

The AI Classroom: Systematic Literature Insights into Quality and Access in Education

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Abstract. *A significant gap in access to quality education persists between developed and developing countries. Artificial Intelligence (AI) offers the potential to bridge this divide by expanding access to quality educational resources. This systematic literature review (SLR) examines 40 articles sourced from eight academic databases. The review identifies key competencies necessary for the effective adoption of AI in higher education institutions (HEIs) in developing countries and explores the benefits of AI-driven education. The analysis is structured around the Technology-Organisation-Environment (TOE) framework, which highlights the interplay among technological, organisational, and environmental factors in the successful integration of AI. The study also emphasises the importance of policy frameworks and guidelines to ensure the responsible use of AI and enhance the experiences of both students and educators. By synthesising current research, this systematic literature review (SLR) provides actionable insights for higher education institutions (HEIs) and policymakers, supporting strategies to reduce the digital divide and enhance educational outcomes through the adoption of AI.*

Keywords. AI adoption, AI education, AI integration, developing countries, educational programs, policy framework, systematic literature review, tertiary institutions

1 Introduction

The world is currently witnessing the transformative power of digital technology in providing access to quality education (Mannuru et al., 2023; Steyn & Eybers, 2023). Access is granted through digitisation, ultimately enabling societal and economic growth (Mathrani et al., 2023). By increasing access to education, we simultaneously invest in human capital and economic development in a country (de Souza Zanirato Maia et al., 2023).

Artificial Intelligence is a series of computational systems that can mimic human decision-making processes (Zawacki-Richter et al., 2019). These machines think like us and for us, providing the

opportunity to streamline the mundane tasks that fill our lives.

Tertiary Institutes use these intelligent technologies to promote collaboration and distance learning, enabling studying to take place whenever and wherever (Velinov et al., 2021). AI in higher education is currently empowering students by tailoring the learning experience to suit their individual needs best, promoting customisable schooling (Labadze et al., 2023). These techniques contribute to achieving Sustainable Development Goals (SDGs) by ensuring inclusive and equitable quality education for all (Opesemowo & Adekomaya, 2024).

However, despite the depth of knowledge on digital technologies used in education, we are still presented with an existing divide within the Global South due to the lack of knowledge and skills regarding the capabilities of AI in Higher Educational Institutes (HEIs) (Mathrani et al., 2022). With the rapid adoption of AI worldwide, rural communities continue to lack proficiency due to limited access and biases (Sekwatlakwatla, 2023). The benefits of these technologies are not equally well understood (Mannuru et al., 2023), highlighting the need for investments and support to ensure that all students, regardless of their circumstances, benefit from these technologies before we exacerbate the digital divide.

This Systematic Literature Review (SLR) aims to take inspiration from the advancements achieved using these technologies in HEIs in the Global North (Aly, 2022), providing a blueprint for the necessary capabilities to achieve similar results in the Global South. The primary objective of this study is to highlight the requirements for adopting Artificial Intelligence (AI) within Higher Educational Institutions (HEIs) and how it can promote accessible, high-quality education in developing countries, sparking a wave of hope and optimism for a future of global educational transformation. This SLR identifies the obstacles that need to be overcome in developing nations to enable this change. This paper aims to answer the following research questions:

- RQ1: What competencies are essential for effective AI adoption in higher education?
- RQ2: What are the benefits of using AI in the Global South's HEIs that lead to access to quality education?

This SLR aims to expand the body of knowledge by providing insights for Higher Education Institutions (HEIs) to leverage the transformative potential of AI in delivering accessible, high-quality education in developing countries. The study is structured as follows: the second section provides a detailed background on the topic of AI used in educational settings, followed by an explanation of the research methodology employed in this systematic literature review (SLR). This is followed by the research findings, after which a detailed discussion of the findings obtained is presented. Section six then presents a conceptual contribution analysed using the Technology–Organisation–Environment (TOE) framework. Finally, this paper concludes with an outline of the key findings identified and their implications, with recommendations for future research.

