

Perception and Utilisation of Artificial Intelligence in Pedagogy: A Comparative Study of Urban and Rural Secondary School Teachers in Cross River State

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ABSTRACT: Artificial Intelligence (AI) is transforming global education by enhancing teaching practices, assessment models, and learner engagement. However, disparities in infrastructure, training, and resource allocation create significant gaps in how AI is perceived and utilised, particularly in developing regions like Nigeria. This study investigates the perceptions, utilisation, challenges, and pedagogical effectiveness of AI among urban and rural secondary school teachers in Cross River State. A mixed-methods comparative survey design was employed, involving 200 teachers (100 urban, 100 rural) from the Calabar Education Zone. Data were collected using the validated "AI in Pedagogy Questionnaire" (AIPQ) and semi-structured interviews. Quantitative data were analysed using t-tests, while qualitative data underwent thematic analysis. Findings revealed that urban teachers have significantly more positive perceptions of AI and higher utilisation compared to rural teachers, who face pronounced infrastructural and training barriers. Urban teachers also reported greater pedagogical effectiveness. No significant gender differences in utilisation were found within either group. The study's recommendations include targeted professional development, infrastructure investment, and policy interventions to bridge the urban-rural AI adoption gap.

KEYWORDS: Artificial Intelligence, Teacher Perception, Pedagogical Effectiveness, Urban-Rural Divide, Digital Divide, Cross River State, Nigeria.

I. INTRODUCTION

Artificial Intelligence (AI) is revolutionising education by enabling personalised learning, automating assessments, and enhancing pedagogical efficiency (Luckin, 2021). AI tools, such as adaptive learning platforms and intelligent tutoring systems, empower teachers to tailor instruction to diverse learner needs and streamline administrative tasks. However, the global adoption of AI in education is uneven, with disparities driven by differences in infrastructure, training, and socio-economic contexts (Holmes et al., 2019). The rapid proliferation of AI presents a unique opportunity to address long-standing educational challenges but also introduces new hurdles related to access and equity. In Nigeria, AI integration in education is in its nascent stage, constrained by limited digital infrastructure and teacher preparedness (Osuji et al., 2023). Cross River State, with its mix of urban and rural schools, exemplifies these challenges. Urban schools often benefit from better internet connectivity, consistent electricity, and greater access to professional development. In contrast, rural schools frequently lack these resources, which exacerbates the digital divide (Okon & Effiong, 2023). This stark contrast suggests that teachers' perceptions and utilisation of AI may differ sharply based on their geographical location. This study, therefore, aims to provide a comprehensive

comparative analysis of urban and rural secondary school teachers in Cross River State to inform strategies for equitable AI adoption.

II. LITERATURE REVIEW

A. AI in Global and Nigerian Education

AI has been widely adopted in developed nations to support classroom learning, improve student assessment, and personalise instruction (Holmes et al., 2019). AI applications like Google Classroom and AI-driven analytics have transformed teaching and learning globally. Luckin (2021) notes that AI can significantly enhance teaching effectiveness, but only if teachers are adequately trained and supported, emphasising the crucial role of teacher-centric readiness. In Nigeria, AI adoption is limited by infrastructural deficits, low digital literacy, and inadequate training (Osuji et al., 2023; Oke & Fernandes, 2020). Studies indicate that Nigerian teachers recognise AI's potential but often lack the skills and resources to implement it effectively.

B. The Urban-Rural Digital Divide

The urban-rural digital divide in sub-Saharan Africa is a well-documented phenomenon. Okon and Effiong (2023) demonstrated that urban teachers in Nigeria have significantly higher digital literacy and access to technology compared to their rural counterparts. Rural teachers contend with erratic electricity, poor internet, and limited professional development, all of which are critical for technology adoption. This disparity is likely to extend to AI, with urban teachers being better positioned to leverage new AI tools and integrate them into their pedagogy.

C. Theoretical Framework: Technology Acceptance Model (TAM)

This study is anchored on the Technology Acceptance Model (TAM), which posits that a user's acceptance and adoption of a new technology are predicted by two key factors: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, 1989). In the context of this study, urban teachers, with their greater access to resources and training, are likely to perceive AI as more useful and easier to use. Conversely, rural teachers, facing significant infrastructural barriers, may find AI more challenging to adopt, thus lowering their acceptance and utilisation. The main objectives of this study are to:

- (a). Compare the perceptions of urban and rural secondary school teachers regarding AI.
- (b). Examine differences in AI utilisation between urban and rural teachers.
- (c). Identify and compare the challenges faced by both groups in adopting AI.
- (d). Assess the pedagogical effectiveness of AI deployment among urban and rural teachers.
- (e). Propose strategies to bridge the urban-rural gap in AI adoption.

