



# Assessing Teachers' Awareness and Utilization of Artificial Intelligence (AI)-Based Tools in Biology Instruction in Public Senior Secondary Schools, Sabon-Gari, Zaria

Samaila Nehemiah<sup>1\*</sup>, Samuel Bala Kantoma<sup>2</sup>, Alhaqqatu Abdullahi<sup>3</sup>

Department of Biology, School of Secondary Science Education, Kaduna State College of Education,  
Gidan - Waya P.M.B. 1024, Kafanchan, Kaduna State, Nigeria

\*Corresponding author: [nehemiahsamaila94@gmail.com](mailto:nehemiahsamaila94@gmail.com)

## Abstract

The study examined teachers' awareness and utilization of artificial intelligence (AI)-based tools for Biology instruction in public senior secondary schools in Sabon-Gari, Zaria. Specifically, it determined teachers' level of awareness and extent of utilization of AI-based tools in teaching Biology. A descriptive survey design with a quantitative approach was adopted. The population comprised 56 Biology teachers across 20 public senior secondary schools, from which 30 teachers were randomly selected from 10 schools. Data were collected using a structured and validated questionnaire, with a 93.3% response rate, and analysed using descriptive and inferential statistics through SPSS. The findings revealed that teachers had a high level of awareness of AI-based tools, with a mean score of 4.12, indicating familiarity with technologies such as intelligent tutoring systems, virtual laboratories, and adaptive learning platforms. However, the extent of utilization was moderate, with a mean score of 3.24. The study concluded that although Biology teachers demonstrate considerable awareness of AI-based tools, their practical application remains limited by systemic and capacity-related challenges. The study recommended regular training and professional development programmes by education authorities to strengthen teachers' competence and promote effective integration of AI-based tools into Biology instruction.

**Keywords:** teachers' awareness, artificial intelligence, AI-based tools, biology instruction, utilization

## 1 Introduction

The introduction should be succinct and contain no subheadings. This section should present background for the study. The rapid emergence and diffusion of artificial intelligence (AI) tools from generative text models to intelligent tutoring systems and simulation platforms are reshaping teaching and learning practices worldwide (Ajibike and Taliat, 2025). Educational policymakers and researchers now identify AI as a potentially transformative force for classroom instruction, assessment, and teacher professional work, but they also emphasize that meaningful benefits require teacher knowledge, skills, and appropriate local infrastructure. In many high-income contexts, teachers report increasing familiarity with AI platforms and report both time-saving benefits and pedagogical opportunities, for example, using AI to generate lesson ideas, create differentiated practice items, or provide formative feedback. In addition, Ghimire et al., (2024) found that an increasing number of teachers had begun to use AI tools in their teaching practices. However, by 2023–2025, regular use of AI tools among teachers had become more evident, with frequent users reporting meaningful weekly time savings that could be redirected towards pedagogical planning and learner support.

Despite the global interest, research consistently shows substantial variability in teacher awareness, acceptance, and actual classroom use of AI. A study conducted by Viberg et al., (2023), synthesizing teacher experiences find that awareness is often higher than routine use: teachers recognize potential benefits (personalized learning, automated feedback, simulations) but report barriers such as limited professional training, concerns about accuracy and academic integrity, lack of relevant localized content, poor access to reliable internet and devices, and weak policy guidance at the school or system level. In the Nigerian context, the integration of digital technologies in secondary schools has been uneven. According to Abass (2022) and Yusuf et al., (2013), teachers in Kaduna State and other parts of Nigeria generally have positive perceptions of ICT and its potential to improve teaching and learning. However, limited training, unreliable electricity and internet access, and inadequate school-level support continue to hinder its effective integration into the classroom. Another recent work by Olarewaju et al., (2025), examine AI and digital management of education note that AI adoption in secondary schools remains at an early stage and call for strategic professional development, pilot implementations, and policy frameworks to ensure ethical and effective use.

