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Assessing the Availability and Utilization of ICT in Teaching Biology in Senior Secondary Schools in South LGA, Kwara State

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Abstract
This study investigated the availability and utilization of Information and Communication Technology (ICT) in the teaching of Biology at senior secondary schools in South Local Government Area (LGA), Kwara State. Adopting a descriptive survey design, the research examined a sample of 10 senior secondary schools and 30 Biology teachers within the LGA. To guide the study, four research questions were formulated. Data collection was carried out using a structured questionnaire designed to assess the availability and extent of ICT use in Biology instruction. The questionnaire was validated by subject experts to ensure its reliability. Data analysis involved both descriptive and inferential statistical methods, including percentage distributions, with a significance threshold of 0.05. Findings revealed that ICT facilities were generally limited in the schools surveyed, and in six of the sampled schools, the use of ICT in Biology instruction was particularly low. The study also established a significant relationship between the availability of ICT resources and effective Biology teaching in senior secondary schools. Additionally, factors such as teachers' gender, academic qualifications, and years of teaching experience were found to have a significant impact on ICT adoption in the classroom. Based on these findings, it was recommended that government agencies take active steps to ensure the provision of adequate ICT resources in senior secondary schools and other educational levels. Furthermore, the study suggested that non-governmental organizations, including the Parents Teachers Association (PTA) and Community Development Associations, contribute to equipping schools with necessary ICT tools to enhance teaching and learning outcomes

Keywords: ICT, Biology Education, Senior Secondary Schools, Educational Resources.

Introduction

The integration of Information and Communication Technology (ICT) in education has significantly transformed teaching methods, particularly in science disciplines such as Biology. In senior secondary schools within the South Local Government Area (LGA), Kwara State, the availability and effective utilization of ICT resources have the potential to enhance students' learning experiences and academic performance. Research suggests that when teachers incorporate ICT tools, such as interactive simulations, virtual labs, and multimedia resources, students exhibit greater engagement and better understanding of complex biological concepts (Adebayo et al., 2022). However, several challenges persist, including limited access to ICT infrastructure, inadequate teacher training, and insufficient technical support required for effective ICT integration in Biology instruction (Olawale & Yusuf, 2023). Moreover, the adoption of ICT in teaching Biology not only supports the delivery of content but also fosters a collaborative learning environment where students can engage in inquiry-based learning. In South LGA, the extent to which ICT is utilized in Biology instruction can significantly impact students' motivation and academic performance. Research has shown that effective use of ICT can facilitate better communication and information sharing among students and educators, thereby enriching the educational process (Ojo, 2023). As schools strive to improve educational quality, understanding the current state of ICT availability and its practical applications in Biology teaching becomes crucial for developing strategies that enhance teaching effectiveness in the region.

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Science and technology have significantly contributed to human development, leading nations, including Nigeria, to prioritize education in Science, Technology, Engineering, and Mathematics (STEM) disciplines (Umar & Salihu, 2015; Enemarie, 2016). Basic science, which serves as a foundational element in these disciplines, is taught at both lower and upper basic school levels. Its integral role as the cornerstone for all science subjects in secondary education emphasizes the importance of basic science in shaping future science and technology professionals in tertiary institutions. Recognizing this, the Nigerian educational curriculum has included basic science as a crucial component to prepare students for advanced studies in related fields (Achor & Ityobee, 2020).

