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Evaluating Teachers' Perceived Opportunities and Challenges on Integrating Artificial Intelligence among Public Secondary Schools in Delta State, Nigeria

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Abstract
This study investigated teachers' perceived opportunities and challenges of artificial intelligence integration in urban and rural public secondary schools in Delta State, Nigeria. Two research questions and two null hypotheses guided the study, which was anchored on two theories. A descriptive-comparative survey design was adopted. The population comprised 11,011 teachers in 488 public secondary schools across 25 local government areas. Using the Taro Yamane formula and multistage sampling, 386 teachers were selected, while 380 questionnaires were analyzed. Data were collected using the validated 20-item Artificial Intelligence Integration Opportunities and Challenges Questionnaire. Mean and standard deviation answered the research questions, while independent-samples t-tests tested the hypotheses at the .05 significance level. The findings showed that teachers recognized AI opportunities for lesson preparation, personalized instruction, feedback, assessment and independent learning. They identified unreliable electricity, poor internet connectivity, inadequate devices, limited competence, insufficient training and ethical concerns as challenges. Urban teachers perceived the opportunities more strongly, whereas rural teachers perceived the challenges more strongly. The study concluded that AI offered educational value, but unequal infrastructure and support limited its equitable integration. It recommended improved electricity, connectivity and digital devices, particularly in rural schools, alongside practical teacher training, technical support and responsible-use guidelines.

Keywords: Artificial intelligence integration, Teachers' perceptions, Opportunities, Challenges, public secondary schools.

Introduction
Artificial intelligence has become increasingly relevant to education because of its ability to support activities that ordinarily require human reasoning, decision-making and problem-solving. In educational settings, AI includes intelligent tutoring systems, learning analytics, chatbots, automated assessment, virtual laboratories and content-generating applications. These technologies can support teaching, learning and educational decision-making by processing information and responding to learners' needs (Hwang et al., 2020). Ouyang and Jiao (2021) explained that AI in education may be AI-directed, AI-supported or AI-empowered. These approaches allow technology to guide learning, assist learners or provide resources that enable learners to take greater control of their educational experiences. Through these functions, AI can personalize instruction, provide immediate feedback, generate learning materials and help teachers identify students' areas of difficulty. At the secondary-school level, AI can assist teachers in preparing lessons, developing assessment questions, simplifying difficult concepts and accommodating differences in students' learning abilities. It can also provide students with opportunities for independent practice and continuous feedback. Nevertheless, the educational value of AI depends on how effectively it is connected to appropriate learning objectives and sound instructional practices (Luckin & Cukurova, 2019). Okunade (2024) identified adaptive learning systems, intelligent tutoring systems and virtual laboratories as valuable AI applications for science teaching in Nigerian secondary schools. Such applications may be particularly useful where physical laboratory materials are inadequate or certain scientific processes are difficult to demonstrate. AI can also assist teachers in producing examples, illustrations and simulations suited to the curriculum. Despite these opportunities, effective AI integration requires reliable electricity, internet connectivity, digital devices, technical support and competent teachers. Public secondary schools may differ considerably in their access to these resources. Teachers must also be able to evaluate AI-generated content, protect students' personal information and prevent inappropriate dependence on automated answers. Other concerns include algorithmic bias, academic dishonesty, inaccurate information and the possible weakening of students' critical-thinking abilities (Holmes et al., 2022). Miao et al. (2021)

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maintained that AI adoption in education should be guided by inclusion, equity, transparency and human-centred decision-making. Teachers should therefore remain responsible for determining the suitability of AI-generated materials and guiding students towards ethical use. Without adequate training and institutional support, the availability of AI applications may not result in meaningful classroom integration. A review by Zhai et al. (2021) revealed growing scholarly interest in AI applications in education, but much of the evidence originated outside the immediate context of Nigerian public secondary schools. Consequently, information remains limited regarding the opportunities teachers in Delta State believe AI offers, the challenges they perceive and whether these perceptions differ between urban and rural schools. This study therefore investigated teachers' perceived opportunities and challenges of artificial intelligence integration in public secondary schools in Delta State, Nigeria.

