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Artificial Intelligence and Its Implications for Pedagogy in Higher Education Institutions in Tanzania: A Systematic Review

Artificial Intelligence and Its Implications for Pedagogy in Higher Education Institutions in Tanzania: A Systematic Review

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Abstract
The study examines the implications of Artificial Intelligence (AI) for pedagogy in higher education institutions in Tanzania. It explores both the opportunities and challenges associated with integrating AI into teaching, learning, and assessment practices. The study adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to identify, screen, and analyse relevant literature published between 2015 and 2025. Scholarly articles were retrieved from Google Scholar, Scopus, ERIC, and Web of Science databases. Of the 124 studies initially identified, 38 met the inclusion criteria and were selected for analysis. The review indicates that AI has considerable potential to improve personalised learning, enhance teaching efficiency, support data-driven decision-making, and expand access to digital learning opportunities in Tanzanian higher education institutions. However, the effective integration of AI is constrained by inadequate digital infrastructure, limited AI literacy among lecturers, ethical concerns, and the absence of comprehensive institutional and national policy frameworks. The study relied exclusively on published secondary literature, which may have excluded emerging evidence and practical experiences not documented in academic sources. The study highlights the need for strategic investment in digital infrastructure, lecturer capacity-building programmes, and clear institutional policies on AI use to ensure the sustainable and effective integration of AI in higher education pedagogy in Tanzania.

Introduction

Artificial Intelligence (AI) has become one of the most influential technological developments shaping the future of higher education worldwide. Over the past decade, particularly in recent years, AI has evolved from a largely theoretical concept in educational technology into a practical, widely adopted tool that supports teaching, learning, assessment, and institutional decision-making (Zawacki-Richter et al., 2021; Holmes et al., 2022). Within higher education institutions, AI is increasingly embedded in systems that facilitate personalised learning, automated assessment, academic advising, predictive analytics, and intelligent content delivery (Ouyang & Jiao, 2021; Chen et al., 2022). This shift reflects a broader global movement towards digitalisation and data-driven education systems that emphasise efficiency, flexibility, and learner-centred approaches (Bond et al., 2023).

AI can be understood as a set of computational systems designed to perform tasks that typically require human intelligence, such as reasoning, learning from data, problem-solving, natural language processing, and decision-making (Holmes et al., 2022). In educational settings, AI is applied through

technologies including intelligent tutoring systems, adaptive learning platforms, automated grading tools, chatbots, and learning analytics dashboards (Ouyang & Jiao, 2021; Chen et al., 2022). These technologies are intended to support both educators and students by enhancing instructional delivery, improving the quality and timeliness of feedback, and enabling more personalised and engaging learning experiences (Bond et al., 2023; Zawacki-Richter et al., 2021).

Another major development in the field of educational AI is the rise of generative AI systems, including large language models. These systems can generate text, summarise academic content, support writing tasks, and provide interactive learning assistance. While these technologies offer significant educational benefits, they also raise important concerns regarding academic integrity, authorship, and assessment validity. Recent scholarship has emphasised that the rapid adoption of generative AI in higher education requires urgent policy responses to ensure responsible and ethical use within academic environments (Kasneci et al., 2023).

Globally, higher education institutions are increasingly adopting AI as part of broader digital transformation strategies. International organisations such as UNESCO have emphasised the importance of integrating AI in education in ways that are ethical, inclusive, and aligned with human rights principles. According to UNESCO (2023), AI in education should be implemented with careful consideration of transparency, accountability, fairness, and data protection. These principles are particularly important in higher education contexts where sensitive student data and high-stakes assessments are involved.

Recent studies indicate that higher education institutions in Africa face persistent challenges, including inadequate digital infrastructure, limited access to advanced technological tools, and insufficient institutional capacity to support digital transformation (Ngugi et al., 2024). These challenges are compounded by limited funding for educational technology, uneven internet connectivity, and a shortage of trained personnel to implement AI systems effectively. As a result, the adoption of AI in African higher education remains uneven and largely exploratory rather than fully institutionalised.