The learning objectives for basic science focus on equipping students with essential scientific skills, such as observation, information organization, generalization, prediction, and experimental design, as outlined by the Federal Republic of Nigeria (FRN, 2013). As Aina (2013) notes, the dynamic nature of science necessitates that educators stay updated with new discoveries and teaching methodologies, particularly through the integration of Information and Communication Technology (ICT). Mbugua et al. (2015) highlight that global investments in ICT aim to enhance teaching and learning experiences, making lessons more engaging and ultimately improving student performance. Despite the potential benefits of ICT in education, its availability and functionality remain uneven, particularly between urban and rural schools. Achor and Ityobee (2020) identified a variety of ICT tools essential for enhancing teaching and learning, but also noted their insufficient availability in many schools. This scarcity can hinder effective usage by both teachers and students. Additionally, studies indicate a low level of ICT skills among students in rural areas due to a lack of hands-on training opportunities (Mabayoje et al., 2015). Research has consistently shown that the integration of ICT in education, especially in science subjects, enhances academic performance by facilitating better learning experiences through multimedia and interactive tools (Basargekar & Singhavi, 2017; Ojo & Okunola, 2023). While the integration of Information and Communication Technology (ICT) in Biology education at the Senior Secondary School level has gained widespread acknowledgment, significant obstacles remain that impede its effective implementation (Eze & Aja, 2014). Many Biology teachers demonstrate a tendency to avoid using ICT, often relying on conventional teaching methods, which can negatively impact students' enthusiasm and achievement in the subject. Influential factors such as the teachers' gender, qualifications, and years of experience play a critical role in their use of ICT tools. Consequently, there is an urgent need to raise awareness among educators and secure government support to provide the essential resources and training required for promoting ICT in Biology instruction. This approach could empower teachers to champion the effective use of technology, thereby enhancing educational outcomes for their students (Alshmrany & Wilkinson, 2017). The effective execution of the updated Biology curriculum is deeply intertwined with the use of ICT, which is vital for facilitating meaningful changes in student behavior and learning. Research highlights that students benefit from multisensory learning experiences, emphasizing the necessity of incorporating ICT into educational practices (Amuchie, 2015). However, many schools lack sufficient technological resources, and the few available often remain in disrepair, limiting teachers' capabilities to incorporate technology into their lessons. This situation raises important concerns about students' engagement and proficiency in Biology, as their learning experiences may not reflect contemporary educational strategies. Therefore, this research seeks to explore the availability and application of ICT in teaching Biology in Senior Secondary Schools located in the South LGA of Kwara State.

Purpose of the Study

The primary objective of this study is to examine the availability and use of Information and Communication Technology (ICT) in Biology instruction at senior secondary schools in South LGA, Kwara State. Specifically, the study aims to:

1. Assess the level of accessibility and utilization of ICT for teaching Biology in senior secondary schools.
2. Investigate the availability and usage of ICT in Biology instruction in relation to teachers' gender.
3. Examine how teachers' academic qualifications influence the availability and use of ICT in Biology teaching.
4. Explore the relationship between teachers' years of experience and their utilization of ICT in Biology instruction.

Research Questions

The study is guided by the following research questions:

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1. To what extent is ICT available and utilized for teaching Biology in senior secondary schools in South LGA, Kwara State?
2. How does the availability and utilization of ICT in Biology instruction vary based on teachers' gender in senior secondary schools?
3. In what ways do teachers' academic qualifications impact the availability and use of ICT in teaching Biology?
4. How do teachers' years of experience influence the availability and utilization of ICT in Biology instruction?

Research Methodology

This study employed a descriptive survey design, which systematically examines and provides an accurate representation of a specific phenomenon. This approach was selected to explore the availability and utilization of Information and Communication Technology (ICT) in Biology instruction at senior secondary schools in South LGA, Kwara State. The target population for the study comprised all senior secondary school Biology teachers within the LGA. A random sampling technique was used to select ten secondary schools—five public and five private institutions. From each school, three Biology teachers were chosen, resulting in a total sample size of thirty (30) Biology teachers for the study. Data were collected using a structured questionnaire titled "Availability and Utilization of ICT in Biology Teaching Questionnaire (AUITBQ)," developed by the researcher. The questionnaire consisted of two sections: Section A: Gathered demographic information about the teachers. -Section B: Assessed the availability and usage of ICT in Biology instruction. To ensure validity, the questionnaire was reviewed by the researcher's supervisor, who provided feedback to enhance its face and content validity before conducting a reliability test. The reliability of the instrument was tested using the test-retest method. It was administered to a separate group of thirty teachers and re-administered after three weeks to ensure consistency. Before data collection, permission was obtained from school principals and department heads, and the cooperation of Biology teachers was sought to facilitate smooth administration. The collected data were analyzed using descriptive statistics such as percentages, while the formulated hypotheses were tested using the chi-square statistical tool at a 0.05 significance level to determine relationships between ICT availability, utilization, and various teacher-related factors.

Results

This section provides the results and analysis of the findings regarding the availability and use of Information and Communication Technology (ICT) in teaching Biology at secondary schools. The findings are organized in tabular format, followed by a discussion of each result.

Research Question 1: To what extent is ICT available and utilized for teaching Biology in senior secondary schools in South LGA, Kwara State?

