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Awareness and Utilization of Artificial Intelligence Among Secondary School Biology Students in Lere, Kaduna State

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Abstract
This study examined the awareness, utilisation, and gender disparities in the use of artificial intelligence among secondary school biology students at Lere, Kaduna State. The research was guided by three objectives, three research questions, and one null hypothesis. A descriptive survey research design was adopted, with a population of 18,210 students and a sample size of 375 respondents selected using a multi-stage sampling technique. Data were collected through a structured questionnaire titled AI Awareness and Utilisation in Biology Learning Questionnaire (AIAUBQ), which yielded a reliability coefficient of 0.74, indicating the instrument's reliability. The data analysis employed mean, standard deviation, and t-test at a 0.05 significance level, using the Statistical Package for Social Sciences (SPSS version 23). The findings revealed a low level of awareness of artificial intelligence tools (ChatGPT and Quillionz) and applications among secondary school biology students in Lere, Kaduna State (mean = 1.91, SD = 0.95). Also, the use of AI tools (ChatGPT and Quillionz) for biology learning is low among secondary school students in Lere, Kaduna State (mean=1.73, SD=0.91), and there is no significant difference in artificial intelligence awareness levels between male and female biology students in secondary schools in Lere, Kaduna State (P=0.09 > 0.05). Based on these findings, it was recommended that the Kaduna state government and NGOs provide essential technological infrastructure to improve access to AI, among other measures.

Keywords: Awareness, Utilisation, Artificial Intelligence, Tools, Biology

Introduction

Across several industries, including education, the use of artificial intelligence (AI) has drastically changed conventional methods. The degree of understanding and use of AI by secondary school students, especially those pursuing biology, is one new topic of research interest. The combination of artificial intelligence (AI) and biology education has enormous potential to enhance instruction, provide cutting-edge resources for studying complex biological concepts, and prepare students for careers in a world that is increasingly reliant on technology. The ability of robots to carry out tasks that normally require human intelligence is known as artificial intelligence (AI) (Russell & Norvig, 2021). AI has recently made inroads into the educational sector, demonstrating its capacity to fundamentally alter how knowledge is disseminated and assimilation. The global market for AI in education was valued at USD 1.47 billion in 2020, according to Grand View Research (2021), and it is projected to expand at a compound annual growth rate of 36.4% between 2021 and 2028. More and more AI tools are being used in schools, particularly in science courses like biology, as seen by the rise in interest and investment. By evaluating student performance and adapting content to suit their specific requirements, artificial intelligence (AI) technology, such as intelligent tutoring systems, machine learning algorithms, and natural language processing tools, can personalise learning.

According to Ugwuoti et al. (2023) and the National Science Board (2015), incorporating these technologies can enhance engagement, improve learning outcomes, and reduce achievement gaps. However, there is still a lack of actual evidence supporting AI's ability to reduce achievement inequalities. For example, Ghosh et al. (2023) pointed out that although predictive analytics and adaptive systems have potential, their efficacy differs greatly depending on the technology and socioeconomic situation. Likewise, Zawacki-Richter et al. (2022) warn that AI can unintentionally exacerbate performance gaps rather than reduce them in the absence of inclusive design and

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fair access. Furthermore, AI-powered virtual reality and augmented reality apps, which give abstract concepts a concrete and understandable form, enable students to engage with biological events in real time within immersive learning settings. AI can be used by educators to customise lessons, find learning gaps, and develop adaptive exams. By enabling students to take control of their education, this degree of personalisation promotes student autonomy and improves understanding. Students must understand the complexities of living things and how they interact with their surroundings to excel in biology lessons. This complexity frequently poses cognitive difficulties for students. Through dynamic visualisations, interactive simulations, and multimedia information, AI tools can help close this gap by giving students a better comprehension of these difficult subjects. For example, Ugwuoti et al. (2023) highlighted how AI-based applications use interactive platforms to help people understand biological concepts. Through virtual reality simulations, students can study anatomical structures and ecological systems in three dimensions, enhancing their spatial awareness (Chang et al., 2018). Similarly, Marx (2013) pointed out that interactive visualisations help learners understand and relate to abstract biological processes like protein folding and molecular interactions.

