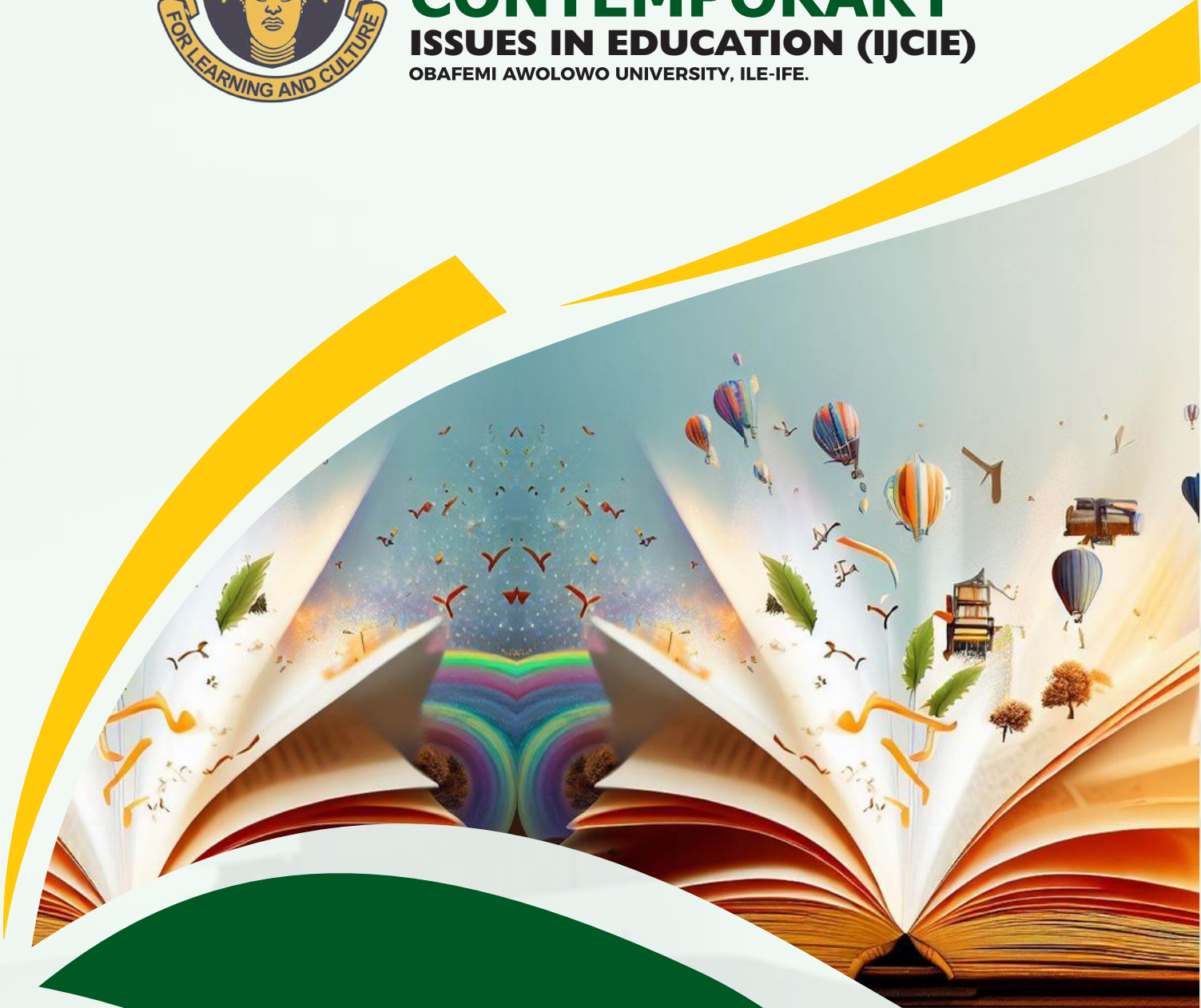




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OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE.



