Examining the Effectiveness of Artificial Intelligence (AI)-Powered Adaptive Learning System in Zambian Schools: A Case of Katoba Secondary School in Chongwe District

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Abstract

This study examined the effectiveness of Artificial Intelligence (AI)-powered adaptive learning systems in Zambian schools within the Chongwe District. Recognizing the Zambian education system's ongoing efforts to improve access and quality, particularly amidst challenges such as limited resources, inadequate infrastructure, and teacher shortages, this research sought to understand the potential of AI to address these challenges. Guided by Institutional Theory and Technology Acceptance Theory (TAM), the research employed a pragmatic research paradigm and a mixed-methods approach, specifically an embedded correlational design. Participants were selected using simple random sampling and purposive sampling techniques. Data were collected from 114 participants through surveys and semi-structured interviews. Quantitative data were analyzed using descriptive statistics, t-tests, and ANOVA analyses. Qualitative data were analyzed using thematic analysis. Findings revealed that teachers overwhelmingly agreed that AI-powered learning systems are necessary for modern teaching and motivate students. They also emphasized the crucial role of teacher training for effective AI integration. However, concerns about internet connectivity and school technology infrastructure were identified, suggesting the need for improved school infrastructure to support AI implementation. Furthermore, the study highlighted the importance of addressing digital equity concerns to ensure equitable access to AI-powered learning resources for all students, which is crucial for fully realizing the potential of AI to significantly improve learner performance in Zambian schools

Keywords: Learner performance, Artificial Intelligence, Education, Adaptive learning

1.0 Background and context of the study

The Zambian education sector grapples with persistent challenges, including limited resources, inadequate infrastructure, and teacher shortages, which significantly impede the quality of learning outcomes (Kalunga & Siwale, 2025; Kanyemba et al., 2023). This study examines the effectiveness of Artificial Intelligence (AI)-powered adaptive learning systems at Katoba Secondary School in Chongwe District, Zambia, to assess if AI can offer viable solutions to these pressing issues. For this research, AI is defined as the computational simulation of human cognitive processes, enabling

machines to perform tasks typically requiring human intelligence, such as pattern recognition, problem-solving, and decision-making (Mohammed & Watson, 2019; Wartman & Combs, 2018). This definition, emphasizing AI's functional capacity to process data and execute complex tasks, is crucial in the context of adaptive learning systems, which tailor educational experiences to individual student needs.

The integration of AI, as defined, holds the potential to personalize learning, enhance student engagement, and streamline administrative tasks (Aina, Opesemowo, & Adekomaya, 2024; Patel & Ragolane, 2024), thereby addressing some of the core challenges faced by Zambian schools. However, the successful implementation of AI necessitates a deep understanding of its impact on learner performance and teacher attitudes within the unique Zambian context, where digital divides and infrastructure limitations are prevalent (Alam et al., 2024). Therefore, this research aims to ascertain the effectiveness of AI-powered adaptive learning systems on learner performance, assess teacher attitudes toward AI integration, and identify the key challenges hindering successful AI implementation at Katoba Secondary School. By focusing on these objectives, this study seeks to provide empirical evidence to inform strategic decisions regarding AI integration in Zambian schools, ultimately contributing to improved educational quality and access (UNESCO, 2024).

2.0 Literature Review

Globally, the adoption of AI in education has varied significantly, with developed nations leading the way. China, for instance, has emerged as a prominent exemplar of AI-driven educational transformation. With a burgeoning AI industry and substantial investments in advanced technologies, China offers insights into how strategic planning and infrastructure development can facilitate AI integration (World Economic Forum, 2025). This context is useful to contrast with sub-Saharan African countries, where the integration of technology in education has been considerably slower (French Development Agency & UNESCO, 2015). Afrobarometer's (2020) assessment, reporting a digital non-readiness score of 56.6% and a digital literacy rate of 31%, underscores the significant digital divide in the region.

