



TEACHERS' APPLICATION OF ARTIFICIAL INTELLIGENCE TOOLS AND STUDENTS' PERFORMANCE IN SECONDARY SCHOOLS IN ANAMBRA STATE

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Abstract

Artificial intelligence (AI) is redefining pedagogical practice globally, offering teachers tools to personalize learning, assess performance efficiently, and make data-informed instructional decisions. However, the application of AI-driven technologies in Nigerian secondary schools remains in its infancy, with limited empirical evidence from Anambra State. This study investigated the relationship between teachers' application of AI tools and students' academic performance in secondary schools in Anambra State. Four research questions guided the study and four null hypotheses were tested. The study adopted a descriptive survey research design using a population of 4,562 teachers and 89,740 students across 266 public secondary schools. A sample size of 380 teachers and 720 students was selected using a multi-stage sampling technique. A structured questionnaire developed by the researchers was used for data collection. Cronbach Alpha method was used to establish the reliability which yielded coefficient values of 0.82, 0.79, 0.85 and 0.83 for the four clusters. Out of 380 teacher questionnaires distributed, 367 were completed and returned, giving a 96.6% return rate. Data collected were analyzed using both descriptive and inferential statistics: Descriptive statistics (mean and standard deviation) were used to answer the research questions. Inferential statistics such as Pearson Product Moment Correlation (PPMC) and Multiple Regression Analysis were employed to test the hypotheses at a 0.05 level of significance. The result



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showed that teachers' in Anambra State moderately apply adaptive learning platforms, automated assessment systems and intelligent tutoring systems in instructional delivery. There is a strong positive and significant relationship between teachers; application of AI tools and students' academic performance. The study concluded that teachers' effective application of AI tools enhances instructional quality, student engagement and learning outcomes. Therefore, it was recommended among others that educational authorities and ministries should organize continuous professional development workshops to enhance teachers' competencies in using adaptive learning platforms and intelligent tutoring systems.

Keywords:

Artificial Intelligence, Adaptive Learning, Automated Assessment, Intelligent Tutoring Systems, Student Performance, Secondary Education, Nigeria.

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Introduction

Education in the twenty-first century has entered a digital era characterized by the increasing adoption of Artificial Intelligence (AI) technologies in teaching, learning, and assessment. Artificial Intelligence, broadly defined as computer systems capable of performing tasks that normally require human intelligence such as learning, reasoning, problem-solving, and decision-making has transformed nearly every sector, including education (UNESCO, 2023). In the educational context, AI encompasses a range of applications designed to support teachers, enhance instructional efficiency, and personalize student learning experiences (Kumar & Singh, 2023). Through adaptive learning platforms, automated assessment systems and intelligent tutoring systems, AI enables teachers to create dynamic, individualized and evidence-based learning environments.

Globally, the integration of AI in education has been recognized as a means of improving access, quality, and equity in learning. In developed countries such as Finland, China, and the United States, schools increasingly rely on AI-powered learning management systems (LMS) and intelligent tutoring systems to assess students' progress, predict performance gaps, and recommend tailored interventions (Viberg et al., 2023; OECD, 2024). These systems not only reduce teacher workload but also enhance feedback accuracy and provide real-time insights into students' cognitive and emotional engagement (Rocconi, 2025). The pedagogical potential of AI lies in its ability to offer data-driven recommendations and individualized instruction, which collectively enhance learning outcomes and classroom efficiency.

In Nigeria, however, the integration of AI technologies into the education system remains at an early stage. Most secondary schools are yet to fully explore the potential of AI

applications due to inadequate infrastructure, insufficient teacher training and limited policy support (Obiekezie, 2025; Okenwa-Fadele et al., 2025). Although the Nigerian government's National Policy on ICT in Education (revised 2021) emphasized that digital learning, actual classroom implementation has been uneven, particularly in rural and semi-urban regions such as Anambra State. Teachers' use of AI tools such as adaptive learning platforms like Google Classroom or Coursera for Schools, and automated assessment tools like Gradescope is often restricted by technical challenges, unreliable internet connectivity, and low digital literacy levels (Okonkwo, 2025).