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Abstract

This work focused on the effect of Information and Communication Technology on the academic achievement of senior school Biology students in Ekiti State, Nigeria. Specifically, the study sought to, examine the mean achievement score of secondary school students taught Biology using ICT compared to those taught using the traditional method and to examine the mean achievement score of male and female students taught Biology using the ICT among others. A sample of 90 students was drawn for the study using the purposive random sampling technique to select two secondary schools whose intact classes were used. The availability of ICT gadgets necessitated the selection of the schools used. An instrument titled Biology Achievement Test (BAT) was designed and used for data collection. The reliability coefficient of 0.84 was ensured using Kudar Richardson 21 ($K-R_{21}$) formula for the instrument. The result of the study revealed that a significant difference exists between the mean achievement score of secondary school students taught Biology using the ICT and those taught using the traditional method ($F_{(1,85)} = 133.062$, $p < 0.05$). Also, there was a significant difference in the mean achievement scores of male and female students taught Biology using the ICT ($t = 5.173$; $df = 43$; $P < 0.05$). Based on the results of the study, it can be concluded that using ICT-based instructional methods has a substantial positive impact on improving students' academic

performance in Biology. The findings also indicate that there are differences in achievement between male and female students when they are taught with ICT-based approaches. The study recommends that the school administrators should encourage the use of ICT in the teaching and learning of Biology by making ICT gadgets available for use in schools. Furthermore, a special programme should be put in place by governmental and non-governmental organizations to provide free ICT learning gadgets for female students to encourage them to use ICT and bridge the gap gender has created on the use of ICT.

Keywords: ICT, Biology, academic achievement, gender, secondary school

Introduction

Biology education has great practical, intellectual, and even aesthetic value. These benefits can only be achieved when students gain a good understanding of Biology. In Nigeria, Biology plays an important role in national development because it prepares young people to become professionals in science-related careers such as medicine, nursing, biochemistry, agriculture, and pharmacology (Olayinka, Ayanda, & Adeoye, 2020).

Despite its importance, many senior secondary school students in Ekiti State still struggle to do well in Biology. Reports from the West African Examinations Council (WAEC) and

research by Olayinka (2016) have shown that most students in the state do not achieve credit passes in Biology. This poor performance prevents many of them from going on to study science courses in higher institutions.

Several reasons have been linked to this problem. These include the lack of adequate teaching materials, limited use of modern teaching methods, and failure to include Information and Communication Technology (ICT) in classroom teaching. ICT has become an essential part of learning across the world, providing access to rich resources and helping teachers deliver lessons more effectively (Rozina, 2014, cited by Mkpanang & Ikott).

Mark (2019) also noted that ICT has economic benefits and helps improve education, business, and society in general. ICT allows teachers and students to access and share information easily, making learning more interactive and engaging. The National Policy on Information Technology in Nigeria supports including ICT in the curriculum so students can develop relevant skills for the modern world.

Kosoko-Oyedeko and Tella (2010) explained that using ICT in teaching Biology can help students develop the skills they need to compete in today's global environment. According to Davies (2009), teachers use ICT not only to prepare lessons but also to deliver them. For example, Oko and Uwatt (2015) found that teachers often use the internet to download materials, create exercises with word processing tools, and present lessons with PowerPoint. They also use ICT to give students extra practice and support.

Ali, Haolader, and Muhammad (2013) pointed out that ICT tools make learning more active and allow students to work independently. ICT encourages teachers and students to keep learning even after school hours.

Using ICT for learning has been shown to help students understand lessons better, remember information longer, and perform well in exams (Arista & Kuswanto, 2018). ICT also plays an important role in the social and economic growth of developing countries (Bamigboye, Aderibigbe, & Buraimo, 2007).

However, studies by Ajayi and Ekundayo (2009) have found that many Nigerian secondary schools still lack enough ICT facilities and that

both teachers and students often do not have the skills to use them confidently.

