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INTEGRATING ARTIFICIAL INTELLIGENCE IN TEACHING AND LEARNING: A SYSTEMATIC LITERATURE REVIEW

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Abstract:

Artificial Intelligence (AI) has rapidly transformed education, offering new possibilities for enhancing teaching and learning. This Systematic Literature Review (SLR) aims to examine how AI has been integrated into educational contexts, identify prevailing research trends, and highlight existing gaps for future inquiry. Guided by the PRISMA 2020 framework, the review followed a transparent and replicable process to ensure methodological rigor. The search was conducted using the Scopus database with predefined inclusion and exclusion criteria, yielding 26 peer-reviewed, open-access studies published between 2021 and 2025. The selected studies explore various AI applications, including adaptive instruction, personalized learning, intelligent feedback systems, language education, and teacher professional development. Findings indicate that AI supports personalized and data-driven instruction by improving learner engagement, motivation, and formative assessment practices. Nevertheless, issues related to ethical use, digital infrastructure, and teacher readiness continue to challenge widespread adoption. Overall, this review underscores the potential of AI to enhance evidence-based, equitable, and sustainable educational practices when implemented with pedagogical alignment and ethical consideration.

Keywords:

Artificial Intelligence, Teaching and Learning, Systematic Review, Personalized Learning, Feedback, Teacher Readiness, Ethics in Education

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Introduction

Artificial Intelligence (AI) has emerged as a powerful catalyst in global education, revolutionizing how teachers design instruction, how students engage with content, and how learning outcomes are assessed (Zhang & Tian, 2025). From automated feedback systems to adaptive tutoring and generative content creation, AI technologies have redefined teaching and learning processes across disciplines (Zhang & Tian, 2025; Cui,2025). Over the past five years, the educational sector has witnessed accelerated adoption of AI tools like ChatGPT, Khanmigo, and other intelligent tutoring systems, driven by the growing emphasis on personalization, learner autonomy, and data-informed pedagogy (Buele et al., 2025; Alvarez & Angeles, 2025). While this transformation aligns with Education 4.0's call for technology-enabled learning ecosystems, it has also sparked pressing questions regarding ethical use, pedagogical fit, and the evolving role of educators.

Moreover, empirical research from 2021 to 2025 reveals a strong interest in integrating AI to enhance learning efficiency, self-efficacy, and assessment quality. For instance, studies on AI-powered instructional videos and adaptive listening platforms have shown measurable gains in comprehension and motivation (Pellas, 2025; Hijriyah et al., 2025). Likewise, investigations into AI-supported grammar learning and blended learning environments demonstrate improved learner performance and engagement when feedback is automated and individualized (Katsarou et al., 2025; Al-Taai et al., 2025). Within higher education, AI applications are increasingly embedded into course management systems, writing support tools, and digital mentoring platforms that offer real-time analytics and formative assessment (Pozdniakov et al., 2024; González-Rico & Lluch Sintes, 2024). Collectively, these studies highlight AI's growing pedagogical influence on how knowledge is delivered, mediated, and evaluated.

Despite such progress, the literature remains fragmented. Several studies focus on technical efficiency or user acceptance rather than pedagogical outcomes (Cui, 2025; Rabab'h & Almoray, 2025), while others address specialized contexts such as medical or STEM education without generalizing implications for broader teaching and learning (Saleem et al., 2024; Abd-alrazaq et al., 2023). Ethical dimensions, ranging from academic integrity to bias and over-reliance, are inconsistently treated across the evidence base (Plecerda, 2024; Kiryakova & Angelova, 2023). Although AI's potential has been studied (Tapalova & Zhiyenbayeva, 2022; Singh & Hiran, 2022), there remains a lack of a systematic empirical synthesis that evaluates what works, for whom, and under what conditions within authentic teaching and learning environments. This methodological gap justifies a structured review of the 2021-2025 empirical literature to consolidate current knowledge and identify research priorities.

The present study, therefore, performs a Systematic Literature Review (SLR) of empirical, open-access journal articles published between 2021 and 2025 that examine the integration of AI in teaching and learning. Following PRISMA 2020 guidelines, this review extracts evidence from 26 peer-reviewed studies indexed in Scopus, encompassing contexts such as language education, teacher training, higher education, and digital assessment. By synthesizing findings across these domains, the review aims to clarify the nature, outcomes, and constraints of AI-supported pedagogy and to guide educators, policymakers, and researchers toward evidence-informed implementation.

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Accordingly, the review addresses the following research questions:

RQ1. How has artificial intelligence been integrated into teaching and learning between 2021 and 2025?

RQ2. What learning, engagement, and pedagogical outcomes have been reported in empirical studies of AI-supported education?

RQ3. What barriers, ethical considerations, and enabling factors influence the successful adoption of AI in teaching and learning contexts?

Literature Review

Theoretical Foundations of AI Integration in Teaching and Learning

The empirical studies reviewed between 2021 and 2025 draw on several theoretical perspectives to explain how AI supports teaching and learning. Frameworks like the Technology Readiness Index (TRI), Technology Acceptance Model (TAM), as well as the Hedonic Information System Acceptance Model (HISAM) are commonly employed to analyze cognitive and emotional determinants of adoption, linking perceived usefulness, enjoyment, and optimism to students' intention to use AI tools (Cui, 2025; Zhang & Tian, 2025). From a pedagogical standpoint, constructivist and social-constructivist perspectives frame AI as a scaffold for active, collaborative, and reflective learning (Jayasinghe, 2024; Mananay, 2024; Pellas, 2025). Meanwhile, heutagogy and Self-Determination Theory emphasize learner autonomy and self-directed knowledge construction through adaptive and mentoring-based systems (Saleem et al., 2024; González-Rico & Lluch Sintes, 2024). Complementing these pedagogical lenses, ethical and human-centred AI frameworks stress transparency, fairness, and academic integrity in algorithmic learning environments (Buele et al., 2025; Plecerda, 2024; Abd-alrazaq et al., 2023). Together, these theories show that effective AI integration depends on technical capability and on robust psychological, pedagogical, as well as ethical foundations that ensure meaningful, equitable learning experiences.

To address the research questions guiding this review, it is therefore important to examine how these theoretical perspectives inform the interpretation of AI integration, learning outcomes, and ethical dimensions. The following section synthesizes the key theories and conceptual models identified across the reviewed studies, highlighting how they collectively underpin the evolving relationship between AI technologies, pedagogy, and learner engagement. Table 1 below summarises the theoretical frameworks identified across the reviewed studies, highlighting their pedagogical relevance and conceptual contribution to AI integration in teaching and learning.

Table 1: Summary of Theoretical Frameworks Identified in Reviewed Studies

Theory / Framework	Authors	Key Principles	Pedagogical Relevance
Constructivist Learning Theory (CLT)	Katsarou et al. (2025); Alvarez & Angeles (2025); Jayasinghe (2024)	Learners build new knowledge by connecting it to prior experiences.	Supports learner-centred, discovery-based, and reflective learning.
Cognitive Load Theory (CLT)	Katsarou et al. (2025)	Learning improves when intrinsic, extraneous, and	Helps teachers design clear, structured, and visually supportive materials.