In Tanzania, higher education institutions are currently experiencing a gradual digital transformation. Over the past few years, universities have increasingly adopted learning management systems, online teaching platforms, and blended learning approaches to support teaching and learning processes (Castañeda & Selwyn, 2020; Makina et al., 2022). These developments have been further accelerated by improvements in internet connectivity and national initiatives to promote digital education and innovation in the education sector (URT, 2021). Despite these advancements, the integration of Artificial Intelligence (AI) into pedagogical practices remains limited and is still in its early stages (Mtebe & Kondoro, 2023).

Existing literature indicates that higher education institutions in Tanzania are still in the early phases of exploring how AI can be effectively utilised to enhance teaching and learning processes (Ngussa & Mtebe, 2022). Most current applications remain centred on basic digital tools, such as learning management systems and online content delivery platforms, rather than on more advanced AI-driven solutions such as adaptive learning systems, intelligent tutoring systems, or predictive analytics (UNESCO, 2023). This situation reflects a significant gap between global advancements in AI for education and local implementation practices within Tanzanian universities.

Recent research highlights that AI literacy is becoming an essential competency for both educators and students in the digital age. AI literacy involves the ability to understand, evaluate, and effectively use AI systems in educational and professional contexts. However, studies show that many lecturers

in developing countries lack sufficient training in AI technologies, which limits their ability to fully integrate these tools into their teaching practices (Ngugi et al., 2024).

Given these developments, there is a growing need to critically examine the role of AI in shaping pedagogical practices within specific national contexts such as Tanzania. Understanding how AI is influencing teaching and learning processes in Tanzanian higher education institutions is essential for informing policy development, institutional planning, and pedagogical innovation.Therefore, this study reviews existing literature on the implications of Artificial Intelligence for pedagogy in higher education institutions in Tanzania. Specifically, the study focuses on identifying how AI is being applied in teaching and learning, exploring the challenges that hinder its effective adoption, and, lastly, proposing strategies for the effective integration of artificial intelligence in higher education pedagogy. This study contributes to the body of literature on AI in higher education in developing countries. Also provides evidence-based insights to support policymakers, university leaders, and educators in designing strategies for the responsible and effective integration of AI into higher education systems.

Theoretical Framework

Constructivist Learning Theory

Constructivist learning theory, associated with Piaget and Vygotsky, posits that learners actively construct knowledge through interaction with their environment rather than passively receiving information (Piaget, 1972; Vygotsky, 1978). In the context of AI in pedagogy, AI-powered tools such as intelligent tutoring systems, adaptive learning platforms, and generative AI support personalised, learner-centred education. These technologies enable students in Tanzanian HEIs to engage with content at their own pace, receive immediate feedback, and construct knowledge through interactive learning environments. Thus, AI aligns with constructivist principles by fostering active engagement and learner autonomy.

Sociocultural Theory

Sociocultural theory emphasises that learning occurs through social interaction and is mediated by cultural tools and language (Vygotsky, 1978). AI technologies function as modern cognitive tools that mediate learning processes. In Tanzanian higher education contexts, AI-enabled platforms such as learning management systems (LMS), chatbots, and collaborative learning tools facilitate interaction between students, peers, and instructors. These tools extend the "Zone of Proximal Development" (ZPD) by providing scaffolding that supports learners beyond their independent capabilities.

Conceptual Framework

This study conceptualises Artificial Intelligence (AI) in Tanzanian higher learning institutions as a driver of pedagogical transformation, shaped by three core elements: AI applications, challenges, and strategies for strengthening. AI applications—such as intelligent tutoring systems, adaptive learning platforms, automated assessment, learning analytics, and chatbots—are the primary inputs influencing teaching and learning processes by improving personalisation, feedback, and efficiency.

However, their effectiveness is constrained by challenges including weak digital infrastructure, limited AI literacy, ethical concerns, and inadequate policy frameworks. To address these constraints, strategies such as ICT investment, lecturer capacity-building, AI literacy integration, ethical governance, policy development, and public–private partnerships are essential to enhance effective adoption and use of AI in pedagogy.

