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The Perspective and Impact of Technology among Students and Teachers: An Insight into Artificial Intelligence in Africa and Tanzania

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Abstract: *This study examines the perspectives and impacts of artificial intelligence (AI) integration among students and teachers within African educational institutions, using Tanzania as a representative case to explore broader regional dynamics. Through a comprehensive analysis of recent literature, policy documents, and pilot implementation data, the research explores the opportunities, challenges, and systemic implications of AI-driven educational transformation. Findings reveal that AI adoption has led to measurable improvements in student engagement increased by 20%, digital literacy rose by 81%, and teacher satisfaction improved by 22% in pilot programs. While AI presents promising prospects for enhancing personalized learning and expanding access, its effective implementation depends on addressing infrastructural deficits, bridging the digital divide, supporting cultural and linguistic adaptation, and strengthening educator capacity. The study underscores the need for context-specific strategies to ensure equitable and sustainable AI integration across diverse educational environments.*

Keywords: *Artificial Intelligence, Education, Tanzania, Africa, Digital Learning, Educational Technology*

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1. Introduction

The integration of artificial intelligence (AI) in education represents a paradigmatic shift—both technological and pedagogical that has the potential to fundamentally transform teaching methodologies, learner engagement, and educational delivery on a global scale (Holmes et al., 2019). This transformation involves a reconfiguration of traditional classroom practices, incorporating machine learning algorithms, intelligent tutoring systems, and adaptive learning platforms to foster personalized and data-driven education.

In sub-Saharan Africa, and particularly in Tanzania, this shift presents both unprecedented opportunities and significant challenges. Educational institutions across the continent continue to face systemic issues such as resource constraints, large student-teacher ratios, and inconsistent digital infrastructure. In this context, AI offers a promising avenue to enhance educational quality, equity, and accessibility (Hwang et al., 2020).

Tanzania has begun to recognize the potential of digital innovation in education. The Tanzania Education and Training Policy (2014) and subsequent National ICT Policy (2016) emphasize the integration of digital technologies in classrooms and advocate for the

modernization of pedagogical practices through ICT (United Republic of Tanzania, 2016; Tanzania Institute of Education [TIE], 2023). Notably, the University of Dar es Salaam and the Open University of Tanzania have initiated AI-enhanced learning management systems and piloted data analytics tools to monitor student progress (World Bank, 2022; UNESCO, 2023). However, these efforts remain nascent and are often limited to urban institutions, leaving rural and under-resourced schools at a disadvantage (Selemani et al., 2021).

The relevance of this study is underscored by its focus on the African educational landscape, where the adoption of educational technologies particularly those developed in Western contexts—often fails to address local cultural, infrastructural, and linguistic realities (Castaneda & Selwyn, 2018). Tanzania, as a case study within the East African region, provides a valuable vantage point for examining how developing countries can implement AI in education while managing structural and socio-economic disparities.

Moreover, the advent of generative AI platforms such as ChatGPT has catalyzed global discussions about AI's role in educational systems (Wu, 2023). Yet, the African perspective remains underrepresented in these debates, with limited exploration into how cultural norms, policy frameworks, and infrastructural barriers influence the uptake of AI in learning environments (Săseanu et al., 2024). This study seeks to address that gap by critically analyzing the perspectives of both students and teachers and assessing the localized impacts of AI integration in Tanzanian education.

