

INFLUENCE OF ARTIFICIAL INTELLIGENCE (AI) ON TEACHING EFFECTIVENESS AND EDUCATIONAL OUTCOMES IN BENUE STATE SECONDARY SCHOOLS, NIGERIA

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ABSTRACT

This study examined the influence of Artificial Intelligence (AI), including ChatGPT, Google Gemini and Microsoft Copilot, on teaching effectiveness and educational outcomes in Benue State secondary schools, Nigeria. Two research questions guided the study and two null hypotheses were formulated and tested at the 0.05 level of significance. A descriptive survey research design was adopted. The population comprised 75,969 secondary school students in 290 public secondary schools across the 23 local government areas of Benue State, from which a sample of 500 students was selected using the Research Advisor Sample Size Table. A multi-stage sampling procedure involving stratified, proportional and simple random sampling techniques was used to select the respondents. Data were collected using a researcher-developed instrument titled Artificial Intelligence, Teaching Effectiveness and Educational Outcomes Questionnaire (AITEEOQ). The instrument was validated by three experts in the Faculty of Education, and a pilot test using Cronbach Alpha yielded a reliability coefficient of 0.82. Mean and standard deviation were used to answer the research questions, while one-sample t-test statistics were used to test the hypotheses against the criterion mean of 2.50. Results showed that AI had a significant positive influence on teaching effectiveness and educational outcomes in Benue State secondary schools. The study concluded that AI can support lesson planning, instructional material development, assessment, feedback, student participation, personalised learning and digital skills when teachers are adequately trained and schools are provided with appropriate infrastructure and ethical guidelines.

Keywords: Artificial Intelligence, teaching effectiveness, educational outcomes, secondary schools, Benue State.

Introduction

Education remains one of the most important sectors for national development because it equips individuals with the knowledge, skills, values and competencies required for personal development, productivity and social advancement. Teachers are central to this process because they plan lessons, facilitate learning, assess students' performance, prepare instructional materials and guide learners toward achieving educational objectives. In recent years, rapid technological progress has transformed educational practice across the world, leading to the adoption of innovative teaching tools and instructional approaches (Sanusi, 2025; Ukpokodu, Awodi, & Eze, 2025). The integration of digital technologies into education has changed how knowledge is created, shared, delivered and assessed, thereby making learning more accessible, flexible and interactive.

Artificial Intelligence (AI) is one of the major technological developments currently influencing modern education. AI refers to computer-based systems capable of performing tasks that ordinarily require human intelligence, such as data analysis, content generation, problem-solving, decision-making, prediction and machine learning (Ezeaku & Agu, 2025). In instructional settings, AI can assist teachers in preparing lesson plans, developing instructional materials, evaluating students' work, generating feedback and identifying learners who require additional academic support. Examples of AI tools that can support teaching and learning include ChatGPT for lesson planning and content generation, Google Gemini for research and instructional support, Microsoft Copilot for document preparation and productivity, Grammarly for writing improvement, QuillBot for paraphrasing and language support, Canva AI for visual instructional materials, Kahoot AI and Quizizz AI for interactive assessment, Khanmigo for personalised tutoring and Turnitin tools for academic integrity.

AI should therefore be viewed as a complementary instructional support system rather than a replacement for teachers. When properly integrated into classroom practice, AI can reduce teachers' workload, improve instructional delivery, promote learner engagement and support data-informed teaching. However, the educational value of AI depends on teachers' digital competence, availability of digital infrastructure, access to reliable internet, institutional support and the ethical use of AI tools. In Benue State, Nigeria, schools are gradually engaging with digital technologies, but many teachers and learners still face challenges such as inadequate digital skills, limited access to AI tools, poor internet connectivity, insufficient electricity supply and lack of structured professional training. These conditions may limit the extent to which AI can be effectively used to improve teaching effectiveness and educational outcomes.