Table 1: Summary of the ICT availability and utilization for teaching Biology in senior secondary schools in South LGA, Kwara State

S/N	ITEMS	SA (%)	A (%)	D (%)	SD (%)
1	Does your school have necessary infrastructure (computer, internet access, e.t.c) to use ICT for teaching biology?	10 (33)	5 (17)	5 (17)	10 (33)
2	Does your school have a dedicated space (computer lab) for using ICT resources for teaching biology?	15 (50)	7 (23)	3 (10)	5 (17)
3	Does your school have access to a variety of ICT resources (online textbook, simulator, virtual tabs, e.t.c) for teaching biology?	15 (50)	5 (17)	5 (17)	5 (17)
4	Are you provided with the necessary training and support to use ICT resources for teaching biology??	5 (17)	10 (33)	10 (33)	5 (17)
5	Do you agree that your school has policies and procedures in place for using ICT resources for teaching biology?	5 (17)	10 (33)	5 (17)	10 (33)

Table 1 presents the teachers' responses. According to the results, 50% agree that teachers' attitudes influence students' academic performance in biology, while the other 50% disagree. Additionally, 50% of the teachers affirm that their schools have dedicated spaces for using ICT resources for teaching biology, while 50% disagree. Furthermore, 67%

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of respondents indicate that their schools have access to a variety of ICT resources for teaching biology, while 32% disagree. Half of the teachers believe they receive the necessary training and support for using ICT resources in teaching biology, whereas 50% disagree. Finally, 50% of respondents agree that their schools have policies and procedures in place for using ICT resources in biology instruction, while 50% disagree.

Research Question 2: How does the availability and utilization of ICT in Biology instruction vary based on teachers' gender in senior secondary schools?

Table 2: Summary of availability and utilization of ICT in Biology instruction varies based on teachers' gender in senior secondary schools

S/N	ITEMS	SA (%)	A (%)	SD (%)	D (%)
6	Do you agree that male and female biology teachers have equal access to ICT resources?	13 (43)	19 (33)	6 (20)	1 (4)
7	Do you disagree that male and female biology teachers have equal access to ICT resources?	4 (13)	11 (37)	11 (37)	4 (13)
8	Do male and female teachers use ICT resources differently?	6 (20)	12 (40)	8 (27)	4 (13)
9	Are there differences in the benefits and challenges of using ICT between male and female teachers?	3 (10)	8 (27)	14 (46)	5 (17)
10	Are there any differences in the recommendations for improving ICT use based on gender	3 (10)	7 (23)	15 (50)	5 (17)

Table 2 indicates that 76% of respondents generally agree that male and female biology teachers have equal access to ICT resources, while 24% disagree. Additionally, 50% of respondents expressed disagreement regarding whether male and female teachers have equal access to these resources, with 50% affirming the opposite. Furthermore, 60% of respondents believe that male and female teachers utilize ICT resources differently, whereas 40% disagree. Regarding the differences in benefits and challenges of using ICT between male and female teachers, 37% of respondents agreed, while 63% disagreed. Lastly, only 23% of respondents agreed that there are differences in recommendations for improving ICT use based on gender, with the remaining 67% disagreeing.

Research Question 3: In what ways do teachers' academic qualifications impact the availability and use of ICT in teaching Biology?

Table 3: Summary of ways teachers' academic qualifications impact the availability and use of ICT in teaching Biology

S/N	ITEMS	SA (%)	A (%)	D (%)	SD (%)
11	Do teachers' qualifications influence students' academic performance in biology?	12 (40)	13 (43)	3 (10)	2 (6)
12	Do teachers with different academic backgrounds perceive ICT resources differently?	4 (13)	18 (60)	6 (20)	2 (7)
13	Does the level of academic qualification influence the frequency of ICT use in biology lessons?	5 (16)	14 (46)	11 (37)	-
14	Do u disagree that ICT resources are more beneficial for teachers with higher academic qualifications?	6 (29)	6 (20)	14 (47)	4 (13)
15	Do you agree that ICT resources are more useful for teachers with more experience?	10 (33)	13 (43)	5 (17)	2 (7)

Table 3 presents the teachers' responses based on academic qualifications. The results indicate that 83% of the teachers generally agree that academic qualifications influence students' academic performance in biology, while 17% disagree. Additionally, 73% believe that teachers with different academic backgrounds perceive ICT resources differently, whereas 27% disagree. Furthermore, 63% agree that the level of academic qualifications affects the frequency of ICT

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use in biology lessons, while 37% disagree. Moreover, 40% agree that it is debatable whether ICT resources are more beneficial for teachers with higher academic qualifications, while 60% disagree. Finally, 76% generally agree that ICT resources are more effective for teachers with greater experience, while 24% disagree.

Research Question 4: How do teachers' years of experience influence the availability and utilization of ICT in Biology instruction?

