



# Impacts of ICT as Tools in Teaching Biology in Senior Secondary Schools

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## Abstract

Information and Communication Technology (ICT) has been pivotal in training across the world. Due to the abstractness of Biology in schools, it is essential to develop an effective strategy of ICT tools to improve student's learning process. Similarly, biology helps people understand how organisms adapt to their environment and the importance of biodiversity in sustaining our planet's delicate balance. Therefore, this study investigates the impacts of ICT as instructional material in teaching and learning biology and its gender dimension in senior secondary school at Ado-Odo Ota local government area of Ogun State, Nigeria. The sample size for this research was 240 which consisted of 180 Biology students and 60 Biology teachers. The research questions were investigated with descriptive statistics; Frequency and percentage with the Statistical Package for Social Science (SPSS). The results show a sizable correlation between information communication and technology and the performance of students offering biology in senior secondary school at Ado Odo Ota local government area of Ogun State. It also showed a notable difference in the performance of male students taught with information and communication technology-related facilities and female students taught with ICT-related facilities in Ado-Odo Ota local government area of Ogun State. It was concluded that ICT tools in Biology class can make students more interested in learning Biology. Therefore, Biology concepts should be incorporated into ICT tools to make learning Biology worthwhile, seamless, and entertaining.

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## Introduction

Biology, a branch of natural science deals with the investigation for a deep understanding of natural phenomena and events. It is one of the central areas of scientific knowledge and is related to topics such as medicine, genetics, zoology, ecology, and public policy (Colleen et al., 2009). Biology is a broad fascinating subject that covers all aspects of life, from the basic cells to complex species. It provides a scientific understanding of everything living on earth, from plants and animals to humans. Additionally, biology helps people understand how organisms adapt to their environment and the importance of biodiversity in sustaining our planet's delicate balance. This is to highlight the importance of biology in the curriculum of secondary schools for adolescents. Kofi Anan, the former United Nations Secretary-General, in recognizing the importance of education of our young ones (adolescents) factors out that owing to achieve the aim of Universal Primary Education by way of 2015; we need to make sure that data and conversation applied sciences release the door of training systems (Mikre, 2011). This suggests the developing demand and progressively more essential region that Information and Communication Technology (ICT) has gotten hold of in education (Mikre, 2011).

Since ICT grants larger possibilities for college students and instructors to modify mastering and educating to personal requirements; society is forcing colleges to supply fantastic responses to this technical innovation. Hence, schools in the Western world invested significantly in ICT infrastructures within the past 20 years, and college students use computer systems more frequently and for a wide range of functions (Volman, 2005). In Nigeria, it seems that most college students and colleges lack amenities such as ICT facilities, these will have an effect on our media units such as projectors, and possibly may additionally enhance the teaching-learning system of the subjects in secondary schools including Biology.

Several research reveals that college students who make use of ICT amenities frequently exhibit greater knowledge of positive factors than those who do now not use ICT technological tools (Flower et al, 2003). This indicates how ICT has positively transformed all fields of humanity such as Education, Aviation, Agriculture, and Manufacturing, among others. Hence, ICTs have become increasingly important for teaching Biology. This is due to several factors, including the following:

1. ICTs allow students to access powerful tools used in biology teaching. These include spectrometers, genetic databases, microscopes, DNA sequencing tools, and more.
2. Students can use ICTs to carry out simulations or virtual experiments on topics such as evolution, cell structure, and metabolism that would often be too expensive or dangerous to perform in class without specialized equipment or hazardous substances present.

3. Teachers can bring content into their classrooms more engagingly with videos and images displayed on interactive whiteboards through online sources like YouTube which may not always otherwise be available to them at school premises.
4. The technology also allows teachers to easily share resources from remote places making cross-country activities possible even if there's limited physical conduction among participants.

Therefore, this study investigates the impacts of ICT as an instructional tool in learning and teaching biology, and its gender dimension in senior secondary school in Ado-Odo Ota local government area of Ogun State, Nigeria.

## Literature Review

### ICT and Educational Transformation in the 21<sup>st</sup> Century

The modern society is known as the knowledge age because of its increased demand for knowledge, however, demand is relatively slow, especially in Africa. The development of human capital requires a good education system. Thus, nations utilizing ICT could move beyond developmental milestones on economic improvement and participation, strengthening networks, and performing public services more effectively and efficiently (Nidup, 2020). ICT has been an important driver for education in many nations (Nidup, 2020). Notably, modern information technology can contribute to economic development; all countries are interested in its expansion and exploration.

Modern society demands that graduate students have a sound understanding of modern electronic devices, and accept computer-based technology, and other types of media that will provide a competitive advantage to them in the global labor market (Mwanda et al., 2017). So far, information technology has shown the potential to enhance education (Nidup, 2020). To harness this potential of information and communication technology, the education system must awaken the need of students to have the necessary skills (Nidup, 2020). Thus, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) proposes to give quality education for young ones to improve both the teaching pedagogy and content of education and training materials, and support innovation and information-sharing through ICT (UNESCO, 2005).

