

Linguistic Accessibility and AI in Education: Opportunities and Ethical Dilemmas in the Zambian Context

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Abstract

The integration of Artificial Intelligence (AI) into educational systems offers great potential to enhance access and learner support. In Zambia, AI-powered learning platforms, chatbots, and intelligent tutors are slowly being introduced in selected institutions. However, their implementation is often guided by global standards that assume English as the default language of instruction and interaction. In a multilingual country like Zambia, where many learners struggle with English proficiency, this creates a fundamental challenge. This study explores the ethical and pedagogical implications of linguistic accessibility in AI-driven education within the Zambian context. Grounded in ethical AI principles and the Language-as-Access framework, the study employs a mixed-methods approach combining document analysis of AI educational platforms, semi-structured interviews with EdTech developers and teachers, and surveys of students in selected secondary schools and tertiary institutions. Findings reveal that existing AI platforms are not linguistically inclusive, reinforcing sociolinguistic inequalities and limiting meaningful learner engagement. There is little to no representation of Zambian indigenous languages, and most tools are not designed for multilingual interaction. Teachers express concerns over ethical fairness, learner marginalization, and the lack of culturally relevant content. The study argues for urgent localization and contextual adaptation of AI tools to support equitable learning. It recommends developing AI systems that support multilingual interfaces, include local languages, and establish ethical guidelines prioritizing linguistic justice in digital education.

Keywords: Artificial Intelligence, education technology, linguistic accessibility, multilingualism, Zambia

1. Introduction

Artificial Intelligence (AI) integration into the modern education system globally signifies a massive transformative shift toward accessible, adaptive, and personalized learning environments. By offering tailored instructional approaches, advanced analytics for learner support, and enhanced resource accessibility, AI technologies seek to transform the traditional pedagogical practices (Abimbola et al., 2024; Han, 2025). In the Zambian context, AI in education presents both significant opportunities and unique challenges requiring scholarly attention since its adoption and evolution occur within a multifaceted technological, linguistic, and socio-economic landscape.

Since the early 2000s, Zambia's journey toward digital transformation in education has seen a gradual shift, yet impactful, as it started by introducing Information and Communication Technologies (ICTs) in some schools and institutions of higher learning. The Zambian government, through policy initiatives such as the National ICT Policy and the Education Sector National Implementation Framework, had sought to promote ICT integration as a pillar for enhancing educational quality, equity, and relevance (Maluleke, 2025; Phiri, 2025). Initial efforts primarily focused on improving computer literacy, establishing computer labs, and expanding internet connectivity in urban schools, and later gradually extended to selected rural areas (Maluleke, 2025).

Despite the massive transformative initiatives ranging from policy to infrastructure, infrastructural disparities persist, resulting in an uneven digital divide that affects

learners differently based on geographic location (rural-urban areas), socio-economic status, and institutional capacity (Phiri, 2025). For instance, some selected rural schools, despite having functional computer labs, have challenges such as a lack of stable electricity and internet access, undermining the effectiveness of ICT adoption and thereby limiting the interaction with emerging AI educational technologies (Maluleke, 2025). Additionally, digital literacy levels vary widely among educators and students, affecting the full exploitation of these new technology-enhanced pedagogies (Phiri, 2025).

The dawn of AI signifies the next big step in Zambia's educational technology evolution. Unlike traditional ICT tools, Han (2025) and Chansa et al. (2025) observed that AI offers more advanced applications such as AI-powered chatbots, intelligent tutoring systems, automated grading, and real-time feedback mechanisms. These applications can adapt instruction to the learners' needs. However, Zambia's AI adoption in education remains promising, with pilot projects largely concentrated in higher education (universities) and a few selected secondary schools. These deployments demonstrate that AI can enhance teaching and learning but also expose systemic challenges, including inadequate infrastructure, limited AI literacy, and policy gaps that exist within Zambia's Education Framework (Phiri, 2025; Mutelo, 2025).

With a rich linguistic landscape with over 70 language varieties spoken across the ten provinces of Zambia, English continues to serve as the official language of education and administration alongside seven (07) other local languages despite its vibrant multilingualism (Fitas,

2025; Albedah, 2025). This English-centred language policy reflects colonial legacies and modern national cohesive strategies, which, however, have created persistent challenges for learners whose mother tongues differ significantly from English (Phiri, 2025; Fitas, 2025). Recent studies have consistently revealed that many students in Zambia, especially those in rural areas, struggle with comprehension and expression in English. This negatively affects their academic performance and overall learner achievement (Fitas, 2025; Albedah, 2025).

