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Ict Assisted Gadgets and Students' Academic Performance in Biology in Abak Local Government Area of Akwa Ibom State, Nigeria

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Abstract

This study examined the effect of digital projectors and desktop computers on students' academic performance in Biology in Abak Local Government Area of Akwa Ibom State. A quasi-experimental research design was adopted. The population comprised 3,428 Senior Secondary School Two (SSS2) Biology students in ten public secondary schools during the 2024/2025 academic session. Six co-educational public secondary schools (three urban and three rural) were selected using purposive and simple random sampling techniques, with intact classes used for the study. The sample consisted of 194 SSS2 Biology students. Data were collected using the Biology Performance Test (BPT), which had a reliability coefficient of 0.78. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses at the 0.05 level of significance. The findings revealed significant differences in the academic performance of students taught using digital projectors, desktop computers, and the expository method. Significant differences were also observed in the performance of male and female students, as well as urban and rural students, across the instructional strategies. Students taught using desktop computers achieved the highest academic performance, followed by those taught with digital projectors, while students taught using the expository method performed least. The study concluded that ICT-assisted instructional tools, particularly desktop computers and digital projectors, significantly enhance students' academic performance in Biology. It was therefore recommended that educational authorities integrate these ICT tools into Biology instruction to improve teaching effectiveness and students' learning outcomes.

Keywords: Biology Education, Information and Communication Technology (ICT), Digital Projectors, Desktop Computers, Academic Performance

1.0 Introduction

The study of science at the senior secondary school level is incomplete without students being adequately exposed to the study of Biology. Biology is a branch of natural science concerned with the study of life and living organisms, including their structures, functioning, growth, evolution, distribution, identification and taxonomy (Duru, Uko, & Utibe, 2024). Being a science of life, Biology occupies a very important position in the senior secondary school curriculum.

In Nigeria, Senior Secondary School Biology Curriculum is designed to prepare students to acquire adequate laboratory and field skills, meaningful and relevant knowledge in Biology. It is also to enable students apply scientific knowledge to everyday life, in matters of personal, community health and agriculture among others (Federal Ministry of Education, 2019).

Onyegegbu (2016) reveals that Biology provides a platform for teaching students to develop the ability to apply science concepts and principles in solving everyday life problems and building a progressive society. There are records in the field of Biochemistry, Physiology, Molecular Biology among others, that made Biology a central focus in most human sphere of life like respiration, radiation, family life, food scarcity management and conservation of natural resources as well as ethics. The importance of effective teaching and learning in Biology cannot be overstated, especially at all levels of education. To achieve this, the introduction of Information and Communication Technology has revolutionized the classroom environment, making it imperative to create a 'wired' classroom environment. In this context, Information and Communication Technology (ICT) plays a vital role in enhancing the teaching and learning of Biology (Ukpong et al., 2026).

Information and Communication Technology (ICT) in education refers to the use of computer- based communication that is incorporated into daily classroom instructional process. In this 21st century, education advances with the help of technology. It is crystally clear that the modern-day classroom needs are very different from the traditional classroom needs (Uko & Uko, 2020). Interactivity, flexibility and convenience have become the order of the day in ICT supported environment. ICT opens up opportunities for learning because it enables learners to access, extend, transform and share ideas and information in multi-modal communication style and format (Akpan, Udofia & Nkoyo, 2016). The rapid development of computer and communication technology has contributed to teachers' use of ICT for classroom instructions (Udofia & Sambo, 2019; Salini & Reeves, 2017) hence, the use of ICT assisted gadgets integration in the classroom is vital. ICT offers an array of technical tools that improve the academic experience, creating a potential for variety, diversity and better organization in education. Akpan, (2024) propounded that in a developing country like Nigeria, the use of "ICT" in the teaching of Biology should be promoted in all secondary schools since the national policy on education has already stated that the broad aims of secondary education within overall national objectives should be preparation for higher education. In specific terms, secondary education should equip students so that they can live effectively in this modern age of science and technology (Federal Ministry of Education, 2019). According to Akpan, Udofia and Nkoyo (2016), the integration of computers and communication offers unprecedented opportunities to the education system with its capacity to integrate enhance and interact with each other over a wide geographical distance in a meaningful way to achieve the learning objectives.

Revolution in ICT has made remarkable impact in the 21st century. In Cronjé (2018) description, ICTs have revolutionized the way people work today and are now transforming education systems. As a result, if schools train students with yesterday's skills and technologies, they may not be effective and fit for tomorrow's world. This is a sufficient reason for ICTs to be accorded global recognition and attention. ICTs are dependable tools in facilitating the attainment of one of the Millennium Development Goals (MDGs), which is achievement of Universal Basic Education by the year 2015. Kofi Anan, the former United Nations Secretary General, had long pointed out that, in order to attain the goal of Universal Primary Education by 2015, it must be ensured that information and communication technologies unlock the door of education systems (Ratheeswari, 2018). This is indicative of the growing demand and increasingly important place that ICTs could receive in education. Since ICTs provide greater opportunities for students and teachers to adjust learning and teaching to individual needs, society is forcing schools to give appropriate response to this technical innovation (Akpan, Udofia & Nkoyo, 2016; Mwanda, et al., 2017).