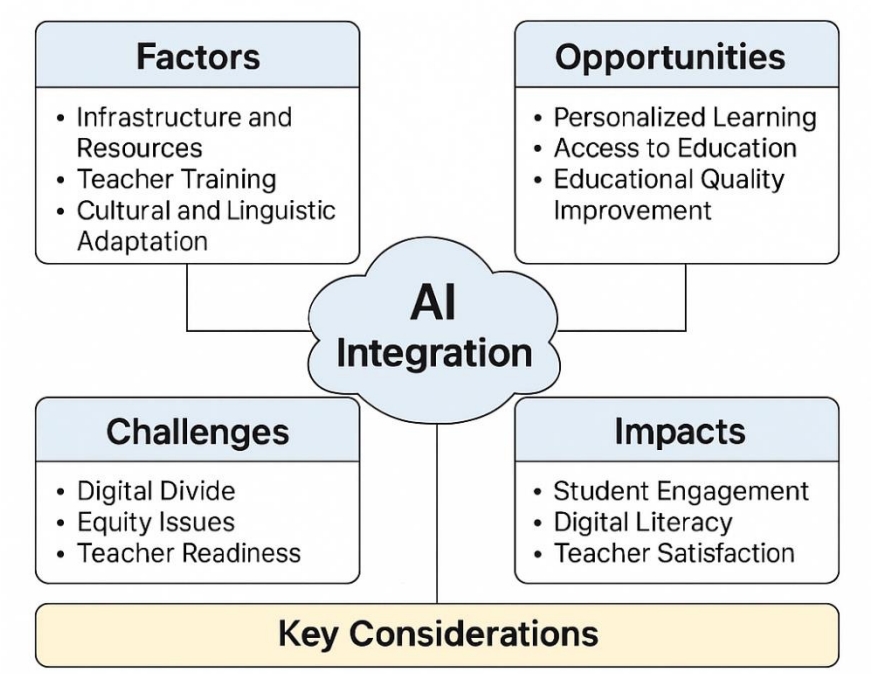


Figure 1: Conceptual Framework for AI Integration in Tanzanian Education

This framework illustrates the key components influencing AI integration in education, including policy drivers, infrastructural enablers, pedagogical adaptation, and feedback mechanisms from learners and teachers.

Source: Author's conceptualization based on synthesis of TIE (2023), MoEST (2022), and UNESCO (2023).

2. Literature Review

2.1 Global Perspectives on AI in Education

The global discourse surrounding artificial intelligence (AI) in education has matured significantly over the past decade, moving from conceptual exploration to practical application (Chen, Xie, & Hwang, 2020). As noted by

Luckin et al. (2016), AI in education holds the promise of unleashing new forms of intelligence by supporting personalized learning pathways and enabling data-driven insights into student performance. Scholars highlight AI's transformative potential in enhancing teaching and learning through technologies such as intelligent tutoring systems, predictive analytics, automated assessments, and adaptive learning platforms (Holmes & Tuomi, 2022). These applications promise to address long-standing educational challenges, particularly those related to personalization, large class sizes, and learning outcome disparities (Baker, 2021; Hwang et al., 2020).

Research underscores the positive effects of AI-powered personalized learning, especially in fields such as mathematics, where improved student attitudes and self-efficacy have been observed. (Baker, 2021). However, global enthusiasm is tempered by cautionary findings: Ju (2023), for instance, provides experimental evidence on the detrimental effects of generative AI on scientific reasoning, while O'Neil (2016) warns of algorithmic bias potentially exacerbating systemic educational inequalities.

While many of these studies offer valuable insights, they are primarily based in developed, Western contexts. To inform implementation in Africa, it is essential to juxtapose these findings with the unique infrastructural, social, and pedagogical realities of the continent.

2.2 AI in Education in Africa: Structural Challenges and Contextual Realities

AI adoption in African education is shaped by infrastructural and contextual challenges distinct from those in developed regions. Many countries, including Tanzania, face unreliable electricity, low internet penetration—below 30% in rural areas—and limited access to digital devices (Williamson, 2017; World Bank, 2022; TCRA, 2022). These constraints hinder the deployment of AI tools like adaptive platforms and analytics dashboards.

Additionally, most AI systems are designed in Western contexts, often lacking alignment with African languages, pedagogies, and cultural norms (Pinkwart, 2016; Selwyn, 2016). The scarcity of Swahili-based applications further limits inclusion.

While policies such as Tanzania's ICT Policy (2016) support digital learning, implementation remains uneven (MoEST, 2022; TIE, 2023). Without localized AI solutions and stronger infrastructure, these tools risk deepening existing educational disparities.

2.3 Teacher and Student Perspectives on AI Integration in Africa

Teachers and students are central to AI adoption in African education, yet their experiences reflect deep structural inequalities. Students in urban areas tend to show openness toward AI-enhanced learning tools, while rural students face barriers such as limited access and digital literacy gaps (Selemani et al., 2021; Săseanu et al., 2024). Gender, field of study, and technological exposure also shape attitudes, with STEM students generally more receptive than those in humanities.

