

Review Article

A Review of the Perceived Benefits and Potential Challenges of Implementing AI in Education in Developing Countries

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Abstract

The goal of this systematic literature review (SLR) is to identify potential benefits and challenges of implementing artificial intelligence (AI) in the education systems of developing countries. To meet our research objectives, we applied a systematic literature review (SLR) approach. We selected a total of 29 research articles using the SCOPUS and Google Scholar databases. Thereafter, we evaluated the quality of the articles using Scimago Journal and Country Rank (SJR). Next, we categorized the key findings as themes (T), contexts (C), and methodologies (M). Our key findings include the following: The developing countries will have four significant benefits while integrating artificial intelligence into their education systems: (1) enhanced learning opportunities, (2) improved efficiency, (3) resource availability, and (4) education scalability potential. However, they will encounter five key challenges while implementing AI in the system: (1) high costs; (2) infrastructure barriers; (3) risks to data privacy; (4) shortage of competence; and (5) concerns about ethics and bias. This review article offers a guide for academics, policymakers, and researchers to deepen their understanding of the perceived benefits and associated risks of incorporating AI into education systems, especially in resource-constrained contexts. Furthermore, this article will serve as a foundation for future research and encourage further experimentation on this topic.

Keywords

Challenges, Benefits, Artificial Intelligence, Developing Countries, Education, Systematic Literature Review

1. Introduction

We anticipate that artificial intelligence (AI), as a disruptive technology, will dramatically transform our lives. Recently, AI has made significant advancements across corporate, consumer, and professional sectors [1]. Additionally, the field of AI has attracted considerable interest from economists [2], military strategists, security experts [3], medical professionals [4-6], and educators [7]. The education sector is also experi-

encing changes due to automation and advancements in artificial intelligence [8].

Modern AI technologies are extensively used in education, including chatbots, academic research, lecture transcription, learning management systems [9], social robots, trial and error methodologies, and virtual reality [10]. Smart Content is an artificial intelligence technology that converts textbooks

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into study materials, including true-false questions, suitable for use on the day of an examination. Prominent smart content mobile applications include Cram101 and JustTheFacts101 [11]. AI tutors can bridge the gap for students by offering personalized feedback and assistance [12]. On the other hand, education technology (EdTech) firms use Emotional AI to classify social and emotional learning and support educators in their endeavors. Emotional AI employs computer vision algorithms to identify and classify human emotions and facial expressions [13].

For educators, artificial intelligence streamlines operational administration, ranging from enrolling new students in educational institutions [14] to grading and evaluating exams or homework. This efficiency allows educators to dedicate more time to hands-on management with their pupils [15]. Additionally, AI can serve as an extended brain, enhancing efficiency and aiding educational leaders in making analytical, data-driven decisions [16]. Furthermore, AI systems assist teachers in designing course curricula tailored to each student's abilities and weaknesses, promoting personalization [17]. Lastly, adaptive learning systems optimize the pace and difficulty of education to align with student achievements, maximizing their progress [18].

In developing countries, AI is transforming education. In India, platforms like Byju's and Embibe offer personalized learning experiences [19], while AI chatbots enhance the student learning experience in higher education [20]. Countries like Kenya and Nigeria are using AI to revolutionize STEM education [21], and the UAE and Saudi Arabia are investing heavily in AI for educational management [22, 23]. Brazil's 'Educação Conectada' program aims to integrate AI into public education to improve literacy rates [24]. Additionally, countries such as Indonesia, Sri Lanka, and Thailand are incorporating AI into their educational curriculums to foster innovation and compete regionally [25, 26]. Self-explanation education (SEE) in Malaysia employs AI to assist, guide, and even interact with students through self-determined learning (SDL) [27]. Rwanda uses AI to teach digital literacy and adapt students for contemporary technology like "Smart Classrooms" to ensure sustainable education [28].

Although AI offers many benefits in education, it also presents significant disadvantages that raise considerable caution [29]. Firstly, AI can have unintended consequences [30], particularly regarding issues of transparency, bias, unfairness, and the potential misuse of predictive models in decision-making [31]. Research indicates that enhancing the technical quality of AI can help mitigate its ethical impacts. However, the costs associated with implementing such technologies raise questions about their viability for all educational institutions [32]. Secondly, educators encounter challenges when adopting relatively new technologies like AI [33, 34]. Many teachers feel overwhelmed, unsure of the best ways to use and learn these new tools [35]. Furthermore, both teachers and students may not fully understand the potential limitations and risks associated with this technology, which can result in inaccurate outputs due to AI hallucinations [36, 37]. Thirdly, there are increasing ethical concerns at the user level related to safety, privacy, trust, and health. To address these challenges, it is essential to establish reliable guidelines, policies, and regulatory frameworks. Unfortunately, the education sector has yet to reach a consensus on structured frameworks or guidelines, nor has it developed policies or enacted regulations to tackle the ethical issues raised by AI [38]. Lastly, research indicates a growing trend of disengagement among university students in Pakistan and China [39]. Many students are opting to avoid self-studying new materials, choosing instead to reduce their effort by delegating tasks and critical cognitive work to machines [29, 37].

Considering all these factors, our study reviews current literature to identify and compare the contextual benefits and challenges [40] associated with the widespread usage and adoption of AI in the education system in emerging nations [38, 41].

Thus, we have formulated the following two research questions:

RQ1: What are the perceived benefits (themes) of using AI in the education system, taking into account research areas (context) and methodologies (used methodology)?

RQ2: What are the potential challenges (themes) of using AI in the education system, taking into account research areas (context) and methodologies (used methodology)?

2. Research Methodology

Table 1. Protocol for Literature Evaluation, Selection, and Search.

