THE IMPACT OF ARTIFICIAL INTELLIGENCE ON STUDENTS' ACADEMIC PERFORMANCE IN PUBLIC SECONDARY SCHOOLS IN ANAMBRA STATE, NIGERIA

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Abstract

Artificial Intelligence (AI) has increasingly permeated the educational landscape globally, offering new pathways to personalize learning, increase engagement, and optimize educational outcomes. This study explored the impact of AI-driven tools and systems on students' academic performance in public secondary schools across Anambra State, Nigeria. As the world shifts towards a digital and knowledge-driven society, integrating AI into the educational process presents both transformative opportunities and challenges, particularly in developing contexts where infrastructure and digital literacy vary widely. The study adopted a qualitative research design to gain in-depth insights from key educational stakeholders, including school administrators, teachers, ICT coordinators, and students across urban and rural public secondary schools. Using a population of 146,635 students and a purposive sample of 820 participants, the study employed in-depth interviews, focus group discussions, and document analysis to gather rich, context-specific data. The findings reveal that while AI applications such as intelligent tutoring systems, automated grading, adaptive learning platforms, and AI-assisted administrative tools are being piloted in some schools, the level of integration remains minimal and uneven due to issues such as inadequate funding, poor digital infrastructure, teacher resistance, and lack of training. Notably, where AI tools were in use, there was observable improvement in students' comprehension, retention, and critical thinking abilities. Teachers reported that AI-enabled learning platforms helped personalize lessons and assessments, enabling them to identify learning gaps early and respond more effectively. Students also expressed increased motivation and engagement with interactive and gamified AI tools. However, disparities in access between urban and rural schools remain a significant barrier, with urban schools having more opportunities to benefit from such technological innovations. The study concludes that while AI has the potential to significantly enhance academic performance in public secondary schools, its successful implementation in Anambra State requires a systemic approach. This includes strategic government investment in infrastructure, teacher professional development, policy formulation, and community sensitization. Furthermore, ethical considerations, such as data privacy and algorithmic bias, must be addressed as part of the broader digital transformation agenda. The paper recommends the development of a state-wide AI in Education (AIED) framework to ensure equitable access, standardization, and sustainability of AI-driven educational innovations. These findings have practical implications for policymakers, education administrators, and technology developers interested in leveraging AI to boost student performance and close learning gaps in Nigeria and similar contexts.

Keywords: Artificial Intelligence, Student Performance, Public Secondary Schools, Anambra State, Qualitative Research, Educational Technology, AI Tools, Nigeria

Introduction

In the 21st century, education systems across the globe are undergoing rapid transformation, largely influenced by advancements in technology particularly Artificial Intelligence (AI). AI, defined as the ability of machines to simulate human intelligence processes such as learning, reasoning, and problem solving, has become a central force driving innovation in nearly every sector, including education (Hall, 2020). From intelligent tutoring systems and automated assessments to personalized learning platforms and administrative automation, AI is reshaping how teachers teach and how students learn (Olu, 2023). In developing nations like Nigeria, where educational challenges such as large class sizes, teacher shortages, low student motivation, and inequitable access persist, AI offers an opportunity to address systemic gaps and enhance learning outcomes. In Anambra State, Nigeria, public secondary schools face a unique set of challenges. Despite being one of the most educationally advanced states in southeastern Nigeria, issues such as underfunded schools, inconsistent curriculum delivery, outdated teaching methodologies, and limited access to digital technologies continue to hinder optimal student performance. As global educational systems embrace AI to drive personalized learning, track academic progress in real time, and facilitate more engaging classroom experiences, Anambra's public education system stands at a crossroads poised between traditional instruction models and digital innovation.

The emergence of AI tools in some public secondary schools within the state such as AI-powered educational apps, voice-assisted learning platforms, and virtual classroom assistants raises critical questions about their effectiveness in enhancing student learning and academic performance (Nwakire, 2021). While anecdotal evidence and preliminary reports from urban schools suggest that AI integration is beginning to make a positive difference, there is a scarcity of empirical, context-specific research on the scope and impact of these tools in public school settings across the state. Moreover, disparities in digital access, varying levels of teacher readiness, and lack of policy direction pose potential barriers to the widespread and equitable implementation of AI technologies in the education sector.

