Artificial Intelligence (AI) Promise for Equitable Education in Emerging Economies

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Systematic Review

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Abstract

In the past decade, artificial intelligence (AI) has emerged as a transformative force in the education sector, particularly in regions characterized by infrastructural and resource constraints, typically low- and middle-income countries. AI holds dual potential: it disrupts traditional educational models through adaptive learning, intelligent tutoring, and automated administrative processes, while simultaneously offering a leapfrogging mechanism to bypass entrenched developmental barriers. This systematic review, adhering to PRISMA guidelines, investigates the role of AI technologies as transformative agents in educational contexts across emerging economies. The findings indicate that AI is fundamentally reshaping the educational landscape in developing countries by redefining teaching roles, expanding access to quality education, transforming assessment practices, and overhauling institutional structures. Key enablers for educational leapfrogging via AI include extensive mobile connectivity, robust public-private partnerships, and the development of contextually relevant content. However, persistent challenges such as digital divides and technical skill gaps remain. While AI-driven innovations promise significant improvements in teaching and learning, issues of digital inequality and ethical concerns are critical. This review provides a foundation for future research and policymaking aimed at democratizing quality education in emerging economies.

Introduction

Artificial Intelligence is rapidly emerging as a transformative force across sectors, with an increasing focus on its impact in education. The 21st-century educational landscape is undergoing a transformative shift known as Artificially Intelligent Education, driven by the integration of artificial intelligence (AI) into learning environments [1]. AI promises to redefine traditional educational methodologies by personalizing learning experiences, automating administrative processes, and delivering detailed insights into student learning patterns and needs [2]; [3]. AI applications in education are fast growing worldwide, impacting educational institutions in developing countries. AI research is ongoing, and AI applications are being implemented to improve learning services, assist teachers in providing excellent education, and boost student learning.

Traditional educational models face challenges, particularly in the emerging economies, where entrenched educational disparities persist. In many developing countries these models have been challenged by issues such outdated infrastructure, technological gaps, inequitable access to quality teaching, and inflexible

learning systems [4]. For instance, in Sub-Saharan Africa, just 22% of primary schools have access to power [5]. Additionally, access to basic amenities like drinking water, computers, and internet is limited, with less than half of schools having these facilities [6]. Technological disparities are evident, with internet penetration in Africa at 39.3% as of 2020, significantly lower than the global average of 62.9% [7]. In Sub-Saharan Africa, 70% of countries have primary school teacher shortages, and 90% do not have sufficient secondary teachers. Similarly, Southern Asia faces a large shortage, requiring nearly 15 million extra teachers by 2030 to satisfy universal education targets, with average pupil-teacher ratios of 34:1 in primary and 29:1 in secondary school, significantly higher than the global average of 18:1 [8]. These systemic challenges underscore the urgent need for innovative solutions to transform education in the emerging economies. Against this backdrop, AI holds the dual potential to act as a disruptive force and a leapfrog mechanism capable of reimagining educational pathways and outcomes. However, the implementation of AI in education must be approached thoughtfully, considering the unique socio-economic and infrastructural contexts of these regions.

Digital transformation is reshaping AI accessibility across emerging economies. In countries like India, Brazil, and Mexico, smartphone ownership in 2023 reached over 60% of the population. While India's smartphone penetration rate approached 71% [9], Brazil's smartphone unit sales in 2023 accounted for 72.4% of the population [10], and Mexico had a large mobile phone user base of over 97 million people [11]. The widespread adoption of smartphones with high-speed internet in many regions has effectively "leapfrogged" traditional landline infrastructure, providing a foundation for transformative educational approaches. This leapfrogging potential is particularly relevant in contexts where traditional infrastructure remains sparse but mobile technology continues to proliferate. The convergence of young demographics and expanding smartphone penetration creates fertile ground for educational innovations that bypass outdated systems and directly address contemporary learning needs. However, existing investigations into AI's role as transformative mechanism in developing countries education remain fragmented, with no comprehensive synthesis available to guide researchers, educational authorities, and policymakers. This gap underscores the urgent need for a systematic review that consolidates AI-related research findings to illuminate how these innovations can support quality teaching and learning in the emerging economies. Therefore, this review is set to examine how AI technologies are transforming traditional educational paradigms across the emerging economies while simultaneously enabling these regions to leapfrog developmental stages that characterized educational evolution in the Global North. The article is organized as follows: first, we present the background to AI research, including the developing countries

context and the situation of education in those countries. We then describe the methodology, followed by the research results and discussion. Finally, we present a conclusion and some lessons learned from the review. The following two research questions (RQs) guide the review:

i. What and how are AI-enabled applications being utilized for educational transformation in educational settings across the Emerging Economies?
ii. What are the key enablers, challenges, and limitations associated with integrating AI tools in the educational systems across the Emerging Economies?

Background

AI Implementation in Education

John McCarthy, a computer scientist, coined the term "artificial intelligence" in 1956. That year, he held a crucial workshop with the goal of creating machines capable of reasoning and using human language [12]. After a quick start, research interest in AI dwindled for a few decades before a comeback in the 1990s, fueled by improvements in machine learning and neural networks [13]. Chat GPT's public release in 2022 represented a notable milestone, demonstrating extraordinary capabilities in natural language processing and generation while also encouraging additional AI developments [14]. Today, AI has a significant impact on a variety of industries, including education, healthcare, finance, manufacturing, and transportation. Educational technology has evolved from 1960s computer-assisted instruction on expensive mainframes to intelligent tutoring systems on desktop computers that provide immediate, personalized feedback, paving the way for modern AI tools by demonstrating the transformative benefits of tailored learning experiences [15]. AI is rapidly changing education by enabling innovative applications in a variety of disciplines, including personalized learning, intelligent tutoring systems, automated grading, and improved administrative operations [16]; [17]. Intelligent tutoring solutions, on the other hand, provide rapid feedback and corrective assistance, which helps reduce learning gaps while releasing teachers from routine instructional responsibilities [18]. Furthermore, using AI into grading systems improves efficiency and fairness by decreasing subjectivity and providing immediate, thorough feedback, giving teachers more time to focus on developing creativity and critical thinking [19]. Furthermore, AI applications in administration, such as automated lesson planning, content development, and schedule management, considerably reduce the workload of educators and school principals, allowing them to focus on strategic projects and direct engagement with students [20].