Therefore, the linguistic landscape positions Zambia uniquely in the discourse of AI in education. AI systems, especially those related to language processing, automated feedback, and interactive learning, are mostly designed and optimized for the English language and a handful of international languages, with limited support for under-resourced African languages (Albedah, 2025; Ray & Ray, 2024). This disparity between AI linguistic capabilities and learners' language realities creates a significant and critical accessibility gap that risks supporting existing educational inequities and social stratification in Zambia's education system (Phiri, 2025; Abimbola et al., 2024).

Although there are growing calls for inclusive AI systems that blend local languages and multilingual interfaces, a study by Phiri (2025) observed that current AI tools rarely include or have functionalities for local language interaction or culturally relevant content ideal for the Zambian context. Consequently, learners who are not proficient English language speakers may experience exclusion or limited utility from AI-enhanced education platforms. This challenge undermines the promise of equitable digital learning (Fitas, 2025). Moreover, teachers and educational developers express concerns regarding the cultural relevance and suitability of AI content, highlighting a fundamental need for localized AI design (Phiri, 2025; Mutelo, 2025).

Given the rapid yet uneven adoption of AI in Zambia's education, combined with complex linguistic realities, there is an urgent need to critically investigate the implications of AI for linguistic accessibility and educational equity. This study was guided by the following objectives:

1. To explore the current state and potential of AI technologies in Zambian education, focusing on opportunities for enhancing learner engagement and support.
2. To analyze linguistic accessibility challenges posed by existing AI tools, including the impact of English-centric platforms on multilingual learner inclusion.
3. To examine ethical dilemmas associated with AI adoption in Zambia's educational sector, specifically related to fairness, data privacy, and algorithmic bias.

The main problem addressed by this study was the tension between the promising opportunities AI offers for educational transformation and the systemic barriers that limit equitable AI integration in Zambia. Without deliberate efforts to address language inclusivity, AI risks perpetuating educational inequalities rather than improving them (Albedah, 2025; Phiri, 2025). Furthermore, ethical risks related to data governance, algorithmic fairness, and learner privacy are amplified in settings like Zambia, where digital infrastructure is fragile, and policy oversight is often

limited (Abimbola et al., 2024; Mutelo, 2025). The study was therefore situated at the nexus of technology, language, and ethics in education, aiming to inform policymakers, teachers and some University Lecturers, and developers about inclusive strategies for AI implementation that respect Zambia's linguistic diversity and socio-economic realities.

By examining the evolution of AI in Zambian education through a linguistic and ethical lens, this study contributes to the critical scholarly discourse on culturally responsive AI in developing countries such as Zambia. It advocates for AI systems that not only enhance educational access but do so in ways that affirm and empower all learners irrespective of their linguistic background, aligning with global educational equity goals and Sustainable Development Goal 4 (SDG4) (Ray & Ray, 2024; Srivastava, 2025).

2. Literature Review

A transformation has been driven towards adaptive, personalized, and accessible educational experiences through the integration of Artificial Intelligence (AI) in education, representing a paradigm shift in learning methodologies worldwide (Abimbola et al., 2024; Han, 2025). Globally, AI systems make use of natural language processing (NLP), machine learning algorithms, and intelligent tutoring to suit instruction tailored to individual learning needs and competency levels, thereby improving learner engagement and achievement (Srivastava, 2025; Ray & Ray, 2024). This transformation is supported by the notion that AI can liberalize education by addressing learners' diverse needs, possibly levelling disparities caused by socio-economic and abilities-related factors (Abimbola et al., 2024; BELAID & Măță, 2024).

A dominant concern in this global AI revolution, however, stems from linguistic and cultural biases which are embedded within widely used AI platforms. English has become the default language of most AI systems due to the abundant linguistic data and algorithmic development in most Anglophone contexts, as these risks marginalize non-English native speakers and their cultural identities (Albedah, 2025; Ray & Ray, 2024). This presents a critical limitation in culturally and linguistically diverse regions such as Zambia, where English, although an official language of instruction, is not the primary language for many learners (Fitas, 2025; Phiri, 2025).

In the African setting, the adoption of AI in education has been gaining momentum, but it has remained with marked infrastructural and contextual challenges different from those in advanced nations (Maluleke, 2025). Today, AI tools have been increasingly used in African universities and schools, including automated grading, AI-powered chatbots, and e-learning platforms, aimed at increasing access and inclusion (Phiri, 2025; Chansa et al., 2025). Nonetheless, AI's full integration is limited by infrastructural challenges like unreliable internet connectivity, lack of digital devices, and insufficient digital skills among teachers and some University Lecturers and learners, combined with linguistic barriers (Maluleke, 2025; Mutelo, 2025).