Odagboyi (2015) looked at whether gender affects Biology performance when using the jigsaw method and found no significant difference between boys and girls. But Mahmood (2012) discovered that female students at the tertiary level had less positive attitudes towards ICT and felt less confident using computers compared to male students. This shows that gender can affect how students perceive and use ICT.

Although more people now understand how important ICT is in improving education, many schools in Ekiti State still face challenges in using it effectively. For this reason, this study aimed to find out how using ICT in teaching Biology affects students' academic achievement in Ekiti State.

Biology is a very important subject that helps students prepare for careers in science, medicine, agriculture, and technology. However, in Ekiti State, many secondary school students still perform poorly in Biology. Reports from public examinations have shown that only a small number of students get the credit passes they need to continue their studies in science-related courses.

One of the main reasons for this poor performance is the continued use of outdated, teacher-centred teaching methods. These methods often fail to make lessons interesting, engaging, or clear to students. As a result, learners do not develop a deep understanding of key Biology concepts, which affects their performance.

Information and Communication Technology (ICT) offers a promising way to improve Biology teaching and learning. When teachers use ICT tools well, lessons can become more interactive and practical. ICT resources also help students visualise abstract ideas, improve their memory of what they have learnt, and encourage them to take more interest in their studies.

Despite these advantages, ICT is not being used effectively in many schools in Ekiti State. Some schools lack the necessary facilities and equipment, and even where resources are available, both teachers and students often lack confidence and skills to use them. There are also

concerns that male and female students may not benefit equally from ICT, which could lead to further differences in academic achievement.

Because of these challenges, this study was carried out to find out whether using ICT in teaching Biology can truly improve students' academic performance. It also aimed to examine whether gender differences play a role in how students respond to ICT-based teaching. The findings will help schools, teachers, and policymakers make informed decisions about using ICT to improve learning outcomes in Biology.

Statement of the Problem

Biology is an important subject that prepares students for careers in science, health, and technology. Sadly, many secondary school students in Ekiti State do not perform well in Biology. Records from public examinations showed that only few students are able to get credit passes, which are needed to continue studying science courses in higher education.

This poor performance has been linked to the use of old teaching methods that focus mainly on the teacher talking while students listen passively. Such approaches often make lessons less interesting and do not help students understand or remember what they have learnt.

Information and Communication Technology (ICT) has the potential to make teaching and learning more effective. ICT tools can make lessons more interactive and engaging. They can help students see and explore Biology concepts in ways that traditional methods cannot.

However, in many schools in Ekiti State, ICT is still not used often or effectively. Some teachers and students also feel unsure or lack the skills to use ICT confidently. Additionally, there are concerns that boys and girls may not benefit from ICT in the same way, which could affect their achievement.

Because of these issues, this study was designed to find out whether teaching Biology with ICT can help improve students' performance and to see if gender differences have any effect on how students benefit from ICT-based instruction.

Purpose of the Study

The study examined the effects of information and communication technology

(ICT) on the academic achievement of senior secondary school students in biology in Ekiti State. Specifically, the study sought to:

- i. examine the mean achievement score of secondary school students taught biology using ICT compared to those taught using the traditional method;
- ii. examine the mean achievement score of male and female students taught biology using the ICT; and
- iii. find out the joint interaction effect of methods and Gender on students' achievement

Research Questions

The following research questions guided the study:

1. What is the mean achievement score of secondary school students taught biology using ICT compared to those taught using the traditional method?
2. What is the mean achievement score of male and female students taught biology using the ICT?

Hypotheses

The following null hypotheses were formulated and were tested at a 0.05 level of significance.

- i. There is no significant difference in the mean achievement score of secondary school students taught biology using the ICT and those taught using the traditional method.
- ii. There is no significant difference in the mean achievement scores of male and female students taught biology using the ICT.
- iii. There is no significant interaction effect of methods and Gender on students' achievement.