Within the sub-Saharan African context, Zambia faces unique challenges and opportunities in AI adoption. Prior research highlights the potential of AI to address persistent issues such as limited resources, inadequate infrastructure, and teacher shortages (Kalunga & Siwale, 2025; Kanyemba et al., 2023). Kalunga and Siwale (2025), for example, examined AI integration in Zambian land administration, revealing the promise of AI technologies while acknowledging the contextual obstacles to adoption, which are similarly applicable to the educational sphere. Kanyemba et al. (2023) further underscored the need for robust AI policies and infrastructural enhancements in higher education, emphasizing that these foundational elements are crucial for successful AI implementation across all levels of education.

However, the effective adoption of AI in Zambian schools is hindered by digital divides and infrastructure limitations. Alam et al. (2024) found that while Zambian librarians exhibit positive attitudes toward AI, they face barriers such as limited expertise and budgetary constraints. These

findings suggest that similar challenges are likely to affect teachers and students in secondary education, necessitating targeted training and resource allocation.

Further, studies examining the effectiveness of AI-powered adaptive learning systems in similar resource-constrained environments provide valuable insights. Adaptive learning systems, which tailor educational content to individual student needs, have shown promise in enhancing student engagement and learning outcomes (Aina, Opesemowo, & Adekomaya, 2024). Aina, Opesemowo, and Adekomaya (2024) demonstrated that AI technology increased student learning and engagement, highlighting the potential for personalized learning experiences. However, the successful implementation of these systems requires careful consideration of contextual factors. Patel and Ragolane (2024), in their study on AI implementation in South African higher education, emphasized the importance of strategic planning and frameworks for effective AI integration.

Teacher attitudes also play a crucial role in the successful integration of AI in educational settings. Research indicates that teachers' perceptions of AI's usefulness and ease of use significantly influence their adoption of AI technologies (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). However, concerns regarding job displacement and the erosion of the human element in education can create resistance (Gocen & Aydemir, 2020; Mifsud, 2018). UNESCO (2024) emphasizes the importance of providing teachers with adequate training and support to ensure they can effectively use AI tools.

Additionally, ethical and sociocultural considerations are paramount in the implementation of AI in education. Liywalii (2024) emphasized the imperative of contextualizing AI development within African values, advocating for a departure from Euro-American-centric approaches. Mwilongo and Matto (2022) examined the broader socio-economic impact of AI in Sub-Saharan Africa, advocating for AI technologies to align with regional needs and cultural contexts. While existing research provides valuable insights into AI integration in Zambia, there remains a need for studies that specifically examine the effectiveness of AI-powered adaptive learning systems in secondary school settings. Furthermore, there is a lack of research that explores teacher attitudes toward AI integration and identifies the key challenges hindering successful AI implementation in Zambian schools. This study aims to address these gaps by examining the effectiveness of AI-powered adaptive learning systems at Katoba Secondary School in Chongwe District, Zambia, and providing empirical evidence that can inform strategic decisions regarding AI integration in the Zambian education sector

1.0 Theoretical underpinning: Institutional theory and Technology Acceptance Model (TAM)

This study utilizes the Technology Acceptance Model (TAM) and Institutional Theory to understand AI adoption in Zambian education. TAM posits that perceived usefulness and ease of use (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) drive individual AI acceptance, influencing usage behavior. However, contextual factors like the digital divide, teacher training, infrastructure, and cultural norms also significantly impact AI adoption in Zambia.

Institutional Theory, a sociological perspective, examines how societal norms and pressures shape educational systems (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Selznick, 1949, 1957). It emphasizes that successful AI implementation requires aligning with existing institutional landscapes, including national curricula and societal norms. In the Zambian context, this involves providing adequate teacher training, addressing institutional disparities, and establishing ethical guidelines for data privacy.

Combining TAM and Institutional Theory provides a robust framework for analyzing AI adoption. TAM explains individual adoption based on perceived usefulness and ease of use, while Institutional Theory examines broader organizational and societal influences. This integrated approach allows for a comprehensive understanding of both individual motivations and systemic pressures, crucial in contexts like Zambia where digital divides and cultural expectations significantly affect AI integration. By considering both individual and institutional dynamics, this study aims to develop effective AI implementation strategies in the Zambian educational setting.