There is an increasing affinity of students for new technologies and products as there is a huge potential for technology to be integrated into education industry (Udofia & Sambo, 2019; Salini & Reeves, 2017). Students are now embracing 'self-learning' through e- learning teaching models which act as a significant communication bridge between students and teachers (Ratheeswari, 2018). ICT help both teachers and students to learn about their respective subject areas. When students are familiar with ICT, learning better with ICT-based environment become easier. There is no doubt that Information and Communication Technology (ICT) is a tool that can be applied to all aspects of human endeavor including teaching and learning (Akpan, Udofia & Nkoyo, 2016; Salini & Reeves, 2017).

The deployment of Information and Communication Technology in Biology education is making major differences in learning and teaching approaches. Schools in the western world have invested a lot in ICT infrastructures over the last 20 years, and students use computers more often and for a much larger range of applications (Onyegegbu, 2016). Information and Communication Technology assisted gadgets for instructions in education are used to enhance creativity, interaction and knowledge sharing which are key to learning. Also, during the last two decades, institutions of higher knowledge have invested heavily in information and communication technologies (ICT). ICT assisted gadgets have made a major impact in the university context, in organizations and in teaching and learning methods (Youssef & Dahmani, 2018). Sunday, Umanah & Udofia (2025) reported a significant improvement in students' performance exposed to computer-based molecular modelling package.

Figure 1: ICT-assisted gadgets



ICT assisted gadgets can be defined as computer-based gadgets for gathering and using information. According to Rashid and Asghar (2016), government started a global investment in the use of ICT assisted gadgets to improve teaching and learning in schools. This has paved way for substantial educational opportunities for students. In Nigeria, several sectors of the economy including the educational sector have already adopted ICT as a tool for innovations, processes and procedures. The adoption of ICT assisted gadgets in developing countries is said to be limited because of the cost implications of procurement, lack of maintenance culture in managing ICT facilities, dearth of technical know-how and so on. The process of adopting the ICT assisted gadgets for instructions is not a single step, but an ongoing and continuous steps that fully support teaching-learning and information resources (Machado & Chung, 2015). ICT has the potential to contribute to substantial improvements in the educational system (Udofia & Sambo, 2019; Ratheeswari, 2018), it can also be used to improve the quality of teaching and learning in the school system as well as injecting innovations.

The ICT assisted gadgets are inclusively classified as projected and non-projected, computers, the Internet, broadcast technology (radio and television), and telephone communications (Al-Mamary, 2020). The use of ICT assisted gadgets in appropriate contexts in education would not only enhance teaching and learning, but also adds value by aiding the effectiveness of learning, or by adding a new dimension which has not been previously used in learning. ICT assisted gadgets for instructions may also be a significant motivational factor in students' learning and can support students' engagement with collaborative learning. For example, students can now access the Internet from their home computers, which have the potential to reduce the barriers of classroom instruction and provide teachers with many new opportunities for instruction. ICT has opened new career opportunities for students who are driven to explore and learn at their own pace and time. But for the purpose of this research, the researcher will focus on the use of Projector and desktop computer ICT assisted gadgets.



2: Digital projector

Projector is one of the ICT assisted gadgets in education which encourage students to participate in active learning. The projected classroom is one of the innovational approaches of teaching and learning in which students view lessons

during teaching and learning activities in classroom (Nikolopoulou & Gialamas, 2015). The use of projector allows the students to have a deeper learning experience when the teacher guides them through the lesson in the class. The lower cognitive work is done at home while the higher cognitive learning is done in class with the teacher. The teacher in this case serves as a facilitator, motivating, guiding, and providing input on students' results (McKnight, O'Malley, Ruzic, Horsley, Franey & Bassett, 2016). Hence, by using Projector as ICT assisted gadget, innovational classroom approach for teaching and learning practices, the teacher can prepare lessons which are projected, and students can view and list them in the class while they learn. This type of activity also increases student's collaborative and ICT assisted learning skills in the classroom with a basic understanding of the subject information imparted by the ICT assisted gadget and in collaboration with the teacher and peers to complete what is commonly known as homework in class (Itighise & Wordu, 2016). Similar to the use of Projector, is the desktop computer ICT assisted gadget.



Figure 3: Desktop computer

Desktop Computer is an electronic device, capable of accepting data through the input device, processing data through the system unit (SU), sending out the result through the output device or store it for future use. It is considered as instructional gadget which would be subsumed into visual materials. In this format, Biology students learn only through the visual sensory modality through the use of computer (Nikou & Economides, 2016). The computer ICT assisted gadget in this study shall limit its application of visual medium to mode of lesson presentation such as graphs, drawing, diagrams, sketches, textbooks. However, some variables such as gender and school location may influence students' mode of learning as well as their academic performance.