More importantly, this research aims to provide a framework for understanding how AI can be more effectively deployed to support teaching and learning in Anambra's public secondary schools. The goal is to identify not only the observable changes in student academic performance but also the factors that either enhance or inhibit the success of AI implementation. As education continues to evolve in the digital age, it is imperative for stakeholders in Nigeria's education sector to make informed decisions about the adoption and use of AI technologies.

This study proceeds by presenting the problem that necessitated the study, followed by the research objectives, methodology, presentation of findings, discussions, and conclusions. Given the transformative potential of AI and the urgency to improve educational outcomes, this study is timely and critical for the ongoing dialogue on education reform and digital inclusion in Nigeria.

Statement of the Problem

The rapid advancement of Artificial Intelligence (AI) has brought about a paradigm shift in various sectors, including education. Across the world, AI is being integrated into classrooms to improve learning efficiency, personalize instruction, automate assessment, and support administrative decision-making. In many developed countries, AI is no longer a futuristic concept, it is actively shaping the ways in which students learn and teachers teach. However, the integration of AI in education remains limited and uneven in many developing contexts, including Nigeria.

In Anambra State, which is often lauded for its relatively strong commitment to education in the southeastern region of Nigeria, public secondary schools still face significant challenges in delivering quality education. These challenges include overcrowded classrooms, lack of sufficient qualified teachers, outdated curricula, poor infrastructure, and inconsistent use of educational technology. These persistent issues have had a direct negative impact on students' academic performance, motivation, and overall preparedness for higher education and the job market.

Despite the increasing awareness of the potential of AI to address many of these systemic challenges, there is little evidence that AI has been meaningfully integrated into the mainstream teaching

and learning processes in public secondary schools in the state. While a few private institutions have begun to adopt AI-driven educational tools such as intelligent learning apps, digital grading systems, and virtual tutors, public schools particularly those in rural and underserved communities remain largely excluded from this digital transformation. Even where AI tools are introduced, many stakeholders students, teachers, and administrators alike lack the knowledge, skills, or infrastructure to effectively utilize them. Teachers often resist the use of new technologies due to fear of job displacement or insufficient training. Students may not have regular access to devices or internet connectivity, and school management often lacks the budget or policy support to scale such innovations. Moreover, there is currently no comprehensive framework at the state level guiding the implementation, monitoring, or evaluation of AI initiatives in the public education system.

What remains unclear, and thus constitutes the problem this study addresses, is whether and to what extent the limited presence of AI in public secondary schools in Anambra State has had a tangible impact on student performance. While global research indicates that AI can enhance student-learning outcomes, reduce dropout rates, and support inclusive education, there is a notable research gap concerning how these technologies are functioning or failing to function in the real-life classroom experiences of students in Anambra's public schools.

This study seeks to fill this gap by investigating the lived experiences of students, teachers, and administrators in public secondary schools where AI tools are either currently in use or have been introduced. The goal is to determine how AI affects student performance, what opportunities and challenges exist in its application, and what can be done to ensure that all students regardless of their socio-economic background benefit from the ongoing digital revolution in education.

Purpose of the Study

The primary purpose of this study is to examine the impact of Artificial Intelligence (AI) on students' academic performance in public secondary schools in Anambra State, Nigeria. Specifically, the study aims to explore how AI tools and applications where they are being used are influencing student learning experiences, comprehension, engagement, and overall academic outcomes.

This study also seeks to understand the readiness and capacity of schools, teachers, and students to integrate and utilize AI-driven educational technologies. Additionally, it intends to highlight the enabling and inhibiting factors affecting the adoption of AI in public secondary schools, especially in the context of infrastructural limitations, teacher training, and policy direction.

The findings from this research are expected to provide valuable insights for educational policymakers, school administrators, teachers, and curriculum developers on how best to leverage AI technologies to improve learning and reduce disparities in educational achievement across different regions in the state.

