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THE ROLE OF ARTIFICIAL INTELLIGENCE IN SHAPING THE FUTURE OF SECONDARY EDUCATION IN BORNO STATE: OPPORTUNITIES AND CONSTRAINTS

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ABSTRACT

Artificial Intelligence (AI) is increasingly influencing education worldwide, yet its role in Nigerian secondary schools remains underexplored. This study examined the opportunities and constraints of AI adoption in secondary education within Borno State. A descriptive survey design was used with 150 respondents (30 principals and 120 teachers) randomly selected from public secondary schools in Maiduguri Metropolis and environs. Data were collected through a validated 20-item questionnaire (Cronbach's Alpha = 0.85) and analyzed using descriptive statistics and Chi-square tests at the 0.05 significance level. Findings revealed that AI presents significant opportunities such as personalized learning, virtual tutoring, and

Introduction

Artificial Intelligence (AI) is transforming educational systems globally, offering new approaches to learning, teaching, and administration. Applications range from adaptive learning platforms and intelligent tutoring systems to automated grading and predictive analytics (Chen, Xie, & Hwang, 2020). These innovations have been shown to improve student engagement, personalize instruction, and support administrators with data-driven decision-making (Holmes, Bialik, & Fadel, 2019).

data-driven decision-making. However, major barriers include weak ICT infrastructure, inadequate teacher training, high costs, and ethical concerns. Urban schools reported more perceived opportunities compared to rural ones, while principals and teachers differed in how they viewed adoption constraints. The study concludes that AI has transformative potential for Borno State's education system but requires investments in infrastructure, teacher training, and strong policy frameworks.

Keywords: Artificial Intelligence, Secondary Education, Borno State, Opportunities, Constraints

In high-income countries, adoption is aided by strong digital infrastructure and well-trained teachers (Khan & Sharma, 2021). Conversely, developing contexts face significant barriers such as underfunded ICT systems, skill gaps, and ethical concerns (Mhlanga, 2022; Ogunode & Abiodun, 2023). Nigeria is no exception: while there is growing recognition of ICT's importance in schools, persistent challenges such as overcrowded classrooms, uneven access to resources, and the rural–urban digital divide limit progress (Eke & Musa, 2019; Abubakar & Danladi, 2022).

For Borno State, where education has been disrupted by prolonged socio-economic challenges, AI could play a crucial role in bridging access gaps. Virtual tutoring and AI-driven learning platforms may compensate for teacher shortages, while predictive analytics could support school planning. Yet, without deliberate policies and targeted investments, adoption may reinforce existing inequalities (Samuel, 2023; Samaila et al., 2024). This study therefore investigates the opportunities and constraints of AI adoption in secondary education in Borno State.

Statement of the Problem

Secondary schools in Borno State face major challenges: insufficient infrastructure, teacher shortages, and unequal access to resources (Eke & Musa, 2019). Although AI could help address these issues, little empirical work has examined its role in this region. Without context-specific evidence, policies risk being misaligned, and AI adoption could deepen educational inequalities rather than bridge them.

Objectives of the Study

i. To examine the opportunities that AI presents for secondary education in Borno State.
ii. To identify the major constraints to AI adoption in Borno State.
iii. To determine differences between urban and rural respondents on perceived AI opportunities.

iv. To ascertain differences between principals and teachers on perceived AI constraints.

Scope of the Study

This study was limited to public secondary schools within Maiduguri Metropolis and selected surrounding communities in Borno State, Nigeria. The geographical focus was chosen because Maiduguri serves as the educational hub of the state and provides a representative context for examining urban–rural disparities.

The population of interest comprised principals and teachers in public secondary schools. Principals were included because they play a central role in policy implementation and school administration, while teachers were selected as the primary users of AI tools in classroom instruction. Students were not included in the study, as the research emphasized institutional readiness and staff perceptions rather than learner experiences.

In terms of content, the study concentrated on two main constructs: (i) the opportunities that AI offers in enhancing teaching, learning, and school administration, and (ii) the constraints that hinder its adoption, such as infrastructural deficits, teacher readiness, cost, and ethical concerns.

