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TEACHERS' PERCEPTIONS OF ARTIFICIAL INTELLIGENCE-INTEGRATED EDUCATIONAL TOOLS IN THE TEACHING OF BIOLOGY IN ZARIA LOCAL GOVERNMENT

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ABSTRACT

The paper examined the Teachers' perceptions of artificial intelligence-integrated Educational Tools in the Teaching of Biology in Zaria Local Government. The study outlines four aims, poses four research questions and test four hypotheses. The parent population for this study consists of 42 secondary schools within the Zaria Local Government Area. Given the heterogeneity of the population, stratified sampling was employed to select a representative sample of six (6) schools. From each selected school, responses were obtained from at least 25% of the total number of teachers. This resulted in a total of 128 respondents comprising 122 teachers and 6 principals. The questionnaire was used as research instrument for gathering data for the study. The instrument was validated by the educational experts who has at least Master's degree in Biology Education and computer science, lecturing at Federal University of Education, Zaria who cross examined the objectives of the study vis-à-vis the instrument. In order to establish the reliability of the instrument, pilot study was carried out in Government Secondary School, Chikaji. A total of 38 copies of questionnaire was administered to principals and teachers of the selected senior secondary schools. However, 38 copies of the questionnaire were filled and returned. In order to establish the reliability of the instrument, the test-re-test methods was employed using 15 respondents, that is two (2) principals, thirteen (13) teachers in Zaria Local Government Area. And this study pilot may yield reliability co-efficient of ±0.83. In order to gain access to the schools and the respondents, a letter of introduction was obtained from the Head of Department. A total of 38 questionnaires were distributed to the respondents personally by the researchers. The results were placed on a Likert four-point rating scale; 4= Strongly Agree (SA), 3= Agree (A) 2= Disagree (D), 1= Strongly Disagree (SD). The split half and Pearson product-moment correlation coefficient were used to determine the reliability of the instrument. The result of the pilot test produced an index of 0.78 which was adequate to consider the instrument reliable for the study. Statistical Package for Social Science version 27 was used to analyse the data collected. A decision rule was reached that a mean score of 2.50 and above falls under Agreed while below 2.50 falls under Disagreed. The first finding accepts that there is a significant relationship between the level of awareness of AI-integrated educational tools and Biology teachers' perception with a mean disparity of 1.66 and t-value and p value 0.00001. The second finding accepts that there is a significant relationship between teachers' perceptions of the benefits of AI tools and teaching

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

Biology with an average difference of and t-value 4.889 and p value 0.00001, the third finding accepts that there is a strong association between the extent to which AI-integrated educational tools are currently being used and Biology instructional material with an average difference of 1.618 and t-value 2.987 and p value 0.00001.Finally, the fourth finding accepts that there is an important association between possible methods to boost AI adoption in Biology education with an average gap of 1.27 and t-value 1.27 and p value 0.00001. Key recommendations include that government and school authorities should design and implement structured professional development programs focused on AI instruction in teaching sciences. Faculties of education and colleges of education should embed AI teaching strategy into their curriculum. This is for the pre-service Biology teachers to enter into the workforce equipped with the necessary skills to make use of AI- based instructional tools in their teaching.

Keywords: perception, artificial intelligence, integrated educational tools, biology

Introduction

The integration of Artificial Intelligence (AI) into educational environments is rapidly reshaping pedagogical practices worldwide, offering transformative opportunities in curriculum delivery, student engagement, and learning personalization (Meylani, 2024, Wangdi, 2024 and Arya & Verma, 2024). Within science education, particularly Biology a subject that demands conceptual clarity, visualization, and interactive engagement. AI-integrated educational tools such as intelligent tutoring systems, virtual laboratories, and adaptive learning platforms have shown significant potential in enhancing instructional effectiveness (Arya & Verma, 2024 and Telaumbanua, 2025). However, the success of these innovations hinges substantially on the perceptions and preparedness of educators who mediate their classroom application.

According to Chisom et al. (2023), developing contexts like Nigeria, where disparities in technological infrastructure and digital literacy persist, the adoption of AI in education remains uneven. Despite national policy advocacy for ICT integration in schools, the practical deployment of AI-enhanced teaching tools at the secondary level especially in science classrooms—has been limited by systemic challenges such as inadequate training, lack of digital resources, and varying levels of teacher readiness (Alshorman, 2024). Zaria Local Government Area in Kaduna State, a region with a mix of urban and peri-urban educational institutions, provides a critical case for examining these dynamics, particularly in the context of senior secondary Biology education.