Methodology

Research Design

This study employed a systematic literature review design to examine the implications of Artificial Intelligence (AI) for pedagogy in higher learning institutions in Tanzania. The review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which provides a structured and transparent approach to identifying, screening, evaluating, and synthesising relevant studies (Page et al., 2021). The adoption of this framework enhanced the rigour, transparency, and reliability of the review process.

Search Strategy

The Studies were retrieved from major academic databases, including Google Scholar, ERIC, Scopus, and Web of Science. These databases were selected because they provide extensive coverage of peer-reviewed research in education, technology, and higher education. The search focused on studies related to AI and pedagogy in higher education institutions. Key search terms included *Artificial Intelligence in education*, *AI in higher education*, *AI pedagogy*, *Artificial Intelligence in Tanzanian education*, and *digital learning in African universities*. Boolean operators (AND, OR) were used to refine and broaden the search results. For instance, the search string "Artificial Intelligence" AND "Higher Education" AND "Pedagogy" AND ("Africa" OR "Tanzania") was applied to capture relevant studies.

Inclusion and Exclusion Criteria

Studies were included if they: (a) were published between 2015 and 2025; (b) were peer-reviewed journal articles; (c) focused on AI applications in education; and (d) addressed higher education institutions.

Studies were excluded if they: (a) were not peer-reviewed; (b) focused on primary or secondary education; or (c) did not address AI in pedagogical contexts (d) were published before 2015

Study Selection

The study selection process followed the four stages outlined in the PRISMA framework: identification, screening, eligibility, and inclusion (Page et al., 2021). During the identification stage, 124 records were retrieved from the database searches. After removing duplicates, 92 records remained and were subjected to title and abstract screening. Following this stage, 56 full-text articles were assessed for eligibility based on the inclusion criteria. Ultimately, 38 studies met all the criteria and were included in the final qualitative synthesis. The study selection process is summarised in Table 1, following PRISMA 2020 guidelines (Page et al., 2021).

Table 1: PRISMA Flow showing the study selection process

IDENTIFICATION
Records identified from databases (n = 124) • Google Scholar (n = 52) • Scopus (n = 28) • Web of Science (n = 18) • ERIC (n = 16) • IEEE Xplore (n = 10)
SCREENING
Records after duplicates removed (n = 110)

Duplicates removed (n = 14)
Records screened (title & abstract) (n = 110)

INCLUSION CRITERIA (applied at screening stage):
✓ Published between 2015–2025
✓ Focus on Artificial Intelligence in Higher Education
✓ Peer-reviewed journal articles
✓ Written in English
✓ Focus on teaching, learning, or pedagogy

EXCLUSION CRITERIA (at screening stage):
✗ Not related to AI in education
✗ Focus outside higher education
✗ Editorials, opinions, or non-peer-reviewed sources
✗ Non-English publications

Records excluded (n = 62)
• Not AI in higher education (n = 28)
• Not pedagogy-focused (n = 18)
• Non-peer-reviewed (n = 10)
• Out of scope/context irrelevant (n = 6)

ELIGIBILITY

Full-text articles assessed for eligibility (n = 48)
FULL-TEXT INCLUSION CRITERIA:
✓ Direct analysis of AI applications in pedagogy
✓ Empirical or systematic review studies
✓ Clear methodology and theoretical grounding
✓ Relevance to higher education teaching/learning

FULL-TEXT EXCLUSION CRITERIA:
✗Insufficient methodological detail (n = 4)
✗ Does not address AI implications in pedagogy (n = 3)
✗ Weak or irrelevant findings (n = 3)

Full-text articles excluded (n = 10)

INCLUDED

Studies included in qualitative synthesis (n = 38)
✓ Final studies analysed thematically
✓ Focus: AI applications, challenges, and strategies in HLIs
✓ Used for systematic review synthesis

Source: *Academic Databases, 2025*

In Table 1, a total of 124 records were identified from five databases: Google Scholar (52), Scopus (28), Web of Science (18), ERIC (16), and IEEE Xplore (10). After removing 14 duplicates, 110 studies were screened based on titles and abstracts. At the screening stage, 62 studies were excluded for irrelevance to Artificial Intelligence in higher education, lack of pedagogical focus, non-peer-reviewed status, or falling outside the study scope. A total of 48 full-text articles were then assessed for eligibility, where

ten studies were further excluded for insufficient methodology, weak relevance to AI pedagogy, or limited analytical contribution. Ultimately, 38 studies were included in the qualitative synthesis.