The time scope of the study covered the 2023/2024 academic session, during which the field survey was conducted.

The study does not extend to private secondary schools, tertiary institutions, or primary schools, as these fall outside the intended focus. Furthermore, while AI adoption was analyzed in terms of perception and readiness, the study did not include experimental implementation of AI tools in classrooms.

Empirical Studies

Samaila et al. (2024) explored teachers' awareness and readiness to use AI-based assessment tools in Kwara State through a qualitative study. They found that teachers were moderately aware and generally willing to adopt AI, but a lack of training limited implementation.

Ogunode and Abiodun (2023) conducted a secondary data analysis of AI education in Nigeria. Their findings emphasized challenges such as infrastructural deficits, underfunding, and limited teacher competence. A key limitation was reliance on secondary sources without field data.

Adoption of Artificial Intelligence in Science Teaching (2023) applied a Technology Acceptance Model survey of science teachers in Cross River State. The study revealed that perceived usefulness and ease of use strongly influenced AI adoption. However, its scope was limited to science teachers.

Ubabudu (2023) conducted a descriptive survey among students in Abuja private schools. Results showed that AI improved personalized learning and engagement but highlighted inequitable implementation across schools.

Samuel (2023) presented a conceptual study on AI's role in Nigeria's education system, stressing its transformative potential while warning of challenges such as high costs, ethical risks, and sustainability.

Chogwu and Adi (2022) investigated AI's use in school supervision and plant management in Abuja through a descriptive survey of principals and vice-principals. They found AI could enhance planning and oversight but neglected teacher and student perspectives.

Okey and Chukwu (2022) surveyed administrators in Enugu State, discovering minimal AI integration but recognition of its potential in communication and policy planning. The study's focus on administration limited insights into classroom teaching.

Ojetunde (2025) used a mixed-methods approach (survey of 327 students and interviews with teachers) to evaluate AI curriculum implementation in Nigerian secondary schools. Findings showed positive student perceptions, especially for problem-solving skills, though infrastructural gaps limited scale-up.

Synthesis of Literature

Across these studies, AI is shown to enhance personalized learning (Ubabudu, 2023), student engagement (Ojetunde, 2025), and administrative efficiency (Chogwu & Adi, 2022). Yet systemic barriers remain—ranging from infrastructure (Ogunode & Abiodun, 2023) and training gaps (Samaila et al., 2024) to ethical dilemmas (Samuel, 2023). While TAM-based evidence points to usefulness and ease of use as key adoption drivers (Adoption of AI in Science Teaching, 2023), research in Nigeria remains fragmented and localized. These gaps underscore the need for empirical evidence specific to Borno State.

Methodology

Research Design

This study adopted a **descriptive survey research design.** According to Creswell and Creswell (2018), surveys are suitable for collecting information on attitudes, practices, and opinions without manipulating variables.

Population of the Study

The population comprised all principals and teachers in public secondary schools across Maiduguri Metropolis and surrounding areas in Borno State. Data from the Borno State Ministry of Education (2023) indicates approximately **1,050 teachers and 85 principals.**

Sample Size and Sampling Technique

A sample of **150 respondents** (30 principals and 120 teachers) was selected, representing about 12% of the population (Israel, 2019). Respondents were chosen using **simple random sampling** to ensure equal representation.

Instrumentation

A structured **20-item questionnaire** was designed, comprising demographic information and items on AI opportunities (10) and constraints (10), measured on a **4-point Likert scale** (Strongly Agree = 4, Strongly Disagree = 1).

Validity and Reliability

Instrument validity was established through expert review by two specialists in educational management and one in educational technology. Reliability was confirmed through a pilot test with 20 teachers outside the sample, yielding a Cronbach's Alpha of **0.85** (George & Mallery, 2019).

Data Collection

Permission was obtained from the Borno State Ministry of Education. Questionnaires were distributed with the help of trained assistants and retrieved within three days.

Data Analysis

Descriptive statistics (mean, standard deviation) answered research questions, while Chi-square tested hypotheses at a 0.05 significance level. A mean benchmark of 2.50 indicated agreement.