Teaching effectiveness refers to the extent to which teachers successfully facilitate learning, engage students, achieve instructional objectives and promote meaningful educational experiences. It involves the use of appropriate instructional strategies, classroom management techniques, assessment methods and communication skills that improve students' understanding and academic performance. Effective teaching is commonly measured through indicators such as lesson delivery, learner involvement, classroom interaction, achievement of learning outcomes and the teacher's ability to adapt instruction to diverse learners' needs (Stronge, 2018). Similarly, Hattie (2017) argued that the quality of instruction is one of the major factors influencing students' academic achievement and broader learning experiences. AI can enhance teaching effectiveness by assisting teachers with lesson planning, instructional content development, assessment, classroom monitoring and feedback. For example, generative AI tools can help teachers produce lesson outlines, examples, assessment questions and simplified explanations of difficult concepts. Learning analytics can also help teachers identify students who are struggling

and provide appropriate interventions. This can make teaching more responsive, organised and learner-centred. Holmes and Tuomi (2022) argued that AI-supported educational technologies can contribute to lesson preparation, learner monitoring and adaptive learning when they are aligned with sound pedagogical principles. Zawacki-Richter et al. (2019) also found that AI applications in education are increasingly used for profiling learners, assessment, evaluation and intelligent tutoring. These roles show that AI can support teachers' instructional decisions, but the teacher remains responsible for interpreting AI-generated outputs and ensuring that instruction is accurate, ethical and contextually appropriate.

Educational outcomes refer to the knowledge, skills, attitudes, values and competencies that learners acquire as a result of educational activities. These outcomes include academic achievement, critical thinking, problem-solving ability, creativity, communication skills, digital competence and lifelong learning skills. Biggs and Tang (2011) described learning outcomes as the intended achievements that students are expected to demonstrate after completing a course or programme. UNESCO (2023) also emphasized that quality education should not only produce academic success but should also develop competencies needed for social and economic participation. In this regard, AI has the potential to improve educational outcomes by providing personalised learning experiences, immediate feedback, adaptive learning pathways and support for students with diverse learning needs. AI can improve educational outcomes by supporting students' participation, motivation, understanding and academic performance. AI-based platforms can provide interactive learning activities, automated feedback, practice questions and explanations that help students learn independently. When used in classrooms, AI can also help teachers differentiate instruction so that students with different abilities and learning styles receive appropriate support. UNESCO (2023) emphasized that generative AI in education should be used to support inclusive and quality learning while protecting learners from ethical risks such as misinformation, privacy violation, bias and overdependence on automated systems. This means that the influence of AI on educational outcomes should not be judged only by academic performance, but also by responsible use, digital competence and learners' ability to think critically about AI-generated content.

Against this background, this study investigates the influence of Artificial Intelligence on teaching effectiveness and educational outcomes in Benue State secondary schools, Nigeria. The study is important because it provides empirical evidence on how students perceive the use of AI-supported teaching practices and their possible contribution to classroom delivery and learning outcomes in a Nigerian secondary school context.

Statement of the Problem

The educational sector is experiencing rapid technological transformation, with Artificial Intelligence emerging as one of the most influential innovations in teaching and learning. AI technologies provide opportunities for personalised instruction, automated assessment, classroom management, lesson planning, feedback delivery and teacher professional development. However, despite these benefits, the effective use of AI in schools depends largely on teachers' digital competence, access to technology, reliable internet connectivity, electricity supply and institutional support. In Nigeria, the digital gap remains a major concern for education. The World Bank (2025), drawing on MICS data, reported that only 9.4% of Nigerian households owned a computer, while 34.6% had access to an internet network at home. This suggests that many teachers and learners still operate in environments where access to basic digital tools is limited.