2. Background

2.1 Application of AI in HEIs

Artificial Intelligence (AI) promotes education in many ways. One example of the use of AI in HEIs is personalised learning and feedback enforced by adaptive systems (Zawacki-Richter et al., 2019). These adaptive and intelligent systems customise educational content according to the learner's preferences (Maier, 2022). Additionally, these systems automate previously manual tasks, allowing educators to spend more time with their students and providing each individual with more focused attention (Baykasoğlu et al., 2018).

Telepresence Robotics is an additional application of AI that enhances education. This technology supports remote students by providing access to videoconferencing and locomotion features (Lei et al., 2022). Teachers are provided with the necessary support to connect with their students (Leoste et al., 2022). The term "Telepresence" gained popularity during the COVID-19 pandemic (Velinov et al., 2021). Language and grammar are simplified using Generative Artificial Intelligence (GAI), which has had a significant impact in the field of education (Mannuru et al., 2023).

GAI refers to a form of AI that generates content based on a provided prompt (Ming Liu, 2023). These services are available on platforms like ChatGPT and CoPilot. Research has proven that this technology improves language writing performance by offering automated suggestions to enhance word choice, sentence structure, and the overall coherence of the text (Maier, 2022).

These incredible AI technologies have not and will not stop there. We have already seen our very first AI Teacher, a new concept of 'machine teachers' that references non-human teachers, which are expected to

play diverse and dynamic roles in education. Jill Watson is the first-ever AI teacher and was introduced to an online Knowledge-Based Artificial Intelligence (KBAI) class. Jill was designed to answer all students' questions within online forums (Kim et al., 2020).

2.2 Challenges and Opportunities of AI Education in Developing Countries

AI has promoted growth in developing countries like South Africa. It is currently being used to address accessibility issues while enhancing the relationships between students and educators (Treve, 2021) by creating an environment that fosters critical thinking, removes language barriers, and more. This highlights the potential of AI intelligence to solve issues in the field of education (Khan et al., 2022), leading to efficient, adaptable, and effective learning systems.

Currently, many students and educators in developing communities struggle with Adoption Anxiety due to the lack of digital skills required to use and understand these technologies (Jatileni et al., 2024). "AI Readiness" refers to the level of understanding and competencies required by individuals to critically evaluate AI technologies (Long & Magerko, 2020) and make informed decisions. In the context of education and training, AI Readiness is not only about learning AI but also about preparing various fields to understand and leverage its capabilities. Experts have noted that the lack of AI proficiency among students and instructors hinders the effective integration of AI into the education sector (Zhai et al., 2021).

AI enhances information sharing; however, it is crucial to address data privacy concerns and algorithmic bias in the context of a developing country (Popenici & Kerr, 2017). These concerns should be addressed with an AI policy framework which provides risk mitigation and opportunities for the use of AI (Chan, 2023).

In developing countries, existing structural issues exist due to unequal access to digital media and supporting services. Notably, female students have less access to digital media, highlighting the digital divide. It is crucial to inform policymakers about the need to plan initiatives that bridge the digital divide and establish equitable, gender-sensitive learning policies (Mathrani et al., 2022).

To ensure a successful and responsible implementation of AI in academic settings, careful consideration and systematic preparation are essential. Ethics in Artificial Intelligence (AI) encompasses privacy protection and bias mitigation, ensuring the ethical and responsible use and development of AI technologies (Hermansyah et al., 2023). AI policies in higher education should address the potential risks and opportunities associated with AI technologies (Chan, 2023).

3 Methodology

By identifying competencies, we aim to empower developing countries to stay ahead in the field of AI Education and learn from the education sector in Developed This study utilises a Systematic Literature Review (SLR) to thoroughly identify and analyse core competencies for effective AI adoption in higher education. Countries. The process follows Dickson's (2023) protocol with an emphasis on transparency and replicability at every stage. The primary objective is to identify both the competencies required for AI readiness and to explore the benefits within higher education institutions.

Comprehensive searches were conducted across the following databases: SpringerLink, ScienceDirect, Sage Publications, Web of Science, ProQuest, and Wiley. The search combined terms related to higher education (e.g., universities, colleges) AND artificial intelligence (e.g., AI adoption, AI tools) AND academic programs or teaching methodologies.