Themes	Explanations
Research Questions	RQ1: What are the perceived benefits (themes) of using AI in the education system, taking into account research areas (context) and methodologies (used methodology)? RQ2: What are the potential challenges (themes) of using AI in the education system, taking into account research areas (context) and methodologies (used methodology)?
Objectives	To highlight the perceived benefits of implementing AI in the education system of developing countries using the TCM method.

Themes	Explanations
Data String	To address the potential challenges related to AI implementation in the education system of developing countries using the TCM method. ‘AI and Education’ OR ‘Education System and ‘AI Technology’ or ‘Artificial Intelligence’ AND ‘De-veloping Countries’ OR ‘Developing Nations’. Step 1: Based on the data string, we randomly selected numerous articles from Google Scholar and SCOPUS covering the period from 2019 to 2024. Step 2: We analyzed the abstracts, introductions, limitations, and areas for further research in the selected articles to identify the most relevant to our research. Step 3: Articles from SCOPUS journals were chosen based on the inclusion and exclusion criteria out-lined in our ‘Inclusion Criteria’ box.
Search Strategy	Step 4: To assess the quality of the articles we selected from Google Scholar, we evaluated them using SJR (2024). Step 5: Following a thorough review of the complete texts, 29 articles were considered the most suitable for the research. Note: From the analysis of these 29 articles, we have identified and highlighted our key findings, in-cluding the themes, contexts, and methodologies. The SJR (2024) ranking includes only Quartiles 1, 2, and 3.
Inclusion Criteria	We reviewed peer-reviewed journal publications and researched empirical articles, including quantita-tive, qualitative, and mixed-methods articles, related to the topic. Note: Among the 29 selected articles, 14 (48.3%) are from Q1 journals, according to the SJR-2024 ranking.
Exclusion Criteria	Books & book chapters Review articles Conference Proceedings Articles published in other languages Articles in press Articles from other disciplines Case studies, editorial, and opinion pieces.
Time Period	2019-2024
Data Sources	SCOPUS and Google Scholar Note: To confirm the quality of the articles, we checked those collected from Google Scholar with SJR as of the year 2024.

Source: Own Study

Systematic Literature Reviews (SLRs) are independent, rigorous academic methods used to identify, evaluate, and synthesize all relevant literature on a topic to draw meaningful conclusions [42]. The primary purpose is to find out the answers to the research questions selected based on the research

gap under consideration. Unlike ordinary literature reviews, SLR uses a formal, methodological approach to ensure reliability and reduce bias in literature selection [43]. This literature review uses Rowley and Stack's SLR five-step method (Figure 1) with the elaboration to meet its research goals [44].

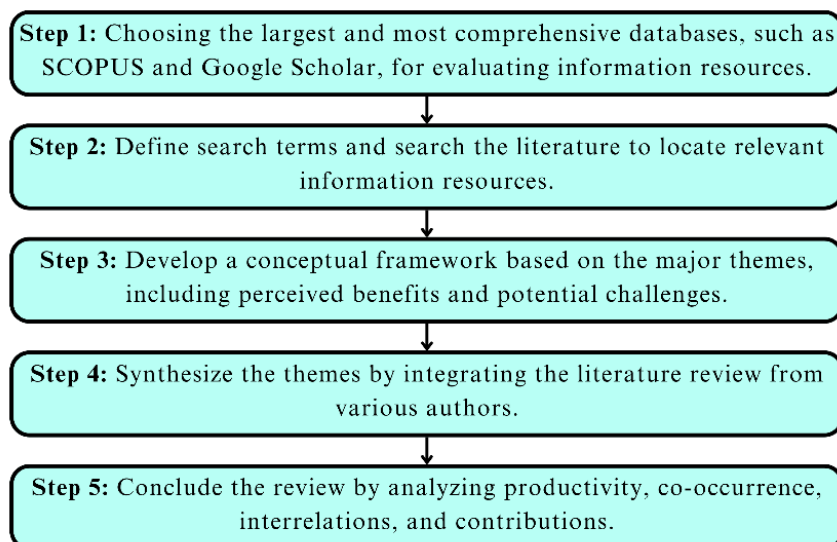


Figure 1. SLR Five-Step Method Proposed by Rowley and Stack (2004).