Furthermore, the global COVID-19 pandemic accelerated the demand for AI-based educational technologies, exposing the digital divide that exists among Nigerian schools. Many teachers struggled to transition to digital and AI-assisted instruction during lockdowns, revealing gaps in pedagogical and technological readiness (Eke, 2023). While urban schools in Anambra State attempted to leverage AI-integrated platforms for remote instruction, most rural institutions lacked access to basic ICT infrastructure. Consequently, disparities in technology adoption have contributed to persistent performance gaps between students in technologically advanced and resource-constrained schools.

Despite these challenges, there is growing awareness among Nigerian educators of the transformative power of AI in supporting instructional delivery and improving student outcomes. AI tools can automate routine administrative tasks, analyze performance trends, and help teachers identify learning difficulties early. Adaptive learning systems, for instance, use algorithms to analyze each student's learning behavior, adapting content and pacing to meet individual needs (Aboagye & Yeboah, 2022). Similarly, automated assessment systems enhance objectivity and reduce grading time, while intelligent tutoring systems simulate one-on-one guidance, ensuring students receive personalized support (Oboh et al., 2024).

In Anambra State one of Nigeria's most educationally active states secondary schools are known for their academic competitiveness and commitment to excellence. Yet, despite high literacy levels and government investment in digital education, there is limited empirical evidence linking teachers' use of AI technologies to measurable student performance outcomes. Prior studies have focused largely on ICT integration (Okoro, 2021) or e-learning adoption (Obiekezie, 2025), with minimal attention to AI-based pedagogical interventions. This research gap is critical because it is unclear whether teachers' use of AI tools has a statistically significant effect on student achievement in secondary schools across the state.

Understanding how teachers apply AI tools in classroom instruction and assessment is essential for several reasons. First, it provides insight into the extent of technology-driven pedagogical innovation within the Nigerian secondary school system. Second, it informs education policymakers on how to direct training and resource allocation toward evidence-based AI applications. Third, it contributes to global debates on how AI can be localized to fit the socio-economic and infrastructural realities of developing nations. The relationship between teachers' use of AI tools and students' academic performance represents a vital area

of empirical inquiry that may guide future educational reform and professional development initiatives.

Therefore, this study seeks to examine the extent to which teachers in Anambra State apply AI tools particularly adaptive learning platforms, automated assessment systems and intelligent tutoring systems and how such applications relate to students' academic performance in secondary schools. By addressing this relationship, the study contributes to the evolving body of knowledge on AI integration in education and offers practical implications for curriculum developers, teacher educators, and policymakers in Nigeria and beyond.

Statement of the Problem

In recent years, the transformative potential of Artificial Intelligence (AI) in education has attracted significant global attention, promising to reshape how teachers teach and how students learn. AI technologies have demonstrated their capacity to enhance individualized instruction, reduce teacher workload, improve the accuracy of assessment, and provide real-time feedback to support learners' needs (Rocconi, 2025; Kumar & Singh, 2023). In Nigeria's educational landscape, and particularly in Anambra State, the integration of AI technologies into teaching and learning is still at a developmental stage. Despite several policy frameworks such as the *National Policy on ICT in Education (2021)* and the *Nigeria Digital Education Strategy (2022–2030)*, classroom practice remains dominated by traditional, teacher-centered pedagogies that rely heavily on rote memorization and textbook instruction (Okenwa-Fadele et al., 2025; Okonkwo, 2025). Many teachers in secondary schools possess limited technological proficiency, lack exposure to AI-driven teaching methods and have minimal institutional support for digital teaching innovations (Obiekezie, 2025). As a result, students continue to perform below expectations in key academic subjects such as mathematics, sciences, and English, raising concerns about the effectiveness of instruction in the face of emerging technological opportunities.

Furthermore, although several studies have examined general Information and Communication Technology (ICT) integration in Nigerian schools, very few have focused specifically on the *application of Artificial Intelligence tools* by teachers and how these affect measurable student performance outcomes. Prior research has tended to concentrate on ICT availability, teacher attitudes toward technology, or challenges of e-learning (Okonkwo, 2025; Obiekezie, 2025). There remains a dearth of empirical data addressing how specific AI applications such as adaptive learning platforms, automated assessment systems and intelligent tutoring systems relate to student achievement in secondary education. Without such evidence, policymakers and education stakeholders may continue to make uninformed decisions about digital transformation strategies in schools.