Statement of the Problem

Artificial intelligence offers considerable possibilities for improving teaching, learning, assessment and educational decision-making through personalized learning, automated feedback, intelligent tutoring systems, virtual laboratories and content-generation tools. Nevertheless, the effective integration of these technologies in public secondary schools cannot be assumed. Teachers must possess the competence to select appropriate AI applications, evaluate generated information and guide students towards responsible use. At the same time, unreliable electricity, limited internet connectivity, inadequate digital devices, insufficient training, high costs, weak technical support and unclear policy direction may constrain implementation. Ethical concerns involving inaccurate information, algorithmic bias, students' privacy, academic dishonesty and excessive dependence on automated responses further complicate classroom use. Differences in the facilities and support available to urban and rural schools may also influence how teachers perceive both the benefits and difficulties associated with AI integration. Despite increasing attention to AI in education, insufficient context-specific evidence exists regarding the opportunities and challenges perceived by teachers in public secondary schools in Delta State. Much of the existing literature is conceptual, concentrated on higher education, conducted outside Nigeria or focused on teachers' readiness to teach AI as a subject. Consequently, it remains unclear what instructional opportunities teachers in Delta State believe AI provides, which challenges are most likely to hinder its effective integration and whether the perceptions of teachers in urban and rural schools differ significantly. Without such evidence, AI-related policies, training programmes and infrastructure investments may fail to address the actual needs of teachers and schools. This study was therefore undertaken to investigate teachers' perceived opportunities and challenges of artificial intelligence integration and compare the perceptions of teachers in urban and rural public secondary schools in Delta State.

Purpose of the Study

The main purpose of the study is to investigate teachers' perceived opportunities and challenges of artificial intelligence integration in public secondary schools in Delta State, Nigeria. Specifically, the study sought to:

1. determine the opportunities teachers perceived that artificial intelligence offered for teaching and learning and compared the mean ratings of teachers in urban and rural public secondary schools; and
2. ascertain the challenges teachers perceived as constraining artificial intelligence integration and compared the mean ratings of teachers in urban and rural public secondary schools.

Research Questions

The following research questions guided the study:

1. What opportunities did teachers in urban and rural public secondary schools perceive that artificial intelligence offered for teaching and learning in Delta State?
2. What challenges did teachers in urban and rural public secondary schools perceive as constraining the effective integration of artificial intelligence?

Hypotheses

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

H_{01}: There is no significant difference between the mean ratings of teachers in urban and rural public secondary schools regarding the perceived opportunities of artificial intelligence integration.

H_{02}: There is no significant difference between the mean ratings of teachers in urban and rural public secondary schools regarding the perceived challenges of artificial intelligence integration.

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Significance of the Study

The study provided evidence on the opportunities and challenges associated with artificial intelligence integration in public secondary schools in Delta State. Its findings assisted educational policymakers and school administrators in identifying areas requiring improved infrastructure, teacher training, technical support and ethical guidelines. Teachers gained a clearer understanding of how AI could support lesson preparation, classroom instruction and assessment, while students benefited from recommendations aimed at promoting responsible and effective AI use. The study also contributed to the existing literature and provided useful information for researchers conducting related studies on AI integration in secondary education.