Teachers are harnessing generative AI tools in versatile ways to enhance learning outcomes. For example, in vocabulary instruction, teachers identify difficult words for upcoming lessons, select an easy-to-use AI tool, create detailed prompts to generate visuals that illustrate those words, and share and credit the images with students to introduce them to AI concepts [21]. Similarly, high school math teachers are using AI to connect math topics to real-world applications by creating word problems, performance tasks, and comprehensive lesson plans with essential questions, practice problems, and extension opportunities, as well as designing inquiry-based activities to promote critical thinking and quantitative literacy [22]. However, teachers are increasingly worried that students might use AI to shortcut authentic learning [23]. Crafting assignments that demand critical thinking and personal engagement while fostering AI literacy to help students grasp its limitations and potential biases. AI tools will continue to evolve and impact the way we operate in every aspect of life.

Educational Contexts in the Emerging Economies

Emerging economies,' which includes regions such as Africa, Asia, Latin America, and the Middle East is home to roughly 7.2 billion people, representing nearly 85% of the global population [24]. In stark contrast to the United States and Europe, over half of these populations are under 25 years old, fueling an urgent demand for scalable education systems [25]. Africa’s demographic trajectory is especially pivotal, as the continent is projected to drive 62% of the world’s population growth through 2050 [26]. Countries such as Nigeria and Tanzania, for instance, anticipate staggering population increases of 50–90% by mid-century [27]. This youth-driven expansion underscores a dual imperative, addressing systemic educational gaps while harnessing innovation to transform these challenges into opportunities for sustainable development.

Despite demographic advantages, developing countries face severe educational problems that hinder the delivery of quality education. These include inadequate funding, a shortage of trained teachers, overcrowded classrooms, and insufficient learning materials [28]. Furthermore, linguistic diversity provides a hurdle, as students frequently receive instruction in languages, they are not proficient in, which affects understanding and learning outcomes [29]. Further, COVID-19 pandemic worsened these issues, leading to prolonged school closures and widening the digital divide. According to the International Commission on Financing Global Education Opportunity,

barely half of primary school children and one-quarter of secondary school children in low- and middle-income countries achieve fundamental learning outcomes, revealing a global learning crisis.

Artificial Intelligence and Educational Transformation

Educational transformation is based on two key concepts: disruptive innovation and technological leapfrogging. The concept of "disruptive innovation," introduced by Clayton Christensen in *The Innovator's Dilemma*, explains how newcomers using cutting-edge technology can displace entrenched institutions [30]. In the emerging economies' education, AI represents such a disruptive force by challenging traditional teaching models, assessment methods, and institutional structures.

In many developing countries contexts, AI helps educational systems overcome constrained infrastructure by exploiting widely adopted mobile technologies and low-cost digital devices. This leapfrogging effect allows countries to rapidly enhance access and quality of education without having to go through conventional stages of development. Together, the ideas of disruptive innovation and technological leapfrogging provide a robust lens to analyze how AI is reshaping educational paradigms, not only by transforming learning and teaching methods but also by revolutionizing institutional frameworks in regions facing systemic challenges.

Methodology

This study presents a systematic literature review that examines the transformative role of artificial intelligence (AI) as both a disruptor and a leapfrog mechanism in education across the emerging economies. A systematic review involves a structured strategy to identifying, evaluating, and synthesizing existing research to answer specific research questions adopting explicit, systematic, and replicable methodologies [31]. This technique is particularly important for understanding the breadth and depth of AI applications in educational contexts, especially in countries with significant educational inequality. As recommended by [32], this systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines [33]. The methodology was designed to ensure rigor and transparency in study identification, screening, and synthesis. PRISMA was chosen because it is widely accepted and used as a standard for systematic reviews in the field of artificial intelligence applications in education.

Therefore, given the recent emergence of relevant literature, a systematic review is useful for gathering information about AIs' dual role in educational settings across the developing countries. Our systematic review consists of the following phases: identifying the research objectives, conducting a literature search, screening relevant research papers, analytical coding and data extraction, and summarizing the findings to highlight trends, gaps, or contradictions. These phases are elaborated below.

Search strategy

Given the range of published sources on artificial intelligence (AI) in education in the emerging economies, a thorough and systematic search was undertaken using four main academic databases: IEEE Xplorer, ERIC, Scopus, and Google Scholar. These databases were chosen for their extensive indexing of peer-reviewed papers in education and technology. The search aimed to identify literature that specifically addressed AI as a transformative mechanism in educational contexts within developing countries. Relevant studies were selected using a search period ranging from January 2022 to April 2025, which was chosen to include the most current developments in AI applications in education.