Gender is a set of characteristics distinguishing between males and females, particularly in the cases of men and women (Duru, Uko & Utibe, 2024). According to Nworgu (2015), Akpan, & Akpan, (2017) there is an acknowledged problem of female under-performance when compared with their male counterparts apparently under equivalent conditions, and this problem of female under-performance appears to be more pronounced in Science and Mathematics. Duru, Uko and Utibe (2024), noted that gender issue is an important factor in educational settings and could be a hindrance to high performance of learners in Biology. Some research works have shown contradicting evidences in Biology due to gender. For instance, in students' academic performance in Biology due to gender, Onekutu and Onekutu (2014) also showed a significant gender influence on Biology students' usage of learning techniques (practice, organization, effort, and time management). Ekineh and Adolphus (2019); Umanah and Sunday (2022) revealed no significant difference between male and female learning results when taught utilizing creative, hands-on, and student-centered teaching techniques. Sunday, Edet and Akpan (2025) found no difference in performance of male female students exposed to computer assisted instruction. This may imply that the effectiveness of using proper measures may have contributed to closing the gender gap. Duru, Uko, and Utibe (2024) in their study found out that there is a significant difference in the academic performance of male and female students in Biology when presented with instructional materials. The location of school may also have an impact on students' academic performance; thus, it is important to consider this variable in this research study.

The location of a school determines to a large extent, the level of student's performance. Akpan (2022), Duru, Uko and Utibe (2023) in their study, opined that school location implies urban-rural setting. Urban schools are those schools in the municipalities or schools found within the towns and rural schools are those located in the villages or semi-urban areas. Biology, just like any other science subject, is influenced by the area in which the school is cited. This affects both the teachers and the learners alike. For instance, a school located in a serene environment such as the Government Reserved Area (GRA) and the ones beside motor parks, noisy environment and commercial nerve centers and border towns cannot be compared in terms of suitability of learning. Hence, the location of a school may determine the academic performance of students.

Academic performance is vital in Education. It is usually counter-productive for learners to undergo a course of learning over specific time frame without recording a high degree of academic achievement. Uko and Uko (2024) consider

academic achievement as the most critical aspect of an instructional encounter. Learners must show mastery and internalize what they have been taught. For learners to excel, they have to be exposed to teaching and learning approaches that will enhance optimal performance and retention. One of such approaches is the utilization of information and communication technology (ICT) assisted gadgets during instruction in Biology.

The West African Examinations Council, Chief Examiners' report of 2023 revealed that students' performance in Biology examination is not encouraging. An examination of the performance of Biology students mirrored a decline in the percentage of Biology candidates obtaining credit grades. In spite of the importance of Biology, students' performance at senior secondary school level remains low (WAEC, 2019). Statistics show that not up to 60% pass at credit level has been recorded in May/June Senior Secondary Certificate Examination (SSCE) in the subject (WAEC, 2023). The senior secondary school Biology candidates have a number of problems associated with both the cognitive and motor skills which have culminated in the low performance in the certificate examination, (Chief Examiner's report, 2023). Such problems identified in the Chief Examiners report (2023) are as follows lack of specific knowledge and inability to exploit; lack of deeper understanding and inability to explain, interprets and apply Biology principles; Lack of deeper understanding of cognition; Inability to use proper biological terms where appropriate and lack of deeper understanding of biological concept.

It should be noted and accepted that students' performance in Biology is a function of instruction (Umoke & Nwafor, 2015). Several factors could be responsible for students' low academic performance in Biology in Akwa Ibom State. Akinette (2016) asserted that teachers' mode of presentation of various biological concepts affect students' performance in the subject. One of the most important factors in the learning process is students' failure to correlate the concept taught with what is in their cognitive structures. The cognitive structure is a structure that represents the relations of concepts in the students' long-term memory and that is based on assumption (Umoke & Nwafor, 2014). Like all other courses of study, Biology education offers a creative field on which the opportunities offered by ICT can be explored.

Students' poor performance as generally observed by Hakan and Azize (2015) has been attributed to teachers' failure to information and communication technology assisted aids for effective teaching and learning, such as the use of computers, and projectors during the teaching and learning process in Biology. Biology requires serious input by the teacher in terms of planning to teach to achieve instructional objectives (Nwosu, 2016). This trend of poor performance of students in Biology and the high percentage of failure if not arrested, will spell doom for the scientific and technological development of the nation. To minimize the failure rate in Biology, Paul (2014), pointed out that Biology teachers have to be trained and re-trained on the use of ICT assisted gadgets in instructional delivery.

The various concepts in Biology require different approaches in delivery. Some Biology concepts are abstracts that cannot be fully comprehended by learners during first time encounter. Students struggle to form their cognitive structures in many alternative conceptions. Some of these concepts include respiratory system, genetic and evolution, (Umoke & Nwafor, 2014). Reviewed literature showed that concept of respiration is highly complex and has many dimensions, as it pertains to all living beings, from human to single cell organism and the dimension of respiratory system differs by species, (Michael, 2015). Garcia Barro, Martinez-Losada and Garciado (2017), established that children at the age of four to seven are aware of the organs in their bodies related to intake of air and food. However, their knowledge of respiratory system is limited. On the other hand, Gultepe, Yildirim and Sinan (2016) found alternative conception among others regarding human respiratory system such as air taken from outside goes to the stomach; breathing can only be executed through the mouth and nose. These are several reasons why students fail to adequately construct the cognitive structure about the concept of respiratory system. Ben-Zvi, (2015) submitted that the inability of students to comprehend some concepts in Biology such as the concept respiratory system is inconclusive is as follows: The process of respiration is a complex process; the respiratory system differs from single cell organism to higher animals. The fact that the processes of respiration involve numerous concepts and each of these concepts is linked with one another thus rendering the respiratory structure more complex.