3. Data Reporting

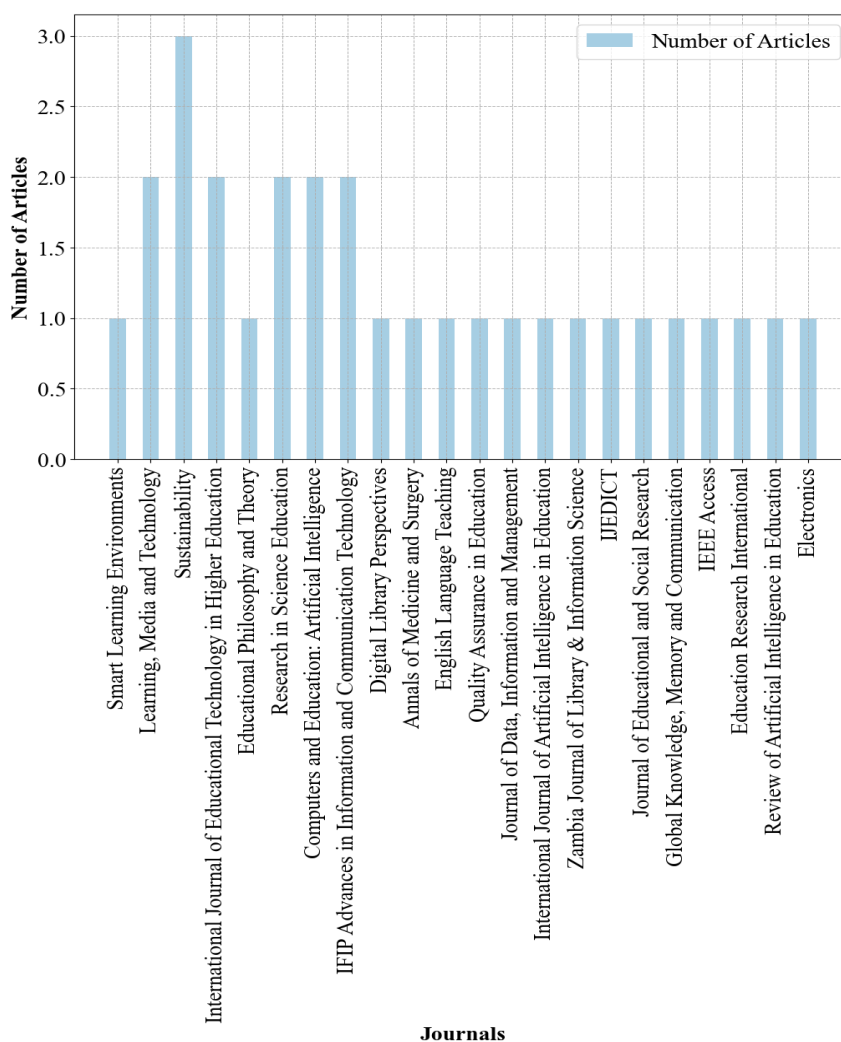


Figure 2. Scheme for AI Implementation in Education. (Source: Own Elaboration).

This section includes detailed statistics and visuals of the 29 articles. Readers will learn about the quality of the selected publications, research contexts, and methodologies.

Figure 2 displays the distribution of collected articles

across various journals. Figure 3 represents the number of articles published in journals ranked by the SJR (Scimago Journal Rank), and we can see in our paper that we have included 75.8% of papers from either Q1 or Q2 journals.

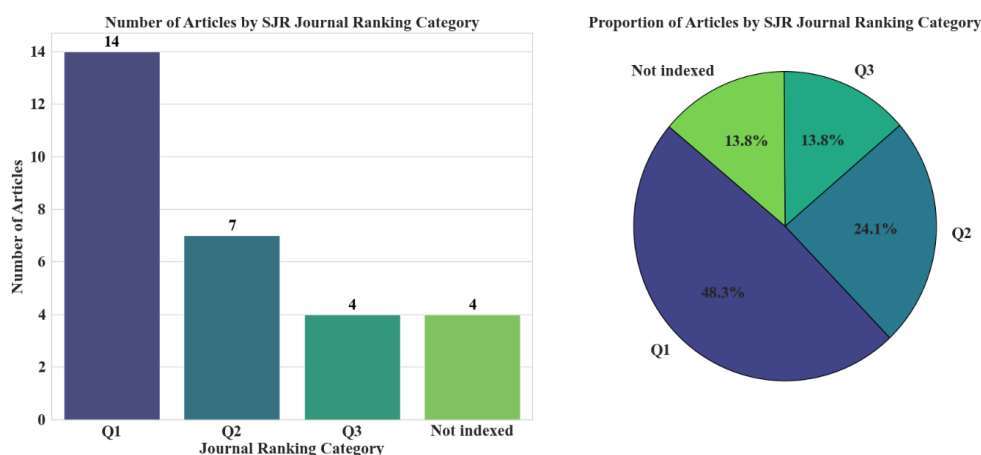


Figure 3. Number of Articles in SJR-Ranked Journals (SJR, 2024). (Source: Own Elaboration).

Figure 4 gives an overview of the contextual distribution of the countries mentioned in the collected paper. However, we have also included specific regions within the same plot, such

as the global, Asia-Pacific, developing countries, and the sub-Saharan African region.

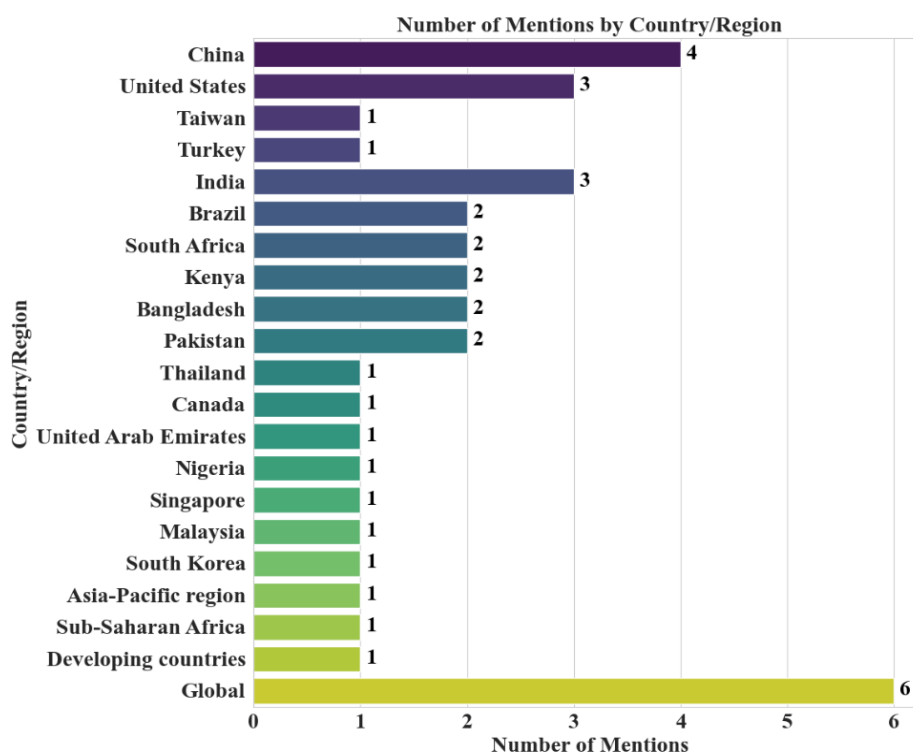


Figure 4. Number of Mentions by Country/Region. (Source: Own Elaboration).