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		germane loads are well managed.	
Social Cognitive Theory (SCT)	Pellas (2025)	Learning occurs through observation, imitation, and social interaction.	Promotes modelling, demonstration, and collaborative learning.
Technology Acceptance Model (TAM)	Alvarez & Angeles (2025); Kiryakova & Angelova (2023)	Perceived usefulness and ease of use shape technology acceptance.	Explains learners' willingness to use digital tools.
Hedonic Information Systems Acceptance Model (HISAM)	Cui (2025)	Intrinsic enjoyment motivates digital tool use.	Highlights emotional engagement and satisfaction in learning.
Technology Readiness Index (TRI)	Cui (2025)	Optimism, innovativeness, discomfort, and insecurity affect readiness for technology.	Assesses learners' confidence and preparedness to adopt AI.
Artificial Intelligence in Education Framework (AIEd)	Katsarou et al. (2025); Tapalova & Zhiyenbayeva (2022); Bekmanova et al. (2021)	Integrates AI, analytics, and pedagogy for personalization.	Enables adaptive, data-driven, and learner-centred instruction.
Intelligent Tutoring System Framework (ITS)	Bekmanova et al. (2021)	AI simulates human tutoring with adaptive support.	Provides tailored feedback and individual scaffolding.
Responsible Artificial Intelligence Framework (RAIF)	Rabab'h & Almoray (2025)	Advocates ethical, transparent, and accountable AI use.	Ensures safe, fair, and culturally sensitive implementation.
Artificial Intelligence Literacy Framework (AILF)	Buele et al. (2025)	Builds affective, behavioural, cognitive, and ethical AI literacy.	Develops critical thinking and ethical awareness in AI contexts.
Universal Design for Learning (UDL)	Katsarou et al. (2025)	Designs flexible, inclusive learning to meet diverse needs.	Promotes accessibility and differentiated instruction.

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Heutagogical Framework (Self-Determined Learning Theory)	Saleem et al. (2024)	Learners self-direct and manage their own learning paths.	Fosters autonomy, reflection, and lifelong learning.
Trust Decision-Making Theory (TDMT)	Li (2025)	Trust and reliability influence technology use.	Enhances learners' confidence in AI systems.
Digital Competence Framework (DigComp 2.1)	Zhang & Tian (2025)	Defines essential digital skills for communication and safety.	Guides development of students' digital and AI competencies.

As illustrated in Table 1, the AI integration in education is grounded in a combination of technological acceptance models (such as TAM, HISAM, and TRI) and constructivist-based learning theories (such as Constructivist Learning Theory (CLT) and Social Cognitive Theory (SCT)). These frameworks collectively highlight that the effectiveness of AI in education relies on learners' ease of use, perceived usefulness, as well as technological readiness and on sound pedagogical alignment, cognitive engagement, and ethical governance. Building on these, the subsequent sections examine the empirical evolution of AI applications in education between 2021 and 2025, tracing how these frameworks have guided research focus, instructional innovation, and learner outcomes over time.

Evolving Landscape of AI in Education (2021–2025)

Between 2021 and 2025, research on AIEd shifted from proof-of-concept systems to classroom-embedded pedagogical applications. Note that early studies emphasized personalized pathways and adaptive feedback mechanisms that catered to individual learning profiles (Tapalova & Zhiyenbayeva, 2022; Bekmanova et al., 2021). By 2023–2025, the focus had expanded to human-centred adoption, ethics, and institutional readiness (Cui, 2025; Zhang & Tian, 2025). Furhermore, investigations across higher-education contexts revealed a convergence between *generative* and *analytic* AI approaches combining predictive algorithms with tools such as ChatGPT, Khanmigo, and Feedback Copilot to enhance instruction and assessment (Pozdniakov et al., 2024; Alvarez & Angeles, 2025). This period also marked a paradigm shift from technical experimentation to pedagogical integration, highlighting AI's role in scaffolding learning, fostering engagement, and enabling self-regulated learning.

Pedagogical Integration and Learning Outcomes

A consistent theme across the corpus is AI's potential to improve learning outcomes when embedded within sound instructional design. Experimental and quasi-experimental studies confirmed significant gains in comprehension, grammar mastery, and listening proficiency when AI delivered adaptive feedback or real-time analysis (Katsarou et al., 2025; Hijriyah et al., 2025). In mathematics and science education, AI-generated instructional videos and intelligent tutors such as MathGPT and Flexi 2.0 enhanced conceptual understanding and self-efficacy (Pellas, 2025; Alvarez, 2024). Within blended and online environments, AI applications increased learner autonomy and motivation through customized sequencing and

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formative feedback (Al-Taai et al., 2025; Bekmanova et al., 2021). Collectively, these findings demonstrate that effectiveness depends less on technology itself than on its pedagogical alignment. AI performs best when used to personalize instruction, prompt reflection, and support metacognitive monitoring.

Teacher and Student Readiness for AI Adoption

Studies on user acceptance identify emotional and cognitive factors as critical predictors of AI uptake. Perceived enjoyment, optimism, and ease of use have a significant impact on students' willingness to engage with AI tools (Cui, 2025), while institutional infrastructure and digital competence moderate these effects (Zhang & Tian, 2025). Among teachers, attitudes are generally positive but tempered by concerns about workload, training, and authenticity of assessment (Rabab'h & Almoray, 2025; Kiryakova & Angelova, 2023). In Iraq and Jordan, surveys of higher-education faculty demonstrated generally positive perceptions of AI's pedagogical value yet underscored limited institutional training, inadequate infrastructure, and the absence of clear policy guidelines governing classroom use (Al-Taai et al., 2025; Rabab'h & Almoray, 2025). These results echo broader calls for AI literacy and capacity-building initiatives to ensure that educators can critically evaluate and ethically implement AI tools.

Ethical Considerations and Academic Integrity

Ethics emerged as a recurring but inconsistently addressed dimension. Students report both enthusiasm for generative AI and anxiety about plagiarism and loss of intellectual agency (Buele et al., 2025; Plecerda, 2024). On the other hand, teachers similarly express fear that unregulated use could erode assessment validity and learner creativity (Jose & Jose, 2024; Kiryakova & Angelova, 2023). Framework-oriented studies propose integrating ethical AI awareness into curricula through transparency, feedback design, and human oversight (Saleem et al., 2024; Abd-alrazaq et al., 2023). Collectively, the literature underscores a moral duality: AI can democratize learning opportunities, yet without explicit ethical governance, it risks amplifying inequities and dependence.