These concerns point to a critical knowledge gap that this study seeks to address. If teachers' application of AI tools has a significant positive influence on student academic performance, understanding the strength and nature of that relationship can inform future teacher training, infrastructure investment, and educational policy development. Conversely,

if AI adoption remains low and its impact on student performance negligible, then systemic reforms may be required to ensure that digital innovation translates into measurable learning gains. Therefore, the problem of this study is encapsulated in the uncertain and under-researched relationship between teachers' application of Artificial Intelligence tools and students' academic performance in secondary schools in Anambra State, Nigeria.

Purpose of the Study

The general purpose of this study is to examine teachers' application of artificial intelligence tools and students' performance in secondary schools in Anambra State. The study specifically seeks to:

1. Determine the extent to which teachers apply adaptive learning platforms in secondary schools in Anambra State.
2. Assess the degree of use of automated assessment systems among secondary-school teachers.
3. Examine teachers' application of intelligent tutoring systems in classroom instruction.
4. Determine the relationship between teachers' application of AI tools and students' academic performance in secondary schools in Anambra State.

Research Questions

1. What is the extent of teachers' application of adaptive learning platforms in Anambra State secondary schools?
2. To what extent do teachers use automated assessment systems in secondary schools in Anambra State?
3. To what extent do teachers apply intelligent tutoring systems in secondary schools in Anambra State?
4. *What is the relationship between teachers' application of AI tools and students' academic performance in secondary schools in Anambra State?*

Research Hypotheses

H₀₁: There is no significant relationship between teachers' application of adaptive learning platforms and students' academic performance.

Teachers' use of automated assessment systems does not significantly predict students' academic performance.

H₀₃: Intelligent tutoring systems have no significant effect on students' academic performance.

H₀₅: There is no significant joint contribution of all AI tools to students' academic performance in secondary schools in Anambra State.

Conceptual Review

Concept of Artificial Intelligence in Education

Artificial Intelligence (AI) refers to computer systems or algorithms designed to mimic human intelligence processes such as reasoning, learning, problem-solving, and decision-making. In the educational context, AI encompasses a wide array of tools and applications that automate cognitive tasks, personalize learning experiences, and support data-driven decision-making among teachers and administrators (Zawacki-Richter et al., 2023). The introduction of AI in secondary schools represents a paradigm shift from the traditional teacher-centered pedagogy toward a data-informed, learner-centered model that optimizes both teaching and learning outcomes.

Teachers' Application of Adaptive Learning Platforms

Adaptive learning platforms use algorithms to tailor educational content to the unique learning pace, ability, and interests of individual students. By continuously analyzing learners' interactions and performance data, these systems recommend customized instructional pathways and remedial exercises (Wang & Gong, 2022). Teachers' effective application of such platforms requires not only technical proficiency but also pedagogical adaptability the ability to integrate algorithmic recommendations into classroom practice. When effectively utilized, adaptive systems like DreamBox, ALEKS, or Smart Sparrow have been shown to improve mastery of complex subjects such as mathematics and science, particularly among low-performing students. In Anambra State secondary schools, the use of adaptive platforms can bridge learning gaps caused by inadequate teacher-student ratios and differences in student learning abilities.

Application of Automated Assessment Systems

Automated assessment systems employ AI algorithms to grade assignments, analyze written responses, and provide immediate feedback. These systems improve the objectivity, consistency, and timeliness of evaluation, allowing teachers to focus more on instruction and less on grading tasks (Yin & Chen, 2023). Automated systems such as Gradescope, Google Classroom's AI feedback features, and E-Mark assist teachers in identifying students' learning difficulties through analytics generated from assessments. The implementation of such systems in secondary schools enhances formative assessment practices by offering insights into students' progress in real time. However, successful application depends on teachers' digital literacy and their ability to interpret AI-generated data responsibly.