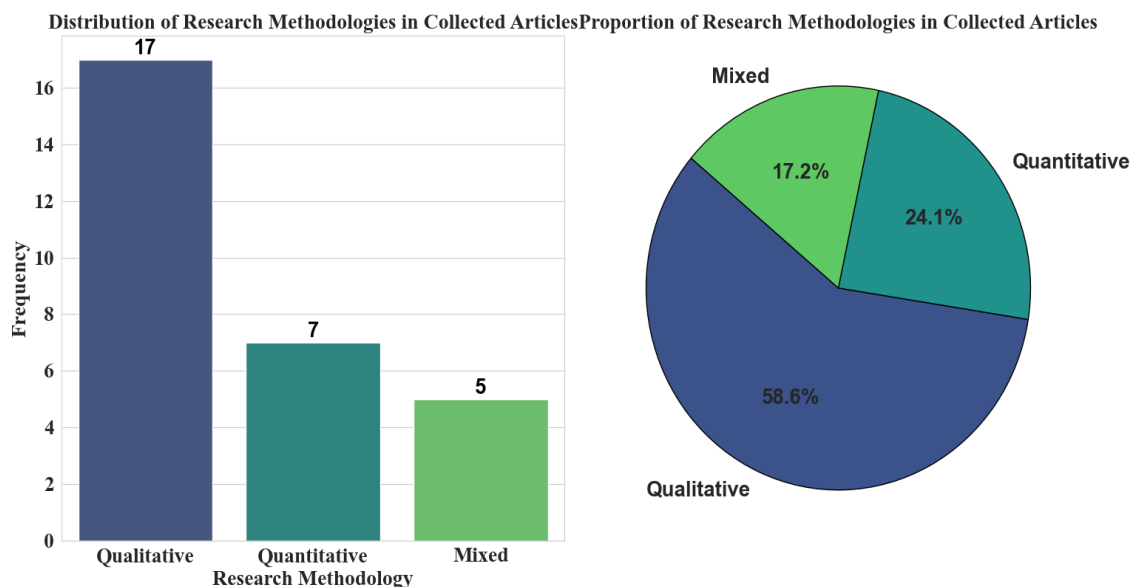


Figure 5. Methodologies Applied in the Collected Articles. (Source: Own Elaboration).

Figure 5 provides an overview of the methodologies used in our collected articles. We have identified 58.6% of the articles as qualitative.

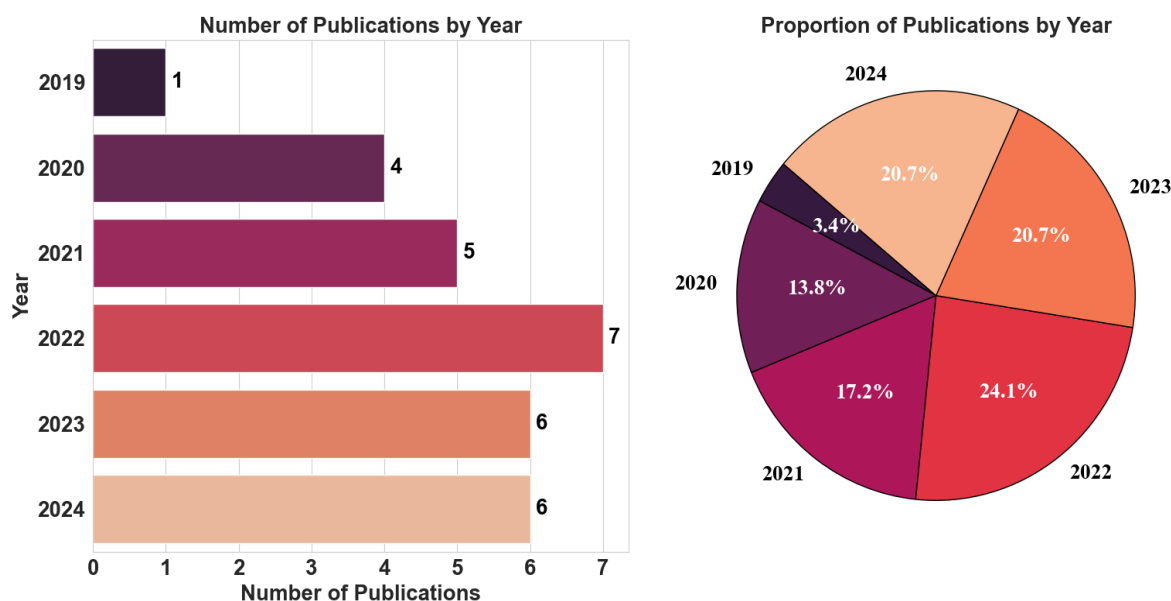


Figure 6. Publications by Year. (Source: Own Elaboration).

Finally, Figure 6 presents a year-wise publication breakdown of our analyzed articles. It shows that 82.8% of the publications are from 2021 to 2024.

4. Results and Discussion

In our paper, we have divided our major findings into three categories, i.e., themes=T (perceived benefits and potential

challenges), contexts=C (primarily developing countries), and methodologies=M (Systematic Literature Review), which is also known as the TCM framework [45].

For discussing the major themes, we created two tables: Table 2 for Perceived Benefits and Table 3 for potential challenges. We have created Table 3 to highlight the contexts (C) and methodologies (M).

In Table 2, we highlighted four significant themes that

represent perceived benefits, each covering several key factors. We have also discussed five main themes in Table 3 as potential challenges, each of which represents multiple factors.