Discipline-Specific Implementations

AI's integration varies by disciplinary context. In language education, systems such as SUNO.AI and MI-aligned chatbots improved listening and communicative competence (Hijriyah et al., 2025; Pitychoutis & Al Rawahi, 2024; Mananay, 2024). In teacher-education programmes, AI-generated video analysis and data dashboards enhanced reflection and performance monitoring (Pellas, 2025). Soft-skills training combined with AI personalized mentoring to strengthen collaboration and emotional intelligence (González-Rico & Lluch Sintes, 2024). Even in specialized domains such as medical and physiology education, AI served pedagogical, not purely technical roles by supporting tutoring, feedback, and adaptive simulations (Saleem et al., 2024; Abd-alrazaq et al., 2023). These studies collectively suggest that disciplinary tailoring, rather than one-size-fits-all adoption, determines the quality of learning outcomes.

Gaps and Need for Systematic Synthesis

Although individual studies demonstrate promising results, the evidence base remains dispersed across contexts, methods, and AI tools. Few comparative analyses exist to identify cross-cutting pedagogical mechanisms or long-term impacts (Zhang & Tian, 2025; Liu & Yushchik, 2024). Moreover, many empirical papers privilege short-term performance metrics over critical examination of cognitive or affective learning processes (Cui, 2025; Alvarez,

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2024). Prior conceptual reviews (Tapalova & Zhiyenbayeva, 2022; Singh & Hiran, 2022) highlight AI's potential but lack systematic screening and synthesis. Consequently, a rigorous SLR is required to integrate empirical findings, evaluate methodological consistency, and illuminate theoretical, pedagogical, and ethical trends across contemporary AI-in-education research.

Methodology

Review Protocol

This study adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to promote transparency and enable replication of the methodology. The protocol guided every stage of the review, identification, screening, eligibility, and inclusion based on predefined criteria for relevance, quality, and accessibility. The process focused exclusively on empirical studies that examined the AI integration in teaching and learning from 2021 to 2025. Secondary reviews, purely technical design papers, and non-educational AI applications were excluded to maintain pedagogical relevance. Figure 1 (PRISMA Flow Diagram) illustrates the review stages, from initial retrieval to final inclusion of 26 studies.

Data Extraction and Synthesis

The study selection process is illustrated in the PRISMA flowchart (Figure 1), which outlines the stages of identification, screening, eligibility assessment, and final inclusion.

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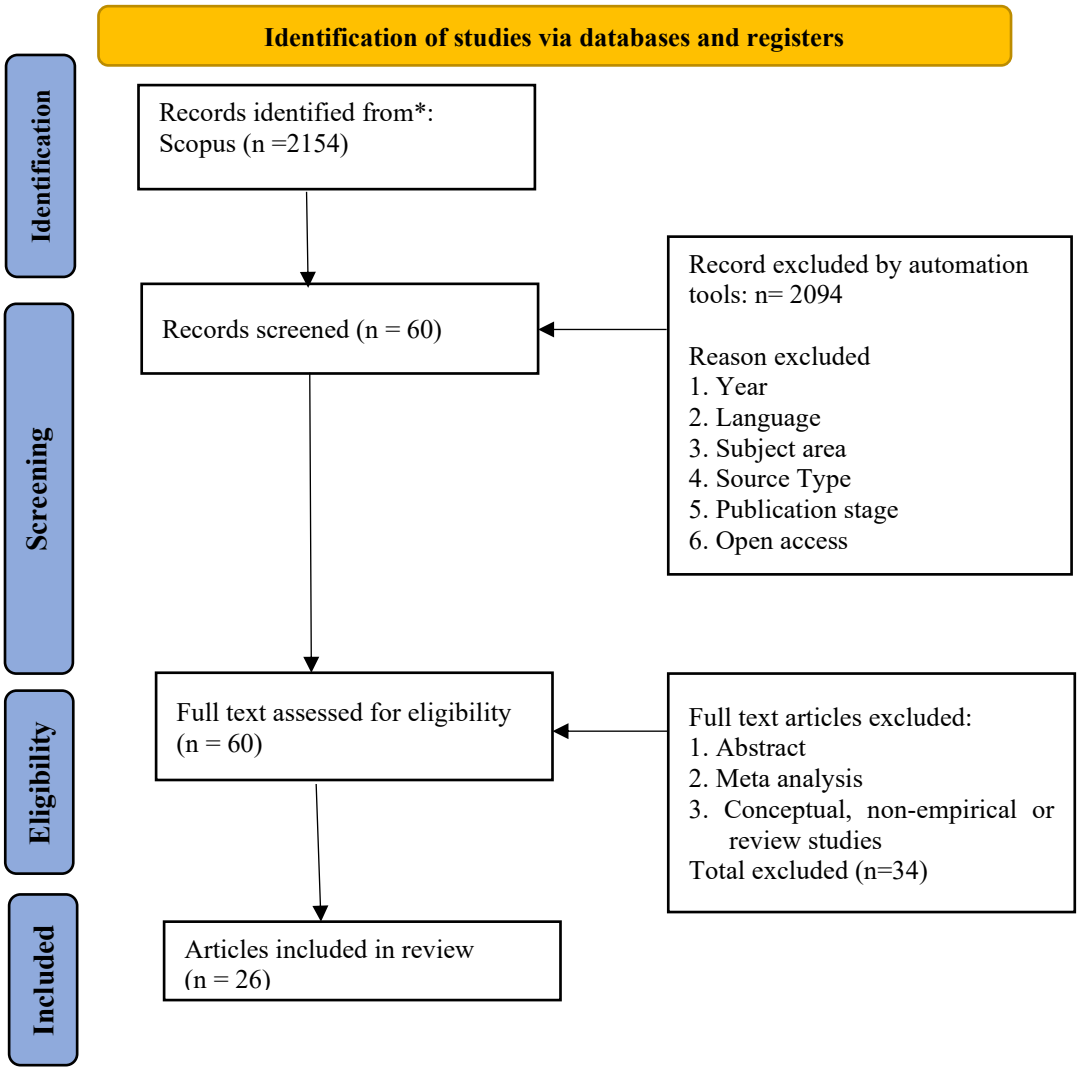

Figure 1: PRISMA Flow Diagram

Search Strategy

A single-database search was conducted in Scopus, given its comprehensive indexing of high-quality educational and social science journals. The Boolean search query combined terms related to AI technology, education, and pedagogy as follows: ("artificial intelligence" OR "machine learning" OR "deep learning" OR "generative AI") AND (education OR learning OR teaching OR instruction) AND (integration OR adoption OR application OR implementation) AND ("personalized learning" OR "adaptive learning" OR "assessment" OR "feedback" OR "analytics"). Consequently, filters were applied to restrict results to English-language, open-access journal articles, within the Social Sciences subject area, published between 2021 and 2025. This yielded 2,154 records, which were subsequently de-duplicated and screened based on titles, abstracts, and keywords.

Eligibility and Selection

The screening process followed three levels: (1) title and abstract review for relevance to AI-supported teaching and learning, (2) full-text assessment to confirm empirical design, and (3) disciplinary verification to ensure alignment with education and social sciences. After

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screening, 26 articles met the inclusion criteria. Studies that were conceptual, review-based, or focused on infrastructure or policy without teaching or learning outcomes were excluded.