Based on these objectives, the following null hypotheses were formulated:

- (a). H_{01} : There is no significant difference in AI perceptions between urban and rural teachers.
- (b). H_{02} : There is no significant difference in AI utilisation between urban and rural teachers.
- (c). H_{03} : There is no significant difference in the challenges faced by urban and rural teachers.
- (d). H_{04} : There is no significant difference in the pedagogical effectiveness of AI between urban and rural teachers.

III. METHODOLOGY

A. Research Design and Population

A mixed-methods comparative survey design was used to provide a comprehensive analysis. The study's population comprised all secondary school teachers in the Calabar Education Zone of Cross River State. A stratified random sampling technique was used to select 200 teachers (100 urban and 100 rural), with a gender-balanced representation (50% male and 50% female) in each group.

B. Instrumentation and Data Collection

The "AI in Pedagogy Questionnaire" (AIPQ), a 50-item instrument, was developed to collect quantitative data. It included sections on demographics, AI perceptions, utilisation, challenges, and pedagogical effectiveness, measured on a 5-point Likert scale. Semi-structured interviews with 20 teachers (10 urban and 10 rural) provided rich, qualitative data. The instrument's content validity was ensured through expert review, and a pilot study yielded a Cronbach's alpha of 0.82, confirming its reliability. Data were collected in person during the 2024/2025 academic year.

C. Data Analysis

Quantitative data were analysed using descriptive statistics (mean, frequency, standard deviation) and inferential statistics (independent t-tests and one-way ANOVA) to test the hypotheses at a .05 significance level. Qualitative data from interviews were thematically analysed using NVivo software to identify recurring themes and provide a deeper context for the quantitative findings.

IV. RESULTS AND DISCUSSION

A. AI Perceptions and Utilization

The study found a significant difference in AI perceptions. Urban teachers ($M=4.10$, $SD=0.45$) reported significantly more positive perceptions than rural teachers ($M=3.25$, $SD=0.60$), rejecting H_{01} ($t(198)=6.85, p<.01$). This aligns with the TAM framework, as urban teachers' greater access to resources likely makes them perceive AI as more useful. Urban teachers ($M=3.95$, $SD=0.50$) also utilised AI tools more frequently than rural teachers ($M=2.90$, $SD=0.65$), rejecting H_{02} ($t(198)=7.92, p<.01$). Qualitative data revealed that urban teachers use tools like Google Classroom and AI-based assessment platforms, while rural teachers' utilisation is limited. A one-way ANOVA showed no significant gender differences in AI utilisation within either group, corroborating other Nigerian studies (Osuji et al., 2023).

B. Challenges and Pedagogical Effectiveness

Both groups reported facing challenges, including inadequate training (82%) and limited infrastructure (79%). However, rural teachers faced significantly greater overall challenges ($M=4.05$, $SD=0.55$) compared to urban teachers ($M=3.40$, $SD=0.50$), rejecting H_{03} ($t(198)=5.62, p<.01$). Thematic analysis highlighted rural teachers' profound concerns about erratic electricity and a lack of reliable internet access, which are foundational for AI use. Urban teachers ($M=4.00$, $SD=0.48$) reported higher pedagogical effectiveness of AI compared to rural teachers ($M=3.10$, $SD=0.62$), rejecting H_{04} ($t(198)=6.98, p<.01$). This disparity reflects urban teachers' ability to use AI for sophisticated tasks like personalised learning and real-time assessments, whereas rural teachers' use is restricted by resource limitations.

V. CONCLUSION AND RECOMMENDATIONS

This study confirms that AI holds transformative potential for education in Cross River State, but its equitable adoption is critically hindered by the urban-rural digital divide. Urban teachers exhibit more positive perceptions, higher utilisation, and greater pedagogical effectiveness, while rural teachers face significant infrastructural and training barriers. The findings underscore the urgency of addressing these disparities to ensure that all teachers and students can benefit from AI.

Based on these findings, the following recommendations are proposed:

- (a). Targeted Professional Development: Develop and implement AI-focused training programs specifically for rural teachers, emphasising foundational digital literacy and practical, low-cost AI applications.
- (b). Strategic Infrastructure Investment: Prioritise investment in reliable electricity and internet infrastructure for rural schools. Public-private partnerships could be leveraged to establish solar-powered internet hubs.
- (c). Equity-Driven Policy Interventions: Policymakers must formulate and enforce policies that ensure the equitable distribution of technology and training resources across all schools, addressing the systemic urban-rural imbalance.
- (d). Foster Peer-to-Peer Learning: Encourage the formation of collaborative networks where teachers can share experiences and best practices, helping to build a supportive community of practice.

The researchers believe that by implementing these strategies, educational stakeholders can foster more effective and equitable educational outcomes across the state, making the promise of AI a reality for every teacher and student.

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