Respiratory system refers to one of the vital systems in living beings which necessitates the intake of oxygen and release of carbon dioxide in a biochemical process of the body (Garcia Barro, Martinez-Losada & Garciado, 2017). It is a structure or system that enhances respiration which is a common characteristic that are indicator of life for all living

beings. Respiratory system is basically of two parts; upper respiratory parts which include nose, mouth, pharynx and the lower respiratory parts including the larynx, trachea, bronchi, bronchioles, lungs and alveoli (Ramalingam, 2016). It has been widely accepted that the quality of instruction plays a key role in student learning outcomes, (Nwosu, 2016). Respiratory system plays a vital function in living beings and its learning requires the use of appropriate instructional strategies for the reduction of the complexities in the understanding of the concept so as to improve students' performance in Biology.

There is no gainsaying that Biology cannot thrive in this modern day without the informative and communicative edge neither can biology education graduates be globally competitive without having been imbued with ICT skills. It is against this background that the researcher investigates the effects of ICT assisted gadgets in use among Biology students. It would also be worthwhile to know how the use of projector, desktop computer ICT assisted gadgets instructional facilities would bridge the gap in biology performance between male and female students' and as well the location of school. This study therefore focuses on the effect of ICT assisted gadgets such as projector and desktop computer on students' academic performance using the concept of respiratory system in Biology.

Furthermore, while this study emphasizes the integration of modern tools it incorporates the expository method (traditional lecture-based instruction) as a critical baseline for comparison. The rationale for including this method is based on the prevailing educational reality in many Nigerian secondary schools, where cost implications of procurement and a dearth of technical know-how often limit the adoption of ICT. Utilizing the expository method – delivered through standard validated lesson notes – allows the researcher to effectively determine if the introduction of the projectors and desktop computers provides a statistically significant improvement over the conventional 'chalk-and-talk' approach currently used to teach complex concepts like the respiratory system.

This method remains relevant because academic performance in Biology is a direct function of instruction, and traditional methods provide the necessary benchmark to measure the "facilitative effect" of new technologies. By maintaining the same content across all groups through validated instructional packages, the study ensures that any recorded gains in student mastery and internalization are attributable to the ICT-assisted delivery rather than the curriculum itself.

2.0 Statement of the Problem

The effectiveness of Information and Communication Technology (ICT) tools in enhancing students learning is a subject of ongoing debate. While projectors and desktop computers offer potential benefits in Biology education through visual aids and interactive learning experiences, their impact on students' academic performance remains unclear. Many Biology concepts are complex and require effective visualization, mental scaffold and engagement to facilitate understanding. This study seeks to investigate the extent to which the use of projectors and desktop computers as ICT-assisted gadgets influences student academic performance in Biology. Specifically, the study addresses the lack of empirical evidence regarding the effectiveness of these specific technologies in improving student learning outcomes in a biology context. The problem is further compounded by the potential of unequal access to these technologies, leading to disparities in learning opportunities among students.

Based on the above hindrances, coupled with the fact that students may not understand what they are taught without effective integration of ICT assisted gadgets, this study is poised to establish whether the use of Projector and desktop computer ICT gadgets in the teaching of Biology by teachers in senior secondary classes could have any facilitative effect on students' academic performance in Biology in Abak Local Government Area of Akwa State, Nigeria. The main purpose of this study is to examine the effect of Projector and desktop computer on students' academic performance in Biology in Abak Local Government Area of Akwa Ibom State.

Research Questions

The following research questions were raised and answered.

1. What difference exists in the mean performance scores of Biology students taught the concept of respiratory system using Projector, desktop computer and those taught using the expository method?

2. What difference exist in the mean performance scores of male and female Biology students taught the concept of respiratory system using Projector, desktop computer and those taught using the expository method?

3. What is the difference in the mean performance scores of urban and rural Biology students taught the concept of respiratory system using Projector, desktop computer and those taught using the expository method?

Hypotheses

The following hypotheses were formulated and tested at 0.5 level of significance.

1. There is no significant difference in the mean performance scores of Biology students taught the concept of respiratory system using Projector, desktop computer and those taught using the expository method.

2. There is no significant difference in the mean performance scores of male and female Biology students taught the concept of respiratory system using Projector, desktop computer and those taught using the expository method.

3. There is no significant difference in the mean performance scores of urban and rural Biology students taught the concept of respiratory system using Projector, desktop computer and those taught using the expository method.

3.0 Research Methods

The study employed a non –randomized pretest posttest control group design. Quasi-experimental design was considered appropriate for the study because intact classes were used to avoid disruption of normal class lessons. Eduwem and Umoinyang (2014), stated that quasi experimental design is a suitable alternative to experimental design when randomization is not used or applied. The design is structurally shown below:

E1	O1	X1	O2
E2	O1	X2	O2
	O1	C	O2

Where:

E = Experimental groups (taught using ICT assisted gadgets)

C = Control group (taught using traditional lecture method).

O1, O2 = Pre-test observations in respect to E and C respectively.

O1, O2 = post-test observations in respect to E and C respectively.

X1 = Treatment (The use of Projector).

X2 =Treatment (The use of desktop computer).