Table 2: Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Population	Learners or teachers in educational settings (school, higher education, teacher training)	Non-educational or administrative AI use
Intervention	Integration or application of AI tools in teaching, learning, or assessment	Purely technical AI development or conceptual frameworks
Outcomes	Learning performance, engagement, self-efficacy, metacognitive or pedagogical outcomes	No educational outcomes reported
Study Design	Empirical (quantitative, qualitative, or mixed-methods)	Conceptual, review, or bibliometric papers
Publication Type	Peer-reviewed, open-access journal articles (2021–2025)	Conference papers, theses, or non-peer-reviewed items
Language	English	Non-English
Accessibility	Full-text available	Restricted-access or paywalled papers

Data Extraction and Analysis

Data for this review were systematically extracted into a structured matrix that included key variables for example, the author and publication year, along with the educational setting and level (K–12, higher education, or teacher training), the type of AI approach or technology applied (for instance, adaptive tutoring systems, feedback mechanisms, chatbots, or generative AI tools), the study design and sample characteristics, as well as the measured outcomes encompassing learning achievement, engagement, self-efficacy, and ethical considerations. Note that each study's key findings and reported limitations were also recorded. Correspondingly, the extracted data were subjected to a qualitative thematic synthesis that combined inductive and deductive coding procedures to uncover overarching trends and patterns. Through this process, five central themes were identified: the role of AI in facilitating personalized and adaptive learning, its function in assessment and feedback, user acceptance and ethical issues, discipline-specific applications of AI, and institutional readiness for AI integration in educational settings.

Disciplinary Scope and Link to Research Question 1

To address RQ1, which explores how AI has been integrated into teaching and learning between 2021 and 2025, it was essential to verify that the included studies fall within the social sciences disciplinary scope. According to the Scopus classification, the social sciences encompass education, linguistics, psychology, communication, and learning sciences. Each study was coded according to its primary field, as presented in Table 3.

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Table 3: Disciplinary Classification of Included Studies

Domain	Number of Studies	Examples of Articles	Remarks
Education / Pedagogy / Teacher Training	15	Tapalova & Zhiyenbayeva (2022); Singh & Hiran (2022); Kiryakova & Angelova (2023); Liu & Yushchik (2024); Jose & Jose (2024); Jayasinghe (2024); Zhang (2024); Plecerda (2024); Alvarez (2024); Pellas (2025); Al-Taai et al. (2025); Abishev et al. (2025); Rabab'h & Almoray (2025); Alvarez & Angeles (2025); González-Rico & Lluch Sintes (2024)	Core teaching and learning contexts
Language and Applied Linguistics	4	Mananay (2024); Cui (2025); Katsarou et al. (2025); Hijriyah et al. (2025);	Focused on ESL/EFL learning and AI scaffolding
Higher Education / Learning Analytics	2	Bekmanova et al. (2021); Pozdniakov et al. (2024)	AI in feedback, mentoring, and digital assessment
Medical and STEM Education (Interdisciplinary)	3	Abd-alrazaq et al. (2023); Saleem et al. (2024); Li (2025)	Included when pedagogy, not clinical training, was primary
Ethics & Policy / Governance	2	Zhang & Tian (2025); Buele et al. (2025);	Addressed AI ethics, governance, and institutional policy implications
Total	26	-	-

This classification confirms that the dataset is firmly situated within the social sciences domain, ensuring that the review maintains disciplinary integrity while incorporating relevant interdisciplinary perspectives. Building on this disciplinary foundation, the following section presents the core findings from the thematic synthesis.

Results and Thematic Findings

Overview of Thematic Analysis

The synthesis of 26 empirical studies revealed five interconnected themes representing current directions in the AI integration in teaching and learning. These themes, which include personalization, assessment and feedback, readiness and ethics, disciplinary applications, and policy and leadership, collectively demonstrate how AI influences pedagogy, learner engagement, and institutional transformation. Across the corpus, most studies employed experimental or quasi-experimental designs, while others used surveys or mixed methods to evaluate user perceptions and learning outcomes. Overall, evidence indicated positive impacts on learner performance, motivation, and engagement. However, persistent concerns surrounding academic integrity, infrastructure, and teacher preparedness.

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Overview of Included Studies

Before delving into the thematic discussion, Table 4 summarises the 26 empirical studies analyzed in this review. The table presents essential information, including the study title, authors, year, research context, educational outcomes, challenges, and identified research gaps. This summary provides an overview of the evidence base that underpins the subsequent thematic synthesis.

Table 4: Summary of Included Studies

Study Title (Author/s)	Study Context / Country	Educational Outcomes	Challenges / Limitations	Identified Gaps / Future Directions
Personalized training model for organizing blended and lifelong distance learning courses and its effectiveness in Higher Education (Bekmanova et al., 2021)	Higher Education-Kazakhstan	Improved personalization, flexible paths, high completion	Single institution; simple interface	Expand to more courses; semantic search; cross-university validation
Artificial Intelligence in Education: AIEd for Personalised Learning Pathways (Tapalova & Zhiyenbayeva, 2022)	Higher Education-Kazakhstan & Russia	Personalized learning pathways, real-time feedback	Uneven AI adoption, data privacy issues	More empirical studies; ethical AI studies
The Impact of AI on Teaching and Learning in Higher Education Technology (Singh & Hiran, 2022)	Higher Education-India	Enhanced teaching efficiency & engagement	Ethical issues, bias	Develop ethical models; teacher training
ChatGPT-A: A Challenging Tool for University Professors in Their Teaching Practice (Kiryakova & Angelova, 2023)	Higher Education-Bulgaria	Helps create materials, quizzes, creativity	Plagiarism, misinformation	Long-term effects; student perspectives
Large Language Models in Medical Education: Opportunities, Challenges, and Future Directions (Abd-alrazaq et al., 2023)	Medical Higher Education-Qatar	Supports curriculum design & personalized learning	Bias, misinformation	Ethical guidelines; educator training
Exploring the prospects of using artificial intelligence in education (Liu & Yushchik, 2024)	Higher Education-China & Russia	Higher student scores & engagement	Low interaction; tech issues	AI in assessment & data analytics
ChatGPT as an innovative heutagogical tool in medical education (Saleem et al., 2024)	Medical Higher Education-India & Norway	Encourages self-directed learning	Bias, accuracy issues	Explore other disciplines; newer models
Educators' academic insights on artificial intelligence: Challenges and opportunities (Jose & Jayaron Jose, 2024)	Global (Higher Ed & School Settings)	Improved motivation, engagement, accessibility	Overreliance; job insecurity	Training, ethics, subject-specific studies