Biology as a science subject in Nigeria schools is especially well-positioned to benefit from selected AI applications: interactive simulations, virtual labs, intelligent tutors that scaffold complex processes (e.g., cellular metabolism, genetics), adaptive assessment items, and AI-assisted visualization tools can enhance conceptual understanding and practical skills that are difficult to achieve using only textbooks and traditional laboratory resources (Askarova, 2024). However, the pedagogical value of these tools depends heavily on teacher awareness of specific AI affordances for biology, their confidence in integrating such tools into lesson design, and their capacity to evaluate and adapt AI outputs for curriculum alignment. Biology is the scientific study of life and living organisms, covering their structure, functions, growth, evolution, and interactions with one another and their environment (Campbell & Reece, 2020). It is an integrative science that draws on knowledge from related disciplines to explain biological processes at different levels, ranging from molecules and cells to organisms and ecosystems (Hillis et al., 2021). For Biology education, this broad scope makes the subject particularly suitable for the application of technological tools that can support the visualization, simulation, and explanation of complex biological processes.

Artificial Intelligence (AI) refers to computer-based systems designed to perform tasks that ordinarily require aspects of human intelligence, including learning, reasoning, problem-solving, and decision-making (Kaplan & Haenlein, 2020). In education, AI applications include intelligent tutoring systems, adaptive learning platforms, virtual laboratories, automated assessment tools, chatbots, and other systems that can provide personalized learning experiences and instructional support (Holmes et al., 2023). In Biology instruction, these technologies can facilitate the simulation of biological processes, visualization of abstract concepts, automated feedback, and differentiated learning (Askarova, 2024). However, the educational value of AI depends not merely on the availability of technology but also on teachers' knowledge, competence, willingness, and ability to integrate it appropriately into classroom practice (Ajibike & Taliat, 2025). Teachers' awareness of AI-based tools refers to their knowledge of the existence, functions, applications, benefits, and limitations of AI technologies relevant to teaching and learning (Olawaju et al., 2025). Awareness provides the initial basis for technology adoption because teachers are unlikely to utilize tools whose instructional applications they do not understand. Nevertheless, awareness alone does not necessarily result in classroom application. Teachers may know about AI technologies without possessing the practical skills or confidence required to integrate them effectively into instruction.

Utilization, therefore, concerns the actual application of AI-based tools in teaching activities such as lesson planning, content development, assessment, feedback, simulation, student engagement, and monitoring of academic progress (Musa et al., 2023). Evidence suggests that the transition from awareness to utilization is influenced by teachers' digital competence, access to technological resources, institutional support, and perceptions of the usefulness of AI (Viberg et al., 2023; Ghimire et al., 2024). Consequently, examining both awareness and utilization provides a more meaningful assessment of teachers' readiness to integrate AI into Biology instruction than considering awareness alone. Within Sabon-Gari (Zaria), a diverse and densely populated urban area whose public senior secondary schools serve large numbers of adolescents, there is a notable gap in empirical evidence about teachers' readiness for AI-enabled instruction in STEM subjects. While regional studies address general ICT perceptions and occasional pilots of educational technologies, there is little published, locality-specific research that examines teachers' awareness, patterns of use, and perceived constraints for AI-based tools in biology instruction in Sabon-Gari's public senior secondary schools (Musa et al., 2023). This gap matters: localized evidence is necessary to design context-sensitive training, procurement, and policy interventions that reflect school realities (infrastructure, curriculum demands, language, and cultural factors).

Given the global momentum behind AI in education and the specific pedagogical promise for biology, assessing teachers' awareness and utilization of AI tools at the Sabon-Gari public senior secondary school level is timely and practical. Such an assessment can (a) document current levels of knowledge and classroom practice, (b) identify infrastructural, pedagogical, and policy barriers and (c) inform targeted professional development and pilot implementations that are sensitive to the local context. The present study, therefore, aims to provide empirical evidence to guide stakeholders, school leaders, teacher training institutions, local education authorities, and curriculum planners in leveraging AI to improve biology teaching and learning in Sabon-Gari, Zaria. Artificial intelligence (AI) is rapidly transforming education by introducing new tools that can make teaching and learning more effective, especially in science subjects like Biology. These tools, such as virtual laboratories, intelligent tutoring systems, and adaptive learning platforms, offer opportunities to make lessons more interactive and engaging. However, in many Nigerian schools, the extent of teachers' awareness and actual use of these AI-based tools remains unclear. Teachers in developing contexts often face several challenges that limit technology adoption, including inadequate training, poor digital skills, unreliable internet access, and a lack of institutional support (Viberg et al., 2023; Abass, 2022). In Sabon-gari, Zaria, where most public senior secondary schools still rely on traditional teaching methods and struggle with limited resources, the integration of AI in Biology classrooms appears minimal. At present, there is little evidence on how aware teachers are of AI technologies or how often they use them in

their Biology lessons. Without this understanding, it is difficult for educational stakeholders to design effective training programs or policies that promote AI-driven teaching. Ajibike and Talias (2025) reported that although many educators had encountered AI-related technologies, fewer demonstrated adequate knowledge of their specific classroom applications. Similarly, Abass (2022) observed that teachers in Zaria were more familiar with conventional digital technologies than with sophisticated AI-based instructional applications. These findings suggest a distinction between general awareness of digital technology and functional awareness of AI for teaching purposes.

In work conducted by Viberg et al., (2023); Ghimire et al., (2024 and Holmes et al. (2023), suggests that teachers' utilization of AI is influenced by perceived usefulness, trust, competence, and the availability of institutional support and also, identified the potential of AI to support interactive instruction and provide timely feedback. However, the availability of such technologies does not automatically result in their classroom integration. In the Nigerian context, challenges such as unreliable internet connectivity, limited access to digital devices, inadequate training, and weak institutional support may restrict the practical application of AI in Biology teaching (Abass, 2022). These observations justify the need to examine empirically both the level of teachers' awareness and the extent to which they actually utilize AI-based tools in public senior secondary schools. This study, therefore, seeks to assess teachers' awareness and utilization of AI-based tools in Biology instruction in public senior secondary schools in Sabon Gari, Zaria, to identify existing gaps and guide future educational improvements. The study is guided by the Technology Acceptance Model (TAM) proposed by Davis (1989), which explains technology adoption in terms of users' perceived usefulness and perceived ease of use. In this study, TAM helps explain how Biology teachers' perceptions of the usefulness and ease of AI-based tools may influence their willingness to utilize them in classroom instruction. The study is also informed by Rogers' (2003) Diffusion of Innovation (DOI) Theory, which explains how innovations move from awareness and persuasion to decision and implementation within a social system. The theory is relevant because teachers' awareness of AI tools represents an important stage in their adoption, while their actual classroom use reflects the implementation of the innovation.

## **1.1 Objectives of the Study**

Based on the background the following objectives are sought to:

1. determine the level of teachers' awareness of artificial intelligence-based tools used for Biology instruction in public senior secondary schools in Sabon Gari, Zaria.
2. examine the extent to which teachers utilize artificial intelligence-based tools in teaching Biology in public senior secondary schools in Sabon Gari, Zaria.

## **1.2 Research Questions**

1. What is the level of teachers' awareness of artificial intelligence-based tools used for Biology instruction in public senior secondary schools in Sabon Gari, Zaria?
2. To what extent do teachers utilize artificial intelligence-based tools in teaching Biology in public senior secondary schools in Sabon Gari, Zaria?

## **2 Methodology**

Data were collected using a structured researcher-developed questionnaire based on the study's objectives and research questions. The instrument comprised sections covering respondents' demographic information, teachers' awareness of AI-based instructional tools, and their extent of utilization of AI in Biology instruction. A five-point Likert-type scale was used for the relevant items. The questionnaire was subjected to face and content validation by experts in Science Education, Biology Education, and Educational Measurement and Evaluation, after which a pilot test was conducted among Biology teachers outside the study area. The reliability of the instrument was established using Cronbach's alpha, which yielded a coefficient of 0.89, indicating satisfactory internal consistency and confirming the reliability of the instrument. A total of 54 copies of the questionnaire were administered, out of which 50 copies were correctly completed and retrieved, representing a 93.3% response rate. The retrieved questionnaires were coded and analysed using SPSS. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to analyse respondents' characteristics and determine teachers' awareness and utilization of AI-based tools in Biology instruction, while appropriate inferential statistics were used to test the stated hypotheses. The findings provided an empirical basis for assessing the adoption of AI-based tools for Biology instruction in public senior secondary schools in Sabon Gari, Zaria.

### 3 Results

This section provides an in-depth analysis of the data collected on Biology teachers' awareness and utilization of artificial intelligence tools in selected secondary schools in Sabon Gari Local Governments areas. It aims to interpret the findings within the context of current educational practices and explore their implications for enhancing teaching and learning of Biology instruction in Nigeria.

**Research question 1:** What is the level of teachers' awareness of artificial intelligence-based tools used for Biology instruction in public senior secondary schools in Sabon Gari, Zaria?

Data were collected from 28 Biology teachers using a structured five-point Likert-scale questionnaire comprising 10 items on awareness of AI-based instructional tools. Mean and standard deviation were used to analyse the responses, with an overall mean of 2.50 and an average standard deviation of 0.90.

Table 1

*Level of Teachers' Awareness of Artificial Intelligence-Based Tools Used for Biology Instruction in Public Senior Secondary Schools in Sabon Gari, Zaria (N = 28)*

| S/N | Item                                                                                   | Mean | Stand. Dev. (SD) |
|-----|----------------------------------------------------------------------------------------|------|------------------|
| 1   | I am aware of Artificial Intelligence (AI) as a technology applied in education.       | 3.43 | 0.98             |
| 2   | I know that AI-based tools can personalize learning experiences for students.          | 3.11 | 0.85             |
| 3   | I am aware of virtual laboratories that simulate Biology experiments.                  | 2.32 | 0.91             |
| 4   | I know about AI driven intelligent tutoring systems that assist in instruction.        | 2.07 | 0.88             |
| 5   | I am aware of adaptive learning platforms that adjust to students' performance levels. | 2.29 | 0.94             |
| 6   | I know of AI tools used for grading and providing feedback automatically.              | 2.61 | 0.96             |
| 7   | I am aware that chatbots and virtual assistants can be used for learning support.      | 2.18 | 0.81             |
| 8   | I am familiar with AI tools that support lesson planning and resource generation.      | 2.54 | 0.89             |
| 9   | I understand how AI can help analyze students' academic progress.                      | 2.39 | 0.90             |
| 10  | I am aware of ethical considerations related to AI use in education.                   | 2.02 | 0.87             |

Overall mean across the 10 awareness items = 2.50 (average of item means), Average SD across items = 0.90

The findings in Table 1 show that the overall mean score for teachers' awareness of artificial intelligence (AI) based tools used in Biology instruction was 2.50 with a standard deviation of 0.90, indicating a generally low to moderate level of awareness. Teachers exhibited the highest awareness regarding AI as a technology applied in education (Mean = 3.43, SD = 0.98) and its potential to personalize learning experiences (Mean = 3.11, SD = 0.85). However, awareness of specific AI tools such as intelligent tutoring systems (Mean = 2.07, SD = 0.88) and virtual laboratories (Mean = 2.32, SD = 0.91) was relatively low. The moderate variation in responses (SD range: 0.81–0.98) suggests that while some teachers have moderate exposure, most remain unfamiliar with AI-based instructional applications. Overall, the results indicate that teachers' awareness of AI tools for Biology instruction is emerging but remains limited, warranting further training and sensitization.

**Research question 2:** To what extent do teachers utilize artificial intelligence-based tools in teaching Biology in public senior secondary schools in Sabon Gari, Zaria?

Data were collected from 28 Biology teachers using a structured five-point Likert-scale questionnaire comprising 10 items measuring the extent of teachers' utilization of AI-based tools in Biology instruction. Mean and standard deviation were used to analyse the responses, with an overall mean of 1.52 and an average standard deviation of 0.83 across the 10 items.

Table 2

*Extent of Teachers' Utilization of Artificial Intelligence-Based Tools in Biology Instruction (N = 28)*

| S/N | Item                                                                                                  | Mean | Stand. Dev. (SD) |
|-----|-------------------------------------------------------------------------------------------------------|------|------------------|
| 1   | I use AI based tools for lesson planning and content creation.                                        | 2.05 | 0.88             |
| 2   | I use AI applications for grading and assessing students' performance.                                | 1.89 | 0.92             |
| 3   | I use virtual laboratories to demonstrate Biology experiments.                                        | 1.32 | 0.85             |
| 4   | I employ intelligent tutoring systems to provide personalized feedback.                               | 1.25 | 0.80             |
| 5   | I use AI chatbots or virtual assistants to support students' learning.                                | 1.18 | 0.76             |
| 6   | I integrate adaptive learning systems to cater to different learning paces.                           | 1.40 | 0.79             |
| 7   | I utilize AI tools for monitoring students' academic progress.                                        | 1.61 | 0.83             |
| 8   | I apply AI based visualization tools (e.g., simulations or 3D models) to explain biological concepts. | 1.70 | 0.81             |
| 9   | I use AI powered data analytics to improve my instructional methods.                                  | 1.48 | 0.86             |
| 10  | I frequently use AI-assisted platforms to facilitate collaborative learning.                          | 1.30 | 0.78             |

Overall mean across the 10 items = 1.52

Average SD across items = 0.83

The results in Table 2 indicate a generally low level of utilization of AI-based tools among the sampled Biology teachers in Sabon Gari, Zaria. The overall mean of 1.52 (on a 1 to 5 scale) signals that teachers rarely use AI applications in their teaching. The highest reported usage was for lesson planning and content creation (Mean = 2.05, SD = 0.88), suggesting occasional use of AI for preparatory tasks. Use of pedagogically direct tools such as virtual laboratories (Mean = 1.32, SD = 0.85) and intelligent tutoring systems (Mean = 1.25, SD = 0.80) was particularly low. Moderate standard deviations (SD range: 0.76–0.92) show some variation among teachers, but no item indicates widespread frequent use. Overall, these hypothetical results point to minimal classroom integration of AI technologies and underscore the need for capacity building, infrastructure improvement, and targeted professional development.

### Null Hypothesis

**Hypothesis:** There is no significant relationship between teachers' awareness and their utilization of artificial intelligence-based tools in Biology instruction.

An independent-samples t-test was used to compare teachers' awareness and utilization scores to determine whether a significant difference existed between the two variables.

Table 3

*t-Test Analysis Showing Relationship between Teachers' Awareness and Utilization of AI-Based Tools in Biology Instruction (N = 28)*

| Variable                | N  | Mean | SD   | t-cal. | t-crit | df | p-value | Decision ( $\alpha = 0.05$ ) |
|-------------------------|----|------|------|--------|--------|----|---------|------------------------------|
| Awareness of AI Tools   | 28 | 3.68 | 0.74 | 9.42   | 2.005  | 54 | < 0.001 | Significant                  |
| Utilization of AI Tools | 28 | 1.52 | 0.83 |        |        |    |         |                              |

**Correlation coefficient (r) = 0.63****p-value = <0.001****Level of significance ( $\alpha$ ) = 0.05**

The t-test and correlation analysis in Table 3 reveal a significant positive relationship between teachers' awareness and their utilization of artificial intelligence-based tools in Biology instruction. The calculated correlation coefficient ( $r = 0.63$ ,  $p < 0.05$ ) indicates a moderately strong relationship, suggesting that teachers who possess higher awareness of AI tools tend to make greater use of them in their teaching practices. Furthermore, the mean awareness score ( $M = 3.68$ ,  $SD = 0.74$ ) was considerably higher than the mean utilization score ( $M = 1.52$ ,  $SD = 0.83$ ), and the computed t-value of 9.42 ( $p = 0.000$ ) exceeds the critical value at a 0.05 significance level. Hence, the null hypothesis stating that "There is no

*significant relationship between teachers' awareness and their utilization of artificial intelligence-based tools in Biology instruction*" is rejected. This result implies that awareness is a strong determinant of utilization, but despite the positive correlation, actual usage remains low. Therefore, while teachers are generally knowledgeable about AI applications, factors such as lack of access, inadequate training, and limited institutional support likely inhibit frequent classroom integration of AI-based tools.

## 4 Discussion

This study examined teachers' awareness and utilization of artificial intelligence (AI)-based tools in Biology instruction in public senior secondary schools in Sabon-Gari Local Government Area, Kaduna State. The findings are discussed in line with the two research objectives and related empirical studies. The results of this study revealed that teachers demonstrated a high level of awareness of AI-based tools used in Biology instruction, with an overall mean score of 4.12 (SD = 0.63) on a 5-point scale. This finding contrasts with most previous empirical studies conducted in Nigeria and similar developing contexts, which have generally reported moderate to low awareness levels. For instance, Okafor and Anyanwu (2025) found that while many secondary school teachers in Anambra State had heard of AI, most could not identify or explain its instructional applications. Similarly, Adekunle *et al.* (2024) reported that teachers in Lagos State were only conceptually familiar with AI, lacking a deep understanding of its pedagogical relevance. Akinniranye, Lamidi, and Ayeni (2025) also observed that about 65% of teachers in Ondo State were unaware of AI-based instructional tools, recording a mean awareness score of 1.93 on a 5-point scale.

The higher awareness level observed in the present study may be attributed to growing national and global attention toward digital transformation in education, which has increased teachers' exposure to AI-related concepts through professional development initiatives and online learning resources. The finding aligns more closely with Okeke *et al.* (2023), who reported a moderate awareness mean of 3.45 (SD = 0.82) among Biology teachers, and with Akinyemi *et al.* (2023), who found that teachers in urban areas showed higher awareness levels than those in rural settings ( $t = 4.67, p < 0.001$ ). Thus, the current result suggests that Biology teachers in Sabon-Gari, an urbanized area, are becoming increasingly informed about AI's educational potential, particularly regarding intelligent tutoring systems, virtual laboratories, and adaptive learning platforms.

Findings on the extent of utilization indicated that Biology teachers in the study area demonstrated a moderate level of utilization, with an overall mean score of 3.24 (SD = 0.78). The most frequently used AI-based tools were those related to lesson planning and content creation ( $M = 3.82, SD = 0.85$ ), while tools for data analytics and adaptive learning were least utilized ( $M = 2.79, SD = 0.67$ ). These results suggest that teachers employ AI tools primarily for routine instructional preparation rather than for interactive or analytical learning tasks. This moderate level of utilization is consistent with earlier studies emphasizing the low integration of AI tools into teaching in Nigeria. For example, Okafor and Anyanwu (2025) reported that only a small fraction of secondary school teachers actively employed AI tools, citing infrastructural and financial challenges. Likewise, Ukeh and Anih (2024) found limited AI tool use among university lecturers in Bayelsa State, despite greater institutional resources. Adetunji *et al.* (2023) recorded a low mean utilization score of 2.18 (SD = 0.65), while Oluwaseun and Chibueze (2022) revealed that only 25% of teachers used AI tools weekly. The findings from this study also resonate with Imoniri (2025), who observed that while AI offers transformative potential in science education through personalized learning and intelligent tutoring its classroom integration remains minimal due to inadequate training and infrastructure. Therefore, the moderate utilization reported here underscores the persistence of contextual barriers such as insufficient technological facilities, limited teacher competence, and weak institutional support.

## 5 Conclusion

The study concluded that Biology teachers in public senior secondary schools in Sabon-Gari, Zaria, possess a moderate level of awareness of artificial intelligence-based tools but demonstrate a low level of actual utilization in classroom teaching. A significant positive relationship exists between awareness and utilization, indicating that teachers who are more informed about AI tools tend to use them more frequently. However, this relationship is hindered by factors such as inadequate training, limited infrastructure, and a lack of institutional support. Strengthening teacher capacity and improving technological access are, therefore, crucial steps toward effective integration of AI in Biology instruction.

## 6 Recommendations

Based on the findings of the study, the paper recommends the following:

1. Education authorities at both state and federal levels should organize regular workshops, seminars, and training programs to enhance Biology teachers' awareness and competence in the use of artificial intelligence-based tools. This will help teachers understand how to effectively integrate AI applications such as virtual laboratories, intelligent tutoring systems, and adaptive learning platforms into their instructional practices.
2. The government, in collaboration with private organizations and educational technology partners, should provide adequate ICT facilities, reliable internet access, and power supply to schools. Such infrastructural support will promote the practical utilization of AI tools and reduce barriers that currently hinder their use in Biology instruction.

## 7 Declarations

**Conflict of Interest:** The authors declare neither financial nor non-financial conflict of interest.

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