Table 4: Summary of teachers' years of experience influences the availability and utilization of ICT in Biology instruction

S/N	ITEMS	SA (%)	A (%)	D (%)	SD (%)
16	Do teachers with more experience use ICT resources more effectively?	9 (30)	15 (50)	5 (17)	1 (3)
17	Does teaching experience affect the attitude toward ICT in biology lesson?	6 (20)	16 (53)	5 (17)	3 (10)
18	Do you strongly agree that teachers with more teaching experience are more likely to use ICT resources?	20 (67)	3 (10)	7 (23)	-
19	Are teachers with more teaching experience likely to use ICT resources?	2 (7)	24 (80)	4 (13)	-
20	Do you agree that teachers with more teaching experience find ICT resources more useful?	18 (60)	10 (33)	2 (7)	-

Source: Field Survey, 2023.

Table 4 presents the teachers' responses regarding the influence of teaching experience. The results indicate that 80% agree that teachers with more experience use ICT resources more effectively, while 20% disagree. Additionally, 73% of respondents generally agree that teaching experience affects attitudes toward ICT in biology lessons, while 27% disagree. Furthermore, 77% strongly agree that teachers with greater teaching experience are more likely to use ICT resources, while 23% disagree. Moreover, 87% agree that teachers with more teaching experience tend to use ICT resources more frequently, whereas 13% disagree. Lastly, 93% of respondents believe that teachers with more teaching experience find ICT resources more useful than those with less experience, while 7% disagree.

Discussion

The study investigated the availability and utilization of ICT tools in teaching Biology among senior secondary school teachers in South LGA, Kwara State. The results indicate that most ICT tools necessary for teaching are not available in secondary schools, and the few that are available are underutilized by teachers. The findings align with those of Ahmed et al. (2018) who reported a lack of ICT tools in schools for teaching in Kwara State. Similarly, Bullard (2017) noted the scarcity of resources such as telephones, satellites, email, the internet, and websites in schools. Interestingly, the analysis found that GSM devices and computers are present in many schools, likely due to Biology teachers using their personal mobile phones and laptops. Furthermore, the analysis revealed that the underutilization of available ICT tools is consistent with the findings of Ndirika and Kanu (2018), who reported low levels of ICT infrastructure use among science teachers in Abia State. This is corroborated by Igboegwu et al. (2022), who found that many senior secondary school Biology teachers in Anambra State were not using ICT in their teaching. Despite the availability of GSM and computers, the study indicated that these tools are seldom used.

Additionally, the results showed that even with efforts to sensitize teachers about the importance of ICT in enhancing Biology teaching, many secondary schools lack proper ICT resources, and teachers do not effectively utilize them. This finding contradicts the principles outlined in policy documents and raises concerns about the effectiveness of these policies, as concluded by Bullard, (2017). Therefore, ensuring the provision of adequate ICT resources and promoting their effective use by Biology teachers is crucial for improving Biology education.

The study identifies significant relationships between several factors and the effective teaching of Biology at senior secondary schools in South LGA, Kwara State. Specifically, there is a notable connection between the availability of

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information and communication technology (ICT) and effective teaching practices. Additionally, teacher gender influences the level of ICT utilization in Biology instruction, as does the teachers' academic qualifications. Furthermore, the years of teaching experience also significantly impact the extent to which ICT is utilized in teaching Biology. These findings highlight the importance of addressing these factors to enhance the effectiveness of Biology education in the region.

Conclusion

This study has shown that ICT tools are insufficiently available in most of the sampled schools in South LGA, Kwara State, and that the tools that are available are not being effectively utilized by Biology teachers, despite the recognized benefits of ICT infrastructure for Biology education. It concludes that information and communication technology is not readily accessible in the majority of these schools, and the effective utilization of the available resources is lacking. Furthermore, the study highlights that factors such as teachers' gender, academic qualifications, and years of teaching experience significantly influence the level of ICT utilization in teaching Biology.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Government at all levels should ensure the adequate provision of Information and Communication Technology (ICT) tools in senior secondary schools and across all levels of education to support effective teaching and learning.
2. Biology teachers should receive training on the proper handling and efficient utilization of available ICT tools to enhance their teaching practices. Additionally, they should commit to utilizing these resources appropriately in their Biology instruction.
3. Biology teachers are encouraged to attend seminars, conferences, and workshops to equip themselves with the skills needed to effectively use information technology tools in teaching Biology and to meet global challenges.
4. There should be initiatives to motivate and encourage Biology teachers to integrate ICT tools into their teaching practices effectively.

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