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Study Title (Author/s)	Study Context / Country	Educational Outcomes	Challenges / Limitations	Identified Gaps / Future Directions
Large Language Models Meet User Interfaces: The Case of Provisioning Feedback (Pozdniakov et al., 2024)	Higher Education-Australia	Better & faster feedback	AI literacy, ethical concerns	Expand GenAI tools; broader testing
Integrating Artificial Intelligence (AI) in Language Teaching: Effectiveness, Challenges, and Strategies (Mananay, 2024)	School Education-Philippines	Improved proficiency & engagement	Low infrastructure; privacy risks	Training, ethics, collaboration
Empowering Soft Skills through Artificial Intelligence and Personalised Mentoring (González-Rico & Lluch Sintes, 2024)	Higher Education-Spain	Better soft skills & employability awareness	Small sample, one institution	Replicate with larger samples
Promoting active learning with ChatGPT: A constructivist approach in Sri Lankan higher education (Jayasinghe, 2024)	Higher Education-Sri Lanka	Active learning, critical thinking	Small sample; did not study negatives	Larger testing; bias & ethics studies
Research on Online Vocal Music Smart Classroom-Assisted Teaching Based on Wireless Network Combined with Artificial Intelligence (Zhang, 2024)	Arts Education (Higher Ed)-China	Improved performance & satisfaction	Domain-specific; limited controls	Cross-discipline studies
Academic integrity: Surrounding the Use of Generative AI in higher education. (Plecerda, 2024)	Higher Education-Philippines	Idea generation, faster tasks	Plagiarism, overreliance	Clear AI-use policies
Evaluating the Impact of AI–Powered Tutors MathGPT and Flexi 2.0 in Enhancing Calculus Learning (Alvarez, 2024)	Higher Education-Philippines	Better calculus performance	Tech issues; overreliance	Long-term evaluation; training
What influences college students to use AI for academic writing? (Cui, 2025)	Higher Education-China	Enjoyment & usefulness increase usage intention	Small sample	Larger multi-field samples
Digital competencies in student learning with generative AI: Policy implications from World-Class Universities (Zhang & Tian, 2025)	Higher Education-Global (88 universities)	Emphasis on digital literacy & safety	Limited focus on collaboration & cybersecurity	Unified frameworks; equity & privacy
Ethical Use of Generative Artificial Intelligence Among Ecuadorian University Students	Higher Education-Ecuador	Ethical use driven by emotional &	Limited to Ecuador	Cross-national comparisons

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Study Title (Author/s)	Study Context / Country	Educational Outcomes	Challenges / Limitations	Identified Gaps / Future Directions
(Buele et al., 2025)		cognitive factors		
Exploring AI Technology in Grammar Performance Testing for Children with Learning Disabilities (Katsarou et al., 2025)	Special Education-Greece	Improved grammar accuracy & engagement	Short duration; not classroom-based	Long-term studies; classroom integration
How Effective Is SUNO.AI in Enhancing Arabic Listening Skills? An Evaluation of AI-Based Personalized Learning (Hijriyah et al., 2025)	Higher Education-Indonesia	Improved listening scores & motivation	Small sample; short-term	Larger samples; interactive features
The Impact of AI-Generated Instructional Videos on Problem-Based Learning in Science Teacher Education (Pellas, 2025)	Higher Education-Greece (Teacher Education)	Better performance & retention	No control group; small sample	Explore adaptive/interactive AI
The Role of Artificial Intelligence Applications in Improving Blended Learning in Iraqi Universities (Al-Taai et al., 2025)	Higher Education-Iraq	Better classroom management & engagement	Poor infrastructure, resistance	Staff training; AI curriculum
An artificial intelligence model in the cognitive and learning activities of university subjects (Abishev et al., 2025)	Higher Education-Kazakhstan & Russia	Improved personalization & academic success	Ethics, privacy, unequal access	Fairness, long-term studies
Jordanian Teachers' Perceptions of Employing Artificial Intelligence Technologies in the Educational Process (Rabab'h & Almoray, 2025)	Public School Education-Jordan	Positive teacher perceptions	Limited training; gender differences	Include private schools; more training
Khanmigo in the Virtual Classroom: A Strategic Evaluation through SWOT and Acceptability Analysis (Alvarez & Angeles, 2025)	Higher Education-Philippines	Better understanding, motivation	Internet dependence; low empathy	Ethical transparency; human–AI balance
AI Foundations in China's Medical Physiology Education: Pedagogical Practices and Systemic Challenges (Li, 2025)	Medical Higher Education-China	Better diagnostics & simulation skills	Privacy issues; resource gaps	Equal access; ethics training

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Methodological Overview of Reviewed Studies

Across the 26 studies analyzed between 2021 and 2025, diverse methodological designs were employed, reflecting both experimental rigor and exploratory inquiry. Approximately 56% adopted quasi-experimental designs, often integrating pre- and post-test measures to evaluate learning gains. For instance, Alvarez (2024) employed a quasi-experimental design with pre- and post-tests to compare the effects of AI-powered tutors on calculus learning. Several research and development (R&D) studies also employed pre- and post-test evaluations to measure learning outcomes, as in Hijriyah (2025), which followed the Hannafin and Peck R&D model to develop and validate SUNO.AI based listening media. Around 23% utilized mixed-method approaches, combining quantitative analytics with qualitative reflections, while 21% relied on survey-based quantitative designs (Cui, 2025) or document-based descriptive analyses of institutional GenAI policies (Zhang & Tian, 2025) to capture learners' attitudes and institutional responses to AI. Despite the growing methodological sophistication, several limitations remain consistent across the corpus. Many studies involved small sample sizes ($n < 100$), short intervention durations (2–4 weeks), and limited control groups, constraining generalizability. Additionally, school-level and longitudinal investigations are still underrepresented compared to higher education research. These methodological gaps underscore the need for larger, comparative, and mixed-longitudinal designs to validate AI's sustained pedagogical and cognitive impact.

Drawing on these methodological insights, the synthesis moves beyond design patterns to examine the substantive outcomes and conceptual directions emerging across the reviewed literature. Collectively, the findings converge on five dominant themes that encapsulate current trends in AI integration within education. These include personalization and adaptive learning, assessment and feedback, readiness and ethics, disciplinary applications, and policy and leadership. Together, they offer a multidimensional understanding of how AI is reshaping teaching and learning processes. The following sections elaborate on each theme in detail, beginning with the most prominent, personalized and adaptive learning.

Theme 1: Personalized and Adaptive Learning

The first theme establishes personalization as AI's most influential pedagogical contribution, driven by adaptive technologies that tailor learning to individual needs. AI's strongest contribution across the reviewed studies lies in personalizing the learning process through adaptive systems, recommender models, and intelligent tutoring. Studies in language and mathematics education consistently reported improved comprehension, retention, and learner confidence when AI tools tailored content to students' individual profiles (Hijriyah et al., 2025; Katsarou et al., 2025; Alvarez, 2024). For instance, SUNO.AI in Arabic listening tasks and MathGPT/Flexi 2.0 in calculus both enabled differentiated instruction and real-time scaffolding, resulting in measurable post-test gains (Hijriyah et al., 2025; Alvarez, 2024). These systems leveraged algorithmic modelling to recognize learners' prior knowledge, predict errors, and deliver instant feedback (Liu & Yushchik, 2024). Similarly, recent developments in medical physiology education demonstrate that adaptive AI systems can personalize learning paths, offering real-time feedback and customized simulations that respond to each learner's progress and needs (Li, 2025). Such findings reinforce the growing role of adaptive algorithms in providing data-driven yet learner-centred experiences.