Methodology

The research design for this study is quasi-experimental, comparing groups without randomization. Two intact classes were used for the study. The population for the study comprised all the senior secondary biology students in Ekiti State. The sample size consisted of ninety (90) SS2 Biology students from co-educational private secondary schools. Both the experimental and the control groups had forty-five students, but

specifically, the experimental group consisted of 20 males and 25 females, while the control group consisted of 22 males and 23 females. Two schools were selected for the study using the purposive random sampling technique. The schools were purposively selected due to the use of ICT gadgets in the schools. The intact classes of the selected secondary schools were used for the study.

An instrument titled “Biology Achievement Test” (BAT) was designed to measure learning outcomes. The instrument was sectioned into two- Section A: Demographic data of students, and Section B: test items. Section B consists of 30 multiple choice questions from the selected topic, the Reproductive system. Each question has four options, letters A to D, each of which only one of the options is correct. Each test item was allotted '1' mark each for the thirty (30) test items. The face and content validation of the BAT instrument was ensured by experts in Measurement and Evaluation and Biology Education. The instrument's reliability was determined by carrying out a pilot test on a sample of 30 SS2 students from a senior secondary school that was not part of the chosen sample. The internal consistency of the BAT was determined using Kuder Richardson 21 (K-R21) formula, and a reliability coefficient of 0.84 was obtained.

Administration of Instrument

In this study the administration of the instrument followed a careful and systematic process.

To collect accurate data, a pretest, known

as the Biology Achievement Test (BAT), was first given to all students. The purpose of this pretest was to measure the students' existing knowledge of biology before any teaching interventions took place. The scores from the pretest served as a baseline to help compare later results fairly.

After the pretest, the treatment stage began and lasted for six weeks. During this period, the experimental group was taught using ICT-based methods, while the control group continued with traditional teaching methods. This difference in teaching approaches was planned to show how ICT might affect students' learning outcomes.

When the six weeks of instruction ended, a post-test, identical to the pretest, was administered to both groups. This post-test allowed the researcher to measure what the students had learned during the treatment period. The results from the post-test were then compared with the pretest scores to see whether there was any significant improvement in the experimental group compared to the control group.

For data analysis, the study made use of Mean and Standard Deviation to summarise the students' scores and describe patterns in their performance. In addition, Analysis of Covariance (ANCOVA) was employed to test the four research hypotheses. ANCOVA helped to control for any differences in the students' pretest scores, making it easier to see the true effect of ICT on their academic achievement. All hypotheses were tested at the 0.05 level of significance, ensuring the results were statistically reliable.

Results

Research Question 1: What is the mean achievement score of secondary school students taught biology using ICT compared to those taught using the traditional method?

Table 1: Mean and Standard Deviation of Pretest and Posttest Mean Scores of Students taught with ICT and Conventional Learning Strategies

Group	Number	BPT	Mean (X)	Standard Deviation	Mean Differences
ICT	45	Pretest	6.47	1.04	12.44
		Posttest	18.91	3.20	
Conventional	45	Pretest	6.36	1.00	7.08
		Posttest	13.44	2.04	

Table 1 shows that the mean difference in students' mean achievement scores before and

after treatment for the ICT group is 12.44, while that of students in the conventional group is 7.08.

This suggests that the use of ICT and conventional method influences students' performance in Biology, with ICT enhanced strategy being the more effective method in

improving students' performance in Biology. The graphical representation below further shows the more effective method in improving students' performance in Biology.