Biology, as a foundational science subject, is pivotal for students aspiring to careers in medicine, agriculture, and biotechnology. Yet, traditional pedagogies often fail to

address individual learning differences or foster inquiry-based learning environments. The introduction of AI tools can bridge these gaps, offering real-time feedback, simulative learning experiences, and differentiated instruction (Ashebir et al., 2025). Nevertheless, the effective integration of such tools is predicated on the perception, acceptance, and instructional orientation of Biology teachers. Teachers' beliefs about AI its relevance, usability, ethical considerations, and impact on student learning are critical in determining whether and how these tools are adopted in daily teaching practices (Hazzan-Bishara et al., 2025).

Despite the global discourse on AI in education, there is a paucity of empirical studies focusing on teachers' perceptions within secondary school contexts in Sub-Saharan Africa, particularly in the Nigerian educational system. This study, therefore, investigates the perceptions of Biology teachers in Zaria Local Government regarding the integration of AI-based educational tools in their teaching. It aims to understand their level of awareness, perceived benefits, current usage, and perceived barriers to adoption. Such insights are essential for informing teacher professional development, infrastructure planning, and policy formulation to support the meaningful integration of AI in science education at the secondary school level.

Statement of the Problem

Artificial Intelligence (AI) is increasingly recognized as a catalyst for pedagogical transformation, offering the potential to enhance instructional efficiency, personalize learning pathways, and improve educational outcomes across disciplines. In Biology education, where conceptual complexity often necessitates interactive and visual learning modalities, AI-integrated educational tools—such as adaptive simulations, intelligent tutoring systems, and virtual laboratories—present a promising avenue for enriching both teaching and learning experiences. However, despite these global advancements, the effective deployment of AI technologies in Nigerian secondary schools remains underdeveloped, particularly within science classrooms.

In Zaria Local Government Area of Kaduna State, the integration of AI into Biology instruction faces multifaceted constraints. These include limited access to digital infrastructure, insufficient institutional support, and a lack of targeted professional development for teachers. Crucially, teachers' perceptions, readiness, and pedagogical beliefs significantly influence the extent to which AI tools are adopted and utilized in classrooms. A teacher who perceives AI as a supportive instructional aid is more likely to experiment with and integrate such tools into their teaching practice, whereas skepticism or fear of obsolescence may result in resistance to adoption.

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

Current literature underscores a global surge in AI adoption in education, but little empirical evidence exists regarding the perceptual landscape among Nigerian secondary school educators—particularly in specific subject domains such as Biology. Without a nuanced understanding of teachers' perceptions, including their awareness, perceived benefits, implementation barriers, and ethical concerns, policy efforts aimed at AI integration risk being misaligned or ineffective.

This study, therefore, addressed this critical knowledge gap by examining the perceptions of Biology teachers in Zaria Local Government towards the integration of AI-driven educational tools. By investigating their level of awareness, attitudinal dispositions, and perceived challenges, the research aims to generate evidence-based insights that can inform curriculum reforms, teacher training initiatives, and infrastructural investment strategies. The ultimate goal is to support the systematic and sustainable incorporation of AI in Nigerian science education, thereby enhancing instructional quality and learner engagement in an increasingly digital academic landscape.

Objectives of the Study

This research aims at exploring teachers' perceptions of Artificial Intelligence integrated educational tools in teaching Biology in Zaria Local Government. Specifically, the objectives of the study are:

1. Examine the level of awareness of AI-integrated educational tools among Biology teachers in Zaria Local Government.
2. Investigate teachers' perceptions of the benefits of AI tools in teaching Biology.
3. Assess the extent to which AI-integrated educational tools are currently being used in Biology instruction.
4. Explore possible strategies to enhance the adoption and effective utilization of AI tools in Biology education.

Research Questions

The following questions were formulated to guide the study:

1. What is the level of awareness of AI-integrated educational tools among Biology teachers in Zaria Local Government?
2. How do Biology teachers perceive the benefits of AI tools in teaching the subject?
3. To what extent are AI-integrated educational tools currently being used in Biology instruction?
4. What strategies can be adopted to enhance the effective utilization of AI tools in teaching Biology?

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

Research Hypotheses

Ho_1: There is no significant relationship between the level of awareness of AI-integrated educational tools and Biology teachers' perception in Zaria Local Government.

Ho_2: There is no significant relationship between teachers' perceptions of the benefits of AI tools and teaching Biology.