Artificial intelligence (AI) techniques can significantly enhance the teaching and learning process when applied appropriately in educational settings, particularly in science courses like biology. Recent developments in artificial intelligence (AI) have enabled a wide range of tools, including machine learning-based adaptive learning platforms that adapt content to a student's learning style and pace; chatbots and virtual teaching assistants that respond to student questions in real time; intelligent tutoring systems (ITS) that provide personalised feedback and guidance; and Natural Language Processing (NLP) applications (Zawacki-Richter et al., 2022; Ghosh et al., 2023). AI-powered virtual reality and augmented reality apps like Labster and Google Expeditions, which recreate complicated biological processes like cellular respiration or the human circulatory system, also make learning more dynamic and immersive (Adeyemo & Balogun, 2024). Automated assessment technologies are growing in popularity because they save teachers time and provide pupils with immediate feedback, and predictive analytics assists teachers in identifying at-risk children early for prompt intervention (Mohammed & Yusuf, 2023). AI programs that can support tailored learning environments include Quillionz, which creates quizzes based on learning materials, and Knewton, a personalised learning platform (Mhlongo et al., 2023). Despite these developments, many educational institutions still use AI tools in diverse ways, usually due to infrastructural constraints and low levels of digital literacy. However, as Adeyele and Ramnarain (2024) pointed out, a more egalitarian and future-ready biology education system may be created by offering instructors and students access to AI-enabled technology and the digital capabilities they need.

The literature offers contradictory results in spite of these many advantages. Some researchers point out significant obstacles, even if studies like Mohammed & Yusuf (2023) and Zawacki-Richter et al. (2022) illustrate the revolutionary potential of AI in improving engagement and learning outcomes. For instance, Adeyele and Ramnarain (2024) found that effective AI integration is hampered by issues with digital literacy among both teachers and students. Similar to this, Mhlongo et al. (2023) noted that the potential advantages of AI technologies are frequently offset by inadequate infrastructure and a lack of technical expertise. This conflict between prospective and actual use highlights the necessity for a well-rounded perspective that takes into account both the advantages and disadvantages of implementing AI in education**.**

Notwithstanding these advantages, there are still huge discrepancies in secondary school learners' awareness of and performance with AI tools. Many pupils are unfamiliar with AI technologies or lack confidence when utilising them. According to Ugwuoti et al. (2023), students usually lack practical experience and comfort using AI tools, even when they are aware that they are employed in education. Furthermore, Adebayo et al. (2021) found that the majority of college students were unaware of AI technology for learning and that there was no statistically significant difference in awareness levels between male and female students. Similarly, instructors employed AI infrequently, according to Mhlongo et al. (2023), who attributed this to a lack of exposure and resources. The challenges are not just awareness. Lack of infrastructure, such as projectors, smart boards, reliable internet access, and enough computers, continues to be a barrier to the effective use of AI in many schools. The incapacity to effectively use technical tools remains one of the largest barriers to the successful integration of technology in education, according to Bingimlas (2009). Additionally, Eze (2022) emphasised that the extent to which AI technologies are utilised in classrooms is significantly influenced by the instructors' attitudes and level of competence with them. When AI is applied effectively, teachers may transform students from passive information consumers into active knowledge seekers by guiding them in active, inquiry-based learning (Adeyele and Ramnarain, 2024).

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While artificial intelligence (AI) holds immense promise for changing biology teaching, its effective deployment rests on. To guarantee that the advantages of AI in education are shared fairly and that students are equipped to meet the needs of the digital age, these gaps must be closed. Little is known about the proficiency and familiarity of biology students in secondary school with AI technologies. To create methods for successfully incorporating AI into biology curricula and promoting the formation of a tech-savvy generation of future biologists, it is imperative to examine their current level of knowledge, the resources at their disposal, and the difficulties they encounter.