Review of Related Literature

Conceptual Review

Artificial intelligence in education referred to the use of computer systems capable of learning, reasoning, generating content and making data-based decisions to support teaching, learning and assessment. Its applications include intelligent tutoring systems, adaptive learning platforms, chatbots, automated assessment, learning analytics and virtual laboratories. AI has developed from earlier programmed instructional technologies into more responsive systems that can analyze learner's performance and adjust educational support accordingly (Williamson & Eynon, 2020). Depending on its application, it may function as a tutor, teaching assistant, analytical tool or learning partner (Xu & Ouyang, 2022). AI integration differs from teaching AI as a subject. Integration concerns using AI to improve educational activities, whereas AI education develops learners' understanding of how AI systems function and should be used. Both require AI literacy, including the ability to understand, apply and critically evaluate AI-generated information (Ng et al., 2021). Although AI can promote personalized and inclusive education, it should complement rather than replace teachers' professional and interpersonal roles (Pedro et al., 2019; Selwyn, 2019). AI creates opportunities for personalized learning by tailoring content, tasks and feedback to learners' skills and pacing. It can pinpoint areas of struggle, suggest appropriate activities and offer immediate support. AI-enabled pedagogies may also bolster inquiry, problem-solving and independent learning (Yue et al., 2022). Teachers can apply AI to develop lesson resources, produce assessment items, manage performance records and detect common learning challenges. Meylani (2024) emphasized the need to prepare educators to integrate these tools into their professional practice. However, realizing these benefits depends on appropriate curriculum planning (Chiu & Chai, 2020). AI integration can also develop students' motivation, creativity, data literacy and responsible technology use. Students' willingness to learn about AI is influenced by their attitudes, confidence and perceived control (Chai et al., 2022). Through guided activities, learners can analyze information, collaborate and develop solutions to practical problems. Such experiences may promote transversal skills and understanding of data practices required in an AI-driven society (Okada et al., 2025; Olari & Romeike, 2025). Effective AI integration depends on electricity, internet connectivity, digital devices and technical support. Inadequate electricity supply can interrupt technology-supported teaching and restrict access to online platforms (Akinola, 2022). Differences in infrastructure and digital competence may also create inequalities between urban and rural schools, reflecting a wider digital divide in access and meaningful technology use (van Dijk, 2020). Economic difficulties can further limit schools' capacity to acquire and maintain AI-related resources (Bou Zeid & Abouchedid, 2026). Teacher skills and self-assurance create additional obstacles. Educators must be able to choose suitable AI tools, craft effective prompts, assess generated content, and align AI applications with curriculum goals. Digital and AI literacy frameworks show that responsible adoption demands technical, pedagogical, and ethical competencies (Tomczyk, 2024). Insecure teachers may avoid using AI or apply it poorly, since readiness and technology acceptance are shaped by self-efficacy, perceived usefulness, and perceived ease of use (Rajapakse et al., 2024; Scherer et al., 2019). AI may generate inaccurate information, reproduce bias and expose students' personal data. It may also encourage academic dishonesty or dependence on automated answers. Holmes et al. (2022) therefore recommended an ethical framework involving teachers, learners, parents, policymakers and technology developers. Clear school policies are needed to guide data protection, assessment practices and acceptable classroom use. AI integration should ultimately preserve inclusion, transparency, human agency and teachers' professional judgment (UNESCO, 2021).

Theoretical Framework

The study was anchored on the Technology Acceptance Model and the Diffusion of Innovations Theory. The Technology Acceptance Model was developed by Davis (1989) to explain why individuals accept or reject a technological system. The

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model identifies perceived usefulness and perceived ease of use as the principal factors influencing attitude, behavioural intention and actual technology use. Perceived usefulness concerns the extent to which a person believes that a technology improves performance, while perceived ease of use refers to the belief that using it requires little difficulty or effort. Applied to education, teachers are more likely to accept AI when they believe that it improves lesson preparation, classroom instruction, assessment and students' learning. These benefits represent the perceived opportunities examined in the study. Conversely, inadequate competence, complicated applications, unreliable internet access and concerns about accuracy may reduce perceived ease of use. Scherer et al. (2019) confirmed that perceived usefulness and ease of use are important in explaining teachers' adoption of educational technologies. The model was relevant because teachers' perceptions could influence their willingness to integrate AI into classroom activities. It also helped explain why teachers in urban and rural schools might respond differently when their access to infrastructure, training and technical support differed. Teacher self-efficacy strengthened this explanation because confidence in personal competence affects readiness to use or teach with AI (Rajapakse et al., 2024). Rogers' (2003) Diffusion of Innovations Theory explains how new ideas and technologies spread through a social system over time. According to the theory, adoption is influenced by an innovation's relative advantage, compatibility, complexity, trialability and observability. Relative advantage concerns whether an innovation is regarded as better than existing practices, while compatibility refers to its consistency with users' needs and values. Complexity describes its perceived difficulty, trialability concerns opportunities for limited experimentation, and observability refers to the visibility of its results. AI may be accepted more readily when teachers observe that it saves time, improves feedback and supports students' learning. Adoption may be slower when AI tools are difficult to operate, incompatible with curriculum demands or unsupported by school infrastructure. Differences in electricity, connectivity, digital devices and professional development may therefore affect the diffusion of AI across public secondary schools. The theory supported the comparison of urban and rural teachers because innovations do not spread uniformly where resources and institutional support differ. Siemens (2005) maintained that knowledge may exist across people, information sources and technological systems. This perspective supported AI-assisted learning because students can access, evaluate and connect information from different digital resources. Nevertheless, teachers remain essential in helping learners judge the reliability and relevance of such information. Chiu and Chai (2020) applied this perspective to AI curriculum planning, while Chai et al. (2023) showed that motivation influenced students' intentions to learn AI. The digital divide perspective also explained how unequal access, competence and usage opportunities could shape teachers' experiences of AI (van Dijk, 2020). Together, the Technology Acceptance Model and Diffusion of Innovations Theory provided individual and institutional explanations for AI integration. The former explained teachers' perceptions and acceptance, while the latter accounted for how school conditions influenced the spread of AI-supported practices. These theories were therefore appropriate for examining perceived opportunities, challenges and urban–rural differences in public secondary schools.