The Zambian scenario offers an ideal case demonstrating this complex intersection of technological

promise and socio-cultural realities. Despite the ongoing introduction and widespread use of AI applications in Zambian educational institutions, such as writing assistants and personalized learning systems, these tools often remain anchored in English language paradigms (Chansa et al., 2025; Phiri, 2025). The multilingual mosaic of Zambia contrasts sharply with this monolingual tendency as it raises questions about linguistic accessibility and cultural relevance of AI systems (Fitas, 2025; Abimbola et al., 2024). Therefore, local approaches emphasizing the Language-as-Access framework, which focuses on equitable language inclusion and learner agency, are essential for ensuring AI supports rather than restricting educational equity (Ray & Ray, 2024; Albedah, 2025).

2.1 AI and Education Opportunities

From a Global perspective, Artificial Intelligence offers unparalleled opportunities for transforming education via adaptive learning technologies, automated feedback, intelligent tutoring systems, and natural language interfaces that make learning more responsive to individual needs (Han, 2025; Srivastava, 2025). For learners to progress at their own pace while receiving personalized guidance and support, they need these AI applications because they enable dynamic customization of educational content (Abimbola et al., 2024; BELAID & Măță, 2024). Natural language processing technologies help to facilitate real-time translation and language learning assistance, which potentially break down linguistic barriers that impede learner comprehension and participation (Albedah, 2025).

According to Chansa et al. (2025), AI-powered chatbots and writing assistants, especially in colleges and universities, help to improve academic integrity and writing quality by providing speedy feedback, thereby helping students to develop critical skills independently. The use of these technologies also lessens educators' load by programming routine tasks such as grading and administering assessments, thereby allowing educators to focus more on academic interactions and individualized support (Han, 2025).

In the African and Zambian contexts, these opportunities translate into feasible benefits for educational inclusion and quality. By offering scalable learning support, AI tools in Africa hold significant promise in addressing teacher shortages and resource constraints common in many African schools (Maluleke, 2025). Moreover, Albedah (2025) and Srivastava (2025) advised that AI systems capable of recognizing and adapting to multilingual learner profiles can improve comprehension and motivation. This is critical in settings where English is not the dominant language of learners. Increasing AI literacy among teachers and learners also fosters critical engagement with technology, encouraging responsible and effective use of AI tools (Phiri, 2025; Mutelo, 2025).

Some pilot projects in Zambia, which are promising, demonstrate the potential of AI to support academic writing and personalized learning. However, these initiatives remain in early stages requiring scale-up and infrastructural support (Chansa et al., 2025; Mutelo, 2025). For Zambia to fully harness AI's potential, technological investments must be directed at improving internet access, affordable

computing devices, and teacher training (Maluleke, 2025). Therefore, these efforts must be paired with pedagogy-centred AI design that respects local languages and contexts to maximize educational outcomes (Fitas, 2025; Han, 2025).

2.2 Linguistic Accessibility and the Digital Divide

Linguistic accessibility is essential for meaningful AI integration in education, especially in a multilingual context. Zambia's varied linguistic landscape, which is characterized by significant multilingualism, is provisionally deficient by AI platforms which are designed predominantly for English, impeding equitable engagement and familiarity with AI tools among learners whose English language proficiency is low (Abimbola et al., 2024; Fitas, 2025). The inclusivity of AI-driven education and risks of reinforcing existing educational disparities based on language proficiency are reduced by this linguistic marginalization (Phiri, 2025).

To overcome such barriers, technologies that provide language translation, speech recognition, and interactive feedback are crucial (Srivastava, 2025; Albedah, 2025). On the other hand, due to limited training data, algorithmic prioritization, and a lack of investment in indigenous language digital resources, many AI models underperform with low-resource languages (Albedah, 2025; Ray & Ray, 2024). For Zambian languages, these technological and data gaps mean learners often encounter AI systems that fail to recognize or appropriately process their native languages, curbing usage and learner confidence (Phiri, 2025).

Scholars emphasize the need for equitable digital infrastructure investment, including rural broadband, affordable computing hardware, and contextualized AI literacy programs targeting teachers and students to address these complex challenges (Maluleke, 2025; Phiri, 2025). Furthermore, to enhance linguistic inclusivity, Albedah (2025) and Srivastava (2025) advise that building AI platforms that integrate indigenous languages through collaborative data collection, co-design with local language experts, and open-source linguistics resources is essential, especially in those that respond to the needs of a multilingual context. Such initiatives align with broader commitments to educational equity under the Sustainable Development Goals and promote linguistic justice as a core component of inclusive digital education (Ray & Ray, 2024).