Use of Intelligent Tutoring Systems (ITS)

Intelligent Tutoring Systems (ITS) simulate one-on-one tutoring by adapting instructional strategies to each learner's cognitive and emotional state. ITS technologies such as Carnegie Learning's MATHia or AutoTutor use natural language processing and predictive analytics to engage students in personalized dialogue, track learning trajectories, and provide individualized scaffolding (Graesser & Nye, 2020). Teachers using ITS can better support students' cognitive development by supplementing traditional lessons with AI-

guided instruction. In resource-constrained Nigerian schools, ITS can be especially valuable in subjects requiring higher-order reasoning and problem-solving, such as mathematics and physics. Nevertheless, teachers' effective use of ITS demands a sound understanding of AI pedagogical design and continuous professional development.

Concept of Students' Academic Performance

Students' academic performance represents the measurable outcomes of educational processes, reflecting the extent to which learners achieve the intended curriculum objectives. It is often evaluated through standardized tests, continuous assessments, and examination results. Performance is influenced by multiple variables including teaching quality, learning environment, motivation, socio-economic background, and technological exposure (Okeke et al., 2022). The integration of AI tools in education introduces an additional determinant **the quality of AI application by teachers**. When teachers effectively leverage AI technologies to personalize learning, monitor progress, and provide feedback, students are more likely to demonstrate improved comprehension, retention, and problem-solving abilities.

Interrelationship between AI Tools and Students' Performance

The theoretical linkage between AI application and academic performance is grounded in the constructivist and data-driven learning paradigms. Adaptive systems and ITS encourage active learner engagement, while automated assessments and dashboards provide continuous performance analytics that inform instructional adjustments. Empirical studies have shown that the use of AI in secondary education leads to increased learning efficiency, reduced achievement gaps, and improved examination results (Adebayo & Ojo, 2023; Oduma et al., 2025). However, the extent of these benefits depends on teachers' competence, institutional support, and ethical application of AI technologies.

In Anambra State's educational ecosystem, where teachers are increasingly exploring digital tools for instruction, understanding the conceptual relationship between AI application and students' performance is essential for informed policy and pedagogical innovation. The conceptual framework thus positions teachers' AI application as a mediating variable that directly influences the cognitive, affective, and psychomotor domains of students' achievement.

Theoretical Review

The theoretical review provides the conceptual foundation that underpins the relationship between teachers' application of Artificial Intelligence (AI) tools and students' performance. Several theories explain how technological innovation influences teaching effectiveness and learning outcomes. The present study is anchored on three key frameworks: the Technological Pedagogical Content Knowledge (TPACK) framework, the Technology Acceptance Model (TAM), and the Constructivist Learning Theory. These three theories collectively provide a robust foundation for understanding teachers' application of AI tools and its impact on students' performance: The TPACK framework explains what teachers must know and integrate content, pedagogy and technology to effectively use AI in classrooms. The TAM addresses why teachers choose to adopt or reject AI technologies,

focusing on perceptions, attitudes and institutional influences. The Constructivist Learning Theory clarifies how AI applications affect students' learning processes, emphasizing active engagement, feedback, and personalized learning pathways.

Together, these theories suggest that the successful application of AI tools in secondary education depends on a dynamic interplay between teachers' professional competence, acceptance of technology, and facilitation of student-centered learning. When these elements align, AI can serve as a powerful catalyst for improved academic performance, creativity, and critical thinking among secondary school students in Anambra State.

Method

The study adopted a descriptive correlational survey research design. This design was considered suitable because it enables the researcher to gather quantitative data on teachers' application of artificial intelligence (AI) tools and students' academic performance without manipulating any variables. The study was conducted in Anambra State, located in the South-East geopolitical zone of Nigeria. The state has six education zones Awka, Onitsha, Aguata, Ogidi, Nnewi, and Otuocho and is known for its high educational standards and concentration of secondary schools. The focus on Anambra State is justified by its early adoption of ICT in education and its strategic efforts toward integrating technology into secondary education, making it a fertile context for studying AI application in teaching and learning.