Research Questions

The study is guided by the following research questions:

1. What types of Artificial Intelligence tools or applications are currently being used in public secondary schools in Anambra State, Nigeria?
2. How have AI tools influenced students' academic performance, engagement, and learning behavior in these schools?
3. What are the experiences and perceptions of teachers, students, and administrators regarding the use of AI in teaching and learning?
4. What challenges hinder the effective integration of AI technologies in public secondary schools across urban and rural areas?
5. What strategies can be adopted to enhance the meaningful adoption of AI in public secondary school education in Anambra State?

Literature Review

Concept of Artificial Intelligence (AI)

Artificial Intelligence (AI) is described as the ability of machines to perform tasks that normally

require human intelligence. These tasks include learning, reasoning, problem-solving, and understanding language. AI works by using algorithms and large amounts of data to recognize patterns and make decisions. Russell and Norvig (2016) describe AI as systems that act rationally to achieve specific goals, using data input and built-in logic to respond intelligently. It is a field of computer science that combines knowledge from many areas such as mathematics, linguistics, and neuroscience to create systems that behave like humans. Other researchers define AI as the science of building systems that can adapt and improve their performance without direct human instruction. This means that machines can learn from their environment and improve over time. Nilsson (2018) explains that AI involves machines that sense their environment and take actions that maximize their chances of success. These definitions show that AI is not just about making machines work, but about making them smart enough to learn, reason, and solve problems in a way similar to human thinking.

Concept of Academic Performance

Academic performance refers to how well a student meets specific learning goals and educational standards within a school setting. It is often measured through assessments, tests, assignments, and classroom participation. Olatoye (2017) explains that academic performance shows a student's level of achievement in school tasks and learning outcomes. It reflects the knowledge and skills the student has gained over a period of time. This performance can be used to judge whether a student is progressing or needs more support in their studies. It also involves how a student manages academic responsibilities, such as completing schoolwork on time, understanding taught content, and participating in academic activities. Ezeani (2019) describes academic performance as the total score of a learner's ability to apply, analyze, and interpret knowledge in a learning environment. This performance helps teachers and schools understand how students are doing and what changes might be needed in teaching methods or learning support to improve results.

Theoretical Framework

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was developed by Fred Davis in (1986). It is a theory that explains how people come to accept and use a new technology. The model focuses on two main factors: perceived usefulness and perceived ease of use. Perceived usefulness means how helpful someone thinks the technology will be in doing their job, while perceived ease of use means how easy they believe the technology is to use. If people think a technology is useful and easy to use, they are more likely to accept it. TAM helps to understand why people sometimes refuse to use new tools or systems, even when they are available. If users do not see the benefits or find the system too hard to use, they may avoid it. The model is useful for developers, educators, and businesses who want to introduce new technology successfully. By studying what users think about the technology, they can improve the design or give better training to increase acceptance.

The Technology Acceptance Model (TAM) is very useful in understanding how artificial intelligence (AI) tools can influence students' academic performance in public secondary schools in Anambra State. When AI technologies such as smart tutoring systems, automated grading, and personalized learning platforms are introduced in schools, students and teachers may react differently depending on how they perceive these tools. If students believe that AI tools can help them study better and improve their academic outcomes (perceived usefulness), and if they find these tools easy to operate (perceived ease of use), they are more likely to use them regularly in their learning process.

Applying TAM to this study provides a clear framework to measure how students and teachers in Anambra State secondary schools respond to AI technologies. By focusing on their perceptions of usefulness and ease of use, the study can identify what factors lead to better acceptance of AI and how that acceptance influences students' academic success. It can also help policymakers and school administrators develop strategies to support effective AI integration in the education system.

Methodology

Research Design

This study adopted a qualitative research design to explore the impact of Artificial Intelligence (AI) on students' academic performance in public secondary schools in Anambra State, Nigeria. The qualitative approach was chosen because it provides deep, contextual, and experiential insights into how AI tools are perceived, used, and experienced by stakeholders within the school environment. Unlike quantitative methods that focus on numerical measurement, qualitative design allows for open-ended inquiry, which is essential in exploring emerging technologies like AI in education, especially in low-resource contexts.