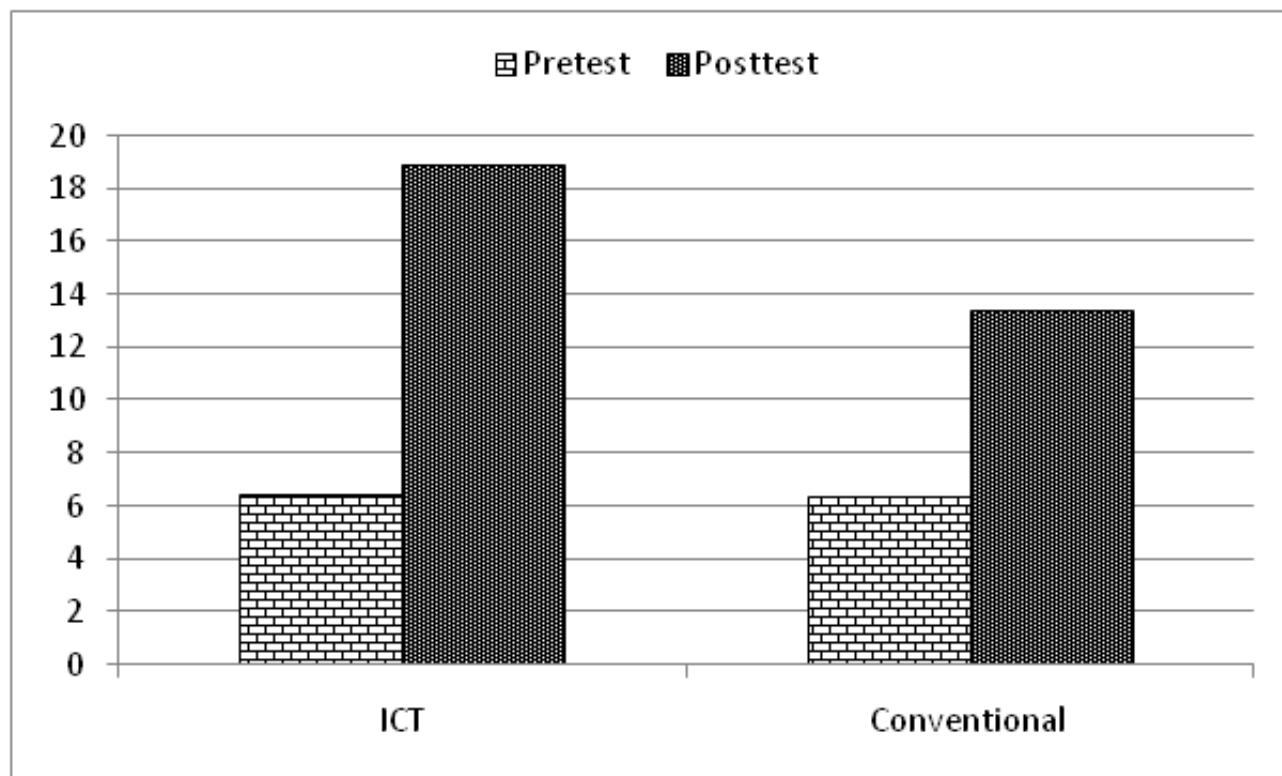


Figure 1: Bar chart showing the mean achievement score of students exposed to ICT and traditional method

Research Question 2: What is the mean achievement score of male and female students taught biology using the ICT?

Table 2: Mean and Standard Deviation of Pretest and Posttest Mean Scores of Male and Female Students taught with ICT

Gender	Number	BPT	Mean (X)	Standard Deviation	Mean Differences
Male	20	Pretest	6.10	0.85	15.00
		Posttest	21.10	3.49	
Female	25	Pretest	6.76	1.09	10.40
		Posttest	17.16	1.37	

Table 2 shows the mean difference in the male and female students' mean achievement scores before and after treatment. The male students' mean difference is 15.00 while that of female students is 10.40. This suggests that the use of ICT

influences both male and female students' performance in Biology, with male students more advantaged than their female counterparts. The graphical representation of the difference is further shown below.