Empirical Review of Related Studies

Zawacki-Richter et al. (2019) conducted a global systematic review of artificial intelligence applications in higher education. The study population comprised 2,656 publications identified from EBSCO Education Source, Web of Science, and Scopus between 2007 and 2018, while 146 articles met the inclusion criteria. The researchers used a systematic-review design and developed a coding framework in EPPI-Reviewer for data extraction. Descriptive analysis was performed with R using the tidyr package. The findings classified AI applications into profiling and prediction, assessment and evaluation, adaptive systems and personalization, and intelligent tutoring systems. The review also revealed limited involvement of educators and inadequate attention to ethical and pedagogical issues. However, its higher-education and document-based orientation did not explain teachers' experiences in public secondary schools in Delta State. Using meta-analytic structural equation modelling, Scherer et al. (2019) investigated teachers' acceptance of educational technologies across multiple countries. The review targeted empirical research on technology acceptance among both pre-service and in-service teachers. Its dataset comprised 114 studies, 124 correlation matrices, and 34,357 teachers. The Technology Acceptance Model and its extensions provided an adequate fit to the pooled data. Perceived usefulness and perceived ease of use influenced behavioural intention indirectly via teachers' attitudes, while there were also direct links from perceived usefulness to behavioural intention and from attitude to actual technology use. Although the results highlighted the central role of teachers' perceptions in adopting technology, the technologies examined were not limited to AI. The study likewise did not address opportunities, challenges, or urban–rural differences specific to secondary-school teachers. In Nigeria, Ayanwale et al. (2022) examined in-service teachers' readiness and intention to teach AI. The finite population of Nigerian

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teachers was not stated. A voluntary online survey produced 385 responses, of which 368 responses from teachers at elementary to high-school levels were analyzed. The study adopted a quantitative cross-sectional survey design and measured eight constructs with a structured questionnaire. Variance-based partial least-squares structural equation modelling was used for analysis. Confidence in teaching AI predicted behavioural intention, while the perceived relevance of AI strongly predicted readiness. Conversely, AI anxiety did not predict intention, and the perceived social benefits of AI did not predict readiness. Despite its relevance to Nigeria, the study combined teachers from different educational levels and concentrated on readiness to teach AI as a subject. It did not specifically examine the perceived opportunities and challenges of AI integration among public secondary-school teachers in Delta State. Chai et al. (2023) surveyed 509 secondary students in Shandong, Zhejiang and Shanghai who had completed at least one semester of AI instruction, using a quantitative model-testing design and a questionnaire on AI knowledge, programming efficacy, autonomy, learning resources, AI for social good, and behavioural intention. EFA (SPSS 25), CFA and SEM (AMOS 25) showed that learning resources, autonomy, and perceptions of AI for social good predicted intention to continue AI learning; AI knowledge did not predict social-good perceptions, and programming efficacy negatively affected autonomy. The sample's restriction to students with prior AI instruction limits applicability to teachers' experiences and infrastructural conditions in Delta State. Rajapakse et al. (2024) surveyed over 1,300 Sri Lankan public-school ICT teachers (≈20% of the national ICT-teacher pool) via snowball sampling, using a Bandura-based self-efficacy questionnaire analyzed with PLS-SEM. Teachers reported low AI-teaching self-efficacy; emotional/physiological states and imagined teaching experiences had the strongest effects, mastery had a smaller effect, and vicarious experience and verbal persuasion were non-significant. The study's focus on ICT teachers and self-efficacy omitted assessment of perceived educational opportunities and technological, ethical, infrastructural, and professional challenges. A different perspective emerged from the cross-national mixed-methods investigation conducted by Okada et al. (2025) in the United Kingdom, Greece, and Brazil. The broader CONNECT project had engaged more than 1,500 teachers and 50,000 students across five countries, while the analytical sample comprised 330 secondary-school students from the three selected countries. Data were collected longitudinally for one year through student self-assessments, teacher ethnographic accounts, researchers' observations, and AI-enabled project work. Quantitative data were analysed with descriptive statistics and exploratory factor analysis in SPSS 27, while qualitative accounts were examined thematically. Seven dimensions of AI-supported transversal competence emerged, including proactive exploration, problem-solving, scientific citizenship, and authentic learning. Scientific citizenship received the strongest ratings, whereas proactive exploration was comparatively weak. However, this intervention-based study measured students' competency development rather than teachers' perceptions of routine AI integration in Nigerian public schools. Yue et al. (2022) systematically reviewed empirical K–12 AI teaching programmes published in the Web of Science database between 2010 and 2022. The eligible empirical publications constituted the population, while 32 studies formed the final sample. Using a systematic-review design, the researchers coded the selected studies according to research characteristics, pedagogical designs, assessment approaches, and outcomes. Descriptive and thematic analyses showed that direct instruction, collaborative learning, participatory learning, project-based learning, game-based learning, and design-oriented learning were frequently employed. Positive outcomes covered AI knowledge, technical skills, attitudes, and engagement. Nevertheless, many studies had small samples and relied substantially on interviews and self-reports. The review did not provide direct evidence from teachers working under the infrastructural and socioeconomic conditions of Delta State. Zhai et al. (2021) reviewed AI-in-education papers indexed in the Social Sciences Citation Index (Education and Educational Research) from 2010–2020, selecting 100 papers (63 empirical reporting 74 studies, 37 analytical) for content analysis. Their coding clustered the literature into development, application, and integration layers and highlighted trends (deep learning, IoT, swarm intelligence, neuroscience, feedback, adaptive and immersive learning) and problems (misapplied AI, shifting teacher/learner roles, social and ethical concerns). As a global synthesis across educational levels, it did not capture how teachers in Delta State perceive these opportunities or whether views vary by school location. Xu and Ouyang (2022) performed a global systematic review using a complex adaptive-systems framework, sampling 53 peer-reviewed articles across three analytical categories. With a conceptual coding framework and qualitative synthesis, they found AI acting as a new subject, a direct learning mediator, or a supportive assistant, altering instructor–student, student–self and student–student relationships. Because their conclusions are drawn from published studies rather than practising teachers, they do not reveal how infrastructure, competence, ethics, cost, and school location influence AI integration in Delta State. Collectively, the studies demonstrated that AI offered opportunities for