The search strategy employed a set of three conceptual blocks. Block 1 included Artificial Intelligence terms such as "artificial intelligence" OR "AI" OR "machine learning" OR "deep learning" OR "neural network*" OR "natural language processing" OR "NLP" OR "intelligent tutor*" OR "adaptive learning" OR "predictive analytics" OR "chatbot*" OR "virtual assistant*." Block 2 focused on education-related terms such as "education*" OR "learning" OR "teaching" OR "pedagog*" OR "school*" OR "classroom*" OR "curriculum" OR "instruction*" OR "academic" OR "student*" OR "teacher*" OR "educational technology". Block 3 incorporated terms specific to the emerging economies context, including "Emerging economies" OR "developing countr*" OR "low-income countr*" OR "middle-income countr*" OR "LMIC*" OR "Africa*" OR "Latin America*" OR "Asia*" OR "leapfrog*" OR "technological leapfrogging" OR "development gap". These blocks were combined with Boolean operators (AND) to ensure that the search captured studies addressing all three dimensions of our research focus. Articles were selected from the databases using the following inclusion criteria:

- Articles published between January 2022 and April 2025.
- Studies published in English.

- Articles in peer-reviewed journals or conference proceedings.
- Empirical primary research studies.
- Studies focusing on AI applications in educational settings across the developing countries, particularly using techniques such as machine learning, deep learning, or natural language processing.

An initial search was conducted in four academic databases: IEEE Xplorer, ERIC, Google Scholar, and Scopus, using keywords relating to artificial intelligence, education, and the emerging economies. The search focused on titles, abstracts, and keywords, and yielded 4,425 articles: 283 from IEEE Xplorer, 789 from ERIC, 1,960 from Google Scholar, and 1,393 from Scopus. The search was then refined using our inclusion criteria to ensure that only publications capable of answering our research questions were included. This refinement decreased the number of potential publications to 487. After removing 19 duplicate records, 468 unique articles remained. We further screened the titles and abstracts of these articles, eliminating 426 that were deemed not relevant. The 42 remaining articles underwent full-text screening, and a further 16 articles that did not fulfill the inclusion criteria were removed. Therefore, 26 published articles were finally selected for the analysis (Fig. 1).

Data extraction and analysis

The data extraction process for this review involves coding essential information such as the title, authors, year of publication, country, educational topic, AI techniques used, software tools and algorithms used, and specific AI application scenarios. This rigorous and systematic search strategy ensured a comprehensive, transparent, and reproducible review of the literature on AI as a transformative mechanism across the developing countries education.

Results and discussion

The studies came from the following regions and countries: twelve in Africa (Ghana, South Africa, Nigeria, Zimbabwe, Sub-Saharan Africa), six in Asia (Sri Lanka, Indonesia, Malaysia, Bangladesh, India), three in the Middle East and North Africa (Saudi Arabia, Egypt, Jordan), three in multi-regional Emerging economies contexts, and two in Latin America and the Caribbean (Brazil) (see Table 1).

AI Applications in Educational Transformation in Emerging Economies

RQ1:What and how are AI-enabled applications being utilized for educational transformation in educational settings across the Emerging Economies?

Across the developing countries, AI is being used to improve learning, streamline administration, and expand access in a variety of educational settings, ranging from elementary classrooms to higher education. We will first discuss the scope of these AI applications (Table 2), followed by Disruption Mechanisms (how they upend traditional paradigms) and Leapfrogging Mechanisms (how they enable rapid modernization by overcoming legacy limits).

Table 1: AI-Supported Educational Transformation in Emerging Economies

ID	Articles	Region	AI Type	Application in Education	Disruption Mechanism	Leapfrogging Effect
1	[34]	Ghana	Generative AI (LLMs)	Simulated teacher training via automated content & assessments	Virtual simulations & personalized feedback	Bypasses expert shortages for quality training
2	[35]	Sri Lanka	Generative AI (LLMs)	Automated content creation & academic support	Replaces manual content generation	Enables rapid modernization despite resource limits
3	[36]	Saudi Arabia	Machine Learning, Deep Learning, NLP	Enhances teaching & administration through data-driven insights	Automates routine tasks	Accelerates system-wide modernization
4	[37]	Africa	BERT, GPT-4, NLP, Generative AI, ML	Automated tutoring, grading & mobile learning	Eases teacher shortages via automation	Leverages mobile tech to bypass infrastructure limits
5	[38]	South Africa	ChatGPT (Generative AI, NLP)	Academic support in teaching, research & assessment	Challenges traditional academic norms	Drives swift digital transformation
6	[39]	Africa	Various AI tools (emphasis on ChatGPT)	Supports content generation, research & administrative tasks	Automates routine academic processes	Upgrades digital capacity in resource-constrained settings
7	[40]	Nigeria	Machine Learning (J48, LR, MLP, etc.)	Predicts student performance using data analytics	Shifts from reactive to proactive monitoring	Enables early interventions for at-risk students
8	[41]	Ghana	Conversational AI (WhatsApp-based NLP/ML)	Real-time, personalized math tutoring via WhatsApp	Replaces traditional teacher-led instruction	Utilizes basic mobile networks for scalable tutoring
9	[42]	Kenya	Broad AI Integration	Integrates AI in teaching & research to enhance academic quality	Redefines curricula through comprehensive AI adoption	Bypasses legacy methods for rapid academic enhancement
10	[43]	Cambodia	LLM & Generative AI (e.g., Gemini, Copilot, ChatGPT)	Reviews AI tools for learning & administrative support	Highlights ethical & assessment challenges	Offers potential for scalable, personalized learning despite hurdles
11	[44]	Indonesia	Deep Learning (MLP, CNN, BiLSTM, LSTM w/ Attention)	Predicting student test scores using advanced deep architectures	Replaces traditional statistics with deep learning for proactive prediction	Enables scalable, personalized interventions in resource-limited settings
12	[45]	Brazil	Traditional ITS (rule-based, adaptive conversational AI)	Enhances online learning via personalized, adaptive tutoring	Disrupts passive, one-size-fits-all models with dynamic feedback	Offers cost-effective, scalable tutoring by bypassing high-end AI costs
13	[46]	Southeast Asia (Indonesia)	AI Literacy Models	Embeds AI literacy within elementary	Transforms conventional STEAM by integrating active	Prepares learners early by bypassing