The study was carried out in Abak Local Government Area of Akwa Ibom State, Nigeria. Population for the study includes all 3,428 senior secondary school two (SSS2) Biology students in the ten public secondary schools during 2024/2025 academic session in Abak Local Government Area of Akwa Ibom State, Nigeria. A sample of one hundred and ninety-four (194) Senior Secondary School two (SSSII) Biology students was selected from the respective sampled schools. Purposive sampling technique was used to select three (3) schools each from rural and urban areas making it six (6) schools in all. Simple random sampling technique was used to select the 194 SSS2 students from six intact classes used out of ten co-educational secondary schools in Abak Local Government Area. The criteria for the selection of the schools were as follows:

- Schools that are currently presenting candidates for the senior secondary certificate examination.
- Schools with well – equipped and functional ICT unit laboratory.
- Schools with at least one professional Biology teacher.

The instrument used for data collection is the biology performance test (BPT). The biology performance test (BPT) instrument is a researcher developed instrument adapted from examination past questions. The instrument was divided into two sections A and B. Section A was designed to capture data of students and section B on the other hand comprised of 25 Biology performance test items. In ascertaining the reliability index was determined using Kuder Richardson's formula -20 and a reliability co-efficient of 0.78 was considered reliable. The data collected was analyzed using descriptive statistics such as mean and standard deviation to answer the research questions, while the null hypotheses was tested using Analysis of Covariance (ANCOVA) where applicable at 0.05 level of significance.

4.0 Results

Research Question One: What difference exists in the mean performance scores of Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method?

Table 1: Summary of descriptive statistics of the performance scores of Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets (expository)

Materials	N	Pretest		Posttest	
		Mean	SD	Mean	SD
digital projector	55	21.11	6.25	38.13	3.98
desktop computer	56	19.36	6.91	40.88	5.07
Expository Method	83	14.75	5.97	22.58	10.77

The result in Table 1 shows the difference in the mean performance scores of Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets. The result indicates that the posttest mean performance difference scores of 40.88 obtained by the students taught the concept of respiratory system using desktop computer is higher than 38.13 obtained by those taught using the digital projector, which is in turn higher than 22.58 obtained by those taught without ICT gadgets (expository). The result also indicates that the posttest standard deviations of 3.98, 5.07, as well as 10.77 are obtained by the students taught using digital projector, desktop computer and those taught without ICT gadgets respectively. Hence, great difference exists in the mean performance scores of Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets.

Research Question Two: What difference exist in the mean performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught with those taught using the expository method?

Table 2: Summary of descriptive statistics of the performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets

Gender	Materials	N	Pretest		Posttest	
			Mean	SD	Mean	SD
Male	digital projector	23	22.04	7.23	36.35	3.69
Female		32	20.44	5.46	39.41	3.73
Total		55	21.10	6.25	38.13	3.98
Male	desktop computer	28	16.75	6.06	40.86	5.10
Female		28	21.96	6.82	40.89	5.13
Total		56	19.35	6.91	40.88	5.07
Male	taught without	41	14.61	6.64	28.83	12.32
Female		42	14.88	5.30	16.48	2.58
Total		83	14.75	5.97	22.58	10.77

The result in Table 2 indicates the difference in the mean performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught with those taught without ICT gadgets. The result indicates that the posttest means performance difference scores of male and female students taught respiratory system using digital projector is 36.35 and 39.41; that of desktop computer is 40.86 and 40.89, while that of those taught without ICT gadgets is 28.83 and 16.48. The values indicate that great difference exists in the mean performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets.

Research Question Three: What is the difference in the mean performance scores of urban and rural Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught with those taught without ICT gadgets?

Table 3: Summary of descriptive statistics of the mean performance scores of urban and rural Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets

Location	Materials	N	Pretest		Posttest	
			Mean	SD	Mean	SD
Urban	digital projector	28	21.25	5.39	37.36	3.69
Rural		27	20.96	7.14	38.93	4.18
Total		55	21.10	6.25	38.13	3.98
Urban	desktop computer	30	21.60	6.71	41.30	5.43
Rural		26	16.77	6.32	40.38	4.67
Total		56	19.36	6.91	40.88	5.07
Urban	taught without	43	13.76	6.86	28.30	12.30
Rural		40	15.80	4.70	16.43	2.44
Total		83	13.65	5.97	21.78	10.77

The result in Table 3 indicates the mean performance difference scores of urban and rural Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets. The result indicates that the posttest means performance difference scores of urban and rural students taught respiratory system using digital projector is 37.36 and 38.93; that of desktop computer is 41.30 and 40.38, while those taught without ICT gadgets is 28.30 and 16.43. The values indicate that great difference exists in the mean performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught without ICT gadgets.

Hypothesis One: There is no significant difference in the mean performance scores of Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method.

Table 4: Summary of analysis of covariance of mean performance scores of Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method

Sources of variance	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14309.410 ^a	3	4769.803	80.181	.000
Intercept	17261.907	1	17261.907	290.176	.000
Pretest	479.823	1	479.823	8.066	.005
ICT assisted gadgets	10131.332	2	5065.666	85.155	.000
Error	11302.652	190	59.488		
Total	227610.000	194			
Corrected Total	25612.062	193			

Significant at $p < .05$, $n = 194$

The result in Table 5 indicates that the F-value of 85.155 with 2 and 194 degrees of freedom at .05 alpha levels is significant since the p-value of .000 is lower than the alpha value of .05. The null hypothesis is rejected, which means that there is significant difference in the mean performance scores of Biology students taught the concept of

respiratory system using digital projector, desktop computer and those taught with those taught using the expository method.