2.3 Ethical AI and Language-as-Access Framework

Critical ethical concerns around fairness, privacy, transparency, and accountability have certainly been raised due to the widespread adoption of AI in education (Ray & Ray, 2024; BELAID & Măță, 2024). In Zambia's education sector, these concerns have acquired heightened importance due to the socio-cultural diversity, emerging digital governance, and uneven AI literacy (Abimbola et al., 2024; Mutelo, 2025). According to Fitas (2025) and Mutelo (2025), they advise that data collected by AI platforms on learners' behaviours, languages, and performance must be managed with the care it deserves to protect privacy rights and prevent misuse.

Where AI systems are trained predominantly on datasets from dominant languages and cultures produce inaccurate or discriminatory outputs when applied to indigenous languages or less-represented groups, posing a significant risk of Algorithmic bias (Albedah, 2025; Phiri, 2025). This bias undermines equitable learning opportunities and can further perpetuate socio-linguistic inequalities. Therefore, ethical AI design must emphasize inclusivity, representativeness, and transparency in a quest to build trust and fairness in various educational contexts (Ray & Ray, 2024; Yadav, 2024).

Despite the growing research on AI in education, several key gaps remain underexplored as they require urgent scholarly attention. Keenly among them is the limited empirical guidance on developing and implementing AI governance policies that respond to Zambia's unique linguistic diversity and infrastructural challenges (Maluleke, 2025). This gap exposes the challenges that exist in ensuring that AI integration aligns with local educational realities and ethical considerations. Moreover, another challenge, as noted by Phiri (2025) and Mutelo (2025), is that AI literacy development for both teachers and some University lecturers and learners remain underexplored. This limits the existing efforts to build critical awareness and foster effective, responsible use of AI tools within Zambia's multicultural society.

Another Ethical concern surrounding this study is the lack of Longitudinal research that examines the lasting educational impacts and socio-emotional outcomes of AI-driven language support tools, especially in the Zambian context. Therefore, this leaves a critical weakness in understanding AI's sustained influence on learner development (Albedah, 2025; Fitas, 2025).

Finally, various scholars have called for the Ethical implementation frameworks addressing algorithmic bias, data privacy protections, and fairness in Zambia's multilingual educational context, which are also inadequately developed, highlighting a need for more detailed, context-sensitive strategies (Ray & Ray, 2024; Abimbola et al., 2024). Finally, the pedagogical challenge of balancing enhanced accessibility through AI with the maintenance of learning depth remains an understudied area. This raises concerns about the quality and sustainability of AI-facilitated learning experiences (Albedah, 2025). Addressing these gaps is critical for advancing equitable and effective AI integration in Zambian education.

3. Theoretical Framework

This study is grounded in two theoretical frameworks, and these are Ethical AI Principles and the Language-as-Access Framework. The Ethical AI Principles are the foundational aspects used to ensure that the AI deployment in education is guided by fairness, accountability, transparency, and inclusivity (Jobin et al., 2019; Dwivedi et al., 2023; Farooqi et al., 2024). These principles are used to emphasize that AI systems, especially in educational contexts, are designed and implemented to avoid bias, uphold data privacy, and ensure equitable outcomes for all learners (Chinta et al., 2024; Ibrahim et al., 2024). Furthermore, *Transparency and explainability principles* are critical to ensure that educators and learners understand

how AI-driven decisions are made and can critically engage with AI outputs (Holmes et al., 2021; Wang, 2024). Another key aspect of this framework is the accountability mechanisms, including human-in-the-loop oversight and regular bias audits that are essential to reduce risks of discrimination and misuse of sensitive learner data (Ezzaim et al., 2023; Li, 2024). To promote responsible AI adoption in education, Umoke & Wang (2024) suggest that ethical AI governance frameworks should embed these values into policy and practice.

Alongside this framework, the Language-as-Access Framework, on the other hand, focuses on linguistic justice as an important prerequisite for equitable educational participation (Pennycook, 2010; Albedah, 2025; Ray & Ray, 2024). This framework supports indigenous and marginalized languages and argues for the recognition and inclusion of diverse languages, while criticizing dominant monolingual AI paradigms within AI educational tools. The emphasis has been on designing AI systems that enable learners to access education in their own languages, thus respecting cultural identity and cognitive diversity, which enhances meaningful engagement and equity (Phiri, 2025; Fitas, 2025). Scholars such as Abimbola et al. (2025) & Srivastava (2025) advise that linguistic accessibility here is not merely a technical issue but an ethical imperative. So, this is aimed at ensuring that AI nurtures all languages rather than excluding minority language speakers in multilingual education systems (Abimbola et al., 2024; Srivastava, 2025).