In Benue State, the problem is more specific because recent interventions show that digital and AI-related teacher training is still emerging. UNICEF, in collaboration with the Benue State Ministry of Education and SUBEB, recently trained 40 master trainers with the aim of reaching 1,000 teachers in the next phase (Vanguard, 2026). Reports also indicate that 660 tablets had earlier been provided to support teacher and student registration on the Nigerian Learning Passport (Punch, 2025). Although these interventions are positive, they remain limited when compared with the educational needs of the state. Benue SUBEB also resumed the recruitment process for over 9,000 teachers, with 48,895 candidates sitting for the Computer-Based Test (Vanguard, 2025). These developments show that teacher capacity, digital literacy and educational technology preparation remain urgent concerns in the state.

Consequently, many schools in Benue State may continue to face challenges such as limited access to educational technologies, inadequate digital skills, poor internet connectivity, insufficient training and low awareness of AI-powered educational tools. As a result, teachers may be unable to fully utilise AI for lesson preparation, individualised instruction, assessment, classroom organisation and improvement of student learning outcomes. While studies have examined educational technology and AI-related learning in Nigeria, limited empirical attention has been given to the influence of AI on teaching effectiveness and educational outcomes in Benue State secondary schools. Therefore, this study specifically investigates the influence of Artificial Intelligence on teaching effectiveness and educational outcomes in Benue State secondary schools, Nigeria.

Purpose of the Study

The purpose of this study was to investigate the influence of Artificial Intelligence (AI) on teaching effectiveness and educational outcomes in Benue State secondary schools, Nigeria. Specifically, the study sought to:

1. determine the influence of Artificial Intelligence (AI) on teaching effectiveness in Benue State secondary schools;
2. ascertain the influence of Artificial Intelligence (AI) on educational outcomes in Benue State secondary schools.

Research Questions

The study was guided by the following research questions:

1. What is the influence of Artificial Intelligence (AI) on teaching effectiveness in Benue State secondary schools?
2. What is the influence of Artificial Intelligence (AI) on educational outcomes in Benue State secondary schools?

Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

1. Artificial Intelligence (AI) has no significant influence on teaching effectiveness in Benue State secondary schools.
2. Artificial Intelligence (AI) has no significant influence on educational outcomes in Benue State secondary schools.

Methodology

The study adopted a descriptive survey research design. This design was considered appropriate because the study sought to collect data from a large number of secondary school students in order to describe their perceptions of the influence of Artificial Intelligence (AI) on teaching effectiveness and educational outcomes without manipulating any variable. The study was conducted in Benue State, Nigeria. The population of the study comprised 75,969 secondary

school students in 290 public secondary schools across the 23 local government areas of Benue State. A sample size of 500 secondary school students was selected for the study using the Research Advisor Sample Size Table. The sample size was considered adequate because it was large enough to represent the population, reduce sampling error and improve the generalisability of the findings.

A multi-stage sampling procedure involving stratified, proportional and simple random sampling techniques was used to select the respondents. Stratified sampling was used to group the students according to educational zones, local government areas and schools. Proportional sampling was used to determine the number of students selected from each stratum based on population size, while simple random sampling was used to select the actual respondents. This procedure ensured that students from different parts of the state had a fair chance of being represented in the study. The instrument used for data collection was a researcher-developed questionnaire titled Artificial Intelligence, Teaching Effectiveness and Educational Outcomes Questionnaire (AITEEOQ). The instrument was designed to obtain students' perceptions of the influence of Artificial Intelligence on teaching effectiveness and educational outcomes. The questionnaire was structured on a four-point Likert rating scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The four-point scale was used to remove the neutral option and encourage respondents to express a definite opinion on each item. The response options were weighted as follows: Strongly Agree = 4, Agree = 3, Disagree = 2 and Strongly Disagree = 1.

The instrument was subjected to face and content validation by three experts: two from Educational Foundations and one from Measurement and Evaluation. The experts examined the items in terms of clarity, relevance, language, coverage of the study variables and suitability for secondary school students. Their corrections and suggestions were used to modify and improve the final version of the questionnaire before administration.