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However, while personalization improved performance, several authors cautioned against over-automation that might reduce metacognitive control or learner agency (Bekmanova et al., 2021). Li (2025) further emphasized that sustainable AI integration requires balancing technological precision with reflective and humanistic teaching practices, ensuring that digital scaffolds support rather than replace critical thinking. These insights underscore that effective personalization depends not solely on data analytics but also on reflective tasks that preserve learner autonomy. The prevalence of adaptive feedback mechanisms extends TAM's perception of usefulness into the pedagogical domain, where learner autonomy, central to Heutagogy, mediates sustained engagement and reflective control, thereby reinforcing RQ1's focus on pedagogically aligned AI integration.

Theme 2: Assessment, Evaluation, and Feedback

The second theme highlights AI's expanding role in transforming assessment practices through scalable, data-driven analytics that enhance evaluative precision. AI-driven assessment tools increasingly employ Large Language Models (LLMs) and analytics for formative and summative evaluation. Studies demonstrated that AI-assisted feedback systems can provide consistent, scalable, and rubric-aligned feedback at a speed unmatched by manual grading (Pozdniakov et al., 2024; González-Rico & Lluch Sintes, 2024). For example, the *Feedback Copilot* prototype analyzed 338 student assignments using natural language processing to generate constructive comments while ensuring rubric fidelity (Pozdniakov et al., 2024). Such systems enhanced transparency and reduced grading time, allowing instructors to focus on higher-order feedback.

AI-generated instructional videos and chat-based assessment tools also promoted active engagement and formative evaluation (Pellas, 2025; Mananay, 2024). However, concerns regarding bias, reliability, and plagiarism remain central (Plecerda, 2024). Researchers highlighted the need for human oversight to verify AI-generated feedback and prevent misinterpretation (Alvarez & Angeles, 2025; Saleem et al., 2024). Despite these challenges, AI-enhanced assessment is widely recognized as a powerful pedagogical innovation capable of providing continuous and personalized evaluation. These systems exemplify Constructivist learning, transforming assessment into iterative knowledge building while reinforcing TAM's dimensions of ease of use and usefulness, directly informing RQ1 and RQ2 by demonstrating how AI strengthens feedback-rich learning environments.

Theme 3: Acceptance, Readiness, and Ethical Concerns

The third theme reveals that ethical and emotional readiness, not technological sophistication ultimately determines sustainable AI adoption. Learner and educator attitudes toward AI adoption constitute a critical determinant of implementation success. Studies grounded in the HISAM as well as the TAM revealed that perceived enjoyment, optimism, and ease of use are the most significant factors influencing acceptance (Cui, 2025). At the institutional level, readiness depends on infrastructure, AI literacy, and training (Zhang & Tian, 2025; Al-Taai et al., 2025). Faculty surveys across Middle Eastern universities showed broad optimism toward AI's educational benefits but persistent apprehension about workload, bias, and job security (Rabab'h & Almoray, 2025).

Correspondingly, ethical considerations emerged as an equally dominant thread. Many studies raised issues of academic integrity, algorithmic transparency, and data privacy (Buele et al., 2025; Plecerda, 2024). Students reported conflicting emotions by viewing AI as both empowering and risky, particularly regarding plagiarism and cognitive dependence. Scholars

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thus advocate ethical frameworks, institutional guidelines, and AI-literacy programs to promote responsible use (Abd-alrazaq et al., 2023; Kiryakova & Angelova, 2023). This theme collectively reveals that adoption success relies as much on human and ethical readiness as on technological capacity. Findings align with HISAM's assertion that emotional readiness and ethical trust shape sustainable adoption, suggesting that technology acceptance is as much affective and moral as it is functional, reinforcing the human-centred dimension of RQ1 and RQ3.

Theme 4: Discipline-Specific Implementations

The fourth theme shows that AI's pedagogical impact is deeply shaped by disciplinary needs and epistemic structures. AI integration was notably shaped by disciplinary context. In language education, adaptive AI systems improved vocabulary acquisition, listening comprehension, and writing quality through personalized tasks and feedback loops (Hijriyah et al., 2025; Mananay, 2024; Pitychoutis & Al Rawahi, 2024). In teacher education, AI-generated videos and analytics dashboards fostered reflection and enhanced pedagogical decision-making (Pellas, 2025). Medical and STEM education applied AI to case-based reasoning and physiological simulations, supporting conceptual understanding and self-paced learning (Saleem et al., 2024; Abd-alrazaq et al., 2023). Other than that, soft skills and mentoring programs leveraged AI to build emotional intelligence and collaborative problem-solving (González-Rico & Lluch Sintes, 2024). Despite these advances, the literature reveals a disciplinary imbalance: the majority of empirical work remains concentrated in higher education and language learning, with fewer studies exploring primary or secondary levels. This highlights the need for diversified research that examines AI's pedagogical impact across broader social science domains. The disciplinary patterns reflect Constructivist principles of contextualized learning and extend Heutagogy's focus on self-determined exploration across domain-specific knowledge landscapes linking back to RQ1 and RQ2's concern with contextual variability.

Theme 5: Institutional Leadership and Policy Directions

The final theme addresses institutional strategies and governance mechanisms for responsible AI adoption. Studies analyzing higher-education policies underscore the necessity of digital literacy frameworks, such as the European DigComp model, to equip learners and educators with ethical and practical competencies (Zhang & Tian, 2025). Faculty-level analyses emphasized the importance of leadership support, infrastructure investment, and clear policy communication (Al-Taai et al., 2025; Rabab'h & Almoray, 2025). The literature also points toward the AI ethics integration into curricular standards to ensure academic transparency and equitable access (Saleem et al., 2024; Buele et al., 2025).

Overall, this theme showcases that sustainable AI adoption requires top-down strategic alignment, combining teacher professional development, ethical governance, and evidence-informed policy frameworks. Without institutional coordination, isolated AI initiatives risk remaining experimental rather than transformative. In this light, the theme reframes HISAM from an individual-centered acceptance model to a systemic framework of institutional sustainability, reinforcing Heutagogical ideals of organizational learning and digital resilience, thereby contributing directly to RQ3's focus on supportive learning environments.

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Summary of Thematic Findings

Across these five themes, empirical evidence from 2021–2025 demonstrates that AI enhances learning outcomes, fosters engagement, and streamlines assessment when pedagogically and ethically grounded. However, technological enthusiasm often outpaces policy readiness and pedagogical training. The strongest results appear in higher-education and language-learning contexts, where adaptive feedback and analytics are effectively employed. Persistent challenges include ethical uncertainty, uneven infrastructure, and limited research in school level learners (from preschool to secondary school). These findings collectively inform the discussion on how AI can be integrated into education systems sustainably and equitably. To consolidate these insights, the following table 5 synthesizes how each theme aligns with the study's supporting theoretical frameworks and highlights representative empirical evidence from 2021–2025.