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personalized instruction, assessment, feedback, problem-solving, learner engagement, and administrative support. They also identified challenges involving teacher competence, self-efficacy, ethical responsibility, resources, and changes in professional roles. Three gaps remained. First, most studies originated outside Nigeria or combined several educational levels. Second, many concentrated on students, ICT teachers, readiness, or behavioural intention rather than teachers' simultaneous perceptions of opportunities and challenges. Third, none directly compared teachers in urban and rural public secondary schools in Delta State. The present study addressed these contextual, population, and variable gaps through a descriptive-comparative survey of public secondary-school teachers in Delta State.

Research Methodology

The study adopted a descriptive-comparative survey research design. This design was appropriate because it enabled the researchers to collect information on teachers' perceived opportunities and challenges of artificial intelligence integration without manipulating any variable. Its comparative component also permitted the comparison of responses obtained. The population comprised of 11,011 teachers serving in 488 public secondary schools across the 25 local government areas of Delta State. These figures were obtained from the staff and school records of the Delta State Post-Primary Education Board dated January 9, 2025. The sample size was determined at a 5% margin of error using Taro Yamane's (1967) simplified sample-size formula for a finite population:

n = N / [1 + N(e)^2]

Where: n = Required sample size; N = Population size; e = Margin of error

Given: N = 11,011; e = 0.05

Therefore: n = 11,011 / [1 + 11,011(0.05)^2]; n = 11,011 / [1 + 11,011(0.0025)]; n = 11,011 / [1 + 27.5275]; n = 11,011 / 28.5275; n = 385.98; n ≈ 386 teachers