To establish the reliability of the instrument, a pilot test was conducted using 30 secondary school students Government Girls Secondary School Makurdi were used. The data obtained from the trial test were analysed using Cronbach Alpha statistics, and a reliability coefficient of 0.82 was obtained. This indicated that the instrument was reliable and suitable for data collection.

Data collected were analysed using mean and standard deviation to answer the research questions. A criterion mean of 2.50 was used as the basis for decision making. Any item with a mean score of 2.50 and above was accepted, while any item with a mean score below 2.50 was rejected. The hypotheses were tested using one-sample t-test statistics at the 0.05 level of significance. The one-sample t-test was considered more appropriate than Chi-square because the data were generated from Likert-scale responses and involved testing whether the observed mean score was significantly higher than the criterion mean rather than testing frequencies or categorical associations.

Results

Research Question One

What is the influence of Artificial Intelligence (AI) on teaching effectiveness in Benue State secondary schools?

Table 1: Mean and Standard Deviation of the Influence of Artificial Intelligence on Teaching Effectiveness

S/N	Item Statement	N	Mean	SD	Decision
1	AI helps teachers prepare instructional materials more effectively.	500	3.16	0.55	Accepted
2	AI improves lesson planning and classroom delivery.	500	3.10	0.58	Accepted
3	AI supports teachers in assessing students' learning progress.	500	3.08	0.57	Accepted
4	AI enhances teachers' ability to provide feedback to students.	500	3.14	0.53	Accepted
5	AI improves teachers' use of innovative teaching strategies.	500	3.12	0.54	Accepted
	Grand Mean	500	3.12	0.54	Accepted

Table 1 shows that the mean scores of all the items were above the criterion mean of 2.50. The grand mean of 3.12 with a standard deviation of 0.54 indicates that Artificial Intelligence has a positive influence on teaching effectiveness in Benue State secondary schools. This means that the respondents perceived AI as useful in lesson preparation, instructional delivery, assessment, feedback and the adoption of innovative teaching strategies.

Research Question Two

What is the influence of Artificial Intelligence (AI) on educational outcomes in Benue State secondary schools?

Table 2: Mean and Standard Deviation of the Influence of Artificial Intelligence on Educational Outcomes

S/N	Item Statement	N	Mean	SD	Decision
1	AI improves students' participation in learning activities.	500	3.09	0.60	Accepted
2	AI helps students learn at their own pace.	500	3.02	0.59	Accepted
3	AI supports better understanding of difficult subject content.	500	3.11	0.56	Accepted
4	AI improves students' academic engagement and motivation.	500	3.07	0.58	Accepted
5	AI contributes to improved students' academic performance.	500	3.01	0.61	Accepted
	Grand Mean	500	3.06	0.57	Accepted

Table 2 shows that all the item mean scores were above the criterion mean of 2.50. The grand mean of 3.06 with a standard deviation of 0.57 indicates that Artificial Intelligence has a positive influence on educational outcomes in Benue State secondary schools. This implies that AI contributes to improved learner participation, individualised learning, better understanding of subject content, motivation and academic performance.

Hypothesis One

Artificial Intelligence (AI) has no significant influence on teaching effectiveness in Benue State secondary schools.

Table 3: One-Sample t-test Analysis of the Influence of Artificial Intelligence on Teaching Effectiveness

Variable	N	Mean	SD	Criterion Mean	Mean Diff.	df	t-cal	p	Decision
Teaching Effect.	500	3.12	0.54	2.50	0.62	499	25.67	< .001	Rejected

Table 3 shows that the mean score of 3.12 was higher than the criterion mean of 2.50. The one-sample t-test result showed a statistically significant difference, $t(499) = 25.67$, $p < .001$. Therefore, the null hypothesis was rejected. This means that Artificial Intelligence has significant positive influence on teaching effectiveness in Benue State secondary schools.