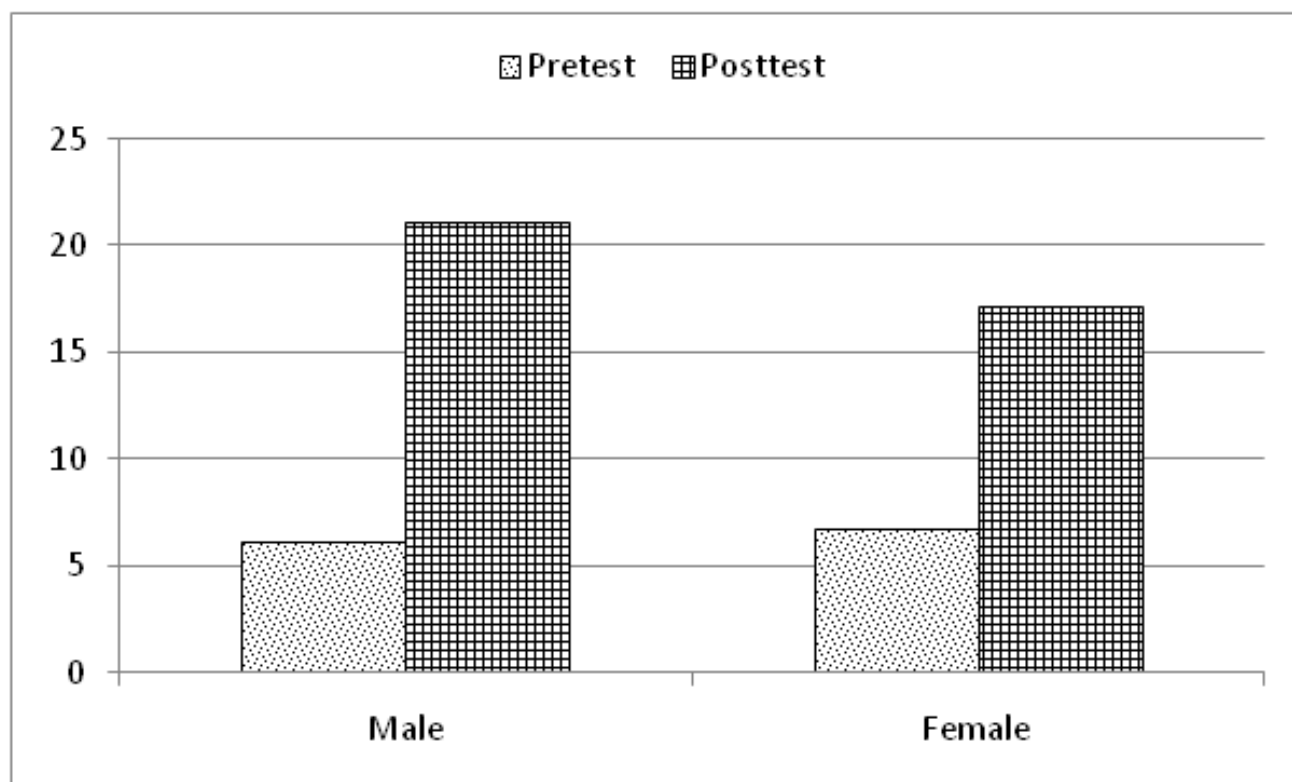


Figure 2: Bar chart showing the mean achievement score of male and female students

Hypotheses Testing

Hypothesis 1: There is no significant difference in the mean achievement score of secondary school students taught biology using the ICT and those taught using the traditional method.

Table 3: Summary of the Analysis of Covariance test on Students' Performance Scores according to Instructional Strategies, and Gender

Dependent Variable: posttest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	846.207 ^a	4	211.552	39.181	.000
Intercept	466.330	1	466.330	86.367	.000
Pretest	.883	1	.883	.164	.687
Strategies	718.457	1	718.457	133.062	.000
Gender	89.718	1	89.718	16.616	.000
Strategies * Gender	77.640	1	77.640	14.379	.000
Error	458.949	85	5.399		
Total	24860.000	90			
Corrected Total	1305.156	89			

The result in table 3 shows that there was no significant difference in the pretest mean achievement score of secondary school students taught biology using the ICT and those taught using the traditional method ($F_{(1,85)}=0.164$, $