2.0 Research Problem and Research Objectives

UNESCO (2019) highlights lifelong learning as central to Sustainable Development Goal 4, emphasizing AI's role in personalized, accessible education (UNESCO, 2024; Edwards & Lee, 2019). AI applications can enhance learning, personalize education, and streamline administrative tasks (Chembe et al., 2023; Schiff, 2022). However, while AI's societal integration grows, education systems, including Zambia's, struggle to adapt (UNESCO, 2024; Agarwal & Goel, 2020; Kuchemba, 2025).

Zambia's limited AI adoption stems from resource constraints, a lack of perceived effectiveness, and implementation costs (Kuchemba, 2025). Zulu et al. (2025) further identify limited resources, inadequate teacher training, and weak ICT policies as hindrances. UNESCO (2019) stresses that AI development must align with human values, promoting equity and inclusion.

Research gaps exist regarding AI-powered adaptive learning's impact on Zambian learner outcomes and teachers' attitudes towards AI (Fullan et al., 2023). While implementation challenges are recognized, specific barriers to sustainable AI adoption remain unclear. Despite growing AI research (Ministry of Science and Technology, 2024; UNESCO, 2024; Kanyemba et al., 2023; Mulenga & Phiri, 2023; Siame & Lubbungu, 2023), further investigation is needed to optimize AI implementation in Zambian schools.

Therefore, this paper seeks to address the following research objectives:

1. To ascertain the effectiveness of AI-powered adaptive learning systems on learner performance at Katoba Secondary School.

2. To assess the attitudes of teachers toward the integration of AI in learning and teaching at Katoba Secondary School.

3. To establish the key challenges hindering the successful implementation of educational AI at Katoba Secondary School.

Hypotheses:

This study also tested the following hypotheses regarding the impact of AI-powered learning systems:

1. **Learner Performance:**

   H_0: There is no statistically significant positive relationship between the use of AI-powered learning systems and learner performance.

   H_1: The use of AI-powered learning systems is positively associated with statistically significant improvements in learner performance.

2. **Teacher Attitudes:**

   H_0: There is no statistically significant positive relationship between integration and training on AI-powered learning systems and teacher attitudes toward AI integration.

   H_1: Integration and training on AI-powered learning systems are positively associated with statistically significant positive shifts in teacher attitudes toward AI integration.

5.0 Research Methodology

Guided by a pragmatic philosophical paradigm, this paper employed a mixed-methods approach, specifically embedded correlational research design which was primarily quantitative and secondarily qualitative. The quantitative component involved a survey questionnaire administered to a sample of 114 participants which included both learners and teachers at Katoba Secondary school in Chongwe District, Lusaka Province, Zambia. The qualitative component involved semi-structured interviews with a purposive sample of 10 participants comprising of ZICTA Acting Director General, 2 Officials from Genius Education Zambia, Permanent Secretary Ministry of Education, 4 teachers and 2 learners. The quantitative data was further analyzed using descriptive and inferential statistics (t-tests, and ANOVA), while the qualitative data was analyzed thematically.

To ensure the validity and reliability of the research, content validity was established through literature review and expert consultation. Additionally, ethical considerations, such as obtaining informed consent from participants and securing permission from authorities, was adhered to.

The following section presents the findings and discussion of this research paper.

6.0 Findings and Discussion

This section presents the findings derived from a mixed-methods investigation into the efficacy of artificial intelligence (AI)-powered adaptive learning systems within the educational context of Katoba Secondary School, Zambia. The methodology incorporated statistical analyses and thematic interpretation of qualitative data, encompassing descriptive statistics, analyses of variance

(ANOVAs), hypothesis testing, and thematic analysis of interview transcripts. The participant cohort, comprising 1,517 individuals, was predominantly female and situated within rural locales, with a representation of students, educators, and administrative staff.

Objective 1: AI-powered adaptive learning systems on learner performance at Katoba Secondary School.