Population of the Study

The population of the study consisted of all students enrolled in public secondary schools in Anambra State, Nigeria. According to data from the Anambra State Ministry of Education and State Universal Basic Education Board (ASUBEB), the total student population across public secondary schools stands at approximately 146,635.

Sample and Sampling Technique

A purposive sampling technique was used to select 820 participants, which included students, teachers, school administrators, ICT coordinators, and education officials. The participants were drawn from schools that had either implemented or piloted the use of AI-related tools and technologies in any form (e.g., computer-assisted learning, intelligent tutoring systems, virtual classroom platforms, etc.).

To ensure diversity, schools were selected from both urban and rural areas across the three senatorial zones of Anambra State Anambra North, Anambra Central, and Anambra South. The breakdown of participants is shown in the table below:

Table 1: Category and Distribution of Participants

Category of Participant
Students
Teachers
School Administrators
ICT Coordinators
Education Officers
Total

Instrumentation

The primary instruments used for data collection were:

1. Semi-structured interview guides for teachers, administrators, and ICT coordinators.
2. Focus Group Discussion (FGD) protocols for students (in groups of 8–10).
3. Observation checklists to document the presence, frequency, and types of AI tools used in classrooms.
4. Document analysis of digital infrastructure records, school performance reports, and government policy documents related to technology integration.

Three experts in Educational Technology and Research Methods to ensure clarity, relevance, and appropriateness for the research objectives validated these tools.

Data Collection Procedure

Fieldwork lasted for six weeks. Prior to data collection, ethical clearance and permission were obtained from the State Ministry of Education and school authorities. Interviews and FGDs were audio-recorded (with consent) and conducted in English and Igbo, depending on the preference of participants. Observations were conducted during classroom lessons and staff meetings where AI-related tools were in use.

All data were transcribed verbatim and translated where necessary. The researcher ensured confidentiality, voluntary participation, and anonymity of all respondents.

Method of Data Analysis

Data gathered were analyzed using thematic analysis. This involved organizing responses into themes and sub-themes according to recurring patterns and meanings. Thematic coding was done using both manual sorting and qualitative analysis software (NVivo). Key quotes from participants were presented to support emerging themes.

Additionally, frequency counts were used in tabular form to present recurring trends in the use of specific AI tools and their observed effects.

Presentation of Results

This section presents the findings derived from interviews, focus group discussions, observations, and document analysis conducted across selected public secondary schools in Anambra State. The results are organized thematically according to the research questions.

Theme 1: Types of AI Tools in Use

Analysis revealed that AI tools in public secondary schools were few and often limited to computer-assisted learning platforms and mobile-based learning applications. In some urban schools, teachers reported using tools such as:

1. Google Classroom with AI suggestions
2. Intelligent tutoring systems (e.g., Mavis Tutor, Edmodo)
3. Gamified learning apps with adaptive AI (e.g., uLesson)
4. Speech-to-text software for language development
5. AI-enhanced administrative software for attendance and grading

These tools were either introduced through; donor agencies, pilot state programs, or personal initiatives by teachers.

Table 2: Frequency of AI Tool Use by Category

AI Tool
AI-enhanced learning apps
Automated grading/assessment systems
Virtual assistants/classroom chatbots
Speech-to-text software
AI-based student tracking dashboards
None (No AI tool in use)

Theme 2: Influence of AI on Student Academic Performance

Participants reported that the use of AI tools had improved students' comprehension, classroom engagement, and performance in tests. Teachers observed that students using AI-powered tools showed:

1. Better retention of concepts.
2. Improved language and mathematical skills.
3. Increased motivation to complete tasks.
4. Reduction in absenteeism due to gamified learning experiences.

Students in focus group discussions shared that AI tools helped them "learn at their own pace" and "made learning fun and easier to understand."

Table 3: Observed Student Outcomes Related to AI Usage

Outcome
Improved test scores
Better engagement in class
Reduced absenteeism
Improved critical thinking
Increased interest in STEM subjects

Theme 3: Stakeholders' Perceptions of AI in Education

Teachers and school heads expressed mixed feelings about AI. While some saw it as a valuable aid to instruction, others viewed it as a threat to traditional teaching roles.