Results

Opportunities of AI in Secondary Education

Table 1 presents respondents' views on the opportunities of AI in secondary education.

Table 1: Mean and Standard Deviation on Opportunities of AI

S/N	Opportunities of AI	Mean	SD	Remark
1	Personalized learning	3.41	0.64	Agree
2	Improved academic performance	3.46	0.61	Agree
3	Real-time feedback	3.33	0.66	Agree
4	Bridging educational gaps	3.40	0.67	Agree
5	Virtual tutoring	3.38	0.70	Agree
6	Administrative efficiency	3.36	0.65	Agree
7	Promotes dynamic classrooms	3.34	0.68	Agree
8	Data-driven decision-making	3.42	0.69	Agree

Interpretation:

The results show that all listed opportunities had mean scores above the benchmark of 2.50, indicating agreement among respondents. The highest-rated opportunities were *improved academic performance* (M = 3.46, SD = 0.61) and *personalized learning* (M = 3.41, SD = 0.64). This suggests that respondents perceive AI as a tool capable of enhancing student outcomes and tailoring instruction to individual needs. Other opportunities such as *virtual tutoring* (M = 3.38) and *bridging educational gaps* (M = 3.40) highlight AI's role in promoting equity and accessibility in education.

Constraints of AI in Secondary Education

Table 2 presents respondents' perceptions of the constraints hindering AI integration.

Table 2: Mean and Standard Deviation on Constraints of AI

S/N	Constraints	Mean	SD	Remark
1	Inadequate ICT infrastructure	3.50	0.71	Agree
2	Limited teacher training	3.47	0.68	Agree
3	Data privacy concerns	3.30	0.75	Agree
4	Algorithmic bias	3.22	0.70	Agree
5	High cost of deployment	3.44	0.73	Agree
6	Unequal rural-urban access	3.36	0.72	Agree
7	Teacher resistance	3.18	0.69	Agree
8	Lack of state policy	3.40	0.66	Agree

Interpretation:

All items scored above 3.00, confirming strong agreement among respondents. The most pressing constraint was *inadequate ICT infrastructure* (M = 3.50, SD = 0.71), followed by *limited teacher training* (M = 3.47, SD = 0.68). This highlights systemic barriers that hinder effective AI adoption in Borno State. Ethical issues such as *data privacy* (M = 3.30) and *algorithmic bias* (M = 3.22) were also acknowledged, consistent with global debates on responsible AI use.

Hypotheses Testing

Hypothesis 1:

There is no significant difference between urban and rural respondents on perceived AI opportunities.

- Result: χ^2 (df = 1, N = 150) = 8.21, $p < 0.05$.
- **Decision:** Reject H0.

- **Interpretation:** Significant differences exist between urban and rural respondents, with urban schools perceiving greater opportunities for AI adoption. This reflects disparities in digital access and infrastructure.

Hypothesis 2:

There is no significant difference between principals and teachers on perceived AI constraints.

- Result: χ^2 (df = 1, N = 150) = 4.89, $p < 0.05$.
- **Decision:** Reject H0.
- **Interpretation:** Significant differences exist between principals and teachers regarding constraints. Principals emphasized infrastructural and policy-related challenges, while teachers focused on training and ethical issues.

Discussion

The findings of this study demonstrate that artificial intelligence (AI) offers multiple opportunities for enhancing secondary education in Borno State. Respondents strongly agreed that AI can foster *personalized learning, real-time feedback, improved student performance, and virtual tutoring*. These opportunities align with global evidence that AI-driven systems adapt instruction to individual learner needs and boost outcomes (Holmes, Bialik, & Fadel, 2019; Ahmad & Bhatti, 2020). Similarly, Mhlanga (2022) highlighted the potential of AI in African contexts to bridge access gaps by providing scalable digital learning solutions, an outcome that resonates with this study's findings on bridging educational inequalities.