Descriptive statistics (N =114) for five variables assessing attitudes of teachers of AI-powered learning systems reported a moderate use of AI systems in class (M = 2.54, SD = 1.107) and a moderate perception that these systems reduce teacher workload (M = 2.78, SD = 1.046), both exhibiting positive skewness (0.369 and 0.365, respectively). Conversely, participants indicated a relatively high perception that AI systems enhance student collaboration and teamwork (M = 3.90, SD = 0.852) and that students adapt quickly to these systems (M = 3.54, SD = 1.115), both showing negative skewness (-0.513 and -0.363, respectively). Notably, participants reported a high perception that AI systems motivate students to learn (M = 4.04, SD = 0.497), with a near-symmetrical distribution (skewness = 0.078). All skewness values were accompanied by a standard error of 0.226 or 0.228. These findings suggest varying perceptions of AI-powered learning systems, with strong agreement on their motivational impact and positive influence on collaboration, while perceptions of their frequency of use and workload reduction were more moderate.

Additionally, five one-way ANOVAs also assessed intergroup variations in attitudes of participants on AI-powered learning systems. Results revealed no significant differences in perceived system usage frequency, teacher workload reduction, student adaptation speed, or student motivation (all ps > .05). However, a statistically significant difference was found regarding the perceived enhancement of student collaboration and teamwork by AI systems, $F(3, 110) = 3.926$, $p = .010$. This indicates that while overall perceptions of AI systems were consistent across the four groups, their views on AI's impact on student collaboration and teamwork differed significantly. Subsequent hypothesis testing, detailed in Table 1, was conducted to further validate these finding.

Table 1. Hypothesis Testing Results: Impact of AI-Powered Learning Systems on Learner Performance

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.695	1	.695	.959	.330
Within Groups	81.139	112	.724		
Total	81.833	113			

Source*: Research Data 2025*

Adopting a significance level of .05, the decision criterion was to reject the null hypothesis if the *p*-value was less than .05. In this case, with a *p*-value of .330 the null hypothesis was not rejected. Therefore, there was no statistically significant evidence to suggest that the AI-powered learning system improves learner performance.

Qualitative results

Table 2: *Qualitative Themes and Illustrative Quotes Regarding the Impact of AI-Powered Learning Systems on Learner Performance*

Themes	Participants quotes
Positive Impact of AI on Collaborative and Independent Learning	*"It has helped me to collaborate with my friends when studying and this has actually improved my performance. It has also helped me to be able learn on my own at the same time providing immediate feedback on whatever, I am researching on."*
Varied Effectiveness of AI on Learning Performance	*"For some learners its effective on their performance but not so for some. In fact the effectiveness of AI powered adaptive learning depends on the subject and the topic the teacher is teaching."*
Limited Impact of AI Compared to Traditional Resources	*"My performance is okay even if AI was used or not because text books were bought for me to read."*

Source*: Research Data 2025*

The qualitative findings reveal three central themes regarding the impact of artificial intelligence (AI) in education, particularly within the Zambian context. The three themes are discussed below;

Facilitation of Collaborative and Independent Learning: The qualitative data analysis revealed the facilitative role of artificial intelligence (AI) in fostering collaborative and independent learning environments, emphasizing its potential to enhance student engagement and address educational disparities through personalized learning strategies. However, the realization of these benefits was contingent upon mitigating the digital divide, ensuring equitable access (Alam et al., 2024; Kanyemba et al., 2023), and implementing culturally sensitive AI tool design, aligning with the Technology Acceptance Model (TAM). Institutional pressures, such as the Zambian government's National AI Strategy, and ethical considerations like data privacy (Patel & Ragolane, 2024), were also identified as influencing AI adoption.

Context-Dependent Variability in AI Effectiveness: The study identified a nuanced perspective on AI's effectiveness, acknowledging its context-dependent variability. Participants noted that AI's

impact on learning performance was contingent upon individual learning styles, technological access, and implementation quality (Aina, Opesemowo, & Adekomaya, 2024), with limited digital infrastructure in Zambia exacerbating existing disparities (Kalunga & Siwale, 2025; Alam et al., 2024). The importance of the human element in education was underscored (Mifsud, 2018), positioning AI as a complementary rather than substitutive tool for educators. The need for targeted training in Zambia, where AI knowledge varies, was also highlighted (Mudenda et al., 2024).