The population of the study comprised all public secondary school teachers and students in Anambra State. According to data from the Anambra State Ministry of Education (2024), there are approximately 4,562 teachers and 89,740 students across 266 public secondary schools. A sample size of 380 teachers and 720 students was selected using a multi-stage sampling technique. Stage 1: Stratified sampling was used to select four education zones (Awka, Onitsha, Nnewi, and Aguata) to ensure representation across geographical areas. Stage 2: From each selected zone, 10 secondary schools were randomly chosen. Stage 3: Within each school, purposive sampling was used to select teachers who had prior exposure to AI-integrated teaching or ICT-based instruction. Their corresponding students were selected through systematic random sampling. Data were collected using a structured questionnaire titled "*Teachers' Application of Artificial Intelligence Tools and Students' Performance Questionnaire (TAAITSPQ)*". The respondents were requested to rate the items on a 5-point rating scale of Very High Extent (VHE), High Extent (HE), Moderate Extent (ME), Low Extent (LE) and Very Low Extent with values 5, 4, 3, 2 and 1 respectively.

The instrument was subjected to face and content validation by three experts from the field. A pilot test was conducted using 40 teachers and 80 students from secondary schools in Enugu State (outside the study area). The data were analyzed using Cronbach's Alpha to determine internal consistency. The overall reliability coefficient obtained was 0.82, indicating a high level of reliability. Subscale reliability coefficients were as follows: Adaptive Learning Platforms = 0.82, Automated Assessment Systems = 0.79, Intelligent Tutoring Systems = 0.85 and Students' Academic Performance = 0.83. These values confirmed the suitability of the instrument for the main study. The researcher, assisted by trained research assistants, personally administered the questionnaires to respondents across the selected schools. This direct approach ensured a high retrieval rate and allowed clarification of any ambiguous items. Out of 380 teacher questionnaires distributed, 367 were

completed and returned, giving a 96.6% return rate. Similarly, 700 student questionnaires were validly completed and analyzed.

Data collected were analyzed using both descriptive and inferential statistics: Descriptive statistics (mean and standard deviation) were used to answer the research questions. Inferential statistics such as Pearson Product Moment Correlation (PPMC) and Multiple Regression Analysis were employed to test the hypotheses at a 0.05 level of significance. The analysis was conducted using SPSS Version 26, which provided detailed correlation matrices and predictive models linking AI tool application to student academic performance indicators (e.g., test scores, classroom participation, and retention rates).

Results

Research Question 1

What is the extent of teachers' application of adaptive learning platforms in secondary schools in Anambra State?

Table 1

Mean Ratings on Teachers' Responses on Adaptive Learning Platforms (n = 367)

S/N	Questionnaire Item	Mean	SD	Decision
1	I use AI-driven platforms that adjust learning content to student ability levels.	3.61	0.73	High Extent
2	I customize tasks using adaptive content recommendations for each learner.	3.48	0.78	Moderate Extent
3	I utilize digital systems that modify lesson difficulty automatically.	3.56	0.81	High Extent
4	I track individual learning progress through adaptive dashboards.	3.43	0.75	Moderate Extent
5	I assign AI-generated personalized practice materials to students.	3.54	0.76	High Extent
6	I encourage students to engage with adaptive homework systems.	3.39	0.79	Moderate Extent
7	I find adaptive systems helpful in differentiating instruction for mixed-ability students.	3.52	0.77	High Extent
8	My school provides adequate support for using adaptive learning platforms.	3.35	0.82	Moderate Extent
Overall Mean		3.48	0.76	Moderate Extent

Findings from Table 1 revealed that teachers in secondary schools moderately applied adaptive learning platforms (ALP) in instructional delivery, with an overall mean of 3.48.

Research Question 2

To what extent do teachers use automated assessment systems in secondary schools in Anambra State?

Table 2
Mean Ratings on Teachers' Responses on Automated Assessment Systems (n = 367)

S/N	Questionnaire Item	Mean	SD	Decision
1	I use AI tools that automatically grade and provide feedback on student assignments.	3.52	0.82	High Extent
2	I employ online testing platforms with automated scoring functions.	3.45	0.84	Moderate Extent
3	I use AI to generate instant performance reports for students.	3.38	0.83	Moderate Extent
4	I find automated grading reliable and time-saving.	3.29	0.87	Moderate Extent
5	My students are more motivated when using AI-based quizzes and tests.	3.41	0.79	Moderate Extent
6	I receive automated diagnostic reports highlighting students' weaknesses.	3.33	0.81	Moderate Extent
7	My school supports the use of AI tools for online assessments.	3.24	0.89	Moderate Extent
8	I integrate automated testing tools regularly in classroom assessments.	3.44	0.80	Moderate Extent
Overall Mean		3.37	0.84	Moderate Extent

Results from Table 2 indicated that teachers' use of automated assessment systems was also moderate (Mean = 3.37). Teachers are aware of their benefits but face infrastructure and training barriers to consistent adoption.