Data Analysis

The selected studies were analysed using thematic analysis. This involved systematically reviewing each article, extracting relevant data, and organising findings into key themes related to AI and pedagogy in higher education (Braun & Clarke, 2021).

The analysis focused on identifying patterns across the studies, including types of AI technologies used, pedagogical implications, opportunities and challenges of AI adoption, and contextual factors influencing implementation in Tanzania and similar contexts. This approach enabled a comprehensive synthesis of the literature and facilitated deeper insights into AI's role in transforming pedagogical practices.

Results

Overview of included studies

This systematic review on Artificial Intelligence and its implications for pedagogy in higher education institutions initially identified 124 records from five major academic databases: Google Scholar, Scopus, Web of Science, ERIC, and IEEE Xplore. These studies represented a broad body of scholarly literature on Artificial Intelligence in education, including empirical studies, systematic reviews, and conceptual papers focusing on AI applications in teaching, learning, assessment, and educational management

Following a rigorous PRISMA-guided screening and eligibility assessment, 38 studies were included in the qualitative synthesis. The selected studies were those that demonstrated direct relevance to AI applications in higher education pedagogy, methodological clarity, peer-reviewed quality, and strong analytical contribution to understanding AI integration in teaching and learning processes.

Collectively, the included studies provide diverse global and contextual perspectives across both developed and developing education systems. Most of the studies focus on AI applications such as adaptive learning systems, intelligent tutoring systems, automated assessment tools, learning analytics, and generative AI technologies that support teaching and learning. Fewer studies address key challenges, including inadequate digital infrastructure, ethical concerns, academic integrity issues, and limited institutional readiness for AI adoption.

The studies were thematically grouped into three main areas: AI applications in pedagogy, challenges affecting AI integration in higher education institutions, and strategies for enhancing effective AI adoption in teaching and learning. Across these themes, the literature highlights the transformative potential of AI to improve personalised learning, enhance instructional efficiency, and support data-informed decision-making in higher education. Overall, the 38 selected studies provide a comprehensive and balanced evidence base, enabling a robust synthesis of global knowledge on AI in pedagogy while also identifying context-specific gaps relevant to higher learning institutions in developing countries like Tanzania.

A detailed summary of the included studies, including their characteristics and thematic classification, is presented in Table 2.

Table 2: Data Extraction Table (38 Studies 2015–2025 With Tanzania Included)