The inclusion criteria included in this SLR:

- **Relevance:** The study should prioritise AI Education by identifying necessary competencies for adoption in higher educational institutes.
- **Publication Date:** Due to the rapid evolution of AI and to ensure the accuracy and relevance of the information used, only articles that have been published in the last five years are considered (2020 – 2024).
- **Language:** The studies must be published in English.
- **Population:** In line with the focus on developing countries and the Global South, only studies that present data, case studies, or empirical findings from these regions were considered. Only one article, published in the USA, was included due to its relevance to the topic and its contribution to developing countries.
- **Publication Type:** acceptable publications include peer-reviewed journal articles and conference proceedings.

Each article retrieved from the search was evaluated by analysing the title and abstract, based on the inclusion and exclusion criteria. An adaptation of the PRISMA diagram is used to illustrate the selection

process (Moher et al., 2010). The PRISMA diagram is presented in Fig. 1 below.

A total of 314 articles were collected from various databases. This was followed by a screening process that involved reviewing titles and abstracts, as well as full-text analysis, to assess eligibility. After removing duplicates, 309 publications were screened for relevance to AI adoption in HEIs. Based on the research questions, 134 articles were excluded, leaving 175 for full-text review. A further 135 were excluded for not meeting criteria, resulting in 40 articles included in the final SLR. In the data analysis part of this systematic literature review (SLR), a thematic analysis was conducted on the 40 academic papers summarising main themes and their corresponding recurring codes. This thematic analysis follows an inductive approach with main codes and sub-themes.

4 Findings

The findings of this SLR are composed through the identification of relevant and popular themes discussing the adoption of AI in tertiary institutions.

Looking at the years of publication, four (4) papers were published in 2020 and 2021, ten (10) in 2022, twelve (12) in 2023, and the remaining ten (10) papers were published in 2024. This effectively showcases the expanding body of knowledge on the application of AI technologies in higher education, highlighting the growing interest in discussion since 2021.

Common ideas and themes identified in the included papers (Byrne, 2022) are presented in Table 1.

The thematic analysis successfully identifies many competencies required for the successful adoption of AI in HEIs. Additionally, the analysis highlights several benefits of using AI tools that can be applied in HEIs in developing countries. The popularity of these themes, as presented in multiple papers, displays their interdependency, as digital infrastructure and governance policies are necessary for the effective use of AI tools. The findings are further synthesised according to the research questions.

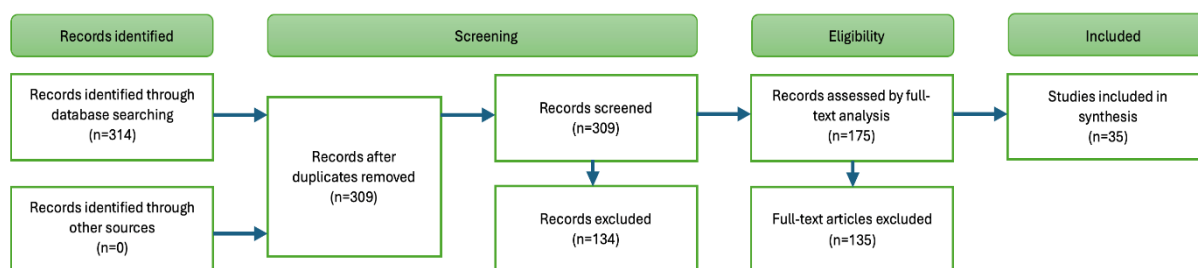


Figure 1. PRISMA Flowchart

Table 1. Thematic analysis themes

Main Themes	Sub themes	Extracted data from articles
Digital Access	Digital Infrastructure	• Quality of internet connections • Access to digital devices • Access to supporting services
Application of AI in HEIs	AI tools	• Personalised student learning • AI student performance evaluation • Remote learning • Improved language with generative AI
AI Compliance Requirements	AI ethics	• Reliability, accuracy & accountability • Data privacy
	AI readiness	• Student and Educator AI familiarity • Adoption anxiety
	Policy frameworks & guidelines	• AI Governance Policy Framework

Research Question 1: What competencies are essential for effective AI adoption in higher education?