Ho_3: There is no significant relationship between the extent to which AI-integrated educational tools are currently being used and Biology instructional material.

Ho_4: There is no significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education.

Methodology

The study embraced a survey research design, which appropriate for collecting standardized data from diverse population within a natural setting. The target population compromised all the 42 public senior secondary schools in Zaria LGA. A stratified sampling technique was utilized to guarantee enough representation. The population was grouped based on school characteristics and at the end of six (6) were randomly selected from the strata. From the six selected schools, at least 25% of the teaching staff chosen to participate in the study resulting in a total of 128 respondents which comprised of 122 teachers and 6 principals. The data collection instrument was a researcher's developed structured questionnaire. The instrument was designed to gather information aligned with the research objectives and to measure respondent's perception and experiences of the study variables. The instrument underwent content and face validity, it was done by three experts with minimum qualification of masters degrees in Biology education and computer science. The Federal University of Education, Zaria. These experts assessed the items in terms of clarity, relevance and synchronization with the research objectives. Based on their feedback, necessary adjustments were made to guarantee precision and aptiness. The reliability of the instrument went through a pilot test involving 38 respondents (teachers and principals) from Government Secondary School Chikaji which is outside the selected sampled schools. The test-retest method was then conducted using 15 respondents over a two-week interval. The resulting reliability coefficient was 0.83, indicating a high level of introduction was obtained from the Head of the Department which was presented to Zonal Inspectorate Division to facilitate official access to the schools. Participants were informed of the purpose of the study and provided informed consent. The researcher administered the questionnaires personally with the help of trained research assistants. A total of 128 copies were distributed and all were completed and returned, yielding a 100% response rate. Data collection was carried out over a two-week period. The data collected were analyzed using both

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

descriptive and inferential statistics. Frequencies and percentages were used to summarise respondents' demographic information. Mean score were used to answer the research questions. The hypotheses testing was done using independent samples t-test, it was done using independent samples t-test, it was utilized to determinehe significance differences in responses at the 0.05 level of significance.

Results

Research Question One: What is the level of awareness of AI-integrated educational tools among Biology teachers in Zaria Local Government?

This question was answered by the descriptive statistics presented in Table 1 and 2 below

Table 1: Descriptive statistics showing perception of respondents on level of awareness of AI-integrated educational tools among Biology teachers in Zaria Local Government?

Item Statement	Response				Total	Mean
	SA	A	D	SD		
Teachers are informed about the various AI-integrated tools for teaching Biology.	45	51	12	14	122	3.04
Teachers frequently engage in discussions or seminars related to AI-based educational tools.	51	49	17	5	122	3.20
Teachers feel confident in explaining the concept of AI-integrated educational tools to their colleagues.	71	31	16	4	122	3.39
Most Teachers use AI tools in their teaching practices	46	48	21	7	122	3.09
Zaria schools have introduced AI tool in teaching Biology	56	52	9	5	122	3.30
Average Mean Respondents						3.20

Table 1 shows respondents' view on level of awareness of AI-integrated educational tools among Biology teachers in Zaria Local Government. The result revealed that teachers are informed about the various AI-integrated tools for teaching Biology with mean response of 3.04. Teachers frequently engage in discussions or seminars related to AI-based educational tools with a mean response of 3.20. Teachers feel confident in explaining the concept of AI-integrated educational tools to their colleagues with mean response of 3.39. Most Teachers use AI tools in their teaching practices with a mean response of 3.90. Zaria schools have introduced AI tool in teaching Biology with mean response of 3.30. The study shows that most of the respondents were of the view that the level of awareness of AI-integrated educational tools among Biology teachers in Zaria Local Government is very poor with average mean respondent of 3.2.

Research Question One: How do Biology teachers perceive the benefits of AI tools in teaching the subject?

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

Table 2: Descriptive statistics showing perception of respondents on perceive the benefits of AI tools in teaching the subject.