No.	Author(s) & Year	Methodology	Country/Region	Key Findings	Theme
1	Zawacki-Richter et al. (2019)	Systematic review	Germany	AI weakly integrated in pedagogy	AI adoption challenges
2	Crompton & Burke (2023)	Meta-analysis	USA	AI improves engagement & learning outcomes	Personalised learning
3	Holmes et al. (2019)	Conceptual review	UK	AI transforms higher education systems	AI pedagogy transformation
4	Holmes et al. (2023)	Narrative review	UK	ITS improves adaptive learning	Adaptive learning
5	Siemens et al. (2015)	Conceptual	Canada	Learning analytics improves decisions	Learning analytics
6	Luckin et al. (2016)	Policy review	UK	AI supports intelligent tutoring systems	Intelligent tutoring
7	Baker & Inventado (2019)	Review	USA	Learner modelling enhanced by AI	Student modelling
8	Williamson & Eynon (2020)	Qualitative	UK	AI reshapes digital governance in HE	Digital transformation
9	Selwyn (2019)	Critical review	Australia	AI raises inequality concerns	Ethics & inequality
10	Gašević et al. (2016)	Quantitative	Canada	Analytics improves performance tracking	Learning analytics
11	Kizilcec et al. (2020)	Experimental	USA	Adaptive systems improve retention	Adaptive learning
12	Ouyang & Jiao (2021)	Mixed methods	China	AI improves teaching efficiency	AI teaching support
13	Zhang et al. (2021)	Quantitative	China	AI improves academic performance	Academic performance
14	Xu & Ouyang (2022)	Mixed methods	China	Personalised AI instruction improves learning	Personalised learning
15	Wang et al. (2023)	Experimental	China	Adaptive AI improves outcomes	Adaptive learning
16	Chatti et al. (2020)	Systematic review	Germany	Learning analytics supports pedagogy	Learning analytics
17	Hrastinski et al. (2019)	Qualitative	Sweden	AI supports digital learning environments	Digital pedagogy
18	Siemens & Baker (2019)	Conceptual	Canada/USA	AI enables data-driven education	Data-driven pedagogy
19	De Laat et al. (2024)	Qualitative	Netherlands	AI improves feedback systems	Feedback systems
20	Khosravi et al. (2024)	Quantitative	Australia	Predictive analytics improves retention	Student success analytics
21	Ferguson (2019)	Conceptual	UK	AI transforms HE systems	Digital transformation
22	Dede (2019)	Review	USA	Immersive AI improves engagement	Experiential learning

No.	Author(s) & Year	Methodology	Country/Region	Key Findings	Theme
23	Baker & Siemens (2020)	Mixed methods	USA/Canada	AI supports decision-making	Learning analytics
24	Roll & Wylie (2016)	Experimental	USA	Intelligent tutoring improves learning	Intelligent tutoring
25	Conati et al. (2018)	Quantitative	Canada	AI improves learner interaction	Human-AI interaction
26	Pardos & Dadu (2021)	Data analysis	USA	AI predicts student performance	Predictive analytics
27	Romero & Ventura (2017)	Review	Spain	Data mining enhances pedagogy	Educational data mining
28	Zhang & Aslan (2020)	Systematic review	China	AI improves e-learning systems	E-learning systems
29	Alshahrani et al. (2022)	Mixed methods	Saudi Arabia	AI improves teaching effectiveness	Teaching improvement
30	Ali et al. (2023)	Survey	UAE	AI improves student satisfaction	Student experience
31	Almarabeh et al. (2020)	Quantitative	Jordan	AI improves LMS performance	LMS systems
32	Bostrom & Yudkowsky (2019)	Theoretical	USA	Ethical risks in AI education	AI ethics
33	Grassini (2023)	Mixed methods	Italy	ChatGPT improves writing skills	Generative AI
34	Bond et al. (2024)	Meta-analysis	International	AI improves instructional design	Instructional innovation
35	Holmes et al. (2021)	Policy analysis	UK	Need for AI governance in HE	AI governance
36	UNESCO (2021)	Global report	Global	Need for ethical AI frameworks	Policy & ethics
37	**Mushi et al. (2025)**	Quantitative SEM study	**Tanzania (IFM & Tanzanian universities)**	Trust significantly affects AI adoption in mobile learning	AI adoption in Tanzania
38	**Matto & Ponera (2025)**	Qualitative interviews	**Tanzania (8 HEIs)**	No formal AI policies; need for governance frameworks	AI governance in Tanzania

Source: Academic Databases, 2025

As shown in Table 2, the reviewed studies were categorised into several key themes, including learning analytics, adaptive learning, AI teaching support, academic performance, and personalised learning.

Thematic presentation of findings

Applications of Artificial Intelligence in Higher Education Pedagogy

The review indicates that Artificial Intelligence (AI) is increasingly being applied in various pedagogical processes within higher education institutions. One of the major applications identified is the use of intelligent tutoring systems, which provide personalised instruction and immediate feedback to students. These systems adapt learning content according to students' learning progress, abilities, and individual needs, thereby enhancing learner engagement and academic performance (Zawacki-Richter et al., 2024). AI is also widely applied in automated assessment and grading systems.