Statement of the Problem

Despite the increasing focus on integrating artificial intelligence (AI) into education globally, secondary school students in many parts of Nigeria, particularly Lere in Kaduna State, still have a very low degree of acceptance and practical usage of AI. It is unclear how frequently students utilise AI tools for learning and how aware they are of these technologies, even though they have the potential to enhance student performance and engagement in science courses like biology. Many students may not be aware of or have limited access to AI-enhanced learning settings, and the majority of secondary schools in Lere still employ traditional teaching methods. Furthermore, gender differences in access to and use of technology continue to be an issue for educational equity. Without sufficient data on how male and female students use AI tools in this context, it becomes difficult to implement effective treatments or teacher support programs. Therefore, to ascertain the level of awareness and practical application of AI in biology teaching among Lere students, an empirical study is necessary. This study attempts to bridge this gap by examining how students perceive and utilise AI and whether there are significant differences between male and female learners.

Objectives of the Study

The objectives of the study are to:

i. determine the level of awareness of artificial intelligence tools and applications among secondary school biology students in Lere, Kaduna State.
ii. ascertain the extent of utilization of artificial intelligence resources for biology learning among secondary school students in Lere, Kaduna State.
iii. determine the difference between Artificial Intelligence awareness and utilisation levels between male and female biology students in secondary schools in Lere, Kaduna State

Research Questions

i. What is the awareness level of artificial intelligence tools and applications among secondary school biology students in Lere, Kaduna State?
ii. To what extent do secondary school students utilise artificial intelligence resources for biology learning?
iii. Is there any difference in artificial intelligence awareness and utilization patterns between male and female biology students in secondary schools in Lere, Kaduna State?

Null hypothesis

$H0_1$: There is no significant difference in artificial intelligence awareness and utilization levels between male and female biology students in secondary schools in Lere, Kaduna State.

Materials and Methods

The research design used in this study was a descriptive survey. All 18,210 senior secondary school biology students in Kaduna State's Lere Local Government Area made up the study's population. A representative sample size of 375 students was chosen for the study using Taro Yamane's formula for determining sample size. Schools were initially divided into urban and rural groups using a multi-stage sampling technique. The Kaduna State Ministry of Education's information on school locations served as the basis for the classification of schools into urban and rural areas. Ten schools in all were chosen using basic random sampling without replacement, five of which were from metropolitan regions and five of which were from rural areas**.** Then, schools from each stratum were chosen using simple random selection. To guarantee representation of both male and female students, proportionate stratified sampling was used to sample students within the chosen schools. A structured questionnaire called the AI Awareness and Utilisation in Biology Learning Questionnaire (AIAUBQ) served as the data gathering tool. Demographic data, an AI awareness scale (Highly Aware, Moderately Aware, Slightly Aware, and Not Aware), and an AI usage scale (Very Often, Often, Rarely & Never) comprised the three parts of the modified 4-point Likert scale questionnaire. Experts in biology education and educational technology verified the tool, and a pilot study confirming its dependability yielded a Cronbach's alpha reliability coefficient of 0.74.

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SPSS version 23 was used for data analysis. To answer the research questions, descriptive statistics including frequency counts, means, and standard deviation were employed. To check for significant gender variations in AI awareness and use, an independent sample t-test was used, with a significance threshold of 0.05. For the research topics, the data were analysed using descriptive statistics (frequency, mean, and standard deviation). Gender-based variations in AI awareness and use were tested using an independent t-test at the 0.05 level of significance.

Results

Following analysis of the data gathered for this study, the findings are presented in Tables 1-4 as follows:

Table 1: Awareness level of Artificial Intelligence Tools

S/N	AI Tools	HA	MA	SA	NA	Mean	SD	Decision
1	Virtual Laboratories (e.g., Labster)	10	35	110	220	1.56	0.77	Low
2	Chatbots (e.g., Chatgpt, Bing AI)	190	120	45	20	3.28	0.87	High
3	AI-based educational videos	40	25	100	210	1.72	0.99	Low
4	Personalised learning apps (e.g., Squirrel AI)	45	20	90	220	1.71	1.02	Low
5	Voice assistants (e.g., Siri, Google Assistant)	60	85	110	120	2.23	1.07	Low
6	AI-generated quizzes or flashcards	15	30	120	210	1.60	0.80	Low
7	AI-integrated Learning Management Systems (e.g., Edmodo AI)	25	23	77	250	1.53	0.88	Low
8	AI-based plagiarism checkers (e.g., Grammarly, Quillbot)	30	50	95	180	1.80	0.97	Low
9	AI voice-to-text or speech analysis tools	28	65	62	220	1.74	0.99	Low
10	AI-enhanced assessment platforms (e.g., Gradescope)	55	45	85	190	1.91	1.10	Low
	Cumulative Mean					1.91	0.95	Low