Table 5: Theoretical Alignment of Thematic Findings with Supporting Frameworks and Representative Studies

Theme	Supporting Theory /Model	Key Theoretical Linkage	Representative Studies
Personalized and Adaptive Learning	TAM, Constructivism, Heutagogy	AI tools strengthen perceived usefulness (TAM), support learner-centred construction of knowledge (Constructivism), and promote autonomy and self-directed learning (Heutagogy).	Hijriyah et al. (2025); Alvarez (2024); Li (2025)
Assessment, Evaluation, and Feedback	TAM, Constructivism	Automated analytics enhance ease of use and feedback efficiency (TAM) while supporting reflective, iterative learning cycles (Constructivism).	Pozdniakov et al. (2024); González-Rico & Lluch Sintes (2024)
Acceptance, Readiness, and Ethical Concerns	HISAM, TAM	Acceptance is shaped by trust, perceived enjoyment, ethics, and emotional responses. Findings extend HISAM by showing fluctuating acceptance based on risk and autonomy.	Cui (2025); Rabab'h & Almoray (2025); Plecerda (2024)
Discipline-Specific Implementations	Constructivism, Heutagogy	AI supports scaffolding across subjects (Constructivism) and encourages self-paced, exploratory learning (Heutagogy).	Pellas (2025); Saleem et al. (2024); Mananay (2024)
Institutional Leadership and Policy Directions	HISAM, Heutagogy	Expands HISAM from individual acceptance to institutional adoption. Highlights organizational learning, digital empowerment, and strategic readiness (Heutagogy).	Zhang & Tian (2025); Buele et al. (2025); Al-Taai et al. (2025)

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Integration of Theoretical Frameworks with Thematic Findings

The thematic synthesis reveals meaningful intersections between the five themes and four dominant theoretical frameworks which are Technology Acceptance Model (TAM), Human Interaction Sustainability and Acceptance Model (HISAM), Constructivism, and Heutagogy. Collectively, these frameworks illuminate how learners, teachers, institutions, and technologies co-evolve in AI-mediated environments. The findings demonstrate that AI's pedagogical impact is shaped not only by system design but also by user acceptance, learner agency, and institutional adaptability. Building on this theoretical integration, Table 5 above illustrates how each theme connects to its corresponding frameworks, clarifying the ways in which empirical findings align with or extend existing theoretical models. This alignment reinforces the argument that the themes are not isolated empirical patterns but, instead, offer deeper theoretical insights into AI adoption and educational transformation.

Discussion

The synthesis of 26 empirical studies published between 2021 and 2025 reveals that AI is reshaping the landscape of teaching and learning across social science education. The five emergent themes show that while AI offers transformative potential in personalization, feedback, and engagement, its successful integration depends on pedagogical alignment, ethical guidance, and institutional support. This section interprets these results in relation to the research questions and theoretical perspectives that informed this review.

Interpreting RQ1: How is AI Integrated into Teaching and Learning?

Evidence across the corpus demonstrates that AI integration extends beyond automation toward pedagogically driven innovation. Personalization emerged as the dominant mode of integration, particularly through adaptive learning systems and recommender models that adjust task complexity to learners' needs (Hijriyah et al., 2025; Alvarez, 2024; Liu & Yushchik, 2024). Such systems align with constructivist and social-constructivist theories, enabling learners to actively construct knowledge through adaptive scaffolds and reflection (Jayasinghe, 2024; Pellas, 2025).

However, AI integration is not evenly distributed across educational contexts Higher education and language learning dominate empirical attention, while primary, secondary, and vocational settings remain underrepresented. This concentration reflects both research accessibility and institutional readiness rather than pedagogical limitation. For instance, language-based applications achieved measurable comprehension gains (Hijriyah et al., 2025), yet parallel studies in STEM and teacher education reported only moderate success due to limited customization and learner readiness (Pellas, 2025; Saleem et al., 2024). Taken together, these findings suggest that AI's pedagogical impact depends heavily on contextual readiness, particularly teacher digital competence and institutional support rather than on technology alone. Thus, RQ1 underscores the movement of AI from experimental use toward integrated learning design guided by human-centred pedagogy.

Interpreting RQ2: What Outcomes Are Reported?

Across quasi-experimental and mixed-methods designs, learning outcomes improved when AI tools provided immediate, data-driven feedback and personalized support (Katsarou et al., 2025; Pellas, 2025 & Zhang, 2024). Subsequently, learners demonstrated higher engagement, confidence, and metacognitive awareness, particularly when feedback was actionable rather than generic (Pozdniakov et al., 2024; González-Rico & Lluch Sintes, 2024). Studies also

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revealed a notable shift from content delivery to process-oriented assessment, where AI tracks progress and guides self-reflection. Similarly, the AI cognitive-learning model proposed by Abishev et al. (2025) demonstrated that intelligent feedback, adaptive learning cycles, and collaborative environments enhance cognitive engagement, motivation, and academic success in higher education. In contrast, studies in secondary and vocational contexts reported inconsistent performance gains, primarily due to uneven digital readiness and over-reliance on automation (Bekmanova et al., 2021). This divergence indicates that AI enhances learning most effectively when balanced with human regulation and reflective guidance, rather than functioning as a self-contained system.

From a theoretical perspective, these outcomes validate Self-Determination Theory and Heutagogy, which emphasize autonomy and self-directed learning (Saleem et al., 2024; González-Rico & Lluch Sintes, 2024). Taken together, the reviewed evidence suggests that AI functions most effectively as a co-regulator of learning, augmenting learners' ability to plan, monitor, and evaluate their learning. Nevertheless, a few studies raised concerns that over-reliance on adaptive recommendations could diminish critical thinking and self-regulation (Bekmanova et al., 2021). Therefore, the overall finding for RQ2 is that AI yields cognitive and affective benefits when designed as a learning partner, not as a replacement for human guidance.

Interpreting RQ3: What Barriers, Ethics, and Enablers Affect Adoption?

RQ3 highlights the human, institutional, and moral conditions shaping effective AI use. Findings reveal that acceptance hinges on *perceived enjoyment, optimism, and ease of use* (Cui, 2025), confirming predictions from TAM and HISAM models. Yet, contextual contrasts emerge: whereas university faculty generally report optimism and curiosity toward AI (Rabab'h & Almoray, 2025), school-level teachers express hesitancy due to limited training and fear of deskilling (Al-Taai et al., 2025). This disparity underscores that positive attitudes alone are insufficient without digital competence and institutional readiness. Ethical tensions also pervade the discourse. Generative AI's cognitive mimicry introduces issues of authorship, plagiarism, and academic honesty (Plecerda, 2024; Buele et al., 2025). Students in technology-oriented disciplines often perceive AI as empowering, while those in social sciences display mixed emotions, oscillating between enthusiasm and anxiety about over-dependence. This contrast suggests that discipline-specific ethical awareness influences acceptance patterns.