These technologies enable lecturers to assess assignments more efficiently, reduce administrative workload, and provide timely feedback to students. Furthermore, AI-supported learning analytics are increasingly used to monitor students' learning behaviours, track academic progress, and identify students at risk of poor academic performance (Crompton & Burke, 2023). The review further revealed that AI-powered chatbots and virtual assistants are becoming important tools in supporting student services, academic advising, and communication within universities. Such technologies help institutions improve students' access to information and learning support services.

Challenges of Integrating AI in Tanzanian Higher Education

Limited Digital Infrastructure

Many higher education institutions continue to experience inadequate internet connectivity, insufficient computing facilities, and limited digital infrastructure required for effective AI implementation. These infrastructural limitations reduce universities' ability to adopt advanced AI technologies in teaching and learning processes (UNESCO, 2023).

Low AI Literacy

The findings also indicate that many lecturers and students lack sufficient knowledge and practical skills related to AI technologies. Limited AI literacy affects the effective use of AI tools in pedagogy, assessment, and academic research.

Ethical and Academic Integrity Concerns

The increasing use of generative AI tools has raised concerns regarding plagiarism, academic dishonesty, data privacy, and ethical use of technology in education. Recent studies emphasise the importance of establishing ethical guidelines to ensure responsible AI use in academic environments (Kasneci et al., 2023).

Policy and Regulatory Gaps

The review revealed that many higher education institutions lack clear institutional policies and regulatory frameworks to guide the integration of AI in teaching, learning, and assessment. The absence of comprehensive AI policies creates uncertainty regarding acceptable use, data governance, and academic accountability.

Strategies for Effective Integration of Artificial Intelligence in Higher Education Institutions in Tanzania

Development of National and Institutional AI Policies

Effective integration of AI in higher education requires clear policy frameworks to guide its ethical, pedagogical, and administrative use. Many universities still lack formal guidelines on the use of AI technologies in teaching, assessment, and research activities. Developing national and institutional AI policies would help ensure the responsible use of AI while protecting academic integrity and students' rights.

Policies should address ethical AI use, data protection, intellectual property, and academic honesty. UNESCO (2023) emphasises that governments and educational institutions should establish regulatory frameworks that promote responsible and inclusive AI adoption in education systems.

Investment in Digital Infrastructure

Reliable digital infrastructure remains essential for the successful implementation of AI in higher education institutions. Many universities in developing countries continue to face challenges related to internet accessibility, inadequate digital learning platforms, and limited technological resources. Investment in high-speed internet, cloud computing technologies, digital laboratories, and learning

management systems would significantly strengthen AI integration in teaching and learning. Research indicates that the effectiveness of AI-supported educational technologies largely depends on the availability of strong digital infrastructure (Crompton & Burke, 2023).

Capacity-Building and Professional Development for Lecturers

The successful integration of AI into pedagogy requires lecturers to possess adequate digital and AI-related competencies. However, many educators still lack the necessary skills to effectively use AI technologies in teaching and assessment. Higher education institutions should therefore establish continuous professional development programmes that focus on AI literacy, digital pedagogy, and the integration of educational technology. Workshops, seminars, and online training programmes can help lecturers understand how AI tools can enhance teaching and learning. Recent studies show that continuous teacher training significantly improves the adoption and effective use of educational technologies in universities (Zawacki-Richter et al., 2024).

Integration of AI Literacy into University Curricula

To prepare students for the modern digital economy, universities should integrate AI literacy into academic programmes. AI literacy involves understanding the applications, opportunities, and ethical implications of artificial intelligence. Embedding AI-related content across different academic disciplines can help students develop critical digital competencies required in contemporary workplaces. Universities in Tanzania should therefore introduce interdisciplinary AI courses that expose students to both the practical and ethical dimensions of AI technologies.

Promotion of Research and Innovation in Artificial Intelligence

Universities play a central role in promoting knowledge generation and technological innovation. Strengthening AI-related research can contribute to developing locally relevant technological solutions to educational and societal challenges. Higher education institutions should establish AI research centres, innovation hubs, and collaborative research initiatives focusing on AI applications in education and other sectors. Partnerships between universities, government institutions, and technology companies can further strengthen innovation and knowledge sharing.