			(Generative AI inspired)	STEAM education	technology-based learning	outdated digital literacy practices
14	[47]	Zimbabwe	AI-driven Tools & Interactive Modules	Integrates AI into peace education for personalized, collaborative learning	Replaces static, content-heavy curricula with dynamic, tech-integrated modules	Accelerates peace education reform despite resource constraints
15	[48]	Developing Countries	Generative AI (Transformers, GANs)	Enables adaptive content generation, personalized tutoring, and automated resources	Shifts from teacher-led instruction to AI-enabled adaptive learning	Overcomes infrastructural constraints to rapidly enhance education
16	[49]	Ghana	Machine Learning (DT, RF, ANN, SVM, NB)	Predicts academic performance using data analytics in higher education institutions	Transitions from reactive assessments to real-time, data-driven analytics	Provides scalable, low-cost ML solutions for early intervention
17	[50]	Sub-Saharan Africa	Various AI Tools (content generators, plagiarism detectors, proctoring)	Examines dual roles in both facilitating academic dishonesty and enforcing integrity	Challenges traditional integrity practices by enhancing digital oversight	Enables rapid, scalable integrity systems that bypass resource-heavy methods
18	[51]	MENA (Jordan, Egypt, Saudi Arabia)	Personalized Adaptive Learning (PAL)	Delivers tailored, adaptive reading support to improve early Arabic literacy	Replaces uniform instruction with real-time, individualized feedback	Empowers resource-constrained schools with scalable adaptive technology
19	[52]	Lower-Middle-Income ASEAN Economies	ML, NLP, Adaptive Algorithms, Generative AI	Infuses sustainable development into education via adaptive, personalized platforms	Transforms static curricula with dynamic, sustainability-integrated content	Bypasses legacy infrastructure for rapid and cost-effective curriculum innovation
20	[53]	Bangladesh	Adaptive & Personalized AI Learning Strategies	Enhances educational sustainability with integrated adaptive teaching tools	Replaces static methods with data-driven, adaptive frameworks	Provides scalable solutions to transition to sustainable educational practices swiftly
21	[54]	Latin America and the Caribbean	Adaptive Learning, Intelligent Tutoring, Automated Assessment	Provides a framework for integrating AI to enhance quality, equity, and efficiency in education	Replaces static, one-size-fits-all models with dynamic, personalized, data-driven practices	Bypasses legacy infrastructure through scalable, cost-effective AI modernization
22	[55]	India	Adaptive Learning, Intelligent Tutoring, NLP, ML	Delivers personalized, adaptive learning with real-time analytics that transform teacher roles	Shifts from teacher-centered instruction to a learner-centric, data-driven model redefining pedagogical roles	Overcomes resource constraints and teacher shortages with scalable digital solutions
23	[56]	Malaysia (Sabah)	Adaptive ML, NLP	Provides personalized adaptive learning	Transforms traditional static curricula by adaptively tailoring	Enables remote and under-resourced communities to access modern,

				platforms and tutoring systems with real-time adjustments	instruction to individual needs	high-quality education
24	[57]	Egypt	Chatbot with NLP	Offers interactive, real-time academic support via a chatbot for student assistance	Replaces conventional, face-to-face support with continuous, personalized digital guidance	Bypasses limitations of traditional support systems by providing immediate, scalable academic assistance
25	[58]	Latin America	ML, DL, NLP	Implements predictive modeling, content analysis, and assistive tools to support decision-making in higher education	Integrates real-time analytics and automated interventions into conventional academic practices	Accelerates reform by rapidly deploying advanced AI solutions that bypass slow, incremental traditional methods
26	[59]	Global South	Adaptive, Predictive, Generative AI	Deploys scalable, personalized, and remote education platforms for diverse learning environments	Disrupts legacy, incremental reforms with mobile-driven, AI-enhanced solutions	Bypasses outdated infrastructure and teacher shortages to enable rapid educational advancement

AI Applications Supporting Educational Transformation in Emerging Economies

Generative AI and Content Creation

Generative AI tools generate educational content such as lesson plans, assessments, simulations, and teaching resources automatically [60]. In Ghana, generative AI is utilized to simulate teacher training through the automated production of practice scenarios, assessments, and feedback mechanisms, giving excellent training to pre-service teachers without the need for expert facilitators [34]. In Sri Lanka, these tools are incorporated into academic support systems, speeding content generation and improving administrative efficiency, allowing for quick modernization of higher education institutions with minimal human capital [35]. These systems employ large language models (LLMs) and other generative techniques to minimize instructors' workloads while guaranteeing that content is current, localized, and pedagogically appropriate. Institutions can use generative models to support multilingual education by automatically translating and contextualizing learning content.

Predictive Analytics and Early Warning Systems

AI-powered predictive model examines educational datasets to estimate student performance, dropout risk, and academic progression [61]. These tools change institutional procedures from reactive assessments to proactive, data-driven decision-making, allowing for early interventions that can prevent academic failure. In Nigeria, machine learning techniques such as J48, Logistic Regression (LR), and Multilayer Perceptron (MLP) are used to identify students who are at risk of underperformance [40]. Ghana uses various models, such as Decision Trees (DT), Random Forests (RF), Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Naïve Bayes (NB), to create scalable, low-cost performance monitoring systems for faculty and administrators to provide timely and personalized academic support [49].