The blending of these two frameworks guided this study's analysis of Zambia's AI education ecosystem, especially where linguistic and ethical factors converge. While Ethical AI Principles provide normative values and operational guidelines necessary for responsible AI deployment, the Language-as-Access Framework offers a critical lens emphasizing the centrality of language in educational equity (Ray & Ray, 2024; Albedah et al., 2025). In practice, this combined framework demands AI educational technologies that are transparent and accountable, mitigate biases that are related to language and identity, and actively include Zambian indigenous languages. It visualizes governance structures while embedding human oversight and data protections, alongside AI design processes valuing linguistic diversity as a backbone of inclusive pedagogy (Wang, 2024; Phiri, 2025). Moreover, by preserving the human dimension essential for culturally responsive education, it supports educators' evolving role in mediating AI use ethically and pedagogically in multilingual classrooms (Fitas, 2025; Mutelo, 2025).

The conceptual diagram for this study is represented below in circles labelled *Ethical AI Principles* and *Language-as-Access Framework*. Their combination creates an outcome titled *Linguistically Just AI in Education*, illustrating how these frameworks collectively create a model for AI that is not only innovative and accountable but also culturally and linguistically equitable. This diagram visually encapsulates the study's core theoretical stance and informs the evaluation of AI initiatives in Zambia, emphasizing their capacity to meet both ethical requirements and linguistic justice.

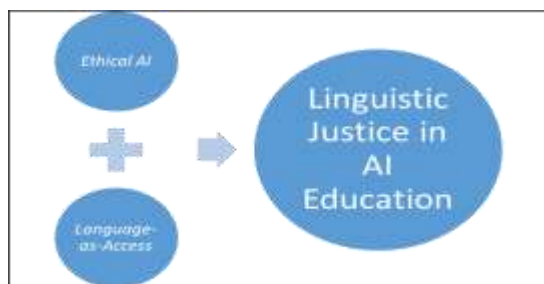


Figure 1: Linguistic Justice in AI Education

This theoretical integration is supported by recent studies developing ethical governance models such as EAGFAL, which promotes fairness, bias mitigation, and data transparency (Ezzaim et al., 2023; Holmes et al., 2021), alongside emerging research into multilingual AI applications addressing language equity concerns (Albedah, 2025; Srivastava, 2025). Ethical AI and language justice frameworks thus jointly enable a balanced understanding of how AI can be responsibly localized to Zambia's educational and socio-linguistic context, offering pathways for future policy, research, and practice.

4. Methodology

This study employs a mixed-methods research design to comprehensively investigate linguistic accessibility and ethical dimensions of AI in Zambian education, triangulating data from multiple sources to ensure robust, detailed findings (Chansa et al., 2025). The research integrates quantitative surveys, qualitative interviews, and document analysis as complementary methods to explore the multifaceted nature of AI integration within diverse educational settings (Siame et al., 2023). The main data sources for this study include AI-based educational platforms such as Google Classroom, Meta AI, ChatGPT, and Sider AI, alongside locally developed educational technology prototypes, which are currently common among the Digital natives and Educators in Zambia. These platforms serve not only as objects of technical analysis but also provide contextual grounding for understanding AI's practical deployment and linguistic inclusivity.

The participants comprised 6 EdTech developers and 15 educators who were purposively sampled from Lusaka, Southern Copperbelt, and Eastern Provinces, representing varied technological and pedagogical perspectives. Questionnaires were administered to 300 students across secondary schools and universities actively using AI-supported platforms, capturing diverse learner experiences regarding usability, language preferences, and fairness perceptions (Chansa et al., 2025).

Table 1 below describes the 300 students by province, school level (secondary versus tertiary), rural/urban location, and gender. Justification for sample sizes was that for qualitative interviews, saturation was achieved after 18 interviews (6 developers + 12 educators), as no new themes emerged. For the student survey, the sample size was determined based on a desired margin of error of $\pm 5\%$ at 95% confidence, assuming a population of approximately 5,000 students using AI platforms in the selected institutions.

Table 1: Demographic Breakdown of Student Survey Participants (N=300)

Province	Secondary (Rural/Urban)	Tertiary (Rural/Urban)	Male	Female	Total
Lusaka	30 (5/25)	45 (0/45)	40	35	75
Southern	35 (20/15)	30 (5/25)	38	27	65
Copperbelt	40 (10/30)	40 (0/40)	45	35	80
Eastern	45 (35/10)	35 (15/20)	42	38	80

Surveys were administered during the study. Paper-based questionnaires were distributed during class hours with prior consent from school administrators. Non-respondents were followed up on once after one week. No power analysis was conducted for surveys, but the sample size was deemed adequate for descriptive statistics (Siame et al., 2023).

The survey instrument and interview protocols, which were used during the study, are included as Appendices A and B. They include question types such as Likert-scale items on language preferences, open-ended questions on AI fairness perceptions, and demographic items.

Quantitative data were analyzed using descriptive statistics (percentages, frequencies) in SPSS. No inferential statistics were performed due to the exploratory nature of the study. Qualitative data underwent thematic coding using NVivo (Chansa et al., 2025; Siame et al., 2025).