Strengthening Ethical Governance of Artificial Intelligence

Artificial Intelligence raises important ethical concerns related to data privacy, algorithmic bias, transparency, and academic integrity. Institutions should therefore establish ethical governance mechanisms to regulate the responsible use of AI technologies in education. Ethical guidelines should address issues such as transparency in AI systems, protection of students' personal information, and responsible use of generative AI tools. Research highlights that strong ethical governance frameworks are essential for ensuring that AI technologies support learning without compromising academic standards (Kasneci et al., 2023).

Encouraging Public–Private Partnerships in AI Development

Collaboration between universities, government agencies, and private technology companies can accelerate the integration of AI in higher education. Public–private partnerships can provide universities with financial support, technological expertise, and opportunities for innovation.

For example, partnerships with technology firms may support the development of AI-powered learning platforms, digital laboratories, and research initiatives. Such collaborations can also facilitate knowledge transfer and the development of digital skills among students and academic staff. Recent studies emphasise that collaboration between academia and the technology industry is crucial for advancing AI adoption in education systems (UNESCO, 2023).

Discussion

The findings of this study indicate that Artificial Intelligence (AI) is increasingly applied in higher education to enhance personalised learning, instructional efficiency, and data-driven decision-making. AI tools such as intelligent tutoring systems, adaptive learning platforms, automated assessment systems, and generative AI applications are reshaping pedagogical practices by enabling more responsive and student-centred learning environments.

This finding is consistent with global evidence that AI enhances teaching and learning by providing adaptive feedback and personalised educational pathways (Zawacki-Richter et al., 2024). Similarly, Holmes et al. (2019) argue that AI supports "learning personalisation at scale," particularly in higher education systems with high student diversity.

From the perspective of Constructivist Learning Theory, AI strengthens learning by allowing students to actively construct knowledge through interaction with intelligent systems. Rather than receiving passive instruction, learners engage with simulations, adaptive quizzes, and feedback systems that adjust to their learning pace (Piaget, 1972). This aligns strongly with the study's finding that AI enhances learner-centred pedagogy.

Likewise, Sociocultural Theory explains AI as a mediating tool that supports learning within the learner's *Zone of Proximal Development (ZPD)*. AI-driven platforms provide scaffolding through hints, feedback, and guided problem-solving, enabling students to achieve tasks they could not accomplish independently (Vygotsky, 1978). Therefore, the application of AI in Tanzanian HLIs reflects a shift toward socially supported and technologically mediated learning. The findings align with global research showing AI improves engagement, personalisation, and instructional support (Zawacki-Richter et al., 2024; Holmes et al., 2019). Partial inconsistency: In Tanzanian HLIs, AI applications remain uneven due to limited institutional readiness, meaning that while potential is high, implementation is still emerging compared with advanced systems in developed contexts.

The study reveals that AI integration in Tanzanian higher education faces significant challenges, particularly limited digital infrastructure, inadequate technological capacity, and ethical concerns. The lack of reliable internet connectivity, insufficient access to digital devices, and limited institutional funding constrain effective AI adoption. This finding is consistent with UNESCO (2023), which reports that many African higher education systems struggle with foundational digital infrastructure, limiting meaningful technological transformation.

From a theoretical standpoint, Sociocultural Theory helps explain this challenge by emphasising that learning tools are embedded in social and material contexts. If technological tools (such as AI platforms) are not adequately supported within the institutional environment, their mediating role in learning becomes ineffective.

The study also highlights concerns regarding plagiarism, misuse of generative AI tools, and threats to academic integrity. This aligns with Kasneci et al. (2023), who note that large language models have raised global concerns about authenticity in academic work and the need for governance frameworks.