4.1. Research Themes (1): The Perceived Benefits of Implementing AI in Education Across Developing Countries

The first perceived benefit theme (T1) we have discussed is Enhanced Learning. Our review showed that AI helps students make the content personalized according to their demands, which in turn increases their learning efficiency and boosts their academic and non-academic performance [17, 46-49]. For example, David Mhlanga (2023) stated in his paper that AI-based services enhance customer experience by aligning the context, technology configuration, and customer preferences [47]. Additionally, the user-friendliness of AI systems in education encourages students to concentrate and remain engaged in activities that enhance their Learning. Further, the performance of students increases by utilizing the adaptive learning mechanism of AI. In the paper by Dimitriadou & Lanitis (2023) and many other papers, it has been stated that AI technology enhances student performance by tailoring educational experiences [41, 46, 47, 50-53]. Moreover, we have reviewed and analyzed the fact that implementing AI in education helps students to stay motivated and engaged in their studies and skill development. The former studies also indicated that the tailored, adapted features provided by AI tools such as ChatGPT boost the motivation and engagement of students and foster their performance in their studies [47, 48, 50].

Our review regarding the second theme, efficiency im-

provement (T2), showed that automated grading and administrative processes and optimized use of educational resources and tools are the major factors for the perceived benefits of implementing AI in the educational sector. Throughout the globe, AI is supporting educators with automated grading systems, the creation of personalized content, and the implementation of predictive analytics for evaluating the academic performance of students [17, 41, 52-55]. Moreover, optimized use of educational resources and tools in improving the effectiveness of the educational sector through AI is ensured by well-funded universities, which tend to have smart classes and policies [9, 46, 55].

Additionally, access to educational resources through digital platforms and virtual learning environments is a factor related to resource availability benefits (T3). ChatGPT is a popular tool, along with other digital resources, in developing countries and worldwide. These AI tools greatly assist in language support, cost efficiency, and availability [47, 49]. Specifically for developing countries, AI tools can assist in implementing an effective distance learning environment and creating instructional designs [17, 49, 56].

Our fourth theme, scalable education (T4), highlighted that by enabling scaling to a large population and providing cost-effective solutions, AI is bringing a positive impact to our education system. AI tools, automated assessments, predictive analytics, and customized learning resources are assisting a wide range of students [41, 52]. Moreover, due to VR and 3D, students are getting practical learning opportunities. All tools are enhancing administrative efficiency in tasks like grading, reviewing, and assignments [17]. Furthermore, nowadays, ChatGPT is used widely due to its cost-efficiency advantage [47]. This tool has expanded the area of opportunity for students.

Table 2. Research Themes (1) - The Perceived Benefits of Implementing AI in Education Across Developing Countries.

Main Themes	Key Factors	Cited authors
Enhanced Learning	Personalized content for individual needs	(Alonso-Secades et al. 2022; X. Chen et al. 2020; Cope et al. 2021; Mhlanga 2023; Songsiengchai et al. 2023)
	Student performance and learning styles benefit from adaptive learning.	(Bhutoria 2022; Cope et al. 2021; Dimitriadou and Lanitis 2023; Jaiswal and Arun 2021; Mhlanga 2023; Zawacki-Richter et al. 2019)
	Increase student motivation and engagement	(Dimitriadou and Lanitis 2023; Mhlanga 2023; Songsiengchai et al. 2023)
Efficiency Improvement	Automates grading and administrative processes	(Almasri 2024; X. Chen et al. 2020; Jaiswal and Arun 2021; Lampou 2023; Owoc et al. 2021; Zawacki-Richter et al. 2019)
	Optimizes the use of educational resources and tools	(Cope et al. 2021; Nakitare and Otiike 2023; Owoc et al. 2021)
Resource Availability	Access to educational resources through digital platforms	(Alonso-Secades et al. 2022; Mhlanga 2023)

Main Themes	Key Factors	Cited authors
Scalable Education	Virtual learning environments	(Alonso-Secades et al. 2022; Awad and Oueida 2024; X. Chen et al. 2020)
	Scale up to a larger population	(Almasri 2024; Jaiswal and Arun 2021)
	Cost-Effective Solutions	(X. Chen et al. 2020; Mhlanga 2023)

Source: own study.

4.2. Research Themes (2) - Possible Challenges of Implementing AI in Education Across Developing Countries

The themes of Table 3 highlight the possible challenges of implementing AI in education. High cost is one of the challenges that developing countries are facing while implementing AI in education (T5). AI tools enhance administration efficiency, provide practical learning opportunities, and offer a smart classroom, but they require a high investment to implement and also incur maintenance and update costs. [17, 50, 55].

The potential challenge theme, which is the infrastructure barrier (T6), found from our review shows that insufficient technology infrastructure and poor connectivity are the major factors for this challenge. There are some noticeable hurdles to implementing AI, especially in smaller universities, which include a lack of funding and insufficient ICT infrastructure [9, 57]. Furthermore, with the growing usage of AI globally, strong connectivity is mandatory for the smooth operation of AI tools. Developing countries are facing challenges mainly because of the poor connectivity available [47, 56].

Security threats and regulatory challenges are significant factors for data privacy risks (T7). According to research, data theft or leakage of sensitive personal information of the users is a growing concern among policymakers, which is making it a challenge to use AI in the education sector [9, 50, 56]. Unfortunately, the opposite side of AI can encourage plagiarism

and many more unethical activities. However, the user's purpose decides whether it will be beneficial or harmful [17, 56].

Another challenge of implementing AI in education across developing countries like Bangladesh is a competency shortage (T8), where a lack of training opportunities for educators and skill gaps are significant issues hindering a country's advancement. In this case, it is essential to integrate insights from various scholarly perspectives. Subsequently, we tried to accumulate a synthesized view based on the works of [41, 49, 53, 54].