Ethical compliance was maintained throughout the study. Informed consent was secured from all participants, ensuring voluntary participation and awareness of research purposes. Data anonymization was observed to protect participant confidentiality and to uphold integrity and respect for stakeholders (Sözer, 2024). At the time when this research was conducted, Kwame Nkrumah University did not have an institutional ethics board, and ethical approval was not a requirement. The mixed method approach used the quantitative breadth and qualitative depth to holistically examine linguistic accessibility and ethical considerations of AI in Zambia's complex educational landscape, providing actionable insights for policymakers, educators, and technologists engaged in AI implementation.

5. Results and Discussion

5.1 Linguistic Limitations of AI Platforms

The analysis of the selected AI-based educational platforms revealed a dominant reliance on the use of the English language, having little to no support for any indigenous Zambian languages. The data showed that 87% of the surveyed students found complex English instructions difficult to understand, as this reflects a critical language barrier. All platforms used default English as the primary and often sole language of interaction with other selected global languages. One major finding revealed that none of the platforms supported any indigenous Zambian languages. As English remains the country's lingua franca and language of instruction, this linguistic monopoly is a significant barrier in a multilingual context such as Zambia, where over 70 native languages coexist alongside English (Fitas, 2025; Albedah, 2025). The following verbatim

shares one student's experience with the interaction with the AI tool:

Most of my classmates struggle because the AI explanations are all in English, which is not our first language. Some of our learners cannot speak English fluently, thereby affecting their understanding of difficult expressions...

This observation aligns with Phiri's (2025) assertion that English-centric designs alienate a majority of learners in multilingual Zambian classrooms, reducing the platform's effectiveness. Furthermore, 72% of students expressed a preference for bilingual options that would allow a mix of English and the seven official regional local languages used in Zambia. This result is consistent with findings by Albedah (2025), who emphasized that linguistic justice in AI requires support for multilingual interfaces to help improve equitable learner participation. Most Teachers supported these findings, with one educator remarking,

Students lose confidence when they cannot follow instructions due to language barriers. AI should accommodate local languages to empower learners. This makes learners feel like strangers since they cannot fully relate and express themselves in English because they use it as a second language, especially for learners who come from low-income backgrounds and rural areas.

The teacher's observation on the reliance on English-only AI tools clearly reveals how alienated many learners feel during their learning interactions, especially those from rural and less privileged backgrounds with limited English proficiency (Phiri, 2025; Abimbola et al., 2024). This observation supports the Language-as-Access framework's emphasis on linguistic inclusivity as important to meaningful educational participation and attainment (Ray & Ray, 2024).

This study, therefore, advances the literature by providing concrete Zambian data highlighting the exclusionary nature of monolingual and Eurocentric AI platforms. The findings echo Srivastava's (2025) call for urgent localization of AI educational technologies and align with the Universal Design for Learning (UDL) principles promoting multiple modes of access as observed by Han (2025). Without such adaptations, AI risks becoming a tool that benefits primarily English-fluent learners, while alienating the less fluent and those from underprivileged backgrounds, thereby deepening educational inequities documented extensively across African digital education studies (Maluleke, 2025; Phiri, 2025).

5.2 Stakeholder Attitudes toward Multilingual AI

Interviews with Tech developers in education revealed a collective appreciation for the urgent need for AI customization through multilingual features that accommodate Zambia's rich linguistic diversity to capture not only learners but all citizens whose quest is to become a part of this massive digital migration. Despite this acknowledgement, several existing barriers have been affecting progress toward multilingual AI. One developer

explained that the main obstacles as observed in the digital industry are:

The scarcity of digitized data in indigenous languages and the high costs of developing language models for minority languages.

This problem mirrors global challenges identified by Albedah (2025) and Srivastava (2025) regarding AI's performance disparities, which cause languages that remain under-resourced. AI risks becoming a tool that benefits primarily English-fluent learners, deepening educational inequities documented extensively across African digital education studies without such adaptations (Phiri, 2025). Other challenges, such as technical limitations, including algorithmic complexity and a lack of trained personnel, further compound difficulties in integrating local languages into most of these AI platforms. For example, one developer remarked,

Developing effective AI for multiple Zambian languages requires expertise and resources not yet widely available...Without national policies prioritizing multilingual AI, there is little incentive or funding to pursue this.

Policy-level gaps worsen these barriers because the absence of one cannot complement the other to fully develop an AI system that meets the demands of a multilingual society. Therefore, both developers and teachers observed that the absence of institutional demand and coherent guidelines encouraging indigenous language AI integration cannot help actualize the Multilingual AI system for countries like Zambia. These findings, therefore, align with Maluleke's (2025) observation that infrastructural inequality and weak policy frameworks significantly impede equitable AI adoption across African education systems.