ICT bridges a lacuna in the education system; by improving the quality of education, increasing the opportunities within education, creating information, and connecting populations in remote areas through better accessibility to resources and people (Nidup, 2020). ICT has been more affordable over the years because of the development of innovations and new devices. ICT builds up the role of making it more important to adapt educational consequences to the modern labor market, revolutionize the content and presentation of education, and promote information literacy (UNESCO, 2008). Kent and Facer (2004) established that the schooling

environment is a decisive setting in which students attend on a large scale of technology-centered activities, while home serves as a supplementary place for routine engagements in a smaller dimension of computer-related activities. Progressively, information technology is used successfully in instruction, learning, and evaluation of students (Fu, 2013).

ICT has been established as a powerful tool for improved education and reformation. Several research established that the precise use of ICT can enhance the quality of education and learning related to actual-life circumstances (Lowther et al., 2008; Weert and Tatnall 2005). Weert and Tatnall's studies indicated that learning, unlike traditionally known approaches, is a continuous lifelong activity in which participants vary their anticipations by seeking information. Over time, they would have to anticipate and be willing to search out new sources of information. The ability to use ICT will be an inevitable requirement for these learners as the advancement in society demands (Mintah, 2015).

Reid (2002), has buttressed that ICT provides students with more time to detect beyond the mechanics of course content, resulting in a better understanding of concepts in the field of study. Utilization of information technology also alters the teaching and learning relationships. Results from Reid's investigation reveal that teachers were notified that the correlation between teacher and student was sometimes more evident about information technology; this correlation increases students' courage when they can assist teachers with technical problems in the classroom (Manhibi, 2019). For this reason, ICT varies from the conventional teacher-centered approach and is essential for teachers to be more creative in personalizing and adapting their materials in the educational process (Manhibi, 2019).

ICT assists learners with their learning by enhancing their connections in communication between them and their instructors (Valasidou et al., 2005). Leuven et al. (2004) added that there are zero facts in the connection between the increase in the use of ICT in education and students' performance. He established consistency in a negative direction and a marginally important correlation between ICT use and some measures of student success. In confirmation of these, some students might use ICT to enhance their free time and spend less time studying; online games and improved communication channels do not necessarily mean raised success (Amankwah, 2015). In contrast, Abdulla et al. (2008) noted that ICT can change the pedagogical process; when, how, and when learning occurs, and the positions of students and teachers in the learning process. Karim and Hassan (2007) revealed significant improvement in digital information varies on how students comprehend, and how printed materials make studying easier. Relying on the rising usage of ICT in education, there has been a demand to solve the myth about using ICT as an intervention in the educational process and its gains on students' academic performance (Mbah, 2010).

### **Essence of ICT in Biology Education**

ICT has transformed various aspects of education, including the learning and teaching processes. It has revolutionized the way biology students in senior secondary schools in Ogun State are taught and has had a significant impact on their learning outcomes (Aririguzoh et al., 2021). ICT has provided students with various resources, such as interactive digital textbooks, online databases, virtual laboratories, and educational websites. These resources enhance the students' understanding of biological concepts, improve their critical thinking and problem-solving abilities, and increase their engagement and motivation.

Furthermore, ICT has facilitated effective communication and collaboration among biology students and their teachers. The introduction of ICT in biology education has also made learning more interactive and hands-on. Through simulations, virtual dissections, and multimedia presentations, students can visualize complex biological processes and gain a deeper understanding of the subject matter. Additionally, ICT has enabled biology teachers to adopt innovative teaching methods and strategies. They can incorporate multimedia presentations, online quizzes and assessments, and real-time data analysis into their lessons. As a result, students can actively participate in their learning and develop critical thinking skills. Overall, the incorporation of ICT in biology education has proven to be beneficial for senior secondary school students in Ogun State. By incorporating ICT into biology education, students can access a vast amount of information and resources that go beyond the limitations of traditional textbooks (Stavreva et al., 2016).

### **ICT in Biology Education: Gender Dimension**

Gender differences in the academic attainment of students are a topic of significant interest and debate among researchers. With the advent of ICT, innovative instructional delivery methods have emerged, potentially impacting how male and female students respond to Biology learning solutions. Several studies have explored the effectiveness of ICT use in education, suggesting that individuals exposed to this instructional delivery method tend to perform better in terms of academic scores compared to those relying on traditional classroom lectures (Allegra, 2013; Saxena et al., 2015). It is essential to note that differences may exist between male and female students in their utilization of ICT and subsequent academic performance in Biology. Some studies have indicated that male students outperform their female counterparts in biology (Daniel et al., 2016). This gender imbalance in technology use and its potential implications for the future roles of men and women is a concern highlighted by these researchers. It raises important questions for educational practitioners, policymakers, and parents.

