PERCEIVED INFLUENCE OF ICT ON SECONDARY SCHOOL STUDENTS' PERFORMANCE IN BIOLOGY IN MAKURDI, BENUE STATE, NIGERIA

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Abstract

This study investigated Information and Communication Technology's perceived influence on Senior Secondary School 2 students' performance in Biology in Makurdi, Benue State, Nigeria. Three research questions and hypotheses guided the study. A descriptive survey research design was adopted for the study. The population of this study consisted of 7,727 students in the Local Government Area. A sample size of one hundred and twenty (120) SS2 science students was drawn from the total population using a stratified random sampling technique. The instrument used for data collection was tagged "Perceived Influence of ICT on Biology Performance Questionnaire (PIIBPQ)". Mean and standard deviation were used to answer the research questions, and chi-square to test the hypotheses at a 0.05 level of significance. The study revealed that students perceived ICT to be helpful to improve their performance in Biology, but the facilities were not available and accessible in the teaching and learning of the subject in Makurdi LGA, Benue State. It was recommended, among other things, that ICT use in the teaching and learning of Biology should be introduced at the senior secondary level to improve students' performance in the subject.

Keywords: ICT, Biology performance, senior secondary school

Background to the Study

Education is the process of facilitating learning or the acquisition of knowledge, skills, values, morals, beliefs, and habits. It can occur in formal or informal settings, and any experience that has a formative effect on how one thinks, feels, or acts may be considered educational. Education develops a country's economy and society and is considered a milestone in national development (Kuranking et al, 2023; Onebunne, 2022).

Historically, education, especially in subjects like biology, was mostly theoretical, relying heavily on lecture-based instruction with minimal use of practical or demonstration methods. Secondary school students who had difficulty understanding certain biology topics lacked the resources to supplement their learning outside the classroom. They often had to depend on family members who may not have had the necessary subject knowledge (Arinde & Mohammed, 2021; Oboqua et al, 2017). In contrast, with the integration of Information and Communication Technology (ICT), students now have access to diverse digital resources and internet-based learning materials, allowing them to study biology more effectively and independently both at home and in school (Achor, Igyu & Ogah, 2020; Oboqua et al, 2018).

In addition, students relied on libraries, which often lacked sufficient materials, but now books and educational content are widely available online, improving access to knowledge. ICT

has enhanced educational practices by supporting continuous learning, critical thinking, data analysis, and personalized instruction. In a recent study in Anambra State, while most biology teachers had basic ICT skills, there were gaps in the effective integration of these skills into classroom instruction (Ugbaja & Okeke, 2020) While this study focuses on student performance, it is essential to recognize that quality teaching and learning are fundamental to any meaningful evaluation. Some Nigerian states have taken steps to provide ICT facilities in secondary schools, including e-learning tablets and computers. However, in practice, ICT use in biology lessons remains low. In Calabar Metropolis, for example, only 16.98% of biology teachers regularly integrated computers into their instruction (Inyang & Uchegbue, 2024, Olofu et al, 2019).

Biology is a core subject in the Nigerian secondary school science curriculum and a prerequisite for professional courses like medicine, biochemistry, and agriculture. Ideally, biology should be taught in well-equipped laboratories. However, most secondary schools lack adequate lab facilities. In recent years, the global shift toward digital learning has promoted ICT-based instruction, including online videos and interactive resources. Effective biology teaching requires active student engagement, which can be enhanced through ICT tools such as videos and animations that appeal to multiple senses. In science, the use of many senses appeals more to the learners and makes learning more meaningful. Videotape as an ICT device appeals to the senses of sight and hearing, respectively. ICT Instructional materials are usually self-explanatory and save the energy the teacher would have used in talking. However, the use of ICT can help understand a difficult subject easily. A survey in Bangladesh has shown that learning becomes interesting and lively through the use of multimedia equipment in the classroom through the active participation of learners in the learning process. It is especially important in biology as computers can present information visually through well-prepared pictures, three-dimensional models, animations, interactive environments, etc. (Wang, 2017; Farhana & Chowdhury, 2019; Adie et al, 2020; Olofu et al, 2017; Inyang et al, 2022).