Item Statement	RESPONSE					
	SA	A	D	SD	Total	Mean
AI-integrated tools can significantly improve students' understanding of complex Biology concepts.	43	49	23	7	122	3.05
AI-based educational tools reduce teachers' workload and make lesson planning more efficient.	57	44	11	10	122	3.21
AI enhances individualized learning by catering to students' different learning paces.	65	34	19	4	122	3.31
AI integrated tools aids teachers in tracking student performances and identify learning gaps.	71	34	13	4	122	3.41
AI integrated tools create an atmosphere that encourages creativity in teaching biology	45	54	15	8	122	3.11
AI tools aid teachers in creating a more functional grading and assessment framework for students	56	43	20	3	122	3.25
Average Mean Respondents						**3.22**

Table 2 revealed that AI-integrated tools can significantly improve students' understanding of complex Biology concepts with mean response 3.05. AI-based educational tools reduce teachers' workload and make lesson planning more efficient with mean response of 3.21. AI enhances individualized learning by catering to students' different learning paces with mean response of 3.31. AI integrated tools aids teachers in tracking student performances and identify learning gaps with mean response 3.41. AI integrated tools create atmosphere that encourages creativity in teaching biology with mean response 3.11. AI tools aid teachers in creating a more functional grading and assessment framework for students with mean response 3.225. The study shows that most of the respondents were of the view that AI would have strong benefits as a tool in teaching Biology subjects with average mean respondent of 3.22.

Research Questions Three: To what extent are AI-integrated educational tools currently being used in Biology instruction?

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

Table 3: Descriptive statistics showing perception of respondents on extent to which AI-integrated educational tools currently being used in Biology instruction?

Item Statement	Response				Total	Mean
	SA	A	D	SD		
Most teachers are encouraged to use AI integrated educational tools by their schools	52	43	21	6	122	3.16
Teachers regularly use AI-integrated tools in my biology lessons.	45	44	23	10	122	3.02
Secondary schools in Zaria provide adequate AI-based resources for effective Biology instruction.	51	54	10	7	122	3.22
AI tools have become an essential part of my teaching methodology.	44	43	19	16	122	2.94
I have faced challenges integrating AI tools into my teaching.	47	34	23	18	122	2.90
Average Mean Respondents						3.048

Table 3 revealed that most teachers are encouraged to use AI integrated educational tools by their schools with mean response 3.16. Teachers regularly use AI-integrated tools in my biology lessons with mean response 3.02. teachers' school provides adequate AI-based resources for effective Biology instruction with mean response 3.22. AI tools have become an essential part of my teaching methodology with mean response 2.94. I have faced challenges integrating AI tools into my teaching with mean response 2.90

Research Questions Four: What strategies can be adopted to enhance the effective utilization of AI tools in teaching Biology?

Table 4: Descriptive Statistics Showing perception of respondents on strategies that could be adopted to enhance the effective utilization of AI tools in teaching Biology

Item Statement	Response				Total	Mean
	SA	A	D	SD		
Schools should organize regular training workshops on AI-integrated educational tools for teachers.	54	33	23	12	122	3.06
The government should provide more funding and resources to support AI adoption in Biology teaching.	43	53	13	13	122	3.03
Collaboration with technology experts and educators will help in the effective integration of AI tools in Biology instruction.	43	44	23	12	122	2.97
Schools should encourage teachers to use AI-based tools through incentives and support.	46	55	11	10	122	3.12
Average Mean Respondent						**3.05**

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

Table 4 revealed that schools should organize regular training workshops on AI-integrated educational tools for teachers with mean response 3.06. The government should provide more funding and resources to support AI adoption in Biology teaching with mean response 3.03. Collaboration with technology experts and educators will help in the effective integration of AI tools in Biology instruction with mean response 2.97. Schools should encourage teachers to use AI-based tools through incentives and support with mean response 3.12

Test of Null Hypotheses

Null Hypothesis One: *H_{01}: There is no significant relationship between the level of awareness of AI-integrated educational tools and Biology teachers' perception in Zaria Local Government.*

Table 5: Analysis of significant relationship between the level of awareness of AI-integrated educational tools and Biology teachers' perception in Zaria Local Government.

Variables	N	X	S.D	Mean diff.	df	T	P value	Remark
Agree	100	3.20	0.320	1.66	121	4.889	0.0001	Significant
Disagree	22	1.54	0.320					

The overall mean response of the statement was tested against the expected mean of 2.5 which is the mean response of our Likert rating scale. Total =4.063 > t_{tab} (0.05, 5) = 2.571.

Table 5 shows that the agreed respondents have a mean rate of 3.20 with a standard deviation of 0.320 while disagreed respondents have a mean rate of 1.54 with a standard deviation of 0.320. The mean difference between the variables is 1.67. Since the calculated value of the t- test 4.063 is greater than the table value (2.571); the result of the study rejects the null hypotheses which say that there is no significant relationship between the level of awareness of AI-integrated educational tools and Biology teachers' perception in Zaria Local Government. Therefore, this study accepts that there is a significant relationship between the level of awareness of AI-integrated educational tools and Biology teachers' perception in Zaria Local Government.