Researchers pointed out that using AI in schools requires teachers and school leaders to learn new skills. However, in a developing nation, most educators and students lack the skills to use AI tools due to a lack of proper training opportunities. These findings are supported by several studies [41, 49, 53, 54] discuss the risk of skill gaps among the administrative staff in using AI properly. Moreover, ethical concerns and biases (T9) present significant potential challenges related to AI. Algorithmic bias and ethical concerns are major factors behind it. It is found through the review that AI can produce biased results, and these results can be repeatable due to human bias as well [47, 50, 56]. Furthermore, AI can be used in an unethical way, such as overusing AI tools to generate content or results, which can lead to plagiarism. These may lead to many other problems, such as reduced creativity among students, teachers guiding lessons in their own way, and many more [9, 17, 53, 56].

Table 3. Research Themes (2) - Possible Challenges of Implementing AI in Education Across Developing Countries.

Main Themes	Key Factors	Cited authors
High Costs	The initial financial investment is high	(X. Chen et al. 2020; Dimitriadou and Lanitis 2023)
	Recurring costs for maintenance and updates	(X. Chen et al. 2020; Owoc et al. 2021)
Infrastructure Barriers	Insufficient technology infrastructure	(Mwilongo et al. 2022; Nakitare and Otiike 2023)
	Poor connectivity	(Awad and Oueida 2024; Mhlanga 2023)
Data Privacy Risks	Security threats may expose sensitive data	(Awad and Oueida 2024; Dimitriadou and Lanitis 2023; Nakitare and Otiike 2023)
	Regulatory Challenges	(Awad and Oueida 2024; X. Chen et al. 2020)

Main Themes	Key Factors	Cited authors
Competency Shortage	Lack of training opportunities for educators	(Almasri 2024; Alonso-Secades et al. 2022; Lampou 2023; Zawacki-Richter et al. 2019)
	Skill Gaps among Staff	(Alonso-Secades et al. 2022)
	Algorithmic bias in educational content	(Awad and Oueida 2024; Dimitriadou and Lanitis 2023; Mhlanga 2023)
Ethical and Bias Concern	Ethical Concerns	(Awad and Oueida 2024; X. Chen et al. 2020; Nakitare and Otike 2023; Zawacki-Richter et al. 2019)

Source: own study.

4.3. Research Contexts (C) and Methodologies (M)

To depict the geographical context of the research on AI and education, we have constructed a review table with the names of the nations and the total number of articles we have found for each country. These studies are mentioned in Table 4. To highlight contexts, we focused on country names instead of zones, districts, divisions, or cities. Most of the studies were empirical, conducted from a global perspective (context),

and focused on the benefits and challenges emerging from using AI in the education sector. Other studies were based on countries like China, the USA, India, Brazil, Africa, Kenya, Thailand, Canada, South Africa, Singapore, Malaysia, South Korea, Pakistan, and Nigeria, along with sub-Saharan Africa and the Asia-Pacific region. Most studies focused on the benefits and challenges of using AI in education. Table 4 also outlines the methodologies that we used in the article on AI and education. From the frequency analysis, 58.6% of the selected articles were conducted using the qualitative method, 24.1% were quantitative, and 17.2% were mixed.

Table 4. Research Contexts (C) and Methodologies (M).

No	Title	Author	Name of the Journal	SJR Rank	Methodology	Context
01	A critical evaluation, challenges, and future perspectives of using artificial intelligence and emerging technologies in smart classrooms	(Dimitriadou and Lanitis 2023)	Smart Learning Environments	Q1	Qualitative	Global
02	Artificial intelligence and education in China	(Knox 2020)	Learning, Media and Technology	Q1	Qualitative	China
03	Promoting Students' Well-Being by Developing Their Readiness for the Artificial Intelligence Age	(Dai et al. 2020)	Sustainability	Q2	Quantitative	China
04	Systematic review of research on artificial intelligence applications in higher education – where are the educators?	(Zawacki-Richter et al. 2019)	International Journal of Educational Technology in Higher Education	Q1	Quantitative	United States, China, Taiwan, and Turkey
05	Artificial intelligence for education: Knowledge and its assessment in AI-enabled learning ecologies	(Cope et al. 2021)	Educational Philosophy and Theory	Q1	Qualitative	United States
06	Exploring the Impact of Artificial Intelligence in Teaching and Learning of Science: A Systematic Review of Empirical Research	(Almasri 2024)	Research in Science Education	Q1	Qualitative	India, Brazil, and South Africa