Hypothesis Two

Artificial Intelligence (AI) has no significant influence on educational outcomes in Benue State secondary schools.

Table 4: One-Sample t-test Analysis of the Influence of Artificial Intelligence on Educational Outcomes

Variable	N	Mean	SD	Criterion Mean	Mean Diff.	df	t-cal	p	Decision
Educ. Outcomes	500	3.06	0.57	2.50	0.56	499	21.97	< .001	Rejected

Table 4 shows that the mean score of 3.06 was higher than the criterion mean of 2.50. The one-sample t-test result showed a statistically significant difference, $t(499) = 21.97$, $p < .001$. Therefore, the null hypothesis was rejected. This means that Artificial Intelligence has a significant positive influence on educational outcomes in Benue State secondary schools.

Findings

The first finding of the study revealed that Artificial Intelligence has a significant positive influence on teaching effectiveness in Benue State secondary schools. This suggests that AI is not merely a technological innovation but also a practical instructional support tool that can strengthen teachers' professional duties. Through AI-assisted lesson planning, automated assessment, instructional material development, feedback generation and identification of learners' needs, teachers can deliver lessons that are more organised, interactive and responsive to students' learning differences. The finding supports Holmes and Tuomi (2022), who explained that AI-powered educational technologies can support lesson preparation, adaptive learning and learner monitoring. It also aligns with Zawacki-Richter et al. (2019), who observed that AI can strengthen instructional decision-making through educational analytics.

The second finding showed that Artificial Intelligence has a significant positive influence on educational outcomes in Benue State secondary schools. This implies that the use of AI in teaching and learning can promote students' understanding, participation, motivation, academic performance, digital competence and creative thinking. AI-supported platforms can provide personalised learning experiences by helping teachers identify students' strengths and weaknesses and by recommending learning activities that address individual learning gaps. This finding agrees with Chen et al. (2020), who found that AI can provide personalised learning support by identifying learners' needs. It also agrees with Kasneci et al. (2023), who reported that AI applications can improve students' engagement, motivation and learning achievement when properly integrated into educational settings.

Conclusion

Based on the findings, the study concluded that Artificial Intelligence has a meaningful and significant influence on teaching effectiveness and educational outcomes in Benue State secondary schools. The study shows that AI is not merely a technological tool but a pedagogical support system that can strengthen lesson planning, instructional delivery, assessment, feedback and learner support when properly integrated into teaching practice. The findings imply that teachers who possess the skills to use AI responsibly are better positioned to design learner-centred lessons, identify students' learning needs, provide timely feedback and support improved academic engagement.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The Benue State Ministry of Education, in collaboration with the Teaching Service Board, school administrators and teacher-training institutions, should organise structured AI capacity-building programmes for teachers. The training should be delivered at state, zonal and school levels and should focus on lesson planning, instructional content development, classroom assessment, feedback generation, adaptive learning and responsible AI use.
2. The Benue State Government, through the Ministry of Education and relevant Local Government Education Authorities, should conduct a digital needs assessment of secondary schools before providing AI-related infrastructure. This assessment should identify schools that lack internet access, functional computers, projectors, electricity supply and secure digital learning platforms. Based on the assessment, government should introduce a phased infrastructure plan, beginning with pilot schools within one academic year before expanding to other schools.
3. School administrators should develop school-level guidelines for the ethical and effective use of AI in teaching and learning. These guidelines should address data privacy, plagiarism, overdependence on AI-generated materials, fairness, learner protection and teacher supervision. Teachers should be encouraged to use AI as a support tool rather than as a substitute for professional judgement, creativity and direct interaction with learners.
4. Teacher education institutions and professional development centres in Benue State should integrate AI literacy, digital pedagogy and educational technology ethics into pre-service and in-service teacher training programmes. This will help teachers understand not only how to use AI tools but also how to evaluate AI-generated content, adapt it to curriculum objectives and protect learners from misinformation.

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