KEY: HA – highly Aware, MA – Moderately Aware, SA – Slightly Aware, NA – Not Aware, SD – Standard Deviation

Benchmark: Mean ≥ 2.50 = High level; Mean < 2.50 low level

Table 1 presents the awareness of various artificial intelligence (AI) tools among secondary school students in Lere, Kaduna State, as indicated by their mean scores and standard deviations (SD). The overall cumulative mean of 1.91, along with a standard deviation of 0.95, suggests that the general awareness of AI tools among the students is quite low. These indicate that some students are more familiar with these tools than others, but overall, there is limited exposure to AI in the context of their biology education.

Table 2: Utilization Level of Artificial Intelligence in Biology Learning

S/N	AI Tools	VO	O	R	N	Mean	SD	Remark
1	Using Chatgpt or an AI chatbot for biology homework	70	115	50	130	2.34	1.15	Low
2	Watching AI-curated biology video lessons	25	50	120	180	1.79	0.91	Low
3	Participating in virtual lab simulations	25	40	80	230	1.63	0.92	Low
4	Practising with AI-generated biology quizzes	15	30	120	210	1.60	0.80	Low
5	Using AI-based apps for biology revision	45	20	90	220	1.71	1.02	Low
6	Receiving AI feedback on biology assignments	15	30	120	210	1.60	0.80	Low
7	Submitting work via AI-integrated platforms (e.g., LMS)	20	35	80	240	1.56	0.87	Low
8	Using AI grammar checkers for biology reports	15	40	100	220	1.60	0.80	Low
9	Using AI voice-to-text to take notes in class	25	50	120	180	1.79	0.91	Low
10	Completing AI-enhanced online biology assessments	25	30	110	210	1.65	0.89	Low
	Cumulative					1.73	0.91	Low

KEY: VO – Very Often, O – Often, R – Rarely, N – Never, SD – Standard Deviation

Benchmark: Mean ≥ 2.50 = High level; Mean < 2.50 low level

Table 2 presents the utilization levels of various artificial intelligence (AI) tools for biology learning among secondary school students in Lere, Kaduna State. The results indicate that the use of AI resources for biology education is generally low. All tools presented in the survey yielded a mean score below the benchmark of 2.50, which signifies a low level of utilization.

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Table 3: Summary of Means and standard deviation of Artificial Intelligence awareness levels between male and female biology students

Gender	N	Mean	SD	Mean Diff.
Male	161	2.00	0.95	
				0.25
Female	214	2.25	0.88	

From the Table 3, it can be observed that female students (mean = 2.25) had a slightly higher mean score for artificial intelligence (AI) awareness compared to male students (mean = 2.00). The difference in the means (0.25) suggests that female students tend to have a higher level of engagement or awareness regarding AI tools for biology learning than their male counterparts.

Table 4: t-test analysis of Artificial Intelligence awareness levels between male and female biology students

Gender	N	Mean	Std. Dev.	df	Tcal	P-Value	Decision
Male	161	2.00	0.95				
				373	2.63	0.09	Not Sig.
Female	214	2.25	0.88				

The t-test analysis in Table 4 of AI awareness and utilisation levels between male and female biology students reveals a statistically significant difference between the two groups. The t-test result, with a t-calculated value of 2.63 and a p-value of 0.09, indicates that the difference in mean scores is not significant at the 0.05 level. This suggests that although female students appear to have a higher level of awareness and utilisation of AI tools in biology education compared to their male counterparts, the difference is not statistically significant.

Discussion

Secondary school biology students in Lere, Kaduna State, have a low awareness of artificial intelligence (AI) techniques and applications (Table 1) (mean = 1.91, SD = 0.95), which is consistent with a larger trend seen in many developing nations. There is a notable lack of integration of AI tools into the educational process, despite the fact that AI has the potential to completely transform education, especially in environments with limited resources (Sharma, 2021). Low understanding of cutting-edge teaching tools like artificial intelligence (AI) is frequently caused by Nigeria's limited access to technology resources and inadequate school infrastructure (Eze, 2022). Additionally, research by Olamide and Nwachukwu (2023) contends that a lack of teacher training in AI applications and a lack of student exposure to these technologies are both responsible for the sluggish uptake of AI tools. However, other research has demonstrated that improving children' understanding of and access to AI in the classroom can greatly improve their learning outcomes (Nguyen et al., 2023), underscoring the significance of incorporating AI literacy into the educational process at an early age.