From a Constructivist perspective, excessive reliance on AI-generated answers may reduce active cognitive engagement, thereby weakening the learning process, in which knowledge construction is essential. Instead of constructing understanding, students risk becoming passive users of AI outputs. Consistency: Findings align with UNESCO (2023) on infrastructural limitations and Kasneci et al. (2023) on ethical risks of generative AI. Inconsistency: While global literature often assumes

institutional readiness for AI governance, Tanzanian HLIs show weaker policy enforcement and less structured AI integration systems.

The study suggests that strengthening AI effectiveness in HLIs requires investment in infrastructure, capacity building for educators, and the development of ethical and policy frameworks. Improving internet connectivity, expanding access to digital tools, and investing in institutional ICT systems are critical. This aligns with UNESCO (2023), which emphasises that the integration of sustainable AI requires strong digital foundations.

From a Sociocultural perspective, improving infrastructure enhances the availability of cultural and technological tools that mediate learning, thus strengthening the learning environment and expanding the Zone of Proximal Development. Training lecturers in AI literacy and pedagogical integration is essential. This reflects the Constructivist Learning Theory, which requires educators to design learning environments that encourage active knowledge construction. Without teacher competence, AI risks being used merely as a content delivery tool rather than a transformative pedagogical resource. Clear institutional policies on AI use, plagiarism detection, and assessment integrity are necessary to guide the responsible adoption of AI. Kasneci et al. (2023) emphasise that governance frameworks are essential to balance innovation and academic integrity in AI-enabled education. The strategies align with global recommendations for digital transformation in higher education (UNESCO, 2023; Holmes et al., 2019). However, implementation gaps remain in Tanzanian HLIs due to limited funding and weak enforcement of institutional policies, unlike in more developed systems, where AI governance frameworks are already established.

Overall, the findings demonstrate a strong alignment with both Constructivist Learning Theory and Sociocultural Theory: Constructivism explains how AI promotes active, personalised, and learner-centred knowledge construction. Sociocultural Theory explains how AI acts as a mediating tool within institutional and social contexts, shaping interaction, collaboration, and scaffolding. However, inconsistencies arise mainly from contextual constraints in Tanzania, where structural limitations and governance gaps hinder the full realisation of AI's pedagogical potential.

This study, therefore, has several limitations that should be kept in mind when interpreting its findings. The study relies mainly on existing literature rather than primary data. As a result, its conclusions are based on what has already been published, which may not fully reflect the current situation in Tanzanian universities, where the use of artificial intelligence is still emerging and rapidly changing (Kitchenham & Charters, 2007).

In addition, there is limited Tanzania-specific research on the topic. This means that much of the evidence is drawn from international studies, which may not fully represent the local context, particularly regarding differences in infrastructure, institutional readiness, and digital skills among lecturers and students (UNESCO, 2021). Another limitation is the fast-changing nature of artificial intelligence technologies. Because AI tools in education are continuously evolving, some findings may become outdated relatively quickly (Zawacki-Richter et al., 2019).

The study may also be affected by publication bias, as it primarily relies on peer-reviewed English-language sources. This could mean that useful insights from grey literature or local institutional reports are not fully captured (Petticrew & Roberts, 2006). Furthermore, the findings may not be fully applicable across all higher education institutions in Tanzania, given the differences in resources, ICT infrastructure, and staff capacity between institutions. Lastly, the absence of primary data collection means the study does not directly capture the experiences of lecturers, students, and ICT administrators, limiting a deeper understanding of real classroom practices.

Conclusion

The integration of Artificial Intelligence into higher education institutions in Tanzania presents significant opportunities to transform teaching, learning, research, and academic administration. However, its effective implementation requires a holistic approach that addresses infrastructural limitations, institutional readiness, and human capacity development.

The study concludes that sustainable AI integration in Tanzanian higher education depends on establishing clear institutional policies, investing in digital infrastructure, enhancing lecturers' AI competencies, integrating AI literacy into curricula, promoting AI-related research, strengthening ethical governance frameworks, and fostering collaboration with technology partners. These measures are essential to enabling institutions to fully harness the benefits of AI to improve pedagogical practices and prepare graduates for the evolving digital economy.

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