Research Question 3

To what extent do teachers apply intelligent tutoring systems in secondary schools in Anambra State?

Table 3
Mean ratings on Teachers' Responses on Intelligent Tutoring Systems (n = 367)

S/N	Questionnaire Item	Mean	SD	Decision
1	AI tutoring systems provide immediate explanations when students make mistakes.	3.68	0.70	High Extent
2	I use AI-driven tutoring aids for individualized instruction.	3.59	0.71	High Extent
3	Intelligent tutoring tools help me track student mastery in real-time.	3.55	0.75	High Extent
4	I use AI tutors to identify students needing extra practice.	3.52	0.72	High Extent
5	I employ AI suggestions to modify teaching strategies based on student responses.	3.46	0.74	Moderate Extent
6	My students engage more effectively when interacting with AI tutoring software.	3.50	0.73	High Extent
7	I use AI to reinforce learning after classroom instruction.	3.61	0.70	High Extent
8	AI tutoring systems enhance my ability to provide immediate feedback.	3.58	0.72	High Extent
9	I integrate AI tutoring in remedial teaching activities.	3.45	0.77	Moderate Extent
10	I receive useful analytics from AI tutors for lesson adjustment.	3.50	0.75	High Extent
11	AI systems help me differentiate tasks according to student strengths.	3.53	0.73	High Extent
12	My school encourages experimentation with intelligent tutoring tools.	3.42	0.78	Moderate Extent
Overall Mean		3.56	0.72	High Extent

Analysis in Table 3 indicated that teachers' application of intelligent tutoring systems (ITS) recorded a moderately high mean score (3.56), highlighting a growing integration of personalized AI learning aids in classroom teaching.

Research Question 4

What is the relationship between teachers' application of AI tools and students' academic performance in secondary schools in Anambra State?

Table 4

Relationship between Teachers' AI Application and Students' Performance

AI Tool	r-value	p-value	Relationship Strength	Decision
Adaptive Learning Platforms	0.68	< 0.01	Strong	Significant
Automated Assessment Systems	0.62	< 0.01	Strong	Significant
Intelligent Tutoring Systems	0.65	< 0.01	Strong	Significant

All AI tools in Table 4 demonstrated a positive and significant relationship with students' academic performance. The strongest correlation was between adaptive learning platforms ($r = 0.68$) and performance, showing that adaptive platforms enhances student learning outcomes. These findings confirm the hypothesis that there is a significant relationship between teachers' application of AI tools and students' academic performance in secondary schools.

Test of Hypotheses

Hypothesis 1

There is no significant relationship between teachers' application of adaptive learning platforms and students' academic performance.

Table 5

Test of Significance of Pearson Correlation between Teachers' Application of Adaptive Learning and Students' Academic Performance

Source of Variation	N	r	p-value	Remark
Teachers' Application of Adaptive Learning	367	0.68	0.01	Sig
Students' Academic Performance				

Analysis in Table 5 shows that there is a significant relationship between teachers' application of adaptive learning platforms and students' academic performance in secondary schools in Anambra State. The calculated r (0.68) had P -value < 0.05 . The null hypothesis was therefore rejected.

Hypothesis 2

Teachers' use of automated assessment systems does not significantly predict students' academic performance.

Table 6

Test of Significance of Pearson Correlation between Teachers' Use of Automated Assessment Systems and Students' Academic Performance

Source of Variation	N	r	p-value	Remark
Teachers' Use of Automated Assessment Systems	367	0.62	0.01	Sig
Students' Academic Performance				

Results in Table 6 shows that teachers' use of automated assessment systems significantly predict students' academic performance in secondary schools in Anambra State. The calculated r (0.62) had P -value < 0.05 . Therefore, the null hypothesis was rejected.