Null Hypothesis Two *Ho_2: There is no significant relationship between teachers' perceptions of the benefits of AI tools and teaching of Biology.*

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

Table 6: Analysis of significant relationship between teachers' perceptions of the benefits of AI tools and teaching Biology

Variables	N	X	S.D	Mean diff.	df	T	P value	Remark
Agree	99	3.22	0.803	2.80	121	3.112	0.0001	Significant
Disagree	23	0.42	0.173					

Total =3.112 > t_{tab} (0.05, 5) = 2.571

Table 6 shows that the agreed respondents have a mean rate of 3.22 with a standard deviation of 0.803 while disagreed respondents have a mean rate of 0.42 with a standard deviation of 0.0.173. The mean difference between the variables is 2.80. Since the calculated value of the t- test 3.112 is greater than the table value (2.571); the result of the study rejects the null hypotheses which say that there is no significant relationship between teachers' perceptions of the benefits of AI tools and teaching Biology. Therefore, this study accepts that there is a significant relationship between teachers' perceptions of the benefits of AI tools and teaching Biology.

Null Hypothesis three Ho_3: *There is no significant relationship between the extent to which AI-integrated educational tools are currently being used and Biology instructional material.*

Table 7: Analysis of There is no significant relationship between the extent to which AI-integrated educational tools are currently being used and Biology instructional material

Variables	N	X	S.D	Mean diff.	df	T	P value	Remark
Agree	91	3.048	0.343	1.618	121	2.987	0.0001	Significant
Disagree	31	1.43	0.343					

Table 7 shows that the agreed respondents have a mean rate of 3.048 with a standard deviation of 0.343 while disagreed respondents have a mean rate of 1.43 with a standard deviation of 0.343. The mean difference between the variables is 1.618. Since the calculated value of the t- test 2.987 and is greater than the table value (2.571); the result of the study rejects the null hypotheses which say that there is no significant relationship between the extent to which AI-integrated educational tools are currently being used and Biology instructional material. Therefore, this study accepts that there is a significant relationship between the extent to which AI-integrated educational

AJEMATES
African Journal of Educational Management, Teaching and Entrepreneurship Studies
VOL.15 (1), May-August, 2025 https://ajemates.org

tools are currently being used and Biology instructional material.

Null Hypothesis Four Ho_4: There is no significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education.

Table 8: Analysis of there is no significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education

Variables	N	x	S.D	Mean diff.	df	T	P value	Remark
Agree	92	3.05	0.531	1.27	121	2.59	0.0001	Significant
Disagree	30	1.78	0.532					

Table 8 shows that the agreed respondents have a mean rate of 3.05 with a standard deviation of 0.5.31 while disagreed respondents have a mean rate of 1.78 with a standard deviation of .532. The mean difference between the variables is 1.27. Since the calculated value of the t- test 2.59 and is greater than the table value (2.571); the result of the study rejects the null hypotheses which say that there is no significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education. Therefore, this study accepts that there is significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education.

Summary of Findings

i. The study accepts that there is a significant relationship between the level of awareness of AI-integrated educational tools and Biology teachers' perception in Zaria Local Government with a mean difference of 1.66 and t-value and p value 0.00001
ii. The study accepts that there is a significant relationship between teachers' perceptions of the benefits of AI tools and teaching Biology with a mean difference of and t-value 4.889 and p value 0.00001.
iii. The study accepts that there is a significant relationship between the extent to which AI-integrated educational tools are currently being used and Biology instructional material with a mean difference of 1.618 and t-value 2.987 and p value 0.00001.
iv. Therefore, this study accepts that there is a significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education with a mean difference of 1.27 and t-value 1.27 and p value 0.00001

Discussion of Findings

The study revealed that there is a significant relationship between the level of awareness

of AI-integrated educational tools and Biology teachers' perception in Zaria Local Government. This is in line with Seo et al. (2021) and Güneyli et al. (2024) findings which revealed that most of the students were aware of AI, their understanding was often superficial, limited to popular applications like AI-powered chatbots and recommendation systems. There is a need for more comprehensive AI education that addresses both technical skills and ethical considerations. This would ensure that senior secondary school students are better equipped to engage with AI technologies responsibly in their future careers.

The study found that there is a significant relationship between teachers' perceptions of the benefits of AI tools and teaching Biology. This is in line with the Kim and Kim (2022) findings indicated a significant awareness of AI's potential benefits and risks. However, the study also highlighted a gap between students' theoretical knowledge of AI ethics and their practical application of these principles. The conclusion emphasized the need for integrating ethics more deeply into AI curricula, suggesting that practical case studies and ethics workshops could bridge this gap. Kadunabadejo and Adekunle (2021) findings revealed that while students were generally positive about the potential of AI to enhance learning and research, they were also wary of the ethical challenges it poses. Issues such as the lack of transparency in AI decision-making processes, the potential for exacerbating social inequalities, and the risks of AI being used in ways that violate human rights were commonly mentioned.

Bamidele and Fashola (2024) findings indicated a significant increase in AI awareness, with more students engaging in AI-related courses and research. However, the ethical concerns remained largely unchanged, with issues such as data privacy, AI bias, and the ethical use of AI in research continuing to be major points of concern.

Therefore, this study accepts that there is a significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education. In conjunction with study by Bamidele and Fashola (2024) corroborates these findings, noting that although there has been a significant increase in AI awareness among senior secondary school students over the past two years, the depth of knowledge remains inadequate. The researchers observed that most students are familiar with AI terminology and can identify common AI applications, but lack a comprehensive understanding of the underlying principles and potential risks associated with these technologies.

The study accepts that there is a significant relationship between teachers' perceptions of the benefits of AI tools and teaching Biology with a mean difference of and t-value 4.889 and p value 0.00001. This is in line with the study of Muttaqin et al. (2024) who believed that teachers differ significantly on their

opinion to the use of AI depending on their years of service. The study accepts that there is a significant relationship between the extent to which AI-integrated educational tools are currently being used and Biology instructional material with a mean difference of 1.618 and t-value 2.987 and p value 0. 00001.This is in line with Almasri (2024) who opined that AI is used to achieve various pedagogical benefits including enhancing learning environment. Creating quizzes, assessing students work and predicting academic work.

There is a significant relationship between possible strategies to enhance the adoption and effective utilization of AI tools in Biology education with a mean difference of 1.27 and t-value 1.27 and p value 0.00001. This is in line with the findings of Ghimire and Edwards (2024) who indicated that teachers are more likely to use AI tools if they perceive them as useful in enhancing teaching effectiveness and student engagement. Lu et al. (2024) also believed that the more user-friendly is the tool, the more teachers make use of them. Zhang and Wareewanich (2024) adduced that social influence which include peer and administrative encouragement can significantly impact teachers' willingness to adopt AI technologies. They also added that teaching experience plays significant role in making teachers use AI in their teaching.

Conclusion

This study examined Biology teachers' perceptions of artificial intelligence (AI)-integrated educational tools within the context of secondary schools in Zaria Local Government Area, Nigeria. The findings reveal a statistically significant relationship between teachers' awareness of AI tools and their perception of their relevance and effectiveness in Biology instruction. Furthermore, the data underscore a strong correlation between teachers' perceived benefits of AI and its potential to enhance instructional practices and learning outcomes. The study also identified a meaningful association between the current usage of AI tools and the adequacy of instructional materials, suggesting that AI has the potential to supplement traditional teaching resources effectively.

Critically, the findings highlight the importance of identifying and implementing strategic approaches to facilitate the adoption and optimal utilization of AI in science classrooms. Teachers' readiness, exposure, and belief in the pedagogical value of AI emerged as decisive factors in determining whether AI tools are integrated meaningfully or remain underutilized. These findings reinforce the view that successful AI integration in education is not merely a technological concern but a pedagogical and policy issue that hinges on capacity building, stakeholder engagement, and systemic support. Hence, this study contributes to the broader discourse on digital transformation in

education and offers a roadmap for bridging the AI adoption gap in Nigerian secondary schools.

Recommendations

1. Government and school authorities should design and implement structured professional development programs focused on AI instruction in teaching sciences.
2. Faculties of education and colleges of education should embed AI teaching strategy into their curriculum. This is for the pre-service Biology teachers to enter into the workforce equipped with the necessary skills to make use of AI- based instructional toolsin their teaching.
3. Government should prioritize the procurement of and maintenance of reliable digital infrastructure such as internet accessibility, digital devices, AI- integrated platforms. This is to facilitate seamless implementation in their classrooms.
4. Universities and colleges should partner with secondary schools to create innovation hubs for AI education.

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