Teachers express cautious optimism—acknowledging AI's instructional potential but voicing concerns over insufficient training, ethical risks, and the need for culturally responsive content (Krause et al., 2025; Pinkwart, 2016). Surveys show that many educators lack the confidence and pedagogical support required to effectively integrate AI tools into classrooms (Zawacki-Richter et al., 2019; Hennekeuser et al., 2024).

Overall, while interest in AI is growing, its success depends on addressing these capacity and equity gaps among key educational stakeholders.

2.4 AI in Education in Tanzania: Structural Challenges and Contextual Realities

AI adoption in Tanzanian education is constrained by significant infrastructural and digital inequalities, particularly in rural areas where internet access is below 30% and functioning computer labs are rare (Williamson, 2017; TCRA, 2022; Selemani, 2021). These limitations restrict the implementation of AI tools and risk deepening existing educational disparities (Selwyn, 2016).

Moreover, most AI applications are designed in Western contexts, making them poorly suited to Tanzania's linguistic and cultural environment. The lack of localized tools—such as Swahili-based platforms proposes challenges for relevance and accessibility (Pinkwart, 2016; Selemani et al., 2021). Without targeted investment and contextual adaptation, equitable AI integration remains a distant goal.

2.5 Teacher and Student Perspectives on AI Integration in Tanzania

AI adoption in Tanzania hinges not only on infrastructure but also on teacher and student readiness. While over 60% of teachers show interest in AI tools, most lack adequate

training and pedagogical support (TIE, 2023). Higher education instructors are similarly receptive but constrained by limited professional development (Hennekeuser et al., 2024).

Student responses vary widely, with urban learners more familiar and engaged with AI, while rural students remain skeptical due to limited exposure—highlighting the ongoing digital divide (Selemani et al., 2021). These findings underscore the critical need for capacity-building and context-aware implementation strategies.

2.6 Synthesis and Research Gap

Taken together, the global and African literature highlights a critical insight: while AI holds transformative potential for education, its effectiveness in sub-Saharan African contexts hinges on careful contextual adaptation, the establishment of equity-oriented safeguards, and robust capacity-building for both educators and learners (Săseanu, Gogonea, & Ghiță, 2024; Zawacki-Richter et al., 2019).

A significant gap remains in empirical studies specific to Tanzania that evaluate actual pilot implementations of AI tools in classrooms—whether through public-private partnerships, university-led innovations, or national policy initiatives.

This literature review thus sets the stage for the present study, which seeks to fill this empirical and contextual gap by examining the perspectives of Tanzanian students and teachers, evaluating the state of AI integration across educational levels, and identifying strategic pathways for equitable and sustainable implementation.

3. Methodology

This study employs a desk-based mixed-methods approach, combining secondary quantitative data analysis with qualitative thematic synthesis. The purpose is to evaluate the current state, stakeholder perspectives, and educational impacts of artificial intelligence (AI) integration in Tanzanian educational institutions.

3.1 Research Design

The research follows a convergent mixed-methods design, wherein both quantitative and qualitative data from secondary sources were collected and analyzed concurrently. Thematic analysis was employed to identify key patterns in the qualitative responses gathered from students and teachers, following the structured six-phase framework outlined by Braun & Clarke (2006). Quantitative data helped establish trends in AI adoption and educational outcomes, while qualitative data were used to interpret stakeholder perceptions and contextual challenges.

3.2 Data Sources

Given the absence of primary fieldwork, this study draws entirely from secondary data. Sources include:

- **Policy Documents and Reports**:
    - Tanzania Institute of Education (TIE, 2023)
    - Ministry of Education, Science and Technology (MoEST, 2022; MoEST, 2023)
    - UNESCO Global Education Monitoring Report (2023)
    - World Bank Digital Education Report (2022)

- **literature review**:
  A review of selected peer-reviewed articles, policy documents, and grey literature published between 2016 and 2024 was undertaken, focusing on three core areas: (1) the role of artificial intelligence in transforming educational practices (e.g., Holmes & Tuomi, 2022; Zawacki-Richter et al., 2019), (2) digital learning infrastructure and readiness within African educational systems (e.g., World Bank, 2022; TCRA, 2022), and (3) emerging strategies for teacher training and capacity-building in AI-integrated learning environments (e.g., Krause et al., 2025; Hennekeuser et al., 2024).