32 out of 40 papers included in this SLR discuss different competencies required for the successful adoption of AI in HEIs and can be grouped into two categories: Digital Access and AI Compliance Requirements; four (4) articles discuss 'Quality Internet Connections,' six (6) articles cover 'Access to Digital Devices,' and two (2) articles explore 'Access to Support Services.' This highlights the necessity for digital infrastructure to ensure digital access competency.

A total of twenty-five (25) out of forty (40) articles discuss competencies included in AI compliance requirements to ensure the successful application of AI in HEIs (Table 2).

Table 2. Components of AI Compliance Requirements

Competency	Focus Area
AI ethics	Reliability, accuracy & accountability; data privacy
AI readiness	Student AI familiarity; educator AI familiarity; absence of adoption anxiety
Policy frameworks & guidelines	AI Governance Policy Framework

Research Question 2: Which benefits of AI applications in the Global South would help achieve access to quality education?

Typical beneficial applications of AI in HEIs highlighted in the present papers for this SLR include:

- Personalised Student Learning (15 Papers)
- AI Student Performance Evaluation (8 Papers)
- Remote Learning (3 Papers)
- Improved Language through Generative Artificial Intelligence (5 Papers)

5 Discussion

The findings highlighted in the previous section are discussed in relation to the research questions.

Research Question 1: What competencies are essential for effective AI adoption in higher education?

Achieving AI readiness and ensuring ethical compliance in Higher Education Institutions (HEIs) in developing countries hinges on a combination of infrastructure-based, ethical, pedagogical, and policy-level strategies. The literature reveals interconnected domains - digital access, AI ethics, AI literacy, and governance structures - each with its own set of competencies, challenges, and implementation mechanisms

Digital Infrastructure. Digital access refers to the differences in the attainability of digital infrastructures, such as the internet and digital devices, among individuals, households, and even businesses (Soomro et al., 2020). Varying levels of digital access arise due to different reasons, including social and economic status. For example, female students in rural areas often reported lower access to digital services, suggesting that personal characteristics may be a factor (Mathrani et al., 2022). Strategies to promote AI adoption begin with bridging digital infrastructure gaps. Ensuring reliable internet, access to devices, and user support services are consistently identified as prerequisites (Gupta & Bhaskar, 2020; Jaiswal, 2021).

COVID-19 highlighted the challenges faced by countries in the Global South when transitioning to online learning, due to poor internet connections and a lack of support services (Maphosa, 2023). This led to students incurring high expenses by purchasing data to participate in learning, highlighting a significant disparity in digital access between developed and developing countries (Sekwatlakwatla, 2023). Despite these challenges, research has indicated that Artificial Intelligence (AI) has the potential to bridge this gap by providing opportunities for quality education (Jaiswal, 2021). However, Gupta and Bhaskar (2020) emphasise that the successful adoption of AI relies on the availability of digital technologies and infrastructure, which should be provided by Higher Educational Institutions (HEIs).

To ensure a successful AI adoption in Higher Education, in terms of digital access, the following competencies have been identified:

- Ensure quality internet connections
- Ensure access to digital devices

- Ensure access to supporting services

Mechanisms proposed in the literature include institutional investments in infrastructure, subsidised data packages, and mobile-based AI platforms as scalable solutions. HEIs must adopt a proactive role in provisioning equitable digital environments.

The subcategories are now discussed in conjunction with the corresponding competencies.

AI Ethics. Many AI tools are being introduced into the education sector, raising concerns that Generative Artificial Intelligence (GAI) is not always accurate and reliable (Labadze et al., 2023). This highlights the importance of students double-checking work generated by chatbots. AI may also lead to a decline in students' writing and critical thinking skills if they become reliant on these automated tools (Chan, 2023), making it important for students to interact with these tools responsibly and with accountability. AI can also bring about privacy concerns, as students may unknowingly share personal information (Tamanna & Sinha, 2024), which can be collected and misused.

Key ethical competencies concerning the use of AI, extracted from multiple academic sources, include:

- Ensure the reliability and accuracy of AI tools used in HEIs
- Promote accountability when using AI tools in HEIs
- Ensure AI tools promote data privacy

Mechanisms such as mandatory ethics training, AI-use policies, and digital literacy curricula have been proposed (Labadze et al., 2023). Institutional adoption of privacy-compliant tools and transparent algorithmic practices is crucial for ensuring ethical alignment.