No	Title	Author	Name of the Journal	SJR Rank	Methodology	Context
07	A meta-review of literature on educational approaches for teaching AI at the K-12 levels in the Asia-Pacific region	(Su, Zhong, and Ng 2022)	Computers and Education: Artificial Intelligence	Q1	Mixed	Asia-Pacific region
08	Artificial Intelligence Technologies in Education: Benefits, Challenges and Strategies of Implementation	(Owoc et al. 2021)	IFIP Advances in Information and Communication Technology	Q1	Mixed	Global
09	Plagiarism conundrum in Kenyan universities: an impediment to quality research	(Nakitare and Otiike 2023)	Digital Library Perspectives	Q1	Mixed	Kenya
10	Emotional AI and EdTech: serving the public good?	(McStay 2020)	Learning, Media and Technology	Q1	Qualitative	Global
11	Personalized education and Artificial Intelligence in the United States, China, and India: A systematic review using a Human-In-The-Loop model	(Bhutoria 2022)	Computers and Education: Artificial Intelligence	Q1	Qualitative	China, India, USA
12	Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Pakistan: A cross-sectional online survey	(Ahmed et al. 2022)	Annals of Medicine and Surgery	Q3	Quantitative	Pakistan
13	Leveraging Artificial Intelligence (AI): Chat GPT for Effective English Language Learning among Thai Students	(Songsienchai et al. 2023)	English Language Teaching	Q2	Mixed	Thailand
14	A conceptual analysis of artificial intelligence (AI) on academic opportunities and challenges: a case study based on higher educational institutions in Bangladesh	(Tamanna and Sinha 2024)	Quality Assurance in Education	Q2	Quantitative	Bangladesh
15	Does artificial intelligence increase learners' sustainability in higher education: insights from Bangladesh	(Sultana and Faruk 2024)	Journal of Data, Information and Management	Q2	Mixed	Bangladesh
16	Analysis of Worldwide Research Trends on the Impact of Artificial Intelligence in Education	(Paek and Kim 2021)	Sustainability	Q2	Quantitative	United States and Canada
17	Education for AI, not AI for Education: The Role of Education and Ethics in National AI Policy Strategies	(Schiff 2022)	International Journal of Artificial Intelligence in Education	Q1	Qualitative	Global
18	Exploring the Impact of Artificial Intelligence in Teaching and Learning of Science: A Systematic Review of Empirical Research	(Almasri 2024)	Research in Science Education	Q1	Qualitative	Several developing countries, including India, Brazil, and South Africa
19	Emerging Assumptions and the Future of Artificial Intelligence in Teaching and Learning Processes in Higher Learning Institutions	(Mwilongo et al. 2022)	Zambia Journal of Library & Information Science		Qualitative	Sub-Saharan Africa

No	Title	Author	Name of the Journal	SJR Rank	Methodology	Context
	tutions in Sub-Saharan Africa: A Review of Literature					
20	Potential of Artificial Intelligence for transformation of the education system in India	(Jaiswal and Arun 2021)	International Journal of Education and Development using Information and Communication Technology (IJEDICT)	-	Qualitative	India
21	The Advantages and Disadvantages of Using Artificial Intelligence in Education	(Al-Tkhayneh, Alghazo, and Tahat 2023)	Journal of Educational and Social Research	Q3	Quantitative	United Arab Emirates
22	The Potential Impact of Artificial Intelligence on Education: Opportunities and Challenges	(Awad and Oueda 2024)	IFIP Advances in Information and Communication Technology	Q3	Qualitative	Kenya, Nigeria, and Bangladesh
23	Artificial intelligence application in university libraries of Pakistan: SWOT analysis and implications	(Ali et al. 2024)	Global Knowledge, Memory and Communication	Q2	Qualitative	Pakistan
24	Artificial Intelligence in Education: A Review	(L. Chen, Chen, and Lin 2020)	IEEE Access	Q1	Qualitative	Global
25	Artificial intelligence in higher education: the state of the field	(Crompton and Burke 2023)	International Journal of Educational Technology in Higher Education	Q1	Qualitative	Global
26	Digital Transformation Education, Opportunities, and Challenges of the Application of ChatGPT to Emerging Economies	(Mhlanga 2023)	Education Research International	Q3	Qualitative	Global
27	The integration of artificial intelligence in education: opportunities and challenges	(Lampou 2023)	Review of Artificial Intelligence in Education	-	Qualitative	Global
28	Artificial Intelligence and Its Role in Education	(Ahmad et al. 2021)	Sustainability	Q2	Qualitative	Singapore, Malaysia, South Korea
29	Designing an Intelligent Virtual Educational System to Improve the Efficiency of Primary Education in Developing Countries	(Alonso-Secades et al. 2022)	Electronics	Q2	Quantitative	Developing Countries

Source: own study.

5. Future Research Directions

The implementation of AI in education across developing countries presents significant opportunities, yet is troubled by formidable challenges that deserve systematic investigation [59]. Future studies should therefore explore cost-mitigation strategies such as public and private partnerships, innovative financing models and the deployment of low-cost AI solutions

to alleviate both initial and ongoing expenses [60]. Equally important is the design of AI applications suited to resource-constrained environments, for example, by developing offline tools, hybrid learning frameworks, and platforms optimized for low-bandwidth contexts, with comparative analyses across regions of differing infrastructure maturity best practices [61]. In practical terms, this would mean developing AI tools that can function on inexpensive devices [62] or without constant internet connectivity, allowing for more

widespread adoption in classrooms with limited access to technology. Moreover, AI applications should be designed to enhance traditional classroom practices, where instructors can use AI for personalized learning, task automation, and data-driven decision-making, all while focusing on fostering engagement with students in environments with fewer resources.

Concurrently, the refinement of data-privacy and security measures tailored to educational settings is essential [63], including the creation of robust protection frameworks and ethical guidelines that safeguard student information and prevent misuse [64]. Moreover, capacity-building initiatives for educators and administrators through scalable, context-sensitive training programs must be evaluated for their efficacy in closing competency gaps [58, 59]. These programs should equip teachers in low-resource settings to integrate

practical AI tools, such as AI-driven content delivery, assessment tools, and communication platforms, to improve teaching and learning outcomes. In addition, research should address algorithmic bias and ethical dilemmas by devising transparent, accountable AI governance models that ensure fairness and inclusivity [63]. Finally, investigations into the social and motivational determinants of AI adoption, taking into account cultural drivers and barriers, will inform strategies to foster acceptance among stakeholders, while comparative studies between developed and developing nations can elucidate how socio-economic variations shape educational outcomes in AI-enhanced learning [64]. Figure 7 schematically depicts how the perceived benefits (T1–T4), potential challenges (T5–T9), and corresponding overcoming factors interact to drive educational advancement through AI implementation in developing countries.