Perceived Limitations of AI Compared to Traditional Resources: Finally, the analysis revealed a thematic concern regarding the perceived limitations of AI compared to traditional pedagogical resources. Participants suggested that traditional teaching methods retained significant value, particularly in contexts with limited infrastructure (Kalunga & Siwale, 2025; Alam et al., 2024), and expressed apprehension regarding AI's potential to erode nuanced human instruction (Mifsud, 2018). UNESCO (2024) was cited, emphasizing that AI should complement, not replace, teachers. Consequently, the study advocates for future research to optimize the integration of AI within educational frameworks, emphasizing a balanced approach that leverages AI's potential while acknowledging the enduring importance of traditional methodologies

Objective 2: Attitudes of teachers toward the integration of AI in learning and teaching.

The descriptive statistics on participants' attitudes towards the integration of AI-powered learning systems revealed that participants ($n = 114$) generally perceived AI-powered learning systems as necessary ($M = 4.29$, $SD = 0.938$) and easy to use ($M = 4.02$, $SD = 0.950$), with positive influences on attitude ($M = 3.86$, $SD = 1.159$) and teaching efficiency ($M = 3.61$, $SD = 1.043$). Moderate concern existed regarding role replacement ($M = 3.23$, $SD = 1.210$). Skewed distributions were observed across all variables

Further, the one-way ANOVAs revealed several statistically significant differences in teachers' perceptions regarding AI-powered learning systems. Teachers' worry about AI replacing traditional roles varied significantly across groups, $F(4, 108) = 5.408$, $p = .001$. Similarly, there was a significant difference in how well teachers perceived AI integration aligning with their teaching philosophy, $F(4, 109) = 5.705$, $p < .001$, and in their perceptions of AI's necessity for modern teaching, $F(4, 109) = 2.723$, $p = .033$. Perceptions of AI making teaching more efficient also varied significantly, $F(4, 109) = 7.924$, $p < .001$. However, the perceived ease of use of AI-powered learning systems did not differ significantly across groups, $F(4, 109) = 1.992$, $p = .101$. These results indicate that while teachers hold varying opinions about the impact and necessity of AI, perceived ease of use remains relatively consistent across the groups studied. These results are validated by the hypothesis testing as presented in table 3.

Table 3: Hypothesis Testing Results: Integration and training on AI powered learning system positively influenced teacher's attitude.

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	31.295	4	7.824	7.079	.000
Within Groups	120.460	109	1.105		
Total	151.754	113			

Source: Research Data 2025

With a significance level of .05, the decision rule was to reject the null hypothesis if the *p*-value was less than .05. Given the *p*-value of .000, we reject the null hypothesis and conclude that there is statistically significant evidence of a difference in attitudes among the groups regarding the integration and training of AI-powered learning systems. The subsequent subsections present qualitative results to further elucidate these quantitative findings.

Qualitative Results

Table 4: Qualitative Themes and Participants Quotes Regarding the Attitudes of teachers toward the integration of AI in learning and teaching.

Theme	Participants quotes
Time Management and Teaching Efficiency	One participant stated, "I've noticed some teachers struggle to manage their time when using AI compared to traditional methods, while others, like myself, find it significantly reduces our workload.'"
Perceived Benefits and Enjoyment of AI Use	Another participant expressed, "I love how AI acts as a self-teaching tool when I miss class, and it helps me recall concepts. It also feels nice and makes teaching enjoyable." By Another participant added by saying, " I am very happy and look forward to seeing this improve and implemented in other schools. AI aligns with my teaching styles and beliefs."
Concerns and Reservations about AI Integration	"A participant shared, 'I feel it shouldn't be used in all subjects or topics. It encourages laziness in some teachers, and I don't like the idea of potentially being replaced by a machine.'

Source: Research Data 2025

The qualitative findings from revealed three primary themes regarding teacher attitudes towards AI integration: time management and teaching efficiency, perceived benefits and enjoyment of AI use, and concerns and reservations about AI integration. These themes are discussed in detail in the preceding paragraphs;

Time management and teaching efficiency: This theme highlighted a polarized experience among teachers. Some reported increased time management challenges when using AI compared to traditional methods, likely due to inadequate training or infrastructure limitations prevalent in the Zambian context, where high teacher workloads are common. This aligns with findings from Kalunga and Siwale (2025), who noted infrastructural challenges in AI integration within Zambian land administration, and Kanyemba et al. (2023), who emphasized policy and infrastructure considerations in higher education. Conversely, others found AI significantly reduced their workload, indicating that when implemented effectively, it can enhance efficiency. This aligns with the Technology Acceptance Model (TAM), which emphasizes the importance of perceived ease of use. If AI tools are perceived as difficult to use, adoption will be hindered. Furthermore, Institutional Theory suggests that administrative pressures to adopt AI, even when teachers struggle, can influence their experiences.

Perceived benefits and enjoyment of AI use: This theme showcased teachers who found AI valuable as a self-teaching tool, enjoyed its application, and felt it aligned with their teaching styles. In a resource-constrained environment like Zambia, AI's ability to supplement learning materials, as highlighted by Oginga and Nyakundi (n.d.) in their discussion of personalized learning, is highly beneficial. This aligns with TAM's concept of perceived usefulness, as teachers recognized the direct benefits of AI in enhancing learning and teaching. Moreover, studies by Aina, Opesemowo, and Adekomaya (2024) demonstrated increased student engagement with AI, supporting the idea that AI can make teaching more enjoyable. If AI aligns with modern pedagogical approaches promoted by the Ministry of Education, teachers may feel normative pressure to adopt it, as described by Institutional Theory.

Concerns and reservations about AI integration : This theme revealed anxieties regarding AI's suitability for all subjects, potential teacher laziness, and job displacement. These concerns are particularly relevant in the Zambian context, where unemployment is a significant issue and the fear of job displacement can create resistance, as noted by Gocen and Aydemir (2020) in their phenomenological study on AI's implications. Such concerns can negatively impact perceived usefulness and ease of use, as described by TAM, and hinder effective implementation. Mifsud (2018) also highlighted concerns about the erosion of the human element in education, which resonates with teachers' anxieties about AI replacing them. Furthermore, ethical concerns, such as data privacy and algorithmic bias, as discussed by Patel and Ragolane (2024) in the South African context, and the perception and challenges noted by Alam et al., (2024) in Zambian libraries, add to the teachers' concerns.

Finally, UNESCO (2024) emphasizes that AI should complement, not replace, teachers, which supports the teachers concern about the need for careful implementation.

In essence, both the qualitative and quantitative data converge, demonstrating that while teachers recognize the potential benefits of AI, they also harbor significant concerns about its impact on their roles and teaching practices. The consistency between the qualitative and quantitative findings reinforces the importance of addressing these concerns through targeted training, clear policy frameworks, and a nuanced approach to AI integration that complements, rather than replaces, traditional teaching methods. These findings therefore underscore the need for a nuanced approach to AI integration in Zambian education.

Objective 3: Key challenges hindering the successful implementation of educational AI

The qualitative findings, revealing significant challenges to AI implementation, are summarized in Table 9. This table presents the identified themes and supporting evidence from the qualitative analysis, highlighting the complexities and obstacles encountered by teachers in integrating AI into their teaching practices. These challenges are discussed in detail in the preceding paragraphs;

Table 5: Qualitative Themes and Participants Quotes Regarding the Key challenges hindering the successful implementation of educational AI

Themes	Participants quotes
Infrastructure and Resource Limitations	**Learner 1 reported,** *"AI makes learning easy, however, Wi-Fi coverage in this school is too small."*
	Learner 2 stated, *"We fail to use AI tools during rainy days because solar doesn't generate power during rainy days."*
	A teacher noted, *"The school only has one room for AI learning, and many times it's overcrowded that we can't even have access to computers and AI machines.*
Lack of Training and Skill Development	**A teacher explained,** *"I don't know how to use these AI tools, so most of the times I just watch when my friends are using them. How I wish someone can teach me how to use these AI tools."*
	A learner stated, *"I have no exposure at home and no skill in using AI tools, this is because only a few learners were trained in the use of these tools."*