Although ICT integration is resource-intensive, it remains one of the most effective and globally adopted teaching innovations. Computer-Assisted Instruction (CAI) can complement traditional methods such as demonstration and discovery. A recent study in Kaduna Metropolis highlighted limited use of ICT in biology classrooms despite the availability of technology, underscoring the need for more training and resource support (Festus, 2024). The shift from teacher-centered to learner-centered education, facilitated by ICT, has become a global trend. In Nigeria, this shift is reflected in efforts to expand digital learning opportunities. A study in Lagos State found that while ICT tools improved learning engagement and interest, challenges such as limited access and poor infrastructure remained barriers (Afolabi & Adebanjo, 2023; *Bessong et al, 2024,* Meremikwu et al**,** 2022; Adie et al, 2019; Olofu et al 2021' Kankpang, 2022).

ICT enables visual presentations of biological concepts through animations, 3D models, and simulations, improving comprehension. Given the importance of biology in shaping scientific understanding and career pathways, ICT-enhanced teaching is essential. However, critical questions remain: Are ICT resources available and accessible to all students? To what extent are these resources used effectively? These concerns form the basis of this study (Bessong et al, 2021).

Research Questions

To guide the study, the following questions were asked:

1. What is ICT's perceived influence on students' performance in Biology in Makurdi, Benue State?
2. How do students view the availability of ICT facilities in the teaching and learning of biology in Makurdi, Benue State?
3. How do students view access to ICT facilities in the teaching and learning of biology in Makurdi, Benue State?

Hypotheses

This study was guided by the following hypotheses at a 0.05 level of significance:

Ho1: There is no significant influence of the use of ICT facilities on the performance of students in biology.

Ho2: There is no significant association among students' responses on the accessibility of ICT tools/facilities in Makurdi LGA.

Ho3: There is no significant association among students on the availability of ICT tools/facilities in biology in Makurdi LGA.

Methodology

The survey research design was adopted for the study. This design is commonly used to collect detailed descriptions of existing educational phenomena to produce data that justify current conditions and practices in educational settings. The population of this study consisted of 7,727 government grant-aided Senior Secondary School two students in Makurdi Local Government Area (Benue State Teaching Service Board, 2020). The sampling was based on only senior secondary schools in the state having ICT facilities for classroom instruction. To this end, a sample size of one hundred and twenty (120) SS2 science students was drawn from the total population using a stratified random sampling technique. The instrument used for data collection was tagged "Perceived Influence of ICT on Biology Performance Questionnaire (PIIBPQ), which was in two parts: Biodata and questionnaire items. The questionnaire items were on a 4-point scale, where negatively skewed items were reverse-coded. The questionnaire was administered and collected immediately after completion to ensure a full return rate. The data was analysed using SPSS for Windows version 21, where means and standard deviations were applied to answer the research questions, while chi-square statistics were used to test the hypotheses at 0.05 level of significance.

Results

The data is presented in tables the analysis is made after each table. The tables are presented following the sequence of the research questions and hypotheses.

Research question one: How do ICT facilities affect student performance in the teaching and learning of Biology in secondary schools in Makurdi, Benue State?

Table 1: Descriptive Statistics for ICT Perceptions of Students on Performance in Biology

S/No.	Item description	N	Mean	Std. Deviation	Decision
1	I get more interested in learning biology using ICT tools such as computers, projectors, tablets, etc.	120	2.93	.645	Agreed
2	Biological concepts are noteasily understood when taught with ICT tools such as Overhead Projectors.	120	2.83	.603	Disagreed
3	Teachers' application of ICT tools such as projectors, computers, and tablets. etc.,teaching Biology does not help improve my grades.	120	2.87	.634	Disagreed
4	Using ICT tools, such as researching biological topics online, improves my grades in biology.	120	2.88	.624	Agreed

5	With the help of the internet, I learn faster because I do research on my own after classes and look up my assignments.	120	2.88	.728	Agreed
6	ICT tools increase the rate of involvement of students in learning in secondary schools since no one would like to be left behind in the ICT innovation.	120	2.93	.610	Agreed
	Valid N (listwise)	120			

Table 1 shows that the students agreed with all the positive items and disagreed with the negative items. This is interpreted using the cut-off mean of 2.5 since all the responses were above the cut-off point. Their responses are also homogeneous, by the small standard deviations. This indicated that when they used ICT facilities either in school or at home, it appeared to have improved their performance in Biology in Makurdi Local Government Area, Benue State.

Research question two: Are the ICT Facilities readily available in the teaching and learning of biology in secondary schools in Makurdi, Benue State?

Table 2: Descriptive Statistics for the Availability of ICT Facilities in Makurdi LGA, Benue State for Teaching and Learning Biology

S/No.	Item description	N	Mean	Std. Deviation	Decision
7	ICT tools are readily available for the teaching of biology in my school.	120	1.88	.588	Disagreed
8	The school authorities provide ICT tools like computers, projectors, and interactive boards.	120	1.81	.569	Disagreed
9	There is no functioning computer Lab in the school.	120	1.75	.583	Disagreed
10	There is no provision of internet or electricity in the school.	120	1.95	.732	Disagreed
11	The school conducts ICT-related training for both students and teachers.	120	1.94	.584	Disagreed
12	Information is much more easily available by using ICT tools.	120	2.88	.568	Agreed
	Valid N (listwise)	120			

Table 2 reveals that there is a low availability of ICT facilities and training for Biology teachers and students in ICT. This is indicated by small means that are lower than the cut-off of 2.5, except for item 12, which is a positive item. Hence, it can be deduced that there is a low availability of ICT facilities in the teaching and learning of ICT in Makurdi LGA, Benue State.

Research question three: Do biology students have access to ICT facilities in secondary schools in Makurdi, Benue State?

Table 3: Descriptive Statistics for the Use of ICT Facilities in Makurdi LGA in Teaching and Learning of Biology

S/No.		N	Mean	Std. Deviation	Decision
13	ICT tools are not readily accessible in teaching and learning biology.	120	1.82	.594	Agreed

14	I have access to ICT tools like computers, projectors, interactive whiteboards, computer labs, and internet access provided by the school authorities.	120	1.94	.714	Disagreed
15	There is Proximity of ICT facilities to the students.	120	1.94	.737	Disagreed
16	Information is much more easily accessible by using ICT tools than by using books.	120	2.94	.714	Agreed
	Valid N (listwise)	120			

The data in Table 3 shows that there is poor accessibility and use of ICT facilities in Makurdi LGA, Benue State. For example, the students disagreed that there was a proximity of ICT facilities for the teaching and learning of Biology in the area. The Table shows low responses but is homogeneous.

Hypothesis 1: There is no significant influence of the use of ICT facilities on the performance of students in biology.

Table 4: Chi-square Statistics for the Responses of Students on the Effect of ICT on Performance in Biology

Chi-square statistics	**Value**	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	6.787[a]	9	.659
Likelihood Ratio	8.354	9	.499
Linear-by-Linear Association	.160	1	.689
N of Valid Cases	120		

The results in Table 4 show that both male and female students studying Biology in the Makurdi LGA agree ($p = 0.689 > 0.05$) that the use of ICT for learning enhances their performance in the subject. This means that ICT significantly increases the performance of students according to their responses. Thus, hypothesis one is rejected.

Hypothesis two: There is no significant association among students on the availability of ICT tools/facilities in biology in Makurdi LGA.

Table 5: Chi-square for the Responses of Male and Female Students on the Availability of ICT Facilities

Chi-square statistics	**Value**	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	13.585[a]	8	.093
Likelihood Ratio	15.335	8	.053
Linear-by-Linear Association	.806	1	.369
N of Valid Cases	120		

Table 5 results reveal that both the male and female students agree that there was a lack of ICT facilities for the effective teaching and learning of Biology in Makurdi LGA, Benue State. This is indicated by the chi-square value of $p = 0.369 > 0.05$. Thus, hypothesis two is also rejected.

Hypothesis three: There is no significant association among students' responses to the accessibility of ICT tools/facilities in Makurdi LGA.

Table 6: Chi-square for the Responses of students on the Use of ICT in Teaching Biology

Chi-square statistics	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.707[a]	8	.122
Likelihood Ratio	14.866	8	.062
Linear-by-Linear Association	.327	1	.567
N of Valid Cases	120		

The results in Table 6 show that there was an association between the responses of male and female students about their perception of the use of ICT facilities in the teaching and learning of Biology in Makurdi LGA, Benue state. This is indicated by $p = 0.567 > 0.05$. Hence, hypothesis three is also rejected.

Discussion of Findings

The findings of this study reveal that students perceive Information and Communication Technology (ICT) as a valuable tool that enhances their academic performance in Biology when effectively utilized. ICT facilitates better understanding through visualizations, simulations, and access to real-time information, transforming traditional science education into an interactive and engaging experience.

Despite these positive perceptions, the study identified a significant scarcity of ICT facilities in the study area, limiting opportunities for both teachers and students to integrate technology into the learning process. This infrastructural gap hinders the potential benefits of ICT, particularly in promoting student engagement and retention of scientific concepts. Supporting this, Babalola, Olumorin, Adetunji, and Omolafe (2023) demonstrated that students taught using low-cost 3D models of plant and animal cells showed significant improvement in understanding, regardless of gender or school type. Similarly, Moffat, Thomas, and Umanah (2023) found that the use of media instructional packages significantly enhanced students' achievement in the circulatory system concept.

Furthermore, both male and female students in this study unanimously reported that the general use of ICT tools in Biology classrooms within Makurdi Local Government Area (LGA) is inadequate. This inadequacy may contribute to suboptimal academic performance in the subject. Farhana and Chowdhury (2019) noted that web-based instructional methods present information in a non-linear and user-driven format, allowing students to navigate learning at their own pace through interactive elements. However, such opportunities are largely inaccessible to students in environments where ICT use is minimal or non-existent.

The effective use of ICT in education is not solely dependent on the availability of equipment; it also requires the competence and readiness of teachers to integrate technology into their instructional practices. Ghavifekr and Rosdy (2015) argue that well-prepared teachers can design interactive, student-centered lessons using ICT tools, thereby improving students' academic performance and engagement. In the absence of adequate training, however, even the best ICT infrastructure may go underutilized. This is corroborated by Inyang and Uchegbue (2024), who found that while a majority of Biology teachers possessed basic ICT skills, only a small fraction demonstrated higher-level competencies necessary for effective integration into teaching. Similarly, Ugbaja and Okeke (2020) reported that secondary school Biology teachers in Anambra State lacked the required ICT competence to effectively use ICT facilities in teaching Biology concepts.

Moreover, Filgona, Sikiyo, Gwany, and Okoronka (2020) emphasized that ICT fosters student-centered learning by stimulating learners to engage in collaborative and independent learning experiences. These interactive learning experiences are particularly valuable in a

subject like Biology, which requires visualization and practical application of theoretical knowledge.

Additional studies highlight systemic challenges in ICT integration. Aladeokin and Shehu (2022) found that while some ICT tools like computer laboratories and generators were available in Ondo State secondary schools, their utilization by teachers for effective Biology instruction was limited. Dogo et al. (2021) and Inyang (2022) reported that in Bauchi State, although ICT facilities like laptops and projectors were present, a significant percentage of teachers lacked proficiency in using them, citing lack of training and time constraints as major barriers. Similarly, Aziaka and Nwogu (2023) identified the unavailability of ICT facilities, erratic power supply, and lack of ICT skills among teachers as significant barriers to ICT integration in science education in Rivers State.

In summary, while students acknowledge the role of ICT in enhancing their understanding and performance in Biology, significant barriers such as a lack of infrastructure and inadequate teacher preparedness continue to hinder its effective use in Makurdi LGA. The findings of this study, supported by prior research, suggest that to fully harness the benefits of ICT in science education, there is an urgent need for systemic investment in ICT infrastructure, targeted teacher training, and the development of ICT-based instructional materials tailored to the local context. Only through such comprehensive efforts can the transformative potential of ICT in education be realized.

Conclusion

The findings of this study highlight the significant potential of Information and Communication Technology (ICT) to enhance the teaching and learning of Biology among secondary school students. Students recognize the positive impact of ICT on their understanding and performance when it is effectively integrated into instruction. However, the study also highlights major challenges, including limited availability of ICT facilities, insufficient teacher training, and poor implementation practices that hinder the effective use of technology in the classroom, particularly in Makurdi Local Government Area.

Recommendations

Based on the findings of the study, the following suggestions are hereby made:

1. ICT use in Biology should be introduced at the senior secondary level to improve students' performance in the subject.
2. Male and female students should be given equal opportunity to use ICT facilities in secondary schools.
3. There should be improved access to ICT facilities at home and schools by parents and school owners as well and the government.

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