The findings also reflect Phiri's (2025) study, emphasizing the need for coordinated multi-stakeholder investment and policy support to realize inclusive AI's benefits not just for the learners but all language users, as this demands costly investments in data collection, labelling, and algorithm re-engineering. For many local startups and institutions, these costs are prohibitive without sustained fiscal and policy support, mainly from the government (Maluleke, 2025; Mutelo, 2025). Moreover, some participants expressed concern over the absence of strong government policies and frameworks incentivizing indigenous language adoption, such as in higher education, as well as AI education, which was frequently cited as a critical obstacle. Developers urged for explicit policy directions and funding to support language technology projects that align with Zambia's language and education goals (Phiri, 2025; Maluleke, 2025).

From a realistic standpoint, practical constraints, including limited datasets, resource deficits, and a lack of supportive frameworks, present formidable barriers, while stakeholder attitudes demonstrate awareness and willingness toward multilingual AI adoption. This study strengthens calls from the literature for strategic policy interventions, capacity building, and cross-sector collaborations to overcome these limitations and expand

linguistic accessibility within AI education platforms (Jobin et al., 2019; Ray & Ray, 2024).

5.3 Ethical Concerns

A series of ethical dilemmas surrounding primary aspects such as fairness, transparency, and cultural relevance emerged from the interviews with 06 EdTech developers and 15 teachers. The data highlighted multiple ethical challenges in Zambia's AI education landscape. *Fairness* was a prominent theme, with participants noting how AI tools inadvertently privilege English-fluent students. One developer openly stated:

Our AI models perform best in English because of the data available, making it easy for us to meet deadlines and work more efficiently, despite creating this as an unfair advantage, but it is a resource issue that cannot be addressed by us, the developers.

This honest admission resonates with Jobin et al.'s (2019) principle of fairness in ethical AI, emphasizing the risk of bias due to language data disparities that promote one language over others.

The other ethical dilemma was *Transparency* concerns, which were widely cited, with teachers and developers lamenting the *Black-box* nature of AI algorithms. Many participants expressed concern over the *Black-box* nature of AI systems, whereby learners and even educators do not fully understand why particular responses or recommendations are generated, away from what they expect as desired outputs, thereby contributing to the growing mistrust and skepticism, especially among learners and educators (Holmes et al., 2021; Wang, 2024). Such opacity or unclear feedback undermines accountability and user trust, reflecting calls by Holmes et al. (2021) and Wang (2024) for explainable AI to ensure responsible educational deployments. In sensitive domains like education, this reflects calls from various scholars in this field to enhance AI explainability to uphold accountability and user agency (Ezzaim et al., 2023; Li, 2024).

Cultural relevance was another pressing ethical issue where AI-generated content was observed to often lack alignment with Zambian cultural contexts, as reported by one educator, as indicated in the example below;

The examples in AI content are mostly foreign, as most of our students can't relate to some of the examples. There is limited data regarding Zambia's Cultural information on most of the AI platforms, especially in the local languages.

This inconsistency aligns with Fitas's (2025) and Ray & Ray's (2024) work emphasizing culturally responsive pedagogy and the integration of local knowledge in AI design. The challenge that remains is that this disconnection not only diminishes learner motivation but also questions the AI's suitability for the local educational landscape.

Educators and Local Tech developers explained that what compounds these issues is the limited local participation in AI design. They acknowledged that there exists a top-down approach driven by foreign companies with minimal local input in the development of these AI models, as explained in the statement below:

We often develop tools abroad with little consultation from Zambian teachers or students. But if more engagements were made with our teachers' local languages, it is possible for us to develop balanced AI models that reflect the language and cultures of our people.

The ethical principles of inclusiveness and socio-cultural fairness, pivotal for effective AI adoption in Zambia, have been undermined by the absence of meaningful involvement from local educators, linguists, and students, echoing Mutelo (2025) and Maluleke's (2025) calls for democratizing AI design processes to ensure equitable representation and cultural fairness. These findings echo scholarly concerns about AI imperialism and the urgent need for broader stakeholder participation to democratize AI development, augment linguistic justice, and enhance educational relevance (Abimbola et al., 2024; Srivastava, 2025). Together, these insights affirm ethical AI challenges highlighted in literature (Jobin et al., 2019; Ray & Ray, 2024; Abimbola et al., 2024), contextualizing them within Zambia's education system and emphasizing the need for governance frameworks that embed fairness, transparency, and cultural relevance.