Across contexts, the absence of institutional frameworks for AI ethics and accountability worsens these tensions (Zhang & Tian, 2025; Saleem et al., 2024). Taken together, the findings point to a clear need for policy-driven guardrails, professional development, and AI literacy programs to promote transparent, equitable, and sustainable integration. Ultimately, while enthusiasm for AI integration is widespread, its long-term success depends on ethical literacy, institutional coordination, and human oversight to ensure that technology complements rather than compromises educational values. These insights not only reveal practical challenges but also carry important theoretical implications for understanding how AI transforms teaching and learning. Building on these ethical and institutional concerns, it becomes essential to examine how broader policy frameworks and issues of equity shape the global landscape of AI adoption.

Policy, Equity, and Global Variation in AI Adoption

While policy considerations surfaced primarily through Theme 5, the present findings indicate that equity and access require deeper attention within the broader discussion of AI integration.

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Across the reviewed studies, infrastructural disparities, linguistic accessibility issues, and uneven digital readiness emerged as structural barriers shaping how effectively AI can support learning. Studies from the Global South frequently cited limited bandwidth, device shortages, and linguistic bias in AI systems as persistent obstacles, contrasting with the more policy-driven, institutionally coordinated implementations observed in Europe and East Asia. This comparison suggests that technological innovation alone is insufficient without addressing the socio-economic and linguistic realities that condition its use.

Furthermore, equity concerns particularly surrounding multilingual accessibility, culturally responsive AI design, and inclusive digital infrastructure appear as cross-cutting implications across all themes. Ensuring that AI systems support diverse languages and reduce algorithmic bias is essential for ethical governance and sustainable adoption. Taken together, these equity-oriented insights highlight the need to interpret AI adoption using broader theoretical perspectives, which are further examined in the following theoretical implications section.

Theoretical Implications

The synthesis confirms that educational AI research is evolving toward multi-theoretical convergence. Cognitive and affective models such as TAM, HISAM, and TRI complement pedagogical theories like Constructivism and Heutagogy, producing a hybrid understanding of how learners interact with intelligent systems. This cross-pollination advances the conceptualization of AI as both a cognitive tool and a pedagogical partner. It also highlights a theoretical evolution from models focused on technology acceptance to frameworks explaining meaningful learning through AI mediation. Such integration bridges psychology, education, and data science, an interdisciplinary trajectory reflective of social-science innovation.

Practical and Pedagogical Implications

For educators, the findings stress the need to embed AI tools within reflective and collaborative learning designs. Teachers should position AI as a *guide for metacognitive processes,* which encourages students to question, verify, and interpret AI feedback. For institutions, professional development programs should emphasize AI literacy, ethics, and data governance to ensure responsible use (Al-Taai et al., 2025; Zhang & Tian, 2025). For policymakers, structured AI adoption policies anchored in frameworks such as *DigComp* are necessary to regulate the pedagogical and ethical use of generative technologies.

Finally, for researchers, future studies should prioritize longitudinal, classroom-based, and cross-level designs to trace how AI influences learning transfer and teacher practice over time. Greater attention to equity, accessibility, and inclusivity is crucial to avoid reproducing digital divides. By aligning technological capacity with human development goals, AI can function not merely as automation but as a transformative instrument of educational innovation.

Synthesis of Discussion

In summary, the reviewed studies collectively portray AI as a catalyst for learner-centred pedagogy when deployed within ethical, theoretically grounded frameworks. The convergence of constructivist, cognitive, and ethical perspectives underscores that AI's educational promise rests on human agency, transparency, and reflective use. While enthusiasm for AI integration is global and growing, the path toward sustainable impact requires careful alignment among teachers, institutions, and policymakers. The following sections conclude this review by highlighting key implications, limitations, and suggestions for the upcoming investigation.

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Research Limitations and Future Directions

This review is limited by its reliance on open-access, Scopus-indexed studies published between 2021 and 2025, which may exclude significant findings from paywalled psychology, computer science, and STEM education databases. Although the review adheres to PRISMA standards, the methodological diversity of included studies indicates that certain approaches particularly longitudinal, mixed-method, and comparative designs remain insufficiently represented. The dominance of research conducted in higher-education contexts and concentrated in Asian, European, and Middle Eastern regions further limits the global generalizability of the findings. Future work should broaden database coverage, incorporate cross-disciplinary sources, and adopt more robust and diverse research designs to examine the sustainability, transferability, and contextual nuances of AI-supported learning. More research is also needed to understand teacher agency, pedagogical decision-making, and classroom orchestration during real-world implementation.

Pedagogical Limitations and Future Directions

Pedagogical insights in the reviewed studies remain limited, as many investigations focus on automated functions of AI systems while offering little detail on how teachers adapt or redesign instruction around these tools. Over-reliance on automation may undermine reflective learning, teacher-student interaction, and opportunities for metacognitive engagement. Additionally, variations in teachers' digital competence and readiness create inconsistencies in AI-enhanced instructional quality. Strengthening pedagogical practice requires targeted professional development that emphasizes reflective AI use, scaffolding strategies, and metacognitive support. Blended approaches where AI-generated feedback is complemented by teacher-mediated interpretation and classroom dialogue can help sustain meaningful learning processes. Designing AI-supported tasks that promote autonomy, critical inquiry, and collaborative problem-solving will ensure that technology enhances, rather than substitutes, pedagogical intent.

Policy Limitations and Future Directions

Policy-related considerations remain underexplored, as few studies examine how institutional governance, long-term strategies, or infrastructure readiness shape AI adoption. Although ethical concerns such as privacy, bias, and academic integrity are frequently acknowledged, empirical investigations into these issues are still sparse. To enable sustainable and equitable implementation, institutions and national systems should develop coherent AI adoption policies grounded in responsible governance frameworks such as DigComp and ethical AI guidelines. Investment in digital infrastructure is essential to ensure equitable access across diverse educational settings. Clear monitoring mechanisms and evaluation systems are also needed to support safe, transparent, and sustainable integration of AI tools, ensuring that innovation is accompanied by accountability and long-term planning.

Conclusion

The synthesis of 26 empirical studies from 2021 to 2025 demonstrates that AI is redefining teaching and learning in social sciences through personalization, adaptive feedback, and learner-centred pedagogy. The most significant contributions emerge when AI systems are guided by constructivist, self-determined, and ethical frameworks, empowering both teachers and learners to co-construct knowledge. Across the literature, AI enhances engagement, feedback quality, and learning outcomes. However, its success relies on teacher readiness, ethical use, and institutional leadership.

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The evidence suggests that AI should not be viewed as a substitute for human intelligence but rather as a collaborative partner in learning, augmenting rather than automating educational processes. As universities and schools worldwide navigate the integration of generative AI, the imperative is clear: to balance technological innovation with human-centred pedagogy, policy coherence, and academic integrity. Ultimately, the reviewed body of research marks a decisive shift in educational paradigms, signalling the evolution of teaching and learning from static instruction to intelligent, interactive, and ethically informed ecosystems. By situating AI within transparent, inclusive, and reflective frameworks, educators can transform digital technologies into powerful instruments for equitable and meaningful learning across social science education.

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