Hypothesis Two: There is no significant difference in the mean performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method.

Table 5: Summary of analysis of covariance of mean performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method

Sources of variance	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17700.817 ^a	6	2950.136	69.733	.000
Intercept	15589.600	1	15589.600	368.495	.000
Pretest	580.080	1	580.080	13.711	.000
ICT assisted gadgets	9605.246	2	4802.623	113.521	.000
Gender	546.068	1	546.068	12.908	.000
ICT assisted gadgets Gender	2290.501	2	1145.250	27.071	.000
Error	7911.245	187	42.306		
Total	227610.000	194			
Corrected Total	25612.062	193			

Significant at $p < .05$, $n = 194$

The result in Table 5 indicates that the F-value of 27.071 with 2 and 194 degrees of freedom at .05 alpha levels is significant since the p-value of .000 is lower than the alpha value of .05. The null hypothesis is rejected, which means that there is significant difference in the mean performance scores of male and female Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method.

Hypothesis Three: There is no significant difference in the mean performance scores of urban and rural Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method.

Table 6: Summary of analysis of covariance of mean performance scores of urban and rural Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17568.262 ^a	6	2928.044	68.070	.000
Intercept	14899.247	1	14899.247	346.373	.000
Pretest	769.779	1	769.779	17.896	.000
ICT assisted gadgets	9937.370	2	4968.685	115.511	.000
Location	537.898	1	537.898	12.505	.001
ICT assisted gadgets Location	2162.996	2	1081.498	25.142	.000
Error	8043.800	187	43.015		
Total	227610.000	194			
Corrected Total	25612.062	193			

Significant at $p < .05$, $n = 194$

The result in Table 6 indicates that the F-value of 25.142 with 2 and 194 degrees of freedom at .05 alpha levels is significant since the p-value of .000 is lower than the alpha value of .05. The null hypothesis is rejected, which means

that there is significant difference in the mean performance scores of urban and rural Biology students taught the concept of respiratory system using digital projector, desktop computer and those taught using the expository method.

5.0 Discussion of Findings

The result of hypothesis one indicated that digital projector, desktop computer significantly influences students' academic performance than those taught without instructional materials in the concept of respiratory system in Biology. The integration of digital projectors and desktop computers as ICT-assisted gadgets has been shown to enhance student learning and academic performance in Biology. This study is in agreement with the works of Bhatti, Chuadhry and Liaqut (2022), that there is a significant impact of electronic gadgets on the academic performance of secondary school students. Moreover, it was also depicted from the result that, modern gadgets greatly improve the performance of educational standards. This is attributed to the visual representation of information, which caters to various learning styles, particularly visual learners. Furthermore, desktop computers facilitate access to a wealth of online resources, simulations, and interactive Biology programs that can deepen students' engagement and comprehension. This study is in consonance with the works of Tolorunleke, Haruna, Aliyu and Danladi (2022) who investigated the impact of Information and Communication Technology (ICT) tools on students' academic performance in Nigerian educational system. Their study showed a significant influence on the use of ICT tools such as Google Classroom, desktop computer can create room for individualized learning and makes learning more interesting and meaningful within and outside the school settings thus, the hypothesis that ICT-assisted gadgets positively influence students' performance in Biology is supported by empirical evidence.

The result of analysis two indicated that male and female students in the experimental groups taught the concept of respiratory system based on digital projector, desktop computer significantly influence students' academic performance than those taught without instructional materials in the concept of respiratory system in Biology. Gender differences in academic performance have been a subject of research particularly in STEM fields, including Biology. This study is in support with the works of Duru, Uko and Utibe (2024), who investigated the impacts of instructional material in teaching and learning Biology and its gender dimension in senior secondary school. The study 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. Moreover, the influence of gender on performance may also be shaped by classroom dynamics and teacher perceptions, where girls may receive more encouragement and support in science subjects (Ogunlowo, Ozbey & Ogunlowo, 2024). The study contradicts the results of Sunday, Umanah, Ntegwung, & Akpan, (2026) who reported no significant difference between male and female exposed to computer-based visualization model. The significant impact of gender on academic performance in Biology aligns with the hypothesis that gender differences play a crucial role in students' academic outcomes.

The result of analysis three indicated that urban and rural students in the experimental groups taught the concept of respiratory system based on digital projector, desktop computer significantly influence students' academic performance than those taught without instructional material in the concept of respiratory system in Biology. Urban schools often have better access to resources such as qualified teachers, laboratory facilities, and ICT tools, which can enhance the learning experience. Conversely, rural schools may face challenges, including limited access to educational technology and fewer extracurricular activities related to Biology, which can hinder student engagement and understanding. This study is in line with the works of Duru, Uko, and Utibe (2023), which determined the effect of DNA animation, improvised model and realia on teaching on students' performance based on school location when used to teach the concept of DNA in Biology in secondary schools. Their findings showed that there was a significant difference in students' academic performance when taught using animation, improvised model and realia in the concept of DNA based on school location than their control group counterparts in Biology. Therefore, the hypothesis that school location significantly affects students' performance in Biology is supported by the findings

6.0 Conclusion

From the findings, it was concluded that students taught using desktop computer performed better followed by digital projector than their control counterparts. Also, male students taught with desktop computer performed better than their female counterparts followed by digital projector; the interaction effect of treatments and gender significantly affects students' academic performance in Biology; treatments and school location significantly affects students' academic performance; treatment, gender and school location have a significant effect on students' academic performance in Biology when taught the concept of respiratory system.

7.0 Recommendations

Based on the findings of this study, several recommendations can be made:

1. It encourages active engagement with ICT tools and resources to enhance learning on the part of the students and promote the use of multimedia and interactive applications that cater to different learning styles. Provide training sessions on effective usage of ICT tools to maximize their potential in Biology
2. On the part of the teachers', it incorporates ICT tools into lesson plans to make Biology lessons more interactive and engaging. Attend professional development workshops focused on integrating technology in teaching methodologies. Collaborate with colleagues to share successful ICT practices and resources
3. School administrators should invest in ICT infrastructure and resources to support technology enhanced learning in Biology and other subjects. Provide ongoing professional development for teachers on the integration of ICT in the classroom. Create policies that encourage the responsible use of technology among students
4. Researchers conduct further studies on the long-term effect of ICT integration on student performance across various subjects. Explore the impact of different ICT tools on diverse student populations to identify best practices. Share findings with educational stakeholders to inform policy and practice.

References

- 1) Akinette, A. M., (2016). Effective methods of Learning difficult concepts in Chemistry. *Chemical Education Research and Practice*, 2(2), 47-54.
- 2) Akpan, A. O & Akpan, I. F (2017) facilitation-activity strategy and pre-service teachers' achievement in Basic Science and Technology. *Journal of Research and Development in Education (JORDE)* 7 (1), 38-47.
- 3) Akpan, A. O (2022). Infographics as Instructional Resource for teaching Basic Science and technology in Junior Secondary Schools in Akwa Ibom State. *A Journal of Basic Education in Nigeria* 8, 197-218.
- 4) Akpan, I. F, Udofia, S. E. & Nkoyo, A. T. (2016). Innovative use of ICT in science teachers' education for sustainable national development. *Journal of Educational Media and Technologies*, 2(1), 1-9.
- 5) Bhatti, M. G, Chuadhry, M.A. & Liaqut, S. (2022) Effects of gadgets on students' academic performance at secondary Level in Islamabad. *Sukkur IBA Journal of Computing and Mathematical Sciences*, 6(1), 79-90
- 6) Cronjé, J. (2018). Towards a model for assessment in an information and technology-Rich 21st century learning environment. *Occasional Paper# 37. National Institute for Learning Outcomes Assessment*.
- 7) Duru, C. M., Uko, P. J & Utibe, U. J. (2023). Effect of DNA animation, improvised model and realia on teaching and students' performance based on school location in Biology in Akwa Ibom State, Nigeria. *Interdisciplinary Journal of Science Education (IJ-SED)*, 5(1), 11-25
- 8) Duru, C. M., Uko, P. J & Utibe, U. J. (2024). Application of DNA animation, improvised model and realia in teaching and students' performance based on gender in Biology in Akwa Ibom State, Nigeria. *African Journal of Educational Foundations*, 5(1), 75-92
- 9) Eduwem, J. D., Umoinyang, I. E. (2014). Item types and upper basic education students' performance in Mathematics in the southern senatorial district of Cross River State Nigeria. *Journal of Moderns Education Review*, 4(1), 57-73.

- 10) Ekineh, D.R. & Adolphus, T. (2019). Early child development and care, 174 (1), 3 – 11.
- 11) Federal Ministry of Education, (FME 2019). Senior secondary school curriculum in Biology Abuja, NERDC Press.
- 12) Gultepe, M. B., Yildirim, O. & Sinan O. (2016). The effects of instructional based constructivist approach on 6th Grade students' achievement about respiration system. *Elementary Education or Line*, 7 (2), 522-536.
- 13) Hakan, Y. & Azize, Y. (2015). The effect of the computer assisted instruction on the academic performance and retention of technical programme students in vocational foreign language. *Procedia - Social and Behavioral Sciences* 174, 2513 – 2518.
- 14) Itighise, A. E. & Wordu, N. C. (2016). Concept and uses of information and communication technology in Education in R. r. Okoye, C. U Eze and M. U. Oluwole (eds) *information and communication technology and education in Nigeria: Challenge and prospects*. Ibadan: Global academic Group online Academic Resources 204-223
- 15) Machado, L. J., & Chung, C. J. (2015). Integrating Technology: The principals' role and effect. *International Education Studies*, 8(5), 43-53.
- 16) McKnight, K., O'Malley, K., Ruzic, R., Horsley, M. K., Franey, J. J., & Bassett, K. (2016). Teaching in a digital age: How educators use technology to improve student learning. *Journal of research on technology in Education*, 48 (3), 194-211.
- 17) Michael, M. C. (2015). *The essential Biology for senior secondary school*. New York: Tonard Publishers Ltd. P5
- 18) Mwanda, G., Mwanda, S., Midigo, R., & Maundu, J. (2017). Integrating ICT into teaching and learning Biology: A case for Rachuonyo South sub-county, Kenya. *International Journal of Education, Culture and Society*, 2(6), 165-171.
- 19) Nigeria Educational Research and Development Council (NERDC). (2015). Workshop on difficult concepts: Biology group report. Lagos: NERDC.
- 20) Nikolopoulou, K. & Gialamas, V. (2015). Barriers to the integration of computers in early childhood settings: Teachers' perceptions. *Education and Information Technologies*, 20(2), 285-301.
- 21) Nikou, S. A., & Economides, A. A. (2016). The impact of paper-based, computer-based and mobile-based self-assessment on students' science motivation and achievement. *Computers in Human Behavior*, 55, 1241-1248.
- 22) Nworgu, B. G. (2015). Evaluating the effects of resource material types reduction to students' cognitive achievement, retention and interest, in *Integrated Science PhD Thesis University of Nigeria Nsukka*. Pp1-4
- 23) Nwosu, A. A. (2016). Using the Instructional Model to communication science. 39th STAN Annual conference Proceedings, 349-353.
- 24) Ogunlowo, S.O., Ozbey, G. & Ogunlowo, D. T. (2024). Impacts of ICT as tools in teaching Biology in senior secondary schools. *International Journal of Academic Studies in Science and Education (IJASSE)*, 2(1), 42-52
- 25) Onekutu, A. & Onekutu, P. O. (2014). Gender differences in achievement in JSS examination in Integrated Science: Implication for national development. In O. O. Okpkeh (Ed). *Review of Gender Study in Nigeria*, 7(2), 45-50.
- 26) Onyegegbu, N. (2016). Using new technologies in crating excitement in Biology laboratory activities. Proceedings of 47th STAN Annual conference pp. 134-137
- 27) Paul, T. (2014). Biology education for social and sustainable development. 23rd biennial education conference as Asian Association for Biology Education (AABE) Nanyang Technology University. Available at <http://www.sensepublishers.P4>
- 28) Ramalingam, S.T. (2016). *Modern Biology for senior secondary schools*. Sixth Edition, Africana First Publishers Plc
- 29) Rashid, T., & Asghar, H. M. (2016). Technology use, self-directed learning, student engagement and academic performance: Examining the interrelations. *Computers in Human Behavior*, 63, 604-612.
- 30) Ratheeswari, K. (2018). Information communication technology in education. *Journal of Applied and Advanced Research*, 3(1), 45-47.
- 31) Salini, R. & Reeves, W. (2017). Factors affecting students' adoption of ICT tools in higher education institutions: an Indian context. *International Journal of Information and Communication Technology Education*, 13(2), April-June 2017

- 32) Sunday, E. S. Edet, A. A. & Akpan, E. I. (2025). Effects of computer assisted instructions and computer animation on the teaching of chemistry in secondary schools. *International Journal of Modern Science and Research Technology*, 3(11), 499-509.
- 33) Sunday, E. S., Umanah, F. I. & Udofia, S. E. (2025). Enhancing students' academic performance in chemical reactions through computer-based molecular modelling, hackathon teaching strategies. *International Journal of Research and Innovation in Social Science (IJRISS)*, IX(IIIS), 1815-1824.
- 34) Sunday, E. S., Umanah, F. I., Ntegwung, G. J., & Akpan, E. I., (2026). Effect of computer-based visualization model on students' academic achievement in the periodic table concept in chemistry. *IJCER (International Journal of Chemistry Education Research)*, 10(1), 76–85. <https://doi.org/10.20885/ijcer.vol10.iss1.art8>
- 35) Tolorunleke, E. A., Haruna, M. M., Aliyu, R. O. & Danladi, M. J. (2022). Impact of ICT tools on students' academic performance in Nigerian Educational System: A theoretical perspective. *Premier Journal of Education*, 6(1), 112-123
- 36) Udofia, S. E. & Sambo (2019). Satisfaction on the utilization of 14.0 technologies on STEM lesson deliveries as perceived by science students. 60th Annual Conference Proceedings of STAN.160-169.
- 37) Ukpong, F. A., Ntegwung, G. J., Sunday, E. S., Obo, I. J., Sunday, M. D., Ubong, N. C., & Ndon, U. U. (2026). Cloud-based e-learning model and students' academic achievement in biology in Mkpato Enin Local Government Area. *International Journal of Social Science Humanity & Management Research*, 5(4), 760-766. <https://doi.org/10.58806/ijsshmr.2026.v5i4n23>
- 38) Umanah, F. I. & Sunday, E. S. (2022). Crosswords puzzle, flashcards teaching strategies and senior secondary school students' academic performance in chemistry. *International Journal of Educational Benchmark (IJEb)*, 22(2), 1-12
- 39) Umoke, J. C. & Nwafor, C. C. (2014). Student understanding of purpose, of model in life biological context. *International Journals of Biology Education*, 2(2),187-198.
- 40) WAEC (2023). West african examination council chief examiner reports for 2019-2023 May/June Senior Secondary School Certificate Examinations. O Level Paper, Lagos: WAEC Press.
- 41) West African Examinations Council, (2019). Analysis of Result, Lagos WAEC.