Conversational Agents and Chatbots

Conversational AI, which includes chatbots linked into platforms such as WhatsApp, provides learners with real-time, individualized academic support [62]. In Ghana, a WhatsApp-based math tutoring chatbot provides personalized learning support using simple mobile technologies and natural language processing (NLP), increasing access for pupils in impoverished locations [41]. In Egypt, chatbots designed for university students offer scalable, instant academic help, replacing face-to-face consultation and providing larger

institutional support via digital channels [57]. These tools give round-the-clock support, answer course-related questions, and enable interactive learning, particularly in bandwidth-constrained contexts where traditional digital education tools may be ineffective.

Intelligent Tutoring Systems (ITS)

Intelligent Tutoring Systems (ITS) provide individualized and adaptive training by monitoring learner responses and modifying content delivery in real time [18]. Unlike traditional e-learning, ITS replaces uniform information delivery with individualized feedback and pacing based on individual performance, mastery and, enhancing engagement. In Brazil, rule-based ITS are employed to deliver scalable, cost-effective tutoring solutions that avoid the need for expensive infrastructure while yet increasing student outcomes through adaptive feedback loops [45]. These technologies provide flexibility to students and extend the teacher's instructional reach in resource constrained contexts.

Adaptive Learning Systems

Adaptive learning platforms powered by AI continuously analyze learner behavior, knowledge levels, and preferences to dynamically adjust instructional pathways [63]. These technologies replace static curriculum with fluid, personalized learning journeys, allowing students to go at their own pace while receiving timely feedback. Adaptive learning systems in India promote data-driven pedagogical transformation by transforming classroom dynamics from teacher-led instruction to student-centered learning settings [55]. Adaptive learning systems are also employed in Malaysia and other regions to boost digital literacy and assist marginalized groups [56]. These tools are especially effective at addressing teacher shortages and various learning demands, promoting inclusivity through scalable customization.

Administrative Automation and Content Analysis

Key administrative operations in educational institutions, such as grading, plagiarism detection, content assessment, and policy evaluation, are automated using natural language processing (NLP) and other artificial intelligence techniques. These solutions boost institutional efficiency by processing massive amounts of data and offering actionable insights. In Saudi Arabia, AI is used to support both educational and administrative operations, such as curriculum development and resource allocation [36]. In broader African contexts, AI technologies aid in academic integrity monitoring, data entry automation, and decision-making process enhancement, effectively replacing resource-intensive manual activities [39].

Table 2: Categories of AI Applications in Educational Transformation Across Emerging Economies

Application Category	Study IDs	Number of Studies
Generative AI and Content Creation	1, 2, 5, 6, 10, 13, 15, 17, 19, 21, 26	11
Predictive Analytics and Early Warning Systems	3, 7, 11, 16, 22, 25, 26	7
Adaptive and Personalized Learning	12, 18, 20, 21, 22, 23, 25, 26	8
Conversational Agents and Chatbots	4, 8, 12, 24	4
Intelligent Tutoring Systems	12, 18, 22	3
AI Literacy and Curriculum Integration	13, 14	2
Administrative Automation and Content Analysis	3, 9, 17, 19, 20	5

Note: Some studies feature multiple application categories, resulting in overlap across categories.

An analysis of AI techniques used in education in the developing regions demonstrates a diverse and balanced use of technologies (Table 3). Machine Learning leads with 38.5% of the research, emphasizing its importance in predictive analytics and personalized learning. Both generative AI and natural language processing (NLP) are used in 34.6% of studies, emphasizing their importance in content creation and language-based instructional aids. Adaptive Learning Algorithms are used in 30.8% of the studies, indicating a desire to adjust educational experiences to specific learner needs. Deep Learning is used in 15.4% of studies, suggesting its growing importance in complicated pattern identification and data processing. Intelligent tutoring systems, conversational AI, and predictive analytics all feature in 11.5% of the literature, highlighting their expanding importance in tailored training, interactive learning experiences, and early detection of at-risk pupils. This distribution demonstrates a multidimensional approach to integrating AI in

education, with the goal of improving learning results, accessibility, and administrative efficiency in a variety of educational environments.

Table 3: AI Techniques Supporting Educational Transformation in Emerging Economies

AI Technique	Number of Studies
Machine Learning	10
Generative AI	9
Natural Language Processing	9
Adaptive Learning Algorithms	8
Deep Learning	4
Intelligent Tutoring Systems	3
Conversational AI	3
Predictive Analytics	3

AI as a Disruptor in Educational Transformation in Emerging Economies

Transformation of Teaching Roles and Pedagogical Approaches

The role of educators in developing nations is being drastically reshaped by AI. AI systems, for instance, may provide curriculum-aligned classroom activities instantaneously, freeing up teachers to concentrate on professional development and tailored instruction. As a result of emerging technologies like generative AI and intelligent tutoring systems, teachers are now co-creators and facilitators of learning rather than sole content providers. For instance, in Ghana, the 21st Century Teacher Educator GPT enhances pedagogical practices by allowing pre-service teachers to create tailored academic materials incorporating localized linguistic, cultural, and curricular content [34]. According to [64], generative AI can facilitate lesson planning and automate administrative duties in Asia-Pacific classrooms, serving as a "partner in pedagogical innovation." According to [38], ChatGPT and other generative AI technologies are disrupting conventional academic standards in South Africa by automating routine teaching tasks so that teachers may concentrate on higher-order facilitation. AI integration is reimagining the classroom paradigm itself. By incorporating active, technology-based learning strategies, [46] show how AI literacy models in Indonesia revolutionize traditional STEAM education. Across Africa, various AI tools support content generation and administrative tasks, shifting educator roles toward mentorship [39]. These transformations enable more personalized, creative pedagogy. Educators use AI for routine tasks and content generation, complementing their expertise and supporting adaptive, student-centered learning.