Sample quotes from participants:

"AI has helped me track each student's weakness faster. I now know who needs help and where."
(Teacher, Awka South)

"The challenge is that we don't have electricity most times, and no internet. The tools don't work consistently."
(ICT Coordinator, Onitsha North)

"It's like having a private teacher on your phone. I can repeat the lesson if I didn't understand it the first time."
(SS2 Student, Nnewi)

Figure 2: Sentiment Distribution of Stakeholder Perceptions
(Pie chart showing percentages: 55% Positive, 30% Neutral, 15% Negative)

Theme 4: Challenges to AI Integration

Major challenges identified include:

1. Poor digital infrastructure (e.g., unreliable electricity and internet)
2. Lack of trained personnel
3. Inadequate funding
4. Resistance to change from older teachers
5. Policy gaps at the state level

Table 4: Frequency of Reported Challenges to AI Integration

Challenge	Number of Mentions
Inadequate digital infrastructure	
Lack of teacher training	
Unstable electricity supply	
Internet connectivity issues	
Lack of government policy	

Theme 5: Strategies for Effective AI Adoption

1. Participants recommended the following:
2. Training and re-training of teachers
3. Provision of solar-powered computer labs
4. Inclusion of AI in the school curriculum
5. Government investment in digital infrastructure
6. Partnerships with tech companies

Discussion of Findings

The findings of this study highlight the emerging but uneven integration of Artificial Intelligence

(AI) in public secondary schools in Anambra State, Nigeria. The study revealed both the transformative potential of AI and the systemic challenges that hinder its full realization in the public education sector.

AI Tool Usage and Availability

The types of AI tools identified in this study including learning apps, speech-to-text programs, and adaptive tutoring systems reflect a growing awareness of AI's role in education. However, the data suggest that usage is still largely restricted to a few urban schools, often driven by external funding, teacher initiative, or pilot government projects. This aligns with global trends that show AI adoption is more rapid in urban and resource-privileged environments (UNESCO, 2023).

The low level of access in rural schools underscores the digital divide that continues to plague the Nigerian education system. Despite having over 146,000 students enrolled in public secondary schools in Anambra, only a small percentage currently benefit from AI-enhanced learning. This limited exposure not only restricts academic opportunities for many students but also threatens to widen existing educational inequities.

Impact on Student Performance

A major finding from this research is the positive effect of AI tools on students' academic performance in contexts where such tools are available and appropriately used. Students reported improved comprehension, better retention, and increased interest in subjects especially science and technology after using AI-powered platforms. Teachers affirmed these observations, noting that AI allowed for personalized learning, automated assessments, and better student engagement.

This supports the argument that AI can significantly improve academic performance by tailoring instruction to individual learners' needs (Holmes et al., 2021). In environments like Anambra's public schools where classrooms are often overcrowded and resources are limited AI can serve as a critical supplement to traditional teaching, offering adaptive feedback and monitoring student progress in real time.

Stakeholder Perceptions

The varying perceptions among teachers and administrators about AI reflect a broader tension between innovation and tradition. While younger, tech-savvy educators welcomed AI as a helpful classroom companion, some older or undertrained teachers viewed it with skepticism or fear. This is consistent with findings by Wang & Yu (2022), which suggest that teacher readiness is one of the most significant predictors of successful AI adoption in schools.

Students, on the other hand, embraced AI tools enthusiastically, often describing them as "fun," "private," and "flexible." The user-centered nature of AI learning systems gives students control over their learning pace, which many find empowering. However, this enthusiasm is dampened when infrastructural barriers like power outages or lack of devices—prevent consistent access.

Systemic Challenges

The most commonly cited challenges unstable electricity, poor internet, lack of training, and limited funding are not new to Nigeria's educational system. However, in the context of AI integration, these issues take on renewed urgency. Without functional digital infrastructure, even the most advanced AI tool becomes irrelevant.