The findings presented offer a robust, empirically grounded account of Zambia's AI education ecosystem's linguistic and ethical dynamics. The linguistic exclusivity of current AI platforms marginalizes non-English proficient learners, compromising equitable access. Ethical dilemmas cluster around fairness, transparency, and cultural relevance, emphasizing the importance of human-centred, locally contextualized AI governance. Stakeholder perspectives reveal an emergent recognition of multilingual AI, tempered by concrete technological, financial, and policy-related barriers. By contextualizing these findings within established theoretical frameworks and prior empirical work, this study demonstrates the urgency of integrating Language-as-Access principles with robust Ethical AI governance to foster linguistically just, culturally relevant, and accountable AI in Zambia's education. The results call for targeted investments, participatory AI design, and inclusive policy frameworks that align with global ethical AI standards yet are sensitive to local linguistic realities.

Table 2: Summary of Quantitative Highlights on AI Linguistic and Ethical Issues in Zambian Education

Variable	Finding
Students reporting English comprehension challenges	87%
Students preferring multilingual AI tools	72%
Teachers perceive AI as culturally biased	68%
Developers acknowledging language bias	61%

5.4 Differences between Secondary and Tertiary Students

Secondary students (n=150) reported significantly greater difficulty with English-only AI interfaces (92%) compared to tertiary students (82%). Tertiary students were more likely to request bilingual options (78%) than secondary students (66%). However, no statistical tests were performed; these are descriptive observations.

5.5 Practical Implications

The practical implications are twofold for policymakers and curriculum developers. The following are the implications for policymakers:

- Allocate specific budget lines for the indigenous NLP dataset collection and annotation.
- Mandate multilingual requirements in public procurement of EdTech.
- Integrate linguistic justice criteria into Zambia's National AI Strategy (2024–2026).

On the other hand are practical implications for developers:

- Design lightweight multilingual chatbots optimized for low-bandwidth areas.
- Prioritize seven official Zambian languages alongside English.
- Engage local teachers and linguists in the co-creation of training data.

6. Limitations

This study has several limitations. First, the cross-sectional design captures perceptions at a single time point, preventing causal claims. Second, social desirability bias may have influenced teacher and developer interview responses, as participants might overstate commitment to linguistic inclusivity. Third, the student survey used self-reported comprehension challenges rather than objective proficiency measures. Fourth, no inferential statistics were applied, limiting generalizability beyond descriptive patterns. Fifth, the sample was drawn from four provinces only, not fully representing all ten provinces of Zambia. Future research should employ longitudinal designs and objective language assessments.

7. Conclusion

Deliberate alignment of technological advancement, ethical responsibility, and linguistic inclusivity guarantees achieving equitable AI integration within Zambia's education ecosystem. The findings of this study clearly highlight that the path toward *linguistically just AI* in education is not merely a technical but one driven by socio-cultural and policy interventions. The main essential undertaking to this vision is the development and open sharing of indigenous language datasets, which will act as an essential foundation for training AI systems capable of understanding and communicating in Zambia's diverse linguistic landscape (Albedah, 2025; Maluleke, 2025). By fostering collaborations among universities, the private sector, and government line ministries, Zambia can establish a sustainable infrastructure for multilingual AI innovation, bridging the persistent gap between language accessibility and digital participation (Phiri, 2025).

On the other hand, the co-creation and partnerships of multilingual AI prototypes between academia and industry offer a pragmatic avenue for developing contextually relevant educational tools. Such initiatives can help generate scalable, culturally grounded applications that align with local learners and pedagogical practices (Mutelo, 2025; Srivastava, 2025). The success of emerging EdTech initiatives demonstrates that local expertise, when properly supported, can drive innovation that aligns with Zambia's linguistic and educational realities (Chansa et al., 2025).

The establishment of comprehensive ethical guidelines for AI in education that embed principles of fairness, accountability, transparency, and linguistic diversity is equally crucial, as guided by Jobin et al. (2019) and Ray & Ray (2024). Incorporating these principles into Zambia's *National AI Strategy (2024–2026)* would help establish ethical and linguistic safeguards aimed at ensuring that AI adoption aligns with human rights and equity priorities (Ministry of Science and Technology, Zambia, 2024). Furthermore, strengthening AI literacy awareness campaigns among educators and learners is important for sustainable adoption. Targeted capacity-building initiatives, particularly in underserved regions, can enhance critical engagement with AI tools and mitigate risks of exclusion (ZANEC, 2025; Phiri, 2025).

Ultimately, the Future of AI in Zambia is very promising, but sustained cross-sector collaboration among government, academia, civil society, and industry will be key to maintaining this new momentum. Through initiatives such as co-creation, shared governance, and contextual responsiveness, Zambia can pioneer a model of *linguistically just and ethically grounded AI in education*, as one that advances inclusion, equity, and cultural relevance in the digital era.

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