Democratization of Educational Access

AI is increasing access to education and resolving long standing inequalities across the emerging economies. [37] observes that in Africa, BERT, GPT-4, and other AI technologies can leverage mobile technology to bypass infrastructure limitations, easing teacher shortages through automation. This democratization extends to remote populations which were previously excluded from quality education. In Kenya, M-Shule uses SMS-based AI to give curriculum-aligned individualized learning to offline students [65]. Similarly, in Nigeria, Solve Education's Ed the Learning Bot provides gamified literacy experiences using Telegram. In Ghana, conversational AI on WhatsApp provides real-time, tailored math education using rudimentary mobile networks [41]. Adaptive machine learning and natural language processing technologies in Malaysia's Sabah region allow remote populations to access modern, high-quality education [56]. According to [59], adaptive, predictive, and generative AI tools are being used across these countries to create scalable, personalized, and remote education platforms for a variety of learning contexts. These technologies disrupt traditional, gradual reforms by providing mobile driven, AI-enhanced solutions that democratize access to great education regardless of geographical or socioeconomic status.

Disruption of Traditional Assessment Paradigms

Artificial intelligence is revolutionizing assessment processes by automating grading and offering real-time feedback. For instance, in South Africa, the Kagiso Trust's digital learning program uses AI to analyze student engagement and comprehension, which informs teaching tactics [66]. Similarly, [40] describe how machine learning tools in Nigeria use data analytics to predict student performance, moving from reactive to proactive monitoring approaches. This significantly alters when and how student progress is assessed. Further,

[44] demonstrates that in Indonesia, deep learning architectures such as MLP, CNN, and LSTM have replaced traditional statistics with advanced predictive models for proactive student performance forecasting. These shifts imply that AI is shifting traditional testing away from static, one-time exams and toward more flexible, project-based assignments that value critical thinking and creativity. This move not only increases evaluation accuracy and timeliness, but it also develops an academic integrity culture by focusing on learning progress rather than memory.

Institutional Structure Disruption

Beyond classroom activities, artificial intelligence is driving significant changes in educational institutions' organizational and administrative structures. Automated systems that use natural language processing and complex data analytics are replacing manual administrative processes, which typically involve retrospective decision making. These systems simplify processes like grading, curriculum design, and policy analysis, increasing operational efficiency [36]; [39]; [42]; [54]. The African Union's Continental Artificial Intelligence Strategy emphasizes the need of AI infrastructure and governance in achieving ethical regulation and innovation [67]. Collaborations among governments, technology corporations, and educational institutions are promoting the development of AI curricula and standards that are adapted to regional needs. For example, the African Leadership University uses AI methods to assess teacher performance and provide individualized professional development resources, improving educational quality [68]. These technologies help decision makers optimize class sizes, staffing, and space use using real-time data insights. As a result, educational systems are evolving into hybrid models that integrate traditional pedagogy with agile, AI-enhanced administrative methods, resulting in more responsive and efficient educational governance.

AI as a Catalyst for Leapfrogging in Educational Transformation in Emerging Economies

Bypassing Traditional Educational Infrastructure

AI applications allow these economies educational systems to bypass traditional infrastructural restrictions that have previously hampered educational progress. [37] highlights how AI technologies, such as BERT, GPT-4, and other advanced models, exploit existing mobile networks in Africa to bypass expensive physical infrastructures. This technology leapfrogging provides advanced digital learning experiences without the need for traditional classroom facilities or large hardware installations. In Ghana, [41] use WhatsApp's conversational AI to provide tailored math tutoring in real-time. This technique uses messaging platforms instead of high-speed internet or expensive computer devices to provide personalized educational help in areas with limited resources. Similarly, in Brazil, the "Teacher-Present High School with Technological Mediation" system employs videoconferencing to deliver education to remote Amazonian villages, democratizing access for over 300,000 students [59]. Similarly, Bangladesh's Noipunno platform uses AI to monitor student attendance and development in real time, supporting over 500,000 teachers and over 5 million pupils and lowering dependency on physical infrastructure [69]. This technology jump accelerates educational modernization by bypassing multiple developmental phases that may take decades to achieve in many parts across the emerging economies.

Expertise Gap Bridging

AI technologies efficiently address shortages of qualified educators and specialized expertise in the emerging economies, allowing educational systems to leapfrog over traditional human resource constraints. By deploying intelligent platforms that simulate expert instruction and provide on demand support, AI helps ensure that quality teaching continues despite skills deficits. Generative AI and simulation-based teacher training systems are being used to create virtual mentorship settings in areas where experts are limited. In India, adaptive learning systems powered by powerful algorithms monitor individual student performance and provide tailored, one-on-one coaching, overcoming the challenges posed by low teacher-to-student ratios [55]. Additionally, conversational agents and chatbots provide continuous academic support by delivering tutoring around the clock via common messaging apps; in both Ghana and Egypt [41]; [57]. AI-powered interventions significantly minimize the dependency on limited human resources. By replicating the presence of highly competent educators and continuously delivering expert-level content, AI bridges the knowledge gap and enables a leapfrog development in educational quality in developing countries.