According to Table 2's results, secondary school pupils in Lere, Kaduna State, are largely not using AI technologies for biology instruction (mean = 1.73, SD=0.91). This result is in line with studies showing that many African countries have low rates of technology use in the classroom (Ali & Habib, 2020). Although artificial intelligence (AI) tools like chatbots, virtual labs, and educational apps have the potential to improve biology education, their actual use in classrooms is hampered by a number of issues, such as restricted device access, low levels of digital literacy among teachers and students, and inadequate internet connectivity (Musa, 2021). Furthermore, in order to successfully incorporate AI into biology instruction, teachers must be trained to use these tools in the classroom in addition to having access to technology. In line with the findings in Lere, a related study by Madu et al. (2022) discovered that although students are typically aware of AI applications, their use is still low because of a lack of teacher assistance and supervision.

An interesting finding that is consistent with research on gender differences in technology adoption is that there was no significant difference in AI awareness and usage patterns between male and female biology students in secondary schools in Lere, Kaduna State (P=0.09> 0.05), according to Tables 3 and 4. Male students are frequently more involved with technology, especially artificial intelligence (AI), than female students, according to research by Araba et al. (2022). Numerous sociocultural reasons, like the belief that science and technology are disciplines dominated by men, might be blamed for this gender disparity (Akinyemi et al., 2023). The difference is closing, though, according to recent studies, particularly when female students are given equal access and support in STEM education (Ibrahim & Salihu, 2023). There may be a need for focused interventions to guarantee that male and

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female students are equally exposed to and benefit from AI tools in education, as the lack of a discernible difference in AI usage observed in Lere may be the consequence of traditional gender roles influencing students' interactions with technology.

It should be noted that this study has certain limitations despite the insights it has provided. First, a large portion of the data was derived from students' self-reported answers, which could be skewed by response bias or social desirability effects. It's possible that students overestimated or underestimated their knowledge of and proficiency using AI tools. Furthermore, the study's conclusions might not apply to all secondary schools in Nigeria because they are restricted to a small number of schools in Lere, Kaduna State. For a more comprehensive understanding of AI integration in biology instruction, future research could include in-person interviews or observations in the classroom.

The Technology Acceptance Model (TAM), which contends that people's acceptance of technology is influenced by perceived utility and simplicity of use, can be used to understand these findings. Students' perceptions of AI products' utility and usability were probably impacted by their limited exposure to them and the absence of digital infrastructure, which led to low adoption rates. In a similar vein, learner-centered strategies and interactive resources like AI-based simulations and virtual labs are highlighted by constructivist learning theory, which, if properly applied, could improve biology idea building. However, the use of these constructivist techniques in the current classroom setting is constrained by the lack of access and teacher support noted in this study.

Conclusion

The study's conclusions point to serious issues with secondary school biology students in Lere, Kaduna State, regarding their awareness of and use of artificial intelligence systems. The overall lack of understanding and the low use of AI resources are reflections of larger social and infrastructure impediments to successful technology integration in education, particularly in settings with little resources. Educational officials, school administrators, and other stakeholders must work together to close these inequalities by making AI tools and resources more widely available, educating teachers on how to utilise them, and advancing equal opportunities for all kids, regardless of gender. In topics like biology, where virtual labs, individualised learning applications, and AI-enhanced assessment tools can greatly improve educational outcomes, integrating AI into secondary school curricula could have a profound positive impact on students' learning experiences.

Recommendations

This study recommends the following:

1. The Kaduna state government and NGOs should provide essential technological infrastructure to improve access to AI.
2. Secondary school biology teachers should be retrained to integrate AI tools into their teaching practices.
3. Kaduna state teachers and students should be motivated to adopt AI-driven methods for their learning and assessment.

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