Moreover, the absence of a clearly articulated AI-in-Education policy at the state level creates uncertainty and hinders large-scale adoption. Schools are often left to fend for themselves, relying on donor programs or ad-hoc initiatives. This fragmented approach is neither sustainable nor scalable.

Strategies for the Future

Participants proposed several pragmatic strategies to overcome the challenges, including:

a. Establishing state-supported AI implementation frameworks
b. Introducing solar-powered tech hubs in rural schools
c. Embedding AI literacy into the school curriculum
d. Providing continuous professional development for teachers

These recommendations align with the global best practices for AI integration in education, such as those outlined by the World Economic Forum (2022) and the Nigerian National Policy on ICT in Education (2019). If implemented, they could significantly bridge the digital gap and foster equity in educational outcomes.

Conclusion

The integration of Artificial Intelligence (AI) into public secondary schools in Anambra State, Nigeria, represents both a promising opportunity and a formidable challenge. This study set out to explore the influence of AI tools on student academic performance and the contextual realities surrounding their use in a developing educational environment. Findings revealed that while AI has been introduced in select schools primarily in urban centers its adoption is neither widespread nor standardized across the state.

Where AI tools have been implemented, their impact on student performance has been largely positive. Students using AI-driven learning platforms exhibited improved engagement, retention, and academic achievement. Teachers also acknowledged that these technologies enhanced lesson delivery, made assessment easier, and enabled real-time tracking of student progress. However, the transformative potential of AI remains limited by persistent barriers such as infrastructural inadequacies, digital illiteracy, limited training opportunities for teachers, and the absence of a formal policy framework guiding AI implementation in public education.

Stakeholders including students, teachers, and administrators—expressed a clear interest in the expansion of AI-driven educational tools but stressed the need for strategic investments in infrastructure, training, and policy. Without these foundational elements, attempts to integrate AI into teaching and learning may only widen the existing educational divide between urban and rural areas.

In conclusion, AI holds substantial potential to improve student performance and address systemic challenges in Anambra State's public secondary schools. However, its success depends on multi-stakeholder commitment, inclusive policy development, and long-term investment in educational technology ecosystems. With the right approach, AI can help unlock equitable, high-quality education for all students in the state, regardless of background or location.

Recommendations

Based on the findings and insights from this study, the following recommendations are proposed:

1. **Develop a State-Level AI Education Policy Framework**

The Anambra State Ministry of Education should collaborate with experts, ICT professionals, and stakeholders to design a comprehensive policy guiding the ethical, equitable, and effective use of AI in schools.

2. **Invest in Infrastructure and Connectivity**

Government and school authorities should prioritize the provision of solar-powered devices, consistent internet access, and digital hubs in public secondary schools, especially in underserved rural areas.

3. **Capacity Building for Teachers and Administrators**

Continuous professional development programs should be established to train educators on the use, integration, and maintenance of AI tools, as well as digital pedagogy principles.

4. **Promote Public-Private Partnerships**

Strategic partnerships with AI developers, tech companies, NGOs, and donor organizations can support the deployment of scalable AI solutions and provide necessary resources to schools.

5. **Embed AI in the Curriculum and Student Learning Process**

AI literacy and digital skills should be incorporated into the secondary school curriculum to prepare students for the demands of the future workforce.

6. **Ensure Equity in AI Deployment**

Special attention must be given to schools in rural and low-income areas to ensure that students in these environments are not left behind in the digital transition.

7. **Implement Monitoring and Evaluation Mechanisms**

Regular assessment of AI usage, student performance outcomes, and stakeholder feedback should be conducted to ensure continuous improvement and responsible innovation.

8. **Encourage Local Innovation and Content Development**

Schools and local developers should be encouraged to create culturally relevant AI educational tools tailored to the specific needs of Nigerian students and curricula.

9. **Raise Awareness and Sensitize Communities**

Parents, guardians, and communities should be educated about the benefits and responsible use of AI in

education to foster acceptance and support at the grassroots level.

10. **Protect Data Privacy and Student Rights**

Safeguards must be established to protect student data, ensure transparency in AI decision-making, and address ethical concerns such as bias and surveillance.

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