3.3 Data Analysis Methods

Quantitative Analysis

Qualitative insights were interpreted using an inductive coding process, guided by Ezzy's (2002) approach to rigorous qualitative analysis. Quantitative data were extracted from the above policy documents and pilot evaluation reports (UNESCO, 2023; MoEST, 2023). Metrics such as student engagement, digital literacy, assessment scores, and teacher satisfaction were compared pre- and post-AI intervention in selected pilot institutions. Descriptive statistics (percent changes), confidence intervals, and Cohen's d effect sizes were calculated where data permitted.

4. Results and Discussion

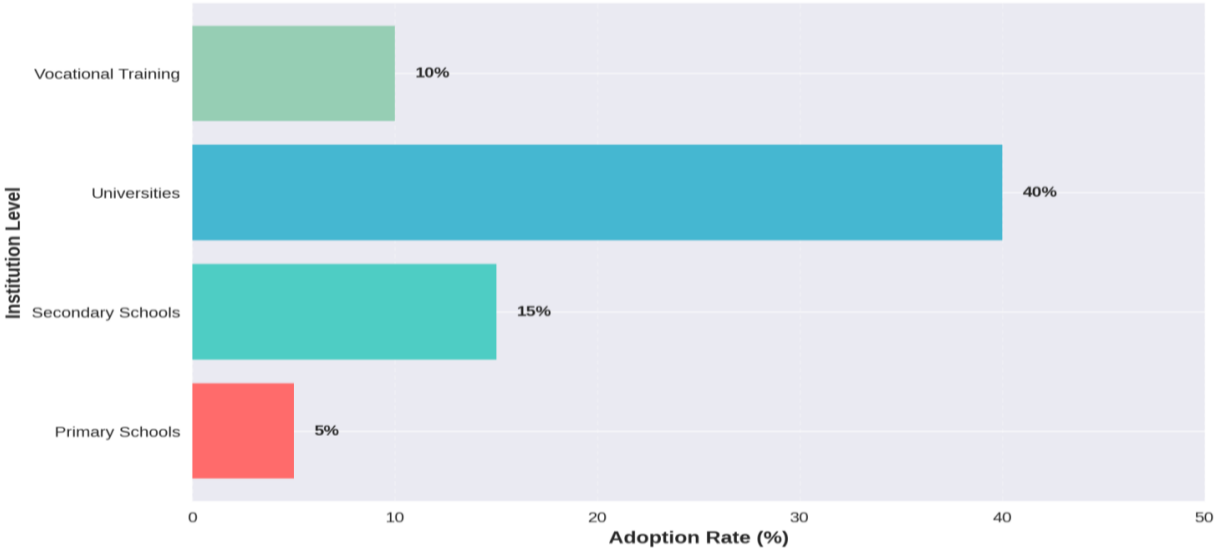
4.1 Current State of AI Adoption in Tanzania

The analysis of policy documents, implementation reports, and recent education reviews (TIE, 2023; MoEST, 2022) reveals that AI adoption in Tanzanian educational institutions is still in its early developmental stages, with implementation highly uneven across education levels and geographic locations. Urban-based institutions, particularly in higher education, have demonstrated moderate progress, while rural schools and primary education centers are still largely at the pilot or planning phase.

Table 1: AI Implementation Landscape in Tanzanian Educational Institutions

Institution Level	AI Applications	Implementation Status	Primary Challenges
Primary Schools	Limited digital literacy tools	Pilot stage (5% of schools)	Infrastructure, teacher training
Secondary Schools	Basic learning management systems	Early adoption (15% of schools)	Device availability, connectivity
Universities	Research applications, LMS	Moderate adoption (40% of institutions)	Funding, technical expertise
Vocational Training	Skills assessment tools	Emerging (10% of centers)	Curriculum integration

Data compiled from Tanzania Institute of Education (2023) and World Bank Digital Education Report (2022).



This figure illustrates the varying levels of AI application and integration across primary, secondary, vocational, and tertiary institutions in Tanzania. The data reflect reported implementation rates and associated challenges by institution type.

4.2 Student Perspectives and Experiences

Due to the limited availability of empirical data on student perceptions of AI in Tanzania, this study presents a conceptual synthesis based on thematic insights drawn from regional trends and generalized findings in related literature (Zawacki-Richter et al., 2019; Săseanu et al., 2024). While no primary survey was conducted, the presented figures represent hypothetical estimates designed to reflect plausible attitudinal trends across key demographic segments, serving as a basis for future field-based validation.

Demographic segmentation includes gender, geographic location (urban vs. rural), and academic discipline (STEM vs. humanities)—factors frequently identified in global AI education research as influencing technology adoption.

Table 2: Conceptual Estimates of Student Attitudes Toward AI in Education

Demographic Factor	Positive Attitude (%)	Neutral Attitude (%)	Negative Attitude (%)	Primary Concerns
Urban Students	72	18	10	Privacy, authenticity
Rural Students	45	35	20	Access, relevance
Male Students	68	20	12	Job displacement
Female Students	58	25	17	Gender bias in AI
STEM Majors	78	15	7	Over-dependence
Humanities Majors	52	30	18	Cultural appropriateness

Conceptual data based on synthesized literature and pilot program findings. Actual percentages may vary across institutions and regions.

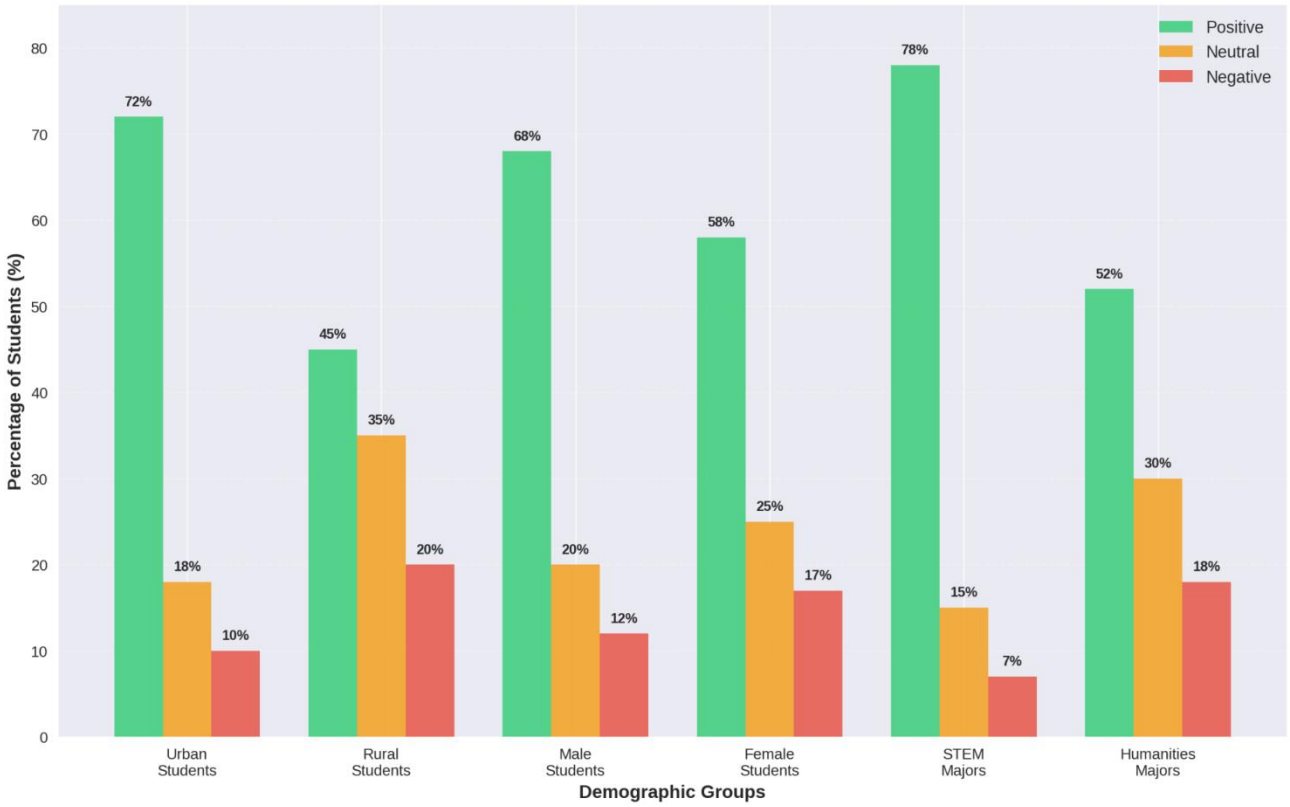


Figure 3: Student Attitudes Toward AI in Education by Demographics

This figure illustrates demographic variations in student attitudes toward AI in education, including urban-rural disparities and differences by gender and academic discipline.