Beyond classroom instruction, this study also revealed that teachers and principals perceive AI as beneficial for *administrative efficiency* and *data-driven decision-making*. This finding is consistent with Chogwu and Adi (2022), who found that AI supports planning and facility management in Abuja schools, and Okey and Chukwu (2022), who noted that administrators in Enugu State viewed AI as a promising tool for communication and policy planning. Together, these results suggest that AI adoption in Borno State could simultaneously improve both learning outcomes and school governance.

In terms of constraints, respondents identified *inadequate ICT infrastructure, limited teacher training, high costs, and data privacy concerns* as major barriers. These findings mirror Ogunode and Abiodun (2023), who stressed infrastructure and funding as systemic barriers in Nigeria, and Samaila et al. (2024), who reported that teachers lacked adequate training in AI-based assessments. Ethical risks such as *algorithmic bias and data misuse* were also noted, echoing Samuel (2023), who cautioned that without ethical safeguards, AI could exacerbate inequities rather than reduce them.

Other noteworthy constraints included *teacher resistance* and *the lack of a clear policy framework*. Teacher resistance to innovation is not unique to Nigeria; however, as Samuel (2023) noted, resistance often reflects inadequate preparation and fears of job displacement. The absence of policy frameworks in Borno State corresponds with broader gaps identified by UNESCO (2021), which emphasized that many African states lack comprehensive AI education policies, thereby limiting coordinated adoption.

Hypothesis testing further revealed significant *urban–rural differences* in perceived opportunities, with urban respondents identifying more benefits. This finding illustrates the digital divide, where urban schools typically have greater access to ICT resources compared to rural ones. It supports UNESCO's (2021) call to prioritize equity in digital education policies. Likewise, the finding that *principals and teachers differ in their perception of AI constraints* reflects earlier work by Chogwu and Adi (2022), who noted that administrators often perceive AI as beneficial for oversight, while classroom practitioners remain skeptical due to practical implementation challenges.

Overall, the results validate the Technology Acceptance Model (TAM), which emphasizes *perceived usefulness* and *ease of use* as drivers of adoption. In this study, while respondents recognized the usefulness of AI, infrastructural and training barriers undermined its ease of use. This duality highlights the importance of addressing systemic constraints to ensure that AI can fulfill its promise in transforming secondary education in Borno State

Conclusion

This study investigated the role of artificial intelligence (AI) in shaping the future of secondary education in Borno State, focusing on its opportunities and constraints. The findings revealed that AI holds significant potential for enhancing teaching and learning through personalized instruction, real-time feedback, improved student performance, virtual tutoring, and bridging educational gaps. Beyond the classroom, AI was also recognized as an important tool for promoting administrative efficiency and data-driven decision-making, which could support school planning and policy formulation.

At the same time, the study identified substantial constraints that must be addressed before these opportunities can be fully realized. Chief among these are weak ICT infrastructure, inadequate teacher training, high implementation costs, data privacy concerns, and ethical risks such as algorithmic bias. Additional barriers include teacher resistance to new technologies and the absence of a clear policy framework to guide AI adoption in education. These findings underscore that while AI's usefulness is widely acknowledged, its ease of adoption remains severely limited by systemic challenges.

The hypothesis tests further highlighted critical disparities: urban respondents perceived more opportunities than rural respondents, reflecting the persistent digital

divide within Borno State; and principals viewed AI constraints differently from teachers, indicating a gap between administrative expectations and classroom realities. Taken together, these results confirm the relevance of the Technology Acceptance Model (TAM) in the Nigerian context, showing that adoption is shaped by both perceived usefulness and ease of use. For Borno State, AI adoption is not simply a technological issue but also a matter of policy, capacity-building, and equity. Unless infrastructural, training, and policy gaps are addressed, AI adoption risks reinforcing existing inequalities rather than transforming education.

Recommendations

- Invest in ICT infrastructure across both urban and rural schools to close the digital divide.
- Provide continuous teacher training and professional development in AI integration.
- Develop state and national policy frameworks to guide responsible adoption of AI in education.
- Address ethical concerns by implementing safeguards on data privacy and algorithmic bias.
- Establish partnerships with private sector and NGOs to reduce costs of AI adoption.
- Introduce AI literacy modules for teachers and administrators to reduce resistance and build confidence.

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