AI Readiness. Artificial Intelligence (AI) Readiness can be defined as the ability to leverage AI technologies and tools to your advantage (Luckin et al., 2022). However, it is not just about learning what AI is; it also involves using it and familiarizing oneself with it, ultimately improving one's mental model of AI technologies and developing a comprehensive understanding of these, as well as the societal implications that come with this technology (Sperling et al., 2024), creating a growing responsibility for both educators and students. When discussing the implications of Artificial Intelligence in Higher Education, many academic papers highlight the anxiety that accompanies this new venture, as educators fear changes to their job roles (Hemachandran et al., 2022; Shahid et al., 2024). Familiarising oneself with these technologies can reduce the anxiety associated with the unknown factor of using them (Tamanna & Sinha, 2024). However, the popularity of discussions on training needed to prepare students and educators for AI readiness is not supported by the required resources. This could lead to limitations in the adoption of AI in HEIs in developing countries, particularly in the absence of relevant governing guidelines and adequate funding.

The following competencies are identified for the promotion of AI Readiness in HEI AI adoption:

- Student AI familiarity
- Educator AI familiarity
- Absence of adoption anxiety

Proposed mechanisms include structured AI-readiness programs, peer-supported learning environments, and national frameworks supporting HEI AI training pipelines.

Policy Frameworks and Guidelines. The final enabler of AI readiness and compliance is a robust governance framework. Policy guidelines are a set of structural frameworks which support the development of understanding Artificial Intelligence (AI) in the education sector (Luckin et al., 2022). AI's potential to revolutionise the education sector (Chan, 2023) highlights the importance of guidelines to form a clear understanding of how to implement these technologies (Linderth et al., 2024), ultimately creating a systematic approach to decision-making on the implementation of these technologies. It is also crucial to establish these frameworks to determine where institutions can contribute by providing the necessary funding and infrastructure to implement AI effectively (Rahiman & Kodikal, 2024).

The following strategy focus areas have been identified to fulfil the competency of developing policy frameworks and guidelines:

- AI adoption guidelines for HEI use
- Governance of AI technologies in HEIs
- Funding for digital Infrastructure.

Effective mechanisms include the co-creation of AI guidelines with stakeholders, integration of AI into institutional strategic plans, and alignment with Sustainable Development Goals.

Research Question 2: What are the benefits of using AI in the Global South's HEIs that lead to access to quality education?

AI Tools. Artificial Intelligence (AI) is a technology that has the potential to transform every sector of our lives (Hemachandran et al., 2022), particularly in the realm of education and learning. Mannuru et al. (2023) describe Generative Artificial Intelligence (GAI) as a powerful tool for enhancing communication skills and removing language barriers. GAI has several strong points, including suggesting improvements in grammar and formatting (Alqahtani et al., 2023), as well as assessing the quality of research literature and identifying reliable sources.

AI has promoted distance learning (Mustopa et al., 2024), enabling students to maintain a social presence without being physically present in a classroom (Leoste et al., 2022), which could benefit students in developing countries by providing them with access to quality education from around the world. However, challenges may arise if there are issues with the quality and speed of internet connections.

A notable creation is the introduction of AI Teachers or 'Machine Teachers' (Kim et al., 2020), designed to answer student questions and provide a virtual reality learning experience (Opesemowo & Adekomaya, 2024). AI has enhanced the teaching

system by providing Personalised Student Learning (Labadze et al., 2023), offering tailored feedback according to individual needs (Chan, 2023), ultimately improving the student's experience and fostering inclusivity (Alam et al., 2023).

Educators also benefit from the capabilities of Artificial Intelligence. AI-driven Student Performance Evaluation systems can grade work while providing feedback (Filgueiras, 2023), streamlining mundane tasks, and giving educators more time for one-on-one instruction (Tamanna & Sinha, 2024). Additionally, AI can predict learning outcomes through big data analysis (Crompton & Burke, 2023) and identify the students who are struggling (Filgueiras, 2023).

The following benefits obtained from the use of AI tools in HEIs, as identified in multiple research sources included in this study, are as follows:

- Personalised student learning
- Automated student performance evaluation
- Remote learning
- Improved language skills and reduced language barriers using Generative Artificial Intelligence (GAI).