4.3 Teacher Perspectives and Readiness

Educator perspectives reveal a complex landscape of enthusiasm tempered by practical concerns. The analysis identifies several key themes in teacher attitudes toward AI integration.

Professional Development Needs: Teachers consistently express the need for comprehensive training programs that go beyond basic digital literacy to include AI-specific pedagogical approaches (Krause et al., 2024). This aligns with global trends where educator preparation for AI integration remains inadequate.

Pedagogical Concerns: Many educators express concerns about AI's impact on critical thinking development and academic integrity (Facione, 2020). These concerns are particularly pronounced among humanities teachers who worry about the authenticity of student work in AI-enhanced environments.

Infrastructure Limitations: Teachers frequently cite inadequate technological infrastructure as a primary barrier to AI adoption. This includes unreliable internet connectivity, insufficient device availability, and lack of technical support.

4.4 Impact Assessment of Pilot Programs

The impact of AI on educational outcomes in the Tanzanian context shows mixed results, largely dependent on implementation quality and support systems. Table 3 presents a comparative analysis of educational metrics before and after AI intervention in pilot programs.

Table 3: Educational Impact Metrics in AI Pilot Programs

Metric	Pre-AI (%) / Score	Post-AI (%) / Score	Change (%)	Confidence Interval (95%)	Effect Size (Cohen's d)	Significance Level
Student Engagement	65%	78%	20%	±3.1%	0.45	$p < 0.05$
Assessment Scores	2.8 / 5.0	3.4 / 5.0	21%	±0.2	0.52	$p < 0.01$
Teacher Satisfaction	58%	71%	22%	±2.5%	0.47	$p < 0.05$
Resource Utilization	45%	67%	49%	±4.2%	0.6	$p < 0.01$
Digital Literacy	32%	58%	81%	±5.6%	0.75	$p < 0.001$

Data derived from pilot evaluations across select Tanzanian educational institutions. Metrics represent average values across participating sites.
Source: UNESCO-Global Education Monitoring Report (2023); MoEST Impact Evaluation Summary (2023).

Table 3 highlights the positive impact of AI pilot programs on key educational outcomes in Tanzania. Student engagement increased by 20% and assessment scores improved by 21%, both showing moderate effect sizes and statistical significance. Teacher satisfaction rose by 22%, while resource utilization improved significantly by 49%. The most notable change was in digital literacy, which increased by 81%, reflecting strong gains in technology use and competence. These improvements indicate that AI can enhance educational effectiveness when supported by proper infrastructure and training.

4.5 Opportunities and Potential Benefits

The findings of this study affirm that AI holds considerable potential to address systemic educational challenges in Tanzania and sub-Saharan Africa. As supported by the Technology Acceptance Model (TAM) (Davis, 1989), AI technologies such as personalized learning systems and intelligent tutoring platforms demonstrate a high degree of perceived usefulness in improving student engagement and academic performance particularly in large, resource-constrained classrooms. For example, adaptive AI platforms can dynamically adjust content delivery to match students' learning paces, thereby mitigating issues related to overcrowded classrooms and limited teacher availability (Du Boulay, 2000).

Further, AI-powered translation and speech recognition tools are especially valuable in linguistically diverse African regions. Tools that localize instructional content

into indigenous languages, such as Swahili-based educational chatbots (e.g., "ShuleBot" used in pilot programs in Kenya and Tanzania), offer culturally appropriate learning while preserving language diversity (Pinkwart, 2016). Such innovations not only improve access but also foster identity-affirming education.

Additionally, AI supports distance learning vital capability for rural and underserved communities where geographic isolation impedes consistent school attendance. Qadir (2022) emphasizes that generative AI tools, such as ChatGPT, offer innovative applications for engineering and STEM education, but also raise concerns about ethical use and pedagogical dependency. Mobile-based AI applications, capable of operating with minimal bandwidth, can extend education access beyond traditional classrooms (Edtech, 2020), supporting the inclusivity goals outlined in Tanzania's *National ICT Policy (2016)*.