Cost Effective Scalability

AI applications provide cost effective alternatives to resource intensive educational approaches, allowing these regions to deliver quality education at scale despite financial constraints. In Brazil, traditional intelligent tutoring systems offer cost-effective and scalable tutoring without requiring high-end AI expenditures, displacing old passive learning methods [45]. AI's cost-effective scalability extends to curriculum innovation. In lower-middle-income ASEAN economies, AI technologies transform static curricula into dynamic, sustainable

content, bypassing legacy infrastructure and enabling rapid, cost-effective curriculum reforms that would otherwise require significant resources and time [52].

RQ2: What are the key enablers, challenges, and limitations associated with integrating AI tools in the educational systems across the Emerging Economies?

Integrating artificial intelligence tools into educational systems is a multifaceted task. It entails a complex interaction of enabling factors, challenges, and constraints that are profoundly influenced by the distinct socioeconomic, technological, and policy environments of each country.

Enabling Factors

Widespread Mobile Technology Adoption

The pervasive availability of mobile devices emerges as a significant enabler for AI integration in developing countries education. For example, Dr. Mmaki Jantjies' M-Thuto app provides science and math resources in both English and indigenous languages, increasing engagement and comprehension in South Africa [70]. Similarly, in Brazil the "Teacher-Present High School with Technological Mediation" system uses videoconferencing to provide education to over 300,000 learners in remote Amazonian villages [59]. According to [37] emphasizes that widespread mobile connectivity underpins educational access across Africa, despite resource constraints, providing a foundation for technological leapfrogging. Furthermore, in Kenya, M-Shule uses AI to deliver adaptive SMS-based learning in Swahili and English to primary school students, while Nigeria's uLesson switched from tablets to low-cost smartphones to provide AI-driven video lessons aligned with the Nigerian curriculum [71]; [72].

Strategic Collaborations and Partnerships

Collaborations between governments, private-sector enterprises, and non-governmental groups have helped to advance AI integration in education. These collaborations provide critical resources, experience, and infrastructure support for the development and deployment of AI-powered educational solutions. For instance, Ericsson, Qualcomm, the Myanmar government, and UNESCO collaborated to deliver tablets and tech training in 31 schools as part of the Connect to Learn Myanmar program, which revolutionized traditional education systems [73]. Similarly, the African Union is drafting a Continental AI Strategy, with a focus on education and the preservation of African languages, and the African Observatory on Responsible AI promotes African perspectives in global AI talks [59]. Multi-stakeholder partnerships enable "policy reform and redesign of higher education frameworks" in Bangladesh, according to [53], whereas [56] emphasizes the importance of "cross-sector collaboration" for efficient AI implementation in Malaysia's Sabah region.

Demographics and Youth Digital Engagement

The demographic advantage of large youthful populations with increasing digital involvement provides momentum for AI adoption across the emerging economies. For example, Africa, which has over 55% of its population under the age of 25, is seeing unprecedented demand for education. This demographic trend highlights the need for scalable AI solutions to address educational needs [59]. According to [34], young people in Ghana are eager to "foster digital literacy and promote innovative pedagogical practices" using AI tools, presenting a generational opportunity for technology integration.

Localization and Cultural Relevance

The creation of contextually relevant AI educational resources is a critical enabler. Creating AI tools and educational content that are specific to local languages, cultures, and educational demands increases relevance and efficacy. Such customization improves learner engagement and leads to improved educational outcomes. For example, in Ghana, the 21st Century Teacher Educator AI incorporates Ghana's National Teacher Education Curriculum Framework and supports numerous local languages, offering culturally relevant educational support [34].

Challenges and Limitations in AI Integration in Emerging Economies

Infrastructure and Resource Constraints

Many developing regions are facing challenges related to inadequate infrastructure, such as unstable electricity, limited internet connectivity, and limited access to digital devices. These challenges impede the successful use of AI technologies in education. The most frequently identified difficulty across studies is inadequate infrastructure. Several scholars, including [37], [54], & [58], highlight

constraints in computers, connectivity, unreliable electricity, and overall digital infrastructure shortfalls. [52] identifies poor digital infrastructure in lower-middle-income ASEAN economies as a significant hurdle to AI integration. Disparities in access to technology increase existing educational inequities. Students in rural or low-income areas often lack the essential equipment and connectivity to benefit from AI-driven educational materials, contributing to a widening digital divide.

Technical Skills and Digital Literacy Gaps

Lack of qualified instructors and technical professionals is a serious impediment to AI integration. Without sufficient training and support, educators may struggle to use AI tools successfully, limiting their potential influence on teaching and learning. For example, [42] underline the importance of ongoing professional development in order to keep up with technological changes in Kenya. Similarly, [35] state that the lack of comprehensive digital literacy programs and insufficient academic knowledge in AI integration hinder the successful implementation of these technologies. These findings highlight the urgent need for structured professional development that is expressly geared to increase skill with AI tools and promote digital literacy.

Ethical and Privacy Concerns

The application of AI in education entails the collection and analysis of massive volumes of student data, creating concerns about privacy, permission, and data security. Ensuring ethical standards and preserving sensitive information are key issues that must be addressed. Many research in the study shows that, while AI has transformative potential, its implementation is frequently accompanied with severe ethical dilemma. For example, [34] warns about ethical bias concerns and the potential of impaired critical thinking as a result of overreliance on AI tools. Similarly, [38] identifies institutional uncertainties and ethical ambiguities that erode confidence in AI-powered systems, noting that these challenges are exacerbated when ethical considerations are not incorporated into the design and deployment processes. Data privacy is also a major concern. [56], argue that the widespread use of student data for individualized learning and performance prediction poses major concerns. In many low resource environments, insufficient cybersecurity protections and uneven data governance processes can result in breaches that reveal sensitive information. This creates an environment in which pupils' personal data can be abused, exacerbating the digital divide between well-resourced and marginalized areas.