Concerns about Misuse and Security	***Teacher 1 expressed concern****, "The government donated tablets, but we are afraid we can't leave learners alone with tablets that are not configured by the school. If we are to monitor what they use the tablets for, this, if not attended to, can create problems for both learners and teachers in the sense that learners can be using those tablets for non-academic things."*
	Teacher 2 reported*, "Work on school computers can be lost if not well protected due to the fact that anyone will have access to the school AI tools. This also discourages the teachers to allow all learners in the computer lab."*

Source: Research Data 2025

Infrastructure and resource limitations: This theme highlighted challenges such as inadequate Wi-Fi and power disruptions, which directly impact the "perceived ease of use" of AI tools, a core component of TAM. As users face constant infrastructural barriers, their perception of AI's usability diminishes, hindering adoption. This aligns with Kalunga and Siwale (2025) and Kanyemba et al. (2023), who documented similar infrastructural challenges in Zambia. From an Institutional Theory perspective, these limitations represent institutional barriers, where even mandated AI adoption is impeded by practical constraints. The school's reliance on weather-dependent solar power further illustrates how external environmental factors can disrupt technology integration.

Lack of training and skill development among teachers and learners: This directly correlates with TAM's "perceived usefulness" construct. Without adequate training, users fail to recognize AI's potential benefits, reducing its perceived value. This aligns with UNESCO (2024), which stresses the importance of teacher competency frameworks. Institutionally, this lack of training reflects gaps in teacher development and curriculum integration, hindering effective AI adoption.

Misuse and security: Misuse and security particularly regarding government-donated tablets, highlight anxieties that negatively affect both "perceived ease of use" and "perceived usefulness" within the TAM framework. These concerns, echoing ethical considerations found in Patel and Ragolane (2024) and Mifsud (2018), stem from a lack of institutional capacity for managing and monitoring AI tool usage. The absence of clear policies and procedures for security and ethical use, a key aspect of Institutional Theory, creates a barrier to effective AI implementation. This is not just a localized issue, as even at the international level, concerns about AI governance are prevalent. The UK government, for example, expressed reservations about a global AI declaration due to concerns about national security and global governance (Kleinman & McMahon, 2025). This highlights that

the challenges faced at Katoba Secondary School, particularly regarding security and ethical use, are part of a broader, global discourse on AI governance and implementation. Thus, both TAM and Institutional Theory, when combined with this broader view of AI governance, provide crucial lenses through which to understand the challenges Katoba Secondary School faces, emphasizing the need for targeted interventions that address both individual user perceptions and broader institutional and global constraints.

Summary of the study

This study, employing a mixed-methods approach, examined the impact of AI-powered adaptive learning systems in a Zambian secondary school. Quantitative data indicated a significant positive impact on collaborative learning, but not overall performance. Teacher attitudes varied significantly regarding AI's impact and necessity, but not its ease of use. Key implementation challenges included infrastructural deficits, training gaps, and security concerns. The findings underscore the necessity of a context-sensitive, nuanced approach to AI integration, emphasizing the importance of addressing both individual user experiences and systemic factors

Recommendations

Based on the findings this study recommends a multi-faceted approach to improve AI integration in Zambian schools, focusing on:

1. **Government Action:** The Ministry of Education should create national AI guidelines, invest in teacher training, improve digital infrastructure, and establish ethical standards.

2. **School Administration:** Schools must prioritize infrastructure improvements, implement targeted teacher training, and develop clear AI usage policies.

3. **Teacher Responsibility:** Teachers should continuously learn about AI, advocate for necessary resources, and use AI as a tool to enhance, not replace, their teaching.

4. **Learner Engagement:** Learners should develop digital literacy, collaborate using AI tools, and communicate any concerns about AI usage.

Recommendations for Future Research

To advance the understanding and effective implementation of artificial intelligence (AI) in Zambian educational settings, future research should prioritize the following areas:

1. **Longitudinal Studies:** Track the long-term impact of AI on students and teachers, and compare different AI models and teaching methods.

2. **Context-Specific Solutions:** Develop AI tools tailored to Zambia's unique educational challenges and explore how cultural factors influence AI adoption.

3. **Ethical and Equity Issues:** Examine the ethical implications of AI, especially in resource-limited settings, and find ways to ensure all students have equal access to AI resources.

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