforcing similar concerns raised in the literature about the digital divide in both student and teacher populations.

From a cognitive perspective, digital dependence and increased anxiety point to potential unintended consequences of AI overuse, such as reduced creativity and heightened psychological stress, particularly when AI systems are poorly designed or overly focused on assessment. Interestingly, anxiety and other cognitive traits such as motivation and learning gains were also reported in some studies as benefits, highlighting increased engagement or improved performance. However, in other contexts, these same characteristics emerged as challenges, especially when AI was used excessively or without proper pedagogical alignment. These challenges have been highlighted by researchers such as Strielkowski et al. [11], who caution against overly technocentric approaches that neglect

pedagogical and emotional considerations. Social challenges, including reduced human interaction and communication barriers, suggest that AI may compromise the relational aspects of education, another area previously identified as underdeveloped in AI-enhanced learning environments.

Table 4. Description of the challenges associated with AI in educational environments.

Category	Challenge	Description	*f*	%
Cognitive challenges	Digital dependence	Over-reliance on AI may weaken traditional problem-solving skills and creativity.	17	11.0
	Increased anxiety	Constant feedback and assessments can create stress and pressure.	9	5.8
	Learning gains reduction	AI may hinder deep learning if misused or poorly designed.	8	5.2
	Increased cognitive load	Excessive information and multitasking can overwhelm students.	6	3.9
	Student's poor digital literacy	AI challenges students with low digital literacy, creating accessibility barriers and widening the knowledge gap.	3	1.9
Personal challenges	Ethical concerns	AI raises ethical concerns about data privacy, algorithmic bias, decision transparency, and student surveillance risks.	23	14.8
	Creativity barriers	Standardized AI-generated content may restrain originality.	9	5.8
	Autonomy limitations	AI reliance might discourage independent learning strategies.	6	3.9
	Motivation issues	AI-driven learning may reduce intrinsic motivation if overused.	5	3.2
Social challenges	Reduced human interaction	AI-driven learning may limit peer collaboration and teacher-student engagement.	8	5.2
	Communication barriers	Overuse of AI-based communication tools may affect interpersonal skills.	3	1.9
Teacher challenges	Teacher resistance	Lack of familiarity or skepticism can hinder AI adoption.	19	12.3
	Technical difficulties	Software glitches, connectivity issues, and integration challenges can disrupt learning.	10	6.5
	Low digital literacy	Limited AI proficiency among educators may reduce its effectiveness.	9	5.8
	High costs	AI implementation requires substantial investment in technology, training, and maintenance.	8	5.2
	Legal aspects	AI in education raises legal concerns about data privacy, intellectual property, accountability, and regulatory compliance.	5	3.2

Challenges such as creativity barriers and autonomy limitations suggest that over-standardization in AI-driven content may inhibit learner agency and originality. These dualities, where certain factors are reported as strengths and weaknesses, highlight the importance of considering contextual, technological, and individual variables when evaluating AI's impact. Compared to earlier studies [19,37], this analysis offers a deeper categorization and highlights the tension between AI's potential and its limitations. Future research and policy must focus on responsible AI design, teacher training, and inclusive practices to ensure that AI complements rather than replaces human-centered education.

5. Limitations of the Study and Future Work

While this review provides a broad overview, several limitations should be considered when interpreting the results. First, we excluded grey literature, such as conference papers, dissertations, and policy reports. While this decision ensured a focus on peer-reviewed studies, it may have led to the exclusion of emerging or context-specific insights not yet captured in journal publications. As such, the findings may slightly overrepresent more established academic perspectives and underrepresent practitioner-driven innovations. Second, while the review identifies general benefits and challenges of AI in education, it does not deeply explore how different AI applications align with specific pedagogical models or teaching strategies across disciplines and contexts. Third, although the results raised ethical concerns and digital dependency, we do not thoroughly examine the long-

term consequences of AI integration, such as changes in teacher roles, student autonomy, or institutional policies.

Furthermore, this review did not apply a formal framework to assess the certainty of the evidence for each outcome. However, the confidence in our thematic findings varies depending on the consistency and clarity of reporting across studies. For example, cognitive and motivational benefits of AI were frequently reported across multiple contexts and supported by converging evidence, suggesting moderate to high confidence in these themes. In contrast, challenges related to digital overdependence or ethical risks appeared less consistently and with more variability in interpretation, indicating lower confidence. While all included studies were peer-reviewed, the heterogeneity in study designs and limited methodological reporting in some cases reduce our overall ability to evaluate certainty systematically.

Future research should develop and validate ethical guidelines and frameworks to support the responsible, transparent, and fair use of AI in education, particularly in areas such as data privacy, bias mitigation, and algorithmic accountability. Also, studies should examine how AI tools support (or conflict with) established pedagogical approaches such as collaborative learning, inquiry-based learning, problem-based learning, game-based learning, constructivism, or connectivism. Additionally, it is important to identify how teachers can be effectively trained and supported to integrate AI into classrooms, both technically and pedagogically, and how this affects their instructional roles. Finally, more longitudinal studies are needed to evaluate the sustained impact of AI on learning outcomes, equity, student well-being, and institutional transformation over time.

6. Conclusions

This systematic literature review examined 132 empirical studies published between 2015 and 2024 to identify the prevailing trends, benefits, and challenges of integrating AI in educational environments. The findings reveal a significant increase in AI-related educational research, especially from 2023 onward, coinciding with the widespread release of tools such as ChatGPT. The analysis highlights that most studies have been conducted in Asia, particularly in China, Taiwan, and Turkey, with notable leadership from the journal *Computers & Education*. Higher education emerges as the most studied level, and language learning, ICT, and science education stand out as the predominant content areas. In terms of benefits, AI is primarily associated with cognitive and personal gains. It enhances learning outcomes, promotes personalized instruction, improves motivation, and fosters autonomy. However, social benefits, such as collaboration and cultural awareness, along with teacher-centered advantages, are less emphasized, suggesting a research gap in socially driven and educator-focused AI applications. Moreover, the affective dimension of learning, such as reducing cognitive anxiety and promoting creativity, remains underexplored. Challenges identified include ethical concerns, potential over-dependence on AI, and issues related to digital literacy and student motivation. These concerns highlight the need for more thoughtful and equitable AI design and implementation, particularly to prevent widening educational gaps or compromising pedagogical integrity. Overall, this review highlights AI's transformative potential to personalize learning, enhance academic outcomes, and support effective teaching practices. However, it also calls for a more balanced research agenda that addresses cognitive, emotional, social, and ethical dimensions. Future efforts should prioritize interdisciplinary collaboration among educators, policymakers, and technologists to ensure AI contributes meaningfully to holistic, inclusive, and sustainable educational ecosystems.

Supplementary Materials: The supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/mti9080084/s1, Table S1: Data extraction form.

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