Cultural and Institutional Resistance

Cultural and institutional resistance pose a critical challenge to integrating AI in education across the developing countries, as entrenched traditional practices and a lack of supportive regulations encourage distrust toward disruptive technologies. Educators and administrators who are used to traditional teacher-centered approaches frequently see AI as a danger to critical thinking and their roles, rather than a complimentary tool [35]. This resistance is exacerbated by the use of non-localized AI technologies that typically fail to fit with local languages, cultural narratives, and pedagogical agendas, resulting in a misalignment between AI's revolutionary promise and the contextual realities of many educational institutions.

Conclusion

This systematic review highlights the transformative role of artificial intelligence (AI) as a disruptive innovation and a leapfrog mechanism in developing countries' education systems. AI applications are being implemented in diverse ways across countries such as Kenya, Ghana, Nigeria, India, Brazil, Sri Lanka, and Bangladesh, among others. These applications include generative content creation, predictive analytics, adaptive learning systems, conversational agents, and administrative automation. These innovations are not merely incremental but fundamentally disruptive redefining teacher roles, transforming assessment paradigms, automating administrative operations, and disrupting long-held institutional structures. AI is enabling new educational models that promote personalization, accessibility, and data driven decision-making.

At the same time, AI provides significant leapfrogging potential by allowing regions to avoid traditional infrastructural and human resource limits. Examples include WhatsApp-based tutoring in Ghana, mobile adaptive learning in Kenya, and AI-powered remote instruction in Brazil's Amazon regions. These approaches show how AI may provide high quality education on a large scale, even in low-resource settings, accelerating educational modernization without the need for decades of slow reform. Nonetheless, significant obstacles remain. These include infrastructural deficits, limited technical skills among educators, ethical concerns regarding data privacy, and cultural resistance to technological change. Addressing these barriers requires tailored, context-sensitive strategies that consider the unique socioeconomic and cultural needs of each region. The review identifies several key enablers of AI-based educational leapfrogging, including widespread mobile phone use, youth digital engagement, collaborations and the development of locally and culturally suitable AI technologies.

This review provides researchers, policymakers, and educators with valuable insights into the transformative potential of AI in the emerging economies' education systems. The main lessons are as follows: (a) AI technologies have the potential to disrupt entrenched educational inequities and accelerate innovation; (b) AI allows for cost-effective, scalable education leapfrogging in under-resourced settings; and (c) Sustainable AI integration necessitates strategic investments in infrastructure, training, and ethical safeguards. It is critical that more educational stakeholders recognize and embrace AI's ability to rethink learning and create an inclusive educational future across the emerging economies.

Declarations

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Clinical trial number

Not applicable.

Ethical approval

Not applicable. This study is a systematic review of previously published literature and did not involve any primary data collection with human participants or animals

Consent to participate

Not applicable. No new data were collected from human participants in this study.

Consent to publish

Not applicable. This article does not contain any individual person's data in any form (including images, videos, or personal details).

Data availability

No new datasets were generated or analyzed during the current study. All data supporting the findings are available in the published articles included in the review, which are cited in the reference list.

Competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Figures

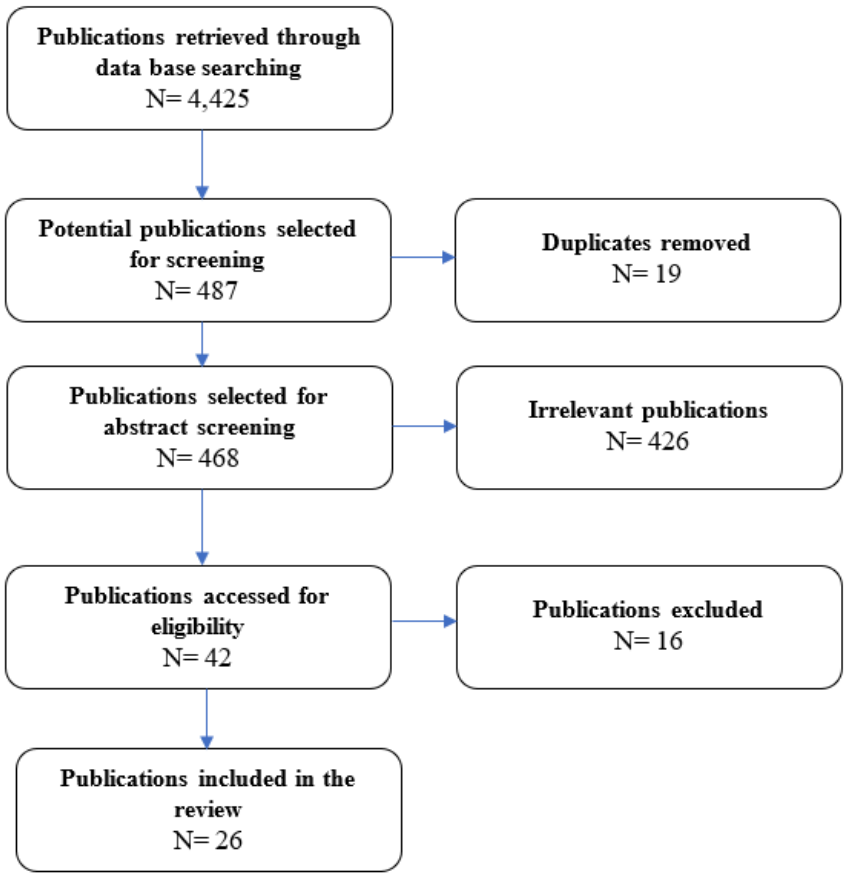

Figure 1

Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram