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## THE IMPACT OF ARTIFICIAL INTELLIGENCE IN EDUCATION: A QUALITATIVE CASE STUDY OF SHALOM SCHOOL IN CHILANGA DISTRICT, ZAMBIA

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### ABSTRACT

This qualitative case study examines the impact of Artificial Intelligence (AI) on education at Shalom School in Chilanga District, Zambia. The primary objectives were to evaluate how AI technologies support teaching and learning, identify the pedagogical and administrative benefits of AI integration, and examine the structural and operational challenges affecting its implementation within a developing context. Adopting an exploratory qualitative methodology, data were collected from 15 teachers and 60 learners through semi-structured interviews, focus group discussions, classroom observations, and descriptive questionnaires. The qualitative findings reveal that AI and supporting digital technologies exert a positive influence on classroom instruction. AI-driven mechanisms facilitate personalized learning by allowing students to progress at their own pace, receive immediate feedback, and access differentiated learning content. For educators, AI tools streamline lesson planning, material development, assessment, and research, thereby mitigating administrative workload. However, systemic barriers severely hinder full adoption. Key challenges include acute shortages of digital hardware, erratic internet connectivity, infrastructural deficits, lack of financial resources, and insufficient professional development in digital pedagogy. The study concludes that while AI holds transformative potential for educational delivery in sub-Saharan Africa, realizing these benefits requires concerted policy interventions, infrastructure investments, continuous teacher training, and contextual ethical guidelines.

**Keywords:** Artificial Intelligence in Education, Qualitative Research, Personalized Learning, Educational Technology, Sub-Saharan Africa, ICT Infrastructure, Shalom School.

## 1 INTRODUCTION

### 1.1 Overview and Background of the Study

The rapid acceleration of digital technologies is fundamentally reconfiguring global educational paradigms. Central to this evolution is Artificial Intelligence (AI)—computer systems engineered to perform cognitive tasks traditionally requiring human intelligence, such as contextual reasoning, pattern recognition, problem-solving, and adaptive decision-making (Holmes et al., 2019). Across the globe, educational systems are progressively integrating AI applications, including Intelligent Tutoring Systems (ITS), adaptive learning platforms, automated assessment tools, and learning analytics, to raise the standard of instruction and optimize administrative processes (Luckin, 2018; Roll & Wylie, 2016).

Global developments illustrate that AI integration enables educators to move past rigid, one-size-fits-all instructional models. By analyzing student interaction data in real time, AI platforms support continuous monitoring and personalized learning trajectories (Popenici & Kerr, 2017). In high-resource educational environments, these technologies have demonstrated a clear capacity to boost student engagement, provide timely formative feedback, and optimize resource allocation (Zawacki-Richter et al., 2019).

Conversely, in developing regions such as Sub-Saharan Africa, the adoption of educational technology proceeds at an uneven pace. While national policy frameworks increasingly emphasize Information and Communication Technology (ICT) as a catalyst for educational modernization and social inclusion, practical implementation remains constrained by economic and structural hurdles (Trucano, 2016). In Zambia, the Ministry of Education has prioritized digital transformation through national ICT policies intended to expand access to digital tools, cultivate digital literacy, and modernize classroom dynamics (Ministry of Education, Zambia, 2020). Despite these strategic aims, primary and secondary schools continue to struggle with inadequate infrastructure, scarce computing hardware, intermittent connectivity, and limited opportunities for specialized teacher training.

Shalom School, located in the Chilanga District of Zambia, serves as a representative case of a community-facing educational institution navigating this technological transition. While the school operates within a policy environment that encourages digital integration, its day-to-day operations highlight the stark reality of resource limitations common across the region. Understanding how AI and underlying digital tools are understood, applied, and constrained within this specific setting provides crucial empirical insights into the real-world viability of educational technology in sub-Saharan Africa.

### 1.2 Problem Statement

Artificial Intelligence is projected to become a multi-billion-dollar global industry within education, driven by its capacity to enhance teaching efficiency, personalize learning environments, and automate administrative tasks (Holmes et al., 2019; Markets and Markets, 2021). However, a significant digital divide persists. Educational institutions in developing countries frequently lack the baseline infrastructure needed to run modern AI tools effectively. Reports indicate that fewer than 30% of schools across Sub-Saharan Africa possess reliable internet access, and the ratio of devices to students remains critically low (UNESCO, 2021).

In Zambia, efforts to implement digital and AI-supported learning are constrained by structural deficits, including inadequate ICT hardware, unstable power supply, high data costs, and insufficient teacher development (Ministry of Education, Zambia, 2020). While global literature extensively documents the theoretical and practical benefits of AI in high-resource settings, empirical qualitative research examining how community schools in Peri-Urban Zambia experience AI technology remains sparse. Consequently, there is a clear knowledge gap regarding how teachers and students perceive, utilize, and adapt to AI tools amid local infrastructure limitations. This study addresses this gap by conducting a qualitative investigation of the impact, opportunities, and implementation barriers of AI at Shalom School in Chilanga District.

### 1.3 Research Objectives

The central objective of this research is to investigate the qualitative impact of Artificial Intelligence on teaching and learning at Shalom School. The specific objectives are:

- To explore how AI technologies and supporting digital tools influence teaching and learning practices within the classroom.
- To identify the specific pedagogical, administrative, and learning benefits derived from AI integration at the school level.

- To examine the structural, financial, and operational challenges that impede the effective implementation of AI technologies at Shalom School.

#### 1.4 Research Questions

- How do Artificial Intelligence and digital educational tools influence classroom teaching and learning practices at Shalom School?
- What are the key pedagogical and operational benefits associated with the use of AI in this educational setting?
- What structural, institutional, and technical challenges constrain the adoption and implementation of AI technologies in the school?

#### 1.5 Significance and Scope of the Study

This study contributes to the growing body of literature on digital transformation in sub-Saharan African education. By capturing the qualitative experiences of educators and learners, the findings offer practical insights for school leaders, policymakers, and educational technology developers aiming to implement context-appropriate solutions.

The geographic and institutional scope of this study is bounded to Shalom School in Chilanga District, Zambia. The participant group comprises 15 teachers and 60 selected learners. The inquiry focuses on qualitative perspectives regarding AI awareness, perceived educational utility, current pedagogical practices, and institutional constraints.

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## 2 LITERATURE REVIEW

### 2.1 Theoretical and Conceptual Foundations of AI in Education

Artificial Intelligence in Education (AIED) represents an interdisciplinary domain combining computer science, cognitive science, learning sciences, and pedagogy (Woolf, 2010). At its core, AI refers to software mechanisms designed to execute functions traditionally requiring human cognition, such as pattern recognition, language processing, problem-solving, and continuous adaptation through algorithms (Holmes et al., 2019). In academic settings, AI is deployed through several major functional models:

- Intelligent Tutoring Systems (ITS): Platforms engineered to provide step-by-step, individualized instruction and corrective feedback without requiring continuous human teacher intervention (Woolf, 2010).
- Adaptive Learning Systems: Data-driven environments that dynamically modify content difficulty, instructional modality, and pacing based on continuous evaluations of learner progress (Luckin, 2018).
- Automated Assessment Systems: Algorithms capable of evaluating student responses, ranging from multiple-choice quizzes to complex prose, providing fast diagnostic feedback (Holmes et al., 2019).
- Learning Analytics Frameworks: Analytical software designed to synthesize learner interaction data, enabling educators to track engagement, identify struggling students early, and refine curriculum design (Zawacki-Richter et al., 2019).

Scholars emphasize that the primary value of AI in educational settings lies not in replacing teachers, but in augmenting human instruction (Selwyn, 2019). By handling routine instructional tasks and administrative duties, AI platforms allow teachers to focus on mentor roles, socio-emotional support, and high-order critical thinking activities (Luckin et al., 2016).

### 2.2 Benefits of AI in Educational Settings

Existing literature highlights three major benefits of integrating AI into educational environments:

#### Personalized Learning and Learner Autonomy

Traditional classroom models rely heavily on standardized, synchronous delivery, which often fails to accommodate varying student learning paces and academic backgrounds. AI-driven adaptive software addresses this issue by constructing custom learning pathways (Holmes et al., 2019). When a student masters a concept, the platform advances to higher-level content; conversely, if a student struggles, the system provides targeted explanations, remedial tasks, and scaffolding (Luckin, 2018). This adaptive cycle fosters learner autonomy, reduces cognitive overload, and helps prevent academic frustration, particularly in diverse classrooms (UNESCO, 2021).

#### Instructional Efficiency and Administrative Relief

Managing large classes imposes a heavy administrative burden on teachers, requiring considerable time for grading, record-keeping, and lesson preparation. AI applications streamline these processes by automating routine tasks (Luckin

et al., 2016). Automated grading tools deliver near-instant feedback to learners, reinforcing correct understandings while memories are fresh. Simultaneously, AI-assisted content generators help teachers design lesson plans, worksheets, and assessment rubrics efficiently, allowing them to devote more time to direct student engagement (Holmes et al., 2019).

#### Expanded Access to Digital Learning Resources

AI platforms can organize, curate, and recommend dynamic learning assets—including open access repositories, interactive simulations, and instructional media—customized to student interests and learning needs (UNESCO, 2021). In resource-constrained schools where physical libraries and updated textbooks are scarce, digital repositories powered by AI offer an important alternative pathway to academic content.

### 2.3 Challenges in Sub-Saharan Africa and the Zambian Context

While AI offers significant educational benefits, its deployment in developing regions faces substantial hurdles. Across Sub-Saharan Africa, digital transformation is obstructed by systemic infrastructure gaps, including reliable electricity, broadband internet, and hardware availability (UNESCO, 2021).

In Zambia, government strategies recognize the importance of ICT integration for national development (Ministry of Education, Zambia, 2020). Recent empirical research in higher education settings shows a growing baseline awareness of AI concepts among Zambian students, such as first-degree students in Chibombo District (Joseph, 2026). However, operationalizing this awareness into functional classroom tools at primary and secondary levels remains constrained by structural factors:

- High student-to-computer ratios.
- Expensive and unstable internet connectivity.
- Frequent power outages.
- Limited funding for school technology maintenance.
- Inadequate professional development programs focused on digital pedagogy (Knox, 2020).

Without targeted interventions and clear policy frameworks, adding AI applications to existing classrooms risks exacerbating educational inequalities rather than reducing them (UNESCO, 2023).

## 3 QUALITATIVE RESEARCH METHODOLOGY

### 3.1 Research Design

This study employs an exploratory, descriptive single-case study qualitative design, centered on Shalom School in Chilanga District, Zambia. Qualitative methodology is uniquely suited for this investigation, as it seeks to capture the lived experiences, perceptions, and contextual meanings constructed by participants within their natural environment (Creswell, 2017; Yin, 2018). Rather than focusing solely on numerical measurements, the qualitative case study approach provides a detailed, contextualized understanding of how AI technologies are perceived, implemented, and constrained in a peri-urban Zambian school (Bryman, 2016).

### 3.2 Target Population and Sampling Strategy

The target population for this study comprised teachers and learners at Shalom School. A purposive sampling strategy was applied to select respondents who possessed direct experience with classroom instruction and exposure to the school's digital tools (Bryman, 2016).

The total sample size (N = 75) consisted of:

- 15 Teachers: Selected across various academic subjects to provide insight into instructional methodologies, administrative integration, pedagogical benefits, and institutional barriers.
- 60 Learners: Selected from upper primary and secondary grades to capture diverse student perspectives regarding technology use, learning engagement, and access challenges.

Purposive sampling ensured that the study engaged participants capable of generating rich, detailed descriptions of the phenomenon under investigation (O'Leary, 2017).

### 3.3 Data Collection Instruments

To ensure data triangulation and enhance the trustworthiness of the qualitative findings, data were collected using three primary qualitative instruments (Creswell, 2017):

- **Semi-Structured Interviews:** Conducted individually with teachers to capture detailed insights into their experiences, pedagogical adaptations, technical struggles, and views on AI in education.
- **Focus Group Discussions (FGDs):** Organized with small groups of learners to encourage interactive discussions regarding their experiences with digital tools, access limitations, and perception of AI-assisted learning.
- **Classroom Observations and Site Audits:** Conducted using a structured observation protocol to evaluate the physical ICT infrastructure, computer lab availability, power reliability, student interaction with digital tools, and active instructional methods.
- **Descriptive Questionnaires:** Used to gather baseline contextual profiles and structured qualitative responses regarding AI awareness, usage frequency, perceived benefits, and operational challenges.

### 3.4 Data Analysis Procedure

Qualitative data were analyzed using Thematic Content Analysis following the six-phase framework established by Braun and Clarke (2006):

- **Familiarization:** Transcribing audio recordings, reading verbatim transcripts, and logging observational field notes.
- **Initial Code Generation:** Coding meaningful phrases, statements, and observational incidents related to AI utility, resource constraints, and teaching strategies.
- **Searching for Themes:** Clustering related codes into broader conceptual categories linked to the research objectives.
- **Reviewing Themes:** Refining themes against the dataset to ensure internal consistency and descriptive validity.
- **Defining and Naming Themes:** Formulating clear thematic definitions capturing the core insights of each category.
- **Producing the Narrative:** Synthesizing qualitative narrative summaries integrated with verbatim participant quotes and descriptive contextual data.

### 3.5 Ethical Considerations

Rigorous ethical standards were maintained throughout the research process (O'Leary, 2017). Approval was secured from relevant institutional review authorities and the administration at Shalom School. Informed consent was obtained from all participating teachers, and parental/guardian assent was obtained for minor learners. Participation was strictly voluntary, with respondents assured of their right to withdraw at any stage without penalty. Confidentiality and anonymity were maintained by assigning alphanumeric pseudonyms (e.g., Teacher A, Student Group 3) and securely storing all electronic audio recordings and transcripts.

## 4 EMPIRICAL QUALITATIVE FINDINGS AND DATA PRESENTATION

### 4.1 Awareness and Conceptual Understanding of AI

Data gathered regarding participant awareness revealed varying levels of familiarity with Artificial Intelligence across the school community.

#### Baseline Awareness Distribution

Table 1 outlines the general distribution of participants who reported prior knowledge or awareness of Artificial Intelligence concepts:

**Table 1: Awareness of Artificial Intelligence among Participants**

| Category | Aware of AI (Yes) | Unaware of AI (No) | Total Participants |
|----------|-------------------|--------------------|--------------------|
| Learners | 40                | 20                 | 60                 |
| Teachers | 13                | 2                  | 15                 |
| Total    | 53                | 22                 | 75                 |

Interpretation: Out of 75 participants, 53 (70.7%) reported basic awareness of AI concepts. Awareness was higher among educators (13 out of 15, or 86.7%) than among students (40 out of 60, or 66.7%).

Qualitative interview narratives show that while teachers generally associate AI with modern software, automated search engines, and smart digital assistants, learners often conceptualize AI through public digital tools, social media features, or science fiction. Teacher B noted during an interview:

"We hear a lot about AI tools like ChatGPT and smart software that helps draft notes or look up answers online, but applying them systematically in our localized lesson plans is still very new to most of us."

#### 4.2 Utilization of Digital Infrastructure in Teaching and Learning

To assess the foundation available for AI deployment, the study evaluated the frequency with which educators and students interact with computing devices (computers, tablets, and smartphones).

**Table 2: Utilization Frequency of Digital Devices for Educational Purposes**

| Frequency of Use | Learner Responses (n=60) | Teacher Responses (n=15) |
|------------------|--------------------------|--------------------------|
| Always           | 20                       | 7                        |
| Sometimes        | 25                       | 6                        |
| Rarely           | 10                       | 2                        |
| Never            | 5                        | 0                        |

Interpretation: The findings demonstrate that digital technology is actively present in the learning environment, though usage frequency varies. All 15 teachers report using digital tools for educational planning or delivery to some degree, with 13 (86.7%) using them "Always" or "Sometimes". Among learners, 45 (75%) engage with digital tools regularly, whereas 15 (25%) use them rarely or never due to access limits.

Field observations confirmed that device access is highly uneven. While teachers frequently rely on personal smartphones and laptops for lesson preparation, students depend primarily on the school's shared computer laboratory, where limited hardware often requires sharing screens.

#### 4.3 Perceptions of AI's Educational Potential

Participants were asked whether they believed AI tools could genuinely improve educational quality at Shalom School.

**Table 3: Participant Perceptions of AI's Capacity to Improve Education**

| Response       | Learner Responses (n=60) | Teacher Responses (n=15) | Combined Total (N=75) |
|----------------|--------------------------|--------------------------|-----------------------|
| Yes (positive) | 45                       | 14                       | 59 (78.7%)            |
| No (negative)  | 15                       | 1                        | 16 (21.3%)            |

Interpretation: An overwhelming majority of participants (78.7%) expressed confidence in AI's capacity to enhance teaching and learning outcomes. Teachers highlighted potential improvements in instructional efficiency, while students focused on better subject comprehension and faster access to information.

During a focus group session, a secondary school student explained:

"When we use smart digital tools, complex science topics become much easier to visualize. The software breaks down difficult ideas into simple explanations that we can re-read at our own pace."

#### 4.4 Perceived Qualitative Benefits of AI Integration

Qualitative analysis identified four core areas where participants observed or anticipated clear benefits from AI integration:

**Table 4: Perceived Primary Benefits of AI in Education**

| Primary Benefit       | Learner Selections | Teacher Selections | Key Qualitative Insights                                                      |
|-----------------------|--------------------|--------------------|-------------------------------------------------------------------------------|
| Personalized Learning | 25                 | 6                  | Content adapts to individual student speeds and academic levels.              |
| Faster Feedback       | 15                 | 4                  | Instant assessment results help students identify and correct errors quickly. |
| Resource Access       | 12                 | 3                  | Expands access to digital textbooks, tutorials, and research material.        |
| Enhanced Methods      | 8                  | 2                  | Helps teachers generate engaging lesson plans and varied teaching materials.  |

- **Customized and Differentiated Learning Pathways:** Educators noted that AI applications help address wide variations in student ability. By offering scaffolded exercises, adaptive platforms support both struggling students and advanced learners within the same cohort (Luckin, 2018).
- **Immediate Feedback Loops:** Learners emphasized the value of instant feedback provided by digital assessment systems. Immediate results allow students to address misunderstandings right away, reinforcing learning more effectively than traditional grading, which can take days.
- **Automated Teacher Task Support:** Teachers highlighted the operational efficiency gained through AI tools. Generating customized worksheets, searching for reference content, and organizing administrative records can be completed much faster, freeing up time for direct student interaction.

#### 4.5 Implementation Challenges and Structural Barriers

Despite strong enthusiasm for AI's potential, data collection revealed significant operational barriers that impede full implementation at Shalom School.

**Table 5: Primary Challenges Constraining AI Implementation**

| Identified Challenge       | Learner Responses | Teacher Responses | Operational Impact Observed                                                   |
|----------------------------|-------------------|-------------------|-------------------------------------------------------------------------------|
| Lack of Computers/Devices  | 30                | 7                 | Low device-to-student ratios force screen-sharing and restrict hands-on time. |
| Poor Internet Connectivity | 15                | 4                 | High data costs and unstable connections cause frequent disruptions           |
| Lack of Teacher Training   | 10                | 3                 | Educators report low confidence in applying AI tools to specialized subjects. |
| High Cost of Technology    | 5                 | 1                 | Limited school budgets restrict software licensing and hardware maintenance.  |

Direct observations at the school supported these findings:

**Hardware Deficits:** The existing computer laboratory contains an insufficient number of functional desktop units relative to student enrollment. As a result, two to four students often share a single screen during practical lessons, limiting individual engagement.

**Connectivity and Power Stability:** Internet connectivity relies on mobile data networks, which are subject to speed fluctuations and high bandwidth costs. Unstable power grids occasionally interrupt computer lab sessions entirely.

**Pedagogical and Skills Gap:** While teachers are motivated, few have received formal training on integrating digital tools or AI frameworks into subject-specific pedagogy. Most rely on trial-and-error, which limits technology use to basic tasks like typing and web searches rather than advanced adaptive learning.

## 5 DISCUSSION

### 5.1 Interpretation of Qualitative Findings

The empirical findings from Shalom School align closely with established literature on technology adoption in developing contexts. The high baseline awareness of AI among educators (86.7%) and students (66.7%) reflects a growing recognition of emerging technologies across sub-Saharan Africa (Holmes et al., 2019). This finding echoes recent studies on AI awareness within the Zambian tertiary sector, such as Joseph's (2026) assessment of first-degree students in Chibombo District, indicating a broader regional momentum toward digital literacy. Participants view AI tools not as a threat, but as valuable assets capable of enriching learning and streamlining school operations.

The clear demand for personalized learning highlighted by both teachers and students reinforces theoretical frameworks developed by Luckin (2018) and Woolf (2010). In large or diverse classrooms, individual instruction is often difficult to sustain manually. Adaptive AI platforms help bridge this gap by offering customized feedback and flexible content delivery. Furthermore, using AI to streamline routine administrative tasks directly addresses teacher workload challenges, a benefit well-documented in global educational research (Selwyn, 2019; Zawacki-Richter et al., 2019).

### 5.2 Contextual Realities and the Infrastructure Gap

However, the reality at Shalom School illustrates a common disconnect in educational technology deployment across developing regions. While national policies actively encourage digital transformation, local infrastructure often lags behind policy ambitions (Ministry of Education, Zambia, 2020; Trucano, 2016). As shown in Table 5, hardware shortages and unstable internet connectivity remain the primary obstacles to implementation. Without reliable hardware, sufficient bandwidth, and stable power, even the most advanced AI educational applications remain largely inaccessible (UNESCO, 2021).

Furthermore, teacher readiness remains a critical variable. Introducing hardware and software without comprehensive professional development programs rarely yields meaningful pedagogical improvements (Knox, 2020). For AI tools to deliver lasting value at schools like Shalom School, technical investments must be paired with structured training in digital pedagogy, ethics, and critical media literacy.

## 6 CONCLUSION

This qualitative case study examined the impact, perceptions, and operational realities of Artificial Intelligence in education at Shalom School in Chilanga District, Zambia. The findings demonstrate that educators and students broadly recognize AI's potential to transform learning experiences. Reported benefits include enhanced support for personalized learning, faster assessment feedback, and reduced administrative load for teachers, and expanded access to digital resources.

At the same time, the study highlights severe implementation bottlenecks. Structural challenges—most notably acute hardware shortages, unreliable internet connectivity, high data costs, and insufficient teacher training in digital pedagogy—continue to prevent the effective, sustained use of AI tools. Bridging the gap between educational potential and practical implementation requires moving past ad-hoc technology adoption toward targeted investment, professional capacity building, and institutional policy support.

### *Strategic Recommendations*

Based on these findings, the following actionable recommendations are proposed for educational administrators, government bodies, and policymakers:

**Targeted Investment in ICT Infrastructure:** Educational authorities and school management should prioritize expanding hardware access at Shalom School. Establishing low-power computer labs supported by solar energy and local offline educational servers (e.g., Kolibri, offline Wikipedia modules) can mitigate power instabilities and internet data costs.

**Continuous Professional Development in Digital Pedagogy:** Ministry officials and school administrators must establish structured, ongoing training programs for teachers. These workshops should move beyond basic computer literacy to focus on practical strategies for integrating AI tools, personalized learning software, and digital assessment techniques into daily instruction.

**Developing Clear Ethical and Usage Guidelines:** National policymakers and school authorities should formulate operational frameworks to guide responsible technology use. These guidelines should address data privacy, academic

integrity, equitable device access, and the ethical use of generative AI tools in assignment preparation and grading (UNESCO, 2023).

**Fostering Public-Private Educational Partnerships:** Schools should actively engage technology vendors, non-governmental organizations, and telecommunications companies to secure subsidized hardware, zero-rated educational internet access, and technical support services.

**Future Research Directions:** Academic researchers should undertake longitudinal studies across a broader sample of urban, peri-urban, and rural schools in Zambia. Comparative research will generate crucial evidence regarding the long-term impact of AI integration on student learning outcomes, retention rates, and educational equity across sub-Saharan Africa.

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### *Disclosure of conflict of interest*

We declare no conflicts of interest regarding this manuscript.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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