A multistage sampling procedure was employed. First, the public secondary schools were stratified according to the three senatorial districts of Delta North, Delta Central, and Delta South. Within each senatorial district, the schools were further classified into urban and rural locations. A proportionate number of schools and teachers was selected from each category, after which simple random sampling was used to select the participating schools and respondents. This procedure ensured adequate representation of teachers across the three senatorial districts and the two school-location categories. Data were collected using a researcher-developed instrument titled the Artificial Intelligence Integration Opportunities and Challenges Questionnaire (AIIOCQ). The instrument consisted of three sections. Section A obtained respondents' demographic information, particularly school location. Section B contained 10 items measuring teachers' perceived opportunities associated with AI integration, while Section C contained 10 items measuring the perceived challenges. The 20 substantive items were rated on a four-point scale of Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). The AIIOCQ was subjected to face and content validation by experts in educational technology and measurement and evaluation. The experts examined the clarity, relevance, appropriateness, and coverage of the items in relation to the purposes and research questions. Their observations guided the correction of ambiguous statements and the removal of repetitive items. The instrument was trial-tested among public secondary-school teachers outside the schools selected for the main study. Cronbach's alpha was used to determine the internal consistency of the opportunities and challenges clusters. The reliability coefficients obtained were [insert opportunities coefficient] and [insert challenges coefficient], respectively, while the overall coefficient was [insert overall coefficient]. Only items that met the minimum reliability benchmark of 0.70 were retained. The selected teachers completed the questionnaire with the assistance of trained research assistants. Ethical approval was obtained from the appropriate institutional research ethics committee, while administrative permission was secured from the relevant education authorities and participating schools. Respondents gave informed consent and participated voluntarily. Their anonymity, confidentiality, and right to withdraw were protected, while the collected data were securely stored and reported only in aggregate form. Completed questionnaires were retrieved, checked for completeness, coded, and prepared for analysis. Mean and standard deviation were used to answer the two research questions. A criterion mean of 2.50 was applied in interpreting the responses. An item with a mean score of 2.50 or above was accepted as a perceived opportunity or challenge, whereas an item with a mean score below 2.50 was rejected. Independent-samples t-tests were used to test the two null hypotheses at the 0.05 level of significance. A null hypothesis was rejected when the probability value was equal to or less than 0.05 but retained when the probability value was greater than 0.05.

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Presentation of Results

Of the 386 questionnaires administered, 380 were correctly completed and used for analysis, representing a response rate of 98.4%. The valid respondents comprised 210 teachers from urban public secondary schools and 170 teachers from rural public secondary schools. The results were presented according to the research questions and corresponding null hypotheses.

Research Question 1

What opportunities did teachers in urban and rural public secondary schools perceive that artificial intelligence offered for teaching and learning in Delta State?

Table 1: Mean and Standard Deviation of Urban and Rural Teachers' Ratings of the Perceived Opportunities of Artificial Intelligence Integration in Public Secondary Schools in Delta State

S/N	Perceived opportunities of AI integration	Urban Public Secondary Schools			Rural Public Secondary Schools		
		Mean	SD	Decision	Mean	SD	Decision
1	Personalizes instruction according to students' learning abilities	3.42	0.58	Agree	3.12	0.65	Agree
2	Provides students with immediate feedback	3.37	0.61	Agree	3.05	0.68	Agree
3	Supports lesson preparation and generation of instructional materials	3.46	0.55	Agree	3.18	0.62	Agree
4	Facilitates automated assessment and grading	3.31	0.64	Agree	2.96	0.71	Agree
5	Assists teachers in identifying students' learning difficulties	3.35	0.60	Agree	3.01	0.69	Agree
6	Improves students' engagement in classroom activities	3.28	0.67	Agree	2.91	0.73	Agree
7	Promotes independent and self-paced learning	3.26	0.65	Agree	2.95	0.70	Agree
8	Provides virtual laboratories and simulations for difficult concepts	3.18	0.72	Agree	2.76	0.78	Agree
9	Improves record management and administrative efficiency	3.32	0.63	Agree	2.89	0.75	Agree
10	Strengthens teachers' digital competence and professional development	3.29	0.64	Agree	2.98	0.71	Agree
Grand mean/standard deviation		**3.32**	**0.41**	**Agree**	**2.98**	**0.48**	**Agree**

Table 1 showed that the mean ratings for all 10 items exceeded the criterion mean of 2.50 for both groups. Urban teachers recorded a grand mean of 3.32 and a standard deviation of 0.41, while rural teachers recorded a grand mean of 2.98 and a standard deviation of 0.48. Teachers in both locations therefore agreed that AI offered opportunities for teaching and learning. Urban teachers nevertheless recorded higher ratings across all the items. Lesson preparation and generation of instructional materials received the highest urban mean of 3.46, while virtual laboratories and simulations recorded the lowest rural mean of 2.76.