Hypothesis 3

Intelligent tutoring systems have no significant effect on students' academic performance.

Table 7

Test of Significance of Pearson Correlation between Teachers' Application of Intelligent Tutoring Systems and Students' Academic Performance

Source of Variation	N	r	p-value	Remark
Teachers' Application of Intelligent Tutoring System	367	0.65	0.01	Sig
Students' Academic Performance				

Analysis in Table 7 shows that teachers' application of intelligent tutoring systems have a significant effect on students' academic performance in secondary schools in Anambra State. The calculated r (0.65) had P -value < 0.05 . The null hypothesis was therefore rejected.

Hypothesis 4

There is no significant joint contribution of all AI tools to students' academic performance in secondary schools in Anambra State.

Table 8

Multiple Regression Analysis between Teachers' AI Application and Students' Academic Performance

Predictor Variable	Beta (β)	t-value	p-value	Remark
Adaptive Learning Platforms	0.31	6.27	<0.01	Significant
Automated Assessment Systems	0.28	5.14	<0.01	Significant
Intelligent Tutoring Systems	0.30	6.02	<0.01	Significant

The regression model in Table 8 was significant at $F(4, 362) = 57.34, p < 0.01$, indicating that the set of AI tools collectively predicted students' performance. The coefficient of determination ($R^2 = 0.64$) indicated that 64% of the variance in students' performance could be explained by the combined effect of the AI tools. Among them, adaptive learning platforms ($\beta = 0.31$) were the strongest predictors, followed by intelligent tutoring systems ($\beta = 0.30$) and automated assessment systems ($\beta = 0.28$). The result confirms that the application of AI tools by teachers significantly enhances students' academic performance in secondary schools in Anambra State.

Discussion

The findings of this study revealed that teachers moderately use adaptive learning platforms in classroom instruction. Despite the moderate level of adoption, the analysis indicated a significant positive relationship between teachers' use of adaptive learning platforms and students' academic performance ($r = 0.64, p < 0.05$). This implies that the more teachers integrate adaptive platforms such as *Google Classroom adaptive quizzes*, *Century Tech*, or *Khan Academy adaptive learning tools*, the more individualized and effective learning becomes. Adaptive platforms help tailor content to students' cognitive levels and learning speed, ensuring that high-performing students are challenged while slower learners receive reinforcement. The significant relationship between adaptive learning platforms and students' performance supports the findings of **Rocconi (2025)**, who demonstrated that adaptive systems help tailor educational experiences to individual learning needs, thereby improving retention and comprehension.

This result is consistent with **Nguyen, Tran, and Lee (2023)**, who found that adaptive learning systems significantly improve individualized learning outcomes in secondary schools across Asia, but their full integration depends on teachers' digital literacy and institutional readiness. Similarly, **Afolabi and Olayinka (2022)** reported that Nigerian teachers demonstrate moderate utilization of adaptive platforms due to limited access to ICT facilities and unreliable internet connectivity. Furthermore, **Okeke and Ogbu (2021)** found in Anambra and Enugu States that teachers recognize the benefits of AI-based personalization but face obstacles such as poor power supply, lack of training, and limited access to paid platforms. In Kenya, **Mwangi and Gachanja (2022)** discovered that adaptive learning software improved students' engagement in mathematics but was used mainly by younger, tech-savvy teachers. Therefore, the moderate adoption found in this study suggests both awareness and willingness among teachers, constrained mainly by infrastructural and policy barriers.

Results of the study revealed that teachers use automated assessment systems moderately. There is a significant correlation indicating that the integration of automated

grading tools positively impacts academic achievement. Automated assessment systems such as Google Forms quizzes, Socrative, or Edmodo assessments provide instant feedback, enabling both teachers and students to monitor progress continuously. These systems save teachers time, enhance objectivity in grading, and promote timely remediation of learning gaps. The results are in line with Alhassan (2022), who found that automated evaluation systems not only improve assessment efficiency but also foster a culture of continuous learning. Similarly, Eze and Okeke (2023) reported that automated feedback encourages self-directed learning among students and motivates them to take greater ownership of their academic progress. Nevertheless, the study observed that many teachers rely on manual testing methods due to poor internet connectivity and limited access to digital devices. The implication is that while automated assessment enhances learning effectiveness, sustained investment in digital infrastructure and teacher training is required for consistent application. The moderate adoption observed in the current study underscores the need for professional development in AI-based assessment literacy among Nigerian teachers.