To further understand the relationship between gender and learning outcomes in biology, additional research is necessary. Investigating whether gender influences the effectiveness of ICT use in educational settings will contribute valuable insights for designing inclusive and effective learning circumstances.

## Methodology

### Research Design and Analysis

A quantitative experimental design was utilized for the present study, through a well-structured questionnaire for collecting information from a sample of students and Biology Teachers as seen in Table 3.1. Data were identified coherently, individually, and in connection with the whole. The data was then labeled by assigning numbers and other symbols for responses to be placed into limited categories. This is significant since the data are mostly descriptive and require translation from qualitative to quantitative form (Ong'amo et al., 2015). After the labeled data had been classified, the large volume decreased and placed in homogeneous groups to obtain a significant correlation (Ong'amo et al., 2015). Then, data were analyzed by descriptive statistics; percentage, and frequency with SPSS using descriptive statistics as indicated in Table 3.1 and Table 3.2.

### Instrument

The researcher visited the research locations to administer copies of the questionnaire to the respondents. This was done under close monitoring to ensure that the respondent filled out the questionnaire appropriately. The instruments were administered and collected back from the respondents immediately upon completion. The respondent's personal information was kept confidential, while research ethics and legal issues in research were observed strictly.

Table 1. Percentage Analysis on Teachers usage of ICT in Teaching

Gender	Teachers (n)	Percentage (%)	Students (n)	Percentage (%)
Male	15	6.25%	65	27.1%
Female	45	18.75%	115	47.9%
Total	60	25%	180	75%

*Source: Field Survey 2023*

Table 2. Percentage Analysis on Teachers usage of ICT in Teaching

Item	Daily	Weekly	All the time	Not Applied
For administration	15	33	05	07
To prepare Handouts	Nil	10	45	05
For online learning	14	30	04	12
For Power point Presentation	Nil	33	22	05
For teaching Students	07	12	35	06
Total	36 (12%)	118 (39.3%)	111 (37%)	35 (11.7%)

Source: Field Survey, 2023

### Ethical Approval

To provide face and content validity of the tool, approval was obtained from the National Teachers Institute, Kaduna, Nigeria. Their suggestions and corrections were considered in modifying the instrument. Also, clearance was obtained from the school Principals across the selected schools, and before the commencement of data collection, verbal informed consent was obtained from each participant. Data privacy was ensured by not including the names of the participants. Anonymity and confidentiality were ensured; all records and relevant materials were stored in a locked cabinet and accessed only by authorized personnel, and the respondents were assured that they were free to opt out of the study at any point whenever they wanted. Moreover, the tool reliability was ascertained through the trial testing on 30 teachers apart from those used for the main study.

### Results and Discussion

Through the assessment of the impacts of ICT on teaching biology in senior secondary schools in Ado-Odo Ota local government area of Ogun State, several key findings were identified. First, integrating ICT into biology teaching has had a significant positive effect on students' learning outcomes (Van Roy, 2012). These findings are consistent with other studies where Students' accessibility to ICT resources were reported to improve understanding of biological concepts, increased engagement, and enhanced critical thinking and problem-solving skills (Van Roy, 2012; Webb, 2005). Second, the use of ICT tools in biology education has made learning more interactive and hands-on (Webb, 2005; Reid, 2002), because this study revealed 39% of Teachers in the study area adopted ICT tools in their teaching process on a weekly basis. Students visualize complex biological processes through simulations, virtual dissections, and multimedia presentations. Similarly, online resources interactive quizzes allowed for self-paced learning and immediate feedback (Palaigeorgiou et. al., 2019).

Third, integrating ICT in biology teaching has provided students access to a large scale of current and relevant knowledge (Van Rooy, 2012). Students were able to access current research articles, watch educational videos, and access online databases and resources.

Furthermore, this study is in line with the study of Van Roy (2012), on the assessment of the impacts of ICT which revealed teachers also benefited from using ICT in biology teaching. ICT helps to increase efficiency in lesson planning and delivery, improved student engagement and participation. Teachers were able to access online educational resources and incorporate multimedia elements into their lessons, making the learning experience more dynamic and engaging for students.

## Conclusion and Recommendations

Conclusively, ICT tools in Biology classes can make students more interested in learning Biology via the exposure it gives to concepts and explanations not commonly seen in classrooms. Biology concepts could be incorporated into ICT tools to make learning Biology worthwhile, seamless, and entertaining. From the results of the current study, the following suggestions are made:

- 1) Biology concepts should be incorporated into ICT tools to make learning biology worthwhile and seamless.
- 2) Female children should be encouraged or mentored closely to increase their interest in using ICT-related gadgets in learning biology to meet up with the global standard.
- 3) Integration of computerized Biology practical should not replace but rather be incorporated as a complement to traditional method of teaching practical Biology.
- 4) Government should organize solid training for Biology Teachers, to make them fit to impact their students.
- 5) Adequate computer Technological tools should be provided for learning in all schools.

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