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Hypothesis 1

There is no significant difference between the mean ratings of teachers in urban and rural public secondary schools regarding the perceived opportunities of artificial intelligence integration.

Table 2: Independent-Samples t-Test of the Difference between Urban and Rural Teachers' Mean Ratings of the Perceived Opportunities of Artificial Intelligence Integration

Variable	Urban Teachers			Rural Teachers			*df*	*t*	*p*	Decision
	N	Mean	SD	N	Mean	SD				
Perceived opportunities	210	3.32	0.41	170	2.98	0.48	378	7.51	< .001	Reject H_{01}

Table 2 showed a calculated t-value of 7.51 with 378 degrees of freedom and a probability value below .001. Because the probability value was less than the .05 significance level, the first null hypothesis was rejected. A significant difference therefore existed between urban and rural teachers' mean ratings of the perceived opportunities of AI integration. The higher mean recorded by urban teachers indicated that they perceived the opportunities more strongly than rural teachers.

Research Question 2

What challenges did teachers in urban and rural public secondary schools perceive as constraining the effective integration of artificial intelligence?

Table 3: Mean and Standard Deviation of Urban and Rural Teachers' Ratings of the Perceived Challenges of Artificial Intelligence Integration in Public Secondary Schools in Delta State

S/N	Perceived challenges of AI integration	Urban Public Secondary Schools			Rural Public Secondary Schools		
		Mean	SD	Decision	Mean	SD	Decision
1	Unreliable electricity supply limits the use of AI applications	3.16	0.71	Agree	3.55	0.59	Agree
2	Poor internet connectivity restricts access to AI platforms	3.11	0.69	Agree	3.51	0.61	Agree
3	Inadequate digital devices hinder AI integration	3.05	0.73	Agree	3.46	0.62	Agree
4	The cost of acquiring and maintaining AI resources is high	3.02	0.70	Agree	3.37	0.65	Agree
5	Teachers possess insufficient competence to use AI effectively	2.96	0.68	Agree	3.29	0.67	Agree
6	Inadequate training and technical support constrain implementation	2.91	0.72	Agree	3.26	0.66	Agree
7	Data privacy and ethical concerns discourage classroom use	2.82	0.75	Agree	3.16	0.70	Agree
8	AI applications may generate inaccurate or biased information	2.76	0.74	Agree	3.11	0.71	Agree
9	AI may encourage academic dishonesty among students	2.83	0.71	Agree	3.17	0.68	Agree
10	Excessive AI use may create dependence on automated answers	2.78	0.73	Agree	3.22	0.66	Agree

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S/N	Perceived challenges of AI integration	Urban Public Secondary Schools			Rural Public Secondary Schools		
		Mean	SD	Decision	Mean	SD	Decision
Grand mean/standard deviation		**2.94**	**0.44**	**Agree**	**3.31**	**0.42**	**Agree**

Table 3 indicated that the mean ratings for all the challenge items exceeded the criterion mean of 2.50. Urban teachers recorded a grand mean of 2.94 and a standard deviation of 0.44, while rural teachers recorded a grand mean of 3.31 and a standard deviation of 0.42. Both groups agreed that the identified factors constrained effective AI integration. Rural teachers recorded higher mean ratings across all 10 items, showing that they perceived the challenges more strongly. Unreliable electricity supply received the highest rural mean of 3.55, followed by poor internet connectivity with a mean of 3.51 and inadequate digital devices with a mean of 3.46.

Hypothesis 2

There is no significant difference between the mean ratings of teachers in urban and rural public secondary schools regarding the perceived challenges of artificial intelligence integration.

Table 4: Independent-Samples t-Test of the Difference Between Urban and Rural Teachers' Mean Ratings of the Perceived Challenges of Artificial Intelligence Integration

Variable	Urban Teachers			Rural Teachers			*df*	*t*	*p*	Decision
	N	Mean	SD	N	Mean	SD				
Perceived challenges	210	2.94	0.44	170	3.31	0.42	378	−8.32	< .001	Reject H_{02}

Table 4 produced a calculated t-value of −8.32 with 378 degrees of freedom and a probability value below .001. Since the probability value was less than .05, the second null hypothesis was rejected. A significant difference existed between the mean ratings of urban and rural teachers regarding the perceived challenges of AI integration. The higher mean recorded by rural teachers indicated that they perceived greater infrastructural, professional and ethical challenges than teachers in urban public secondary schools.

Discussion of Finding

The first finding revealed that teachers in both urban and rural public secondary schools perceived AI as offering opportunities for teaching and learning. Every opportunity item recorded a mean above the 2.50 criterion for both groups, showing that teachers recognized AI's usefulness for personalizing instruction, providing immediate feedback, preparing materials, conducting assessments, identifying learning difficulties and supporting independent learning. This finding agreed with Hwang et al. (2020), who identified feedback, assessment and personalization as major applications of AI in education. It also supported Xu and Ouyang's (2022) view of AI as a tutor, teaching assistant and supportive learning tool. Lesson preparation and the generation of instructional materials received the highest ratings, with means of 3.46 for urban teachers and 3.18 for rural teachers. Teachers therefore appeared to value AI most for reducing the time and effort required to develop lesson content, examples and assessment materials, consistent with Meylani (2024). Virtual laboratories and simulations received the lowest ratings, although their means remained acceptable. Their lower position may reflect the specialized devices, connectivity and competence required to use them, despite their value for explaining difficult scientific concepts (Okunade, 2024). The first hypothesis showed a significant difference in perceived opportunities. Urban teachers recorded a higher grand mean of 3.32 than rural teachers, who recorded 2.98; consequently, the null hypothesis was rejected. Urban teachers may have perceived AI's benefits more strongly because better electricity, connectivity, devices, training and technical support enabled greater exposure to its applications. Scherer et al. (2019) established that perceived usefulness and ease of use influenced teachers' adoption of educational technologies. Better access may therefore have allowed urban teachers to observe AI's usefulness more readily. The finding also reflected the digital divide described by van Dijk (2020), in which location influences access to and meaningful use of technology. The second finding revealed that teachers in both locations perceived all the identified factors as challenges to AI integration. Unreliable electricity received the highest rating among urban teachers (M = 3.16) and rural teachers (M = 3.55), followed by poor internet

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connectivity and inadequate digital devices. Infrastructure therefore represented the most immediate obstacle to classroom integration. The finding agreed with Bou Zeid and Abouchedid (2026), who highlighted economic and infrastructural barriers to AI-supported educational innovation. Insufficient teacher competence, inadequate training and weak technical support were likewise accepted as challenges. This finding supported Rajapakse et al. (2024), who reported low AI-teaching self-efficacy among public-school teachers, and Tomczyk (2025), who emphasized the technical, pedagogical and ethical competencies required for responsible AI integration. Privacy, inaccurate or biased information, academic dishonesty and dependence on automated answers were also accepted, although they received lower ratings than infrastructure. These concerns showed that AI integration involved ethical as well as material difficulties. Holmes et al. (2022) similarly identified privacy, bias, accountability and human agency as central issues, while Miao et al. (2021) emphasized transparent, responsible and human-centred use. The second hypothesis also revealed a significant location difference. Rural teachers recorded a higher challenge grand mean of 3.31 than the urban mean of 2.94, leading to rejection of the null hypothesis. Rural teachers therefore experienced or anticipated infrastructural, professional and ethical barriers more strongly. This result was consistent with the digital-divide perspective because unequal access and opportunities for meaningful technology use produce different experiences across locations (van Dijk, 2020). It also supported Rogers' (2003) position that innovations do not spread uniformly when resources, institutional support and opportunities for experimentation differ. Together, the findings produced a clear pattern: urban teachers perceived greater opportunities, whereas rural teachers perceived greater challenges. This did not indicate that AI was less relevant to rural education. Rather, it suggested that infrastructure, access and professional support shaped the extent to which teachers could recognize and realize its value. The study therefore extended earlier reviews by providing location-specific evidence from public secondary-school teachers in Delta State (Zhai et al., 2021; Xu & Ouyang, 2022).

Conclusion

The study concluded that teachers in urban and rural public secondary schools recognized the instructional opportunities offered by artificial intelligence but also faced substantial infrastructural, professional and ethical challenges. Urban teachers perceived greater opportunities, whereas rural teachers experienced greater challenges, indicating that effective and equitable AI integration depended on reliable infrastructure, teacher competence, technical support and responsible-use guidelines.

Recommendations

Based on the findings of the Study the following were recommended:

1. The Delta State Government should provide reliable electricity, internet connectivity and digital devices, particularly in rural schools.
2. Teachers should receive regular practical training and technical support on educational AI applications.
3. Schools should establish clear guidelines for ethical, safe and responsible AI use.

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