Furthermore, results of the study indicated that teachers applied intelligent tutoring systems moderately in instructional delivery and a significant positive relationship between intelligent tutoring systems and student academic performance. This implies that teachers frequently use AI tutoring tools to offer individualized guidance and feedback to students. This agrees with **Chen and Wang (2023)**, who reported that ITS significantly improved students' engagement and knowledge retention in secondary science classes in Taiwan. **Musa et al. (2025)** found that intelligent tutoring systems increased students' mathematics achievement through immediate, individualized feedback loops. Similarly, **Adeyemo and Adeniran (2022)** noted that Nigerian teachers increasingly adopt AI tutoring systems in mathematics instruction, particularly platforms that simulate interactive problem-solving. **Bai and Yang (2021)** found that ITS promotes self-paced learning, enabling weaker students to catch up with their peers. Likewise, **Park and Kim (2023)** discovered that ITS tools like Carnegie Learning and ALEKS improved students' critical reasoning and exam performance. A more recent study by **Dogo and Eze (2024)** in northern Nigeria showed that teachers who incorporated AI-based tutoring apps into lessons recorded improved student engagement and fewer absenteeism cases. However, they also highlighted issues such as subscription costs and inadequate ICT support. These findings collectively affirm that ITS enhances the personalization of learning experiences, fostering deeper comprehension and motivation among learners when properly integrated.

Correlation results revealed strong and significant positive relationships between teachers' use of Artificial Intelligence tools and students' academic performance. This finding corroborates **UNESCO (2023)**, which asserts that AI-assisted pedagogy enhances instructional precision, leading to improved learning outcomes. Similarly, **Bai and Yang (2021)** and **Zhao et al. (2023)** confirmed that AI integration correlates positively with student motivation, self-regulated learning, and examination success. **Ogunyemi and Adegbile (2022)** in Nigeria found that AI-enhanced instruction significantly improved senior secondary students' mathematics scores compared to traditional teaching. **Abubakar and Ibrahim (2023)** also demonstrated that the use of AI-powered analytics increased student participation and reduced dropout rates. Furthermore, **European Commission (2023)** documented that integrating AI into lesson planning and evaluation enhances teacher efficiency and reduces

learning inequality. **Mwangi and Gachanja (2022)** supported this by noting that AI-adopting schools in Kenya achieved better results in national assessments. Therefore, this study affirms that effective application of AI tools particularly dashboards, tutoring systems, and adaptive platforms substantially contributes to enhanced student performance, engagement, and feedback responsiveness.

Conclusion

Based on the findings of this study, it is concluded that teachers' in Anambra State moderately apply adaptive learning platforms, automated assessment systems and intelligent tutoring systems in instructional delivery. There is a strong positive and significant relationship between teachers; application of AI tools and students' academic performance. AI adoption is constrained mainly by limited digital infrastructure, insufficient training and inadequate institutional support. Therefore, the study concludes that teachers' effective application of AI tools enhances instructional quality, student engagement and learning outcomes.

Recommendations

Based on the conclusions drawn, the following recommendations are made:

1. Educational authorities and ministries should organize continuous professional development workshops to enhance teachers' competencies in using adaptive learning platforms and intelligent tutoring systems.
2. The government should provide adequate digital infrastructure such as stable internet connectivity, ICT laboratories, and AI-compatible devices in secondary schools to facilitate AI integration in teaching and assessment.
3. School administrators should develop policies that encourage the regular use of AI-driven teaching and assessment tools, including digital grading platforms and data dashboards.
4. Schools should partner with educational technology developers to customize AI solutions suitable for local contexts and curriculum needs.
5. Education boards should implement monitoring frameworks to evaluate the impact of AI tool usage on teaching effectiveness and student performance regularly.
6. Teacher education institutions should include AI literacy and instructional technology courses in their curricula to prepare future educators for technology-enhanced pedagogy.

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