6 Conceptual contribution

To further conceptualise the competencies required to aid the adoption of AI in HEIs of developing countries, a Technology–Organisation–Environment (TOE) framework is used (Malik et al., 2021). The TOE framework model is presented in Fig. 2 below.

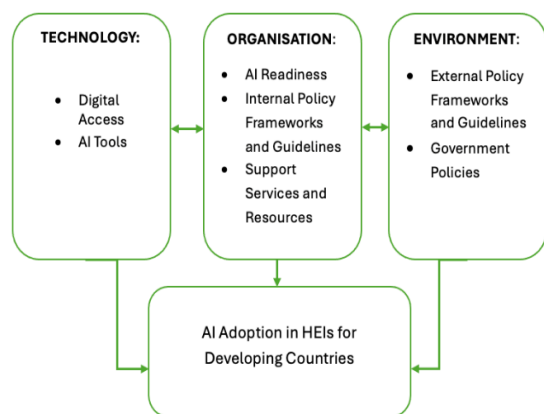


Figure 2. TOE Framework Conceptual Model

The TOE framework displays the various technological, organisational, and environmental competencies required for the adoption of AI in HEIs of developing countries and display their interdependencies.

The technology factor discusses the necessity for AI tools and digital access, which includes competencies such as access to quality internet connections, digital devices and supporting services.

The organisational factor highlights the need for AI readiness, internal policy guidelines, and relevant support services, including maintenance and training services, for the effective use of AI tools. The environmental factor discusses the need for external policy frameworks that govern the use of AI in HEIs and the conformance of government policies, such as data privacy laws. The interdependencies displayed in this TOE framework underscore the need for competencies to coexist simultaneously for the successful adoption of AI in HEIs of developing countries.

7 Conclusion

This paper employed a Systematic Literature Review (SLR) approach, where a total of 40 previously published academic papers were collected from various online databases and subjected to several screening phases to determine their relevance to answering our research questions. The research questions aimed to identify the key competencies required for the effective adoption of Artificial Intelligence (AI) in Higher Education Institutions (HEIs), specifically in developing countries (RQ1), and to highlight the potential benefits obtained from its implementation in accessing quality education in developing countries (RQ2). A thematic analysis was applied to group similar points of discussion in a more meaningful manner, grouping codes under corresponding themes and sub-themes.

This SLR has successfully investigated and identified the key competencies required for the effective adoption of AI in higher education institutions in developing countries, as well as the potential benefits. Through an in-depth analysis of the selected 40 academic papers, we have found two categories of competencies required for the successful adoption of AI in HEIs being Digital Access, composed of the digital infrastructural competencies, and the AI Compliance Requirements category composed of the sub-competency categories including: AI ethics, AI readiness and Policy Frameworks and guidelines that need to be present for the successful implementation of AI in HEIs and to obtain the benefits from using AI technologies in HEIs to access quality education in developing countries.

The research highlights an interlinking relationship between technology infrastructure, organisational infrastructure and environmental infrastructure through the conceptualisation using the TOE framework. The main challenge of the digital divide presents disparities in access to digital devices, along with limits on quality internet connections and the availability of supporting services. These create a significant barrier to the successful adoption of AI in HEIs in developing countries. This divide is emphasised by economic and personal characteristics

getting in the way, where female students face further limitations in obtaining access.

This review identified several AI tools that have the power to revolutionise and increase access to quality education in the Global South, including personalised student learning, automated student performance evaluation, and improved language using GAI. These tools present promising opportunities to expand on quality and accessible education in developing countries by creating a space to learn from any location while removing language barriers. This effective implementation relies on the presence of digital infrastructure and devices required for the use of these AI tools.

The SLR highlights the need for policy guidelines and frameworks that govern the adoption and use of these technologies in higher education. Furthermore, this review highlights the need for both students and educators to familiarise themselves with these technologies to lessen the effects of AI anxiety or resistance to change. This emphasises the need for training programs on how to adopt and use these tools effectively.

Although this SLR identified the need for training programs to increase AI readiness, there is a lack of research on how these programs can be effectively implemented. It is suggested that further research investigates the development of these training programs.

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