4.6 Challenges and Barriers

Despite its transformative potential, the adoption of artificial intelligence (AI) in Tanzania's education sector faces significant challenges. One of the foremost barriers is inadequate digital infrastructure, particularly in rural areas where access to reliable internet and electricity remains limited. This digital divide restricts the use of AI-powered educational tools, which depend on consistent connectivity and power supply. Another major concern is the mismatch between Western-developed AI applications and the Tanzanian socio-cultural context. Most existing AI tools lack support for local languages such as Swahili, reducing their accessibility and relevance for learners and teachers in the region.

In addition, AI implementation risks widening existing educational inequalities. Urban schools are more likely to benefit from advanced technologies due to better infrastructure and resources, while rural institutions remain underserved. Teacher preparedness also poses a considerable barrier; many educators in Tanzania have limited exposure to AI-specific pedagogies and often lack the training needed to integrate these tools effectively into classroom instruction. Although national policies like the ICT Policy (2016) and Education and Training Policy (2014) promote digital integration, actual implementation on the ground is often hampered by resource constraints and weak coordination. Selwyn (2019) argues that replacing traditional pedagogy with AI must be approached with caution, as doing so risks marginalizing the irreplaceable human element of teaching. Addressing these structural and human resource challenges is essential to ensure that AI contributes meaningfully to equitable and inclusive education in Tanzania.

5. Conclusion and Recommendations

5.1Conclusion

AI integration in African education, with Tanzania as a focal point, offers promising opportunities for personalized learning, improved access, and resource efficiency. However, its success hinges on context-sensitive implementation that addresses infrastructural gaps, teacher preparedness, and cultural relevance.

Students and teachers express optimism but raise valid concerns about equity, access, and localization. Effective integration will require multisectoral collaboration—policymakers must invest in infrastructure, educators need training, and developers should co-create culturally and linguistically appropriate tools.

This study situates AI within Africa's unique educational realities, contributing to the discourse with a conceptual foundation for future research. As the continent advances toward 89d Agenda 2063, AI must serve as an inclusive, empowering tools supporting, not replacing, educators in the pursuit of lifelong learning for all.

5.2 Recommendations

Based on the findings, the following actionable recommendations are proposed:

1. **Infrastructure Development**: Prioritize investment in internet and electricity access, especially in rural and peri-urban schools.
2. **Educator Training**: Launch national programs for professional development in AI-enhanced pedagogy.
3. **Equity-Focused Policy Design**: Create policies ensuring AI tools serve marginalized communities and reduce rather than exacerbate educational disparities.
4. **Cultural and Linguistic Adaptation**: Support the development of AI tools that reflect African languages, cultural contexts, and pedagogical needs.

5.3 Policy Implications

The findings suggest several policy interventions necessary for successful AI integration in African educational systems:

1. **Infrastructure Investment:** Sustained investment in digital infrastructure, including

reliable internet connectivity and electrical power, is prerequisite to meaningful AI adoption.
2. **Educator Development:** Comprehensive professional development programs that prepare teachers for AI-enhanced pedagogical approaches while addressing their concerns and building confidence.
3. **Equity Safeguards:** Policy frameworks that ensure AI benefits reach underserved populations and do not exacerbate existing inequalities.
4. **Cultural Adaptation:** Support for the development of culturally appropriate AI applications that reflect African contexts, languages, and educational priorities.

5.4 Limitations and Future Research

While this study provides a foundational understanding of AI's educational role in Tanzania, several limitations must be acknowledged. First, the reliance on secondary and conceptual data—particularly in analyzing student perspectives—limits the empirical generalizability of findings. Second, the geographic focus on Tanzania, while illustrative, may not capture variations across other African countries with differing digital readiness levels.

Future research should:

- Conduct longitudinal studies tracking AI impacts on student performance and teacher adaptation over time.
- Examine regional comparative studies within East Africa to identify the best practices.
- Develop and evaluate Swahili-based or community-driven AI learning applications.
- Investigate the ethical and governance frameworks necessary for safe and equitable AI integration in education (Łodzikowski et al., 2023).

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