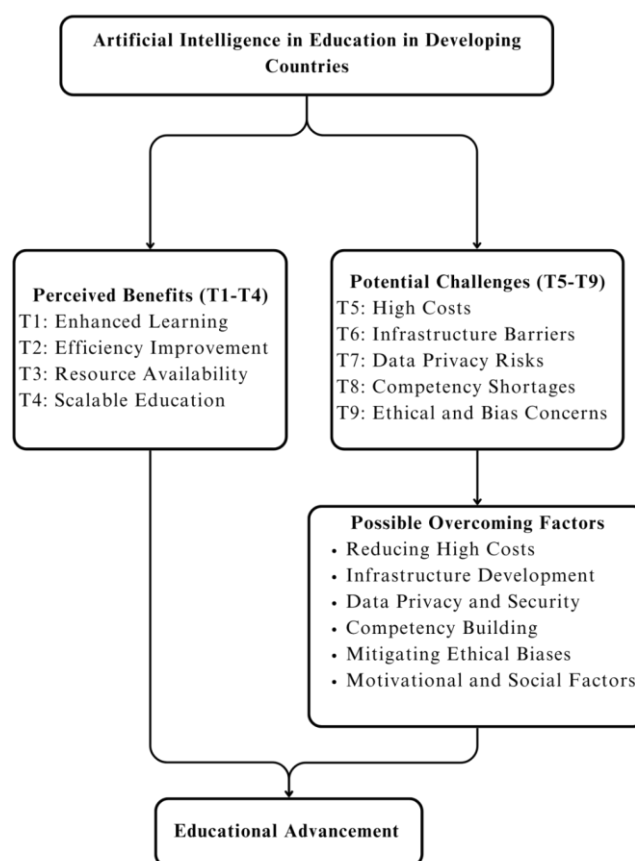


Figure 7. Future Research Directions for Artificial Intelligence in Education in Developing Countries. (Source: Own Elaboration).

6. Conclusion

This review article serves as guidance for academics, policymakers, and researchers, providing a more profound understanding of the implications of AI in the education sector. The content serves as a comprehensive guide for understanding the influence of AI in education, providing valuable

perspectives on its benefits, challenges, and the direction for future research, particularly in developing countries. The article's findings also indicate that there are serious consequences to consider. Firstly, the article pointed out the perceived benefits of AI implication in the education sector. It can guide both educators and students to efficiently use AI tools to enhance teaching and learning activities in developing countries. AI tools can significantly enhance teaching and

learning activities by improving learning outcomes. Secondly, the article also found out the potential challenges that can be faced throughout the process of implementing and using AI tools for educational purposes. These challenges will help policymakers create structured and regulated policies to address them, particularly in developing countries. Thirdly, the paper intends to improve the literature in the context of developing countries. Understanding these challenges is difficult for policymakers who need to develop structured and regulated policies to address these issues, ensuring that AI tools can be effectively and ethically integrated into educational systems. Fourthly, NGOs and development agencies may acquire creative ideas that can support them in program design. Finally, researchers may further explore the opportunities and challenges for using AI in education, following the findings of the article. The review sets the stage for future research by identifying both opportunities and challenges associated with AI in education. Researchers are encouraged to explore these areas further to better understand how AI can be effectively utilized and how potential issues can be addressed, particularly in developing countries.

To ensure the responsible and equitable adoption of AI in education, policymakers must prioritize policy frameworks that address infrastructural needs, safeguard ethical standards, and ensure teacher preparedness. Focus should center on fostering public-private partnerships to reduce costs, investing in scalable AI solutions, and implementing robust data privacy protections. Additionally, teacher training and capacity-building should be mandatory to enable effective AI integration. Crucially, clear governance and ethical guidelines are needed to address algorithmic bias and promote fairness in developing countries' AI-enhanced educational systems.

As we have shown in our research paper, many different publications have focused on the area of artificial intelligence, its widespread usage across various fields, its implication in education, and its distinctive benefits and challenges. The majority of the studies were incorporated from a global point of view. In this study, we have primarily focused on the developing countries and conducted an SLR to point out the perceived benefits and potential challenges of implementing AI in education. We defined the key findings of this review as themes (T), contexts (C), and methodologies (M). Considering our review, we explored significant perceived benefits such as enhanced learning (1), efficiency improvement (2), resource availability (3), and scalable education (4). Moreover, we covered potential challenges such as high costs (1), infrastructure barriers (2), data privacy risks (3), competency shortage (4), and ethical and bias concerns (5). Developing countries were the main context (C) for this review paper. Regarding the methodologies (M), 58.6% of the articles collected were qualitative.

This review article was diligently completed by adapting SLR principles, as a systematic literature review can provide a reliable and comprehensive synthesis of the existing research on a given topic. This method ensures a high standard of

evidence; it also means that relevant studies in other languages or from other types of publications may not be included. Despite that, necessary significant constraints were taken into account. We have only included peer-reviewed journal publications and empirical articles from 2019 to 2024, written in English. We also maintained the SJR ranking for the selected articles. 48.3% of selected articles are from Q1 (SJR-2024) journals. However, studies conducted in different languages other than English articles may have additional findings or even contradict our findings.

Abbreviations

SLR	Systematic Literature Review
SJR	Scimago Journal and Country Rank
AI	Artificial Intelligence
EdTech	Education Technology
STEM	Science, Technology, Engineering, and Mathematics
SDL	Self-determined Learning
DS&AI	Data Science and Artificial Intelligence
RQ	Research Question
Q	Quartiles
T	Themes
C	Contexts
M	Methodologies
LLM	Large Language Models

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The author used large language models (LLMs), including ChatGPT (OpenAI, GPT-4, August 2025 version), to assist with grammatical corrections and enhance coherence. Additionally, Python (version 3.10) was used for data analysis and figure generation. All outputs were thoroughly reviewed and edited by the author, and the author takes full responsibility for the content of this publication.

Author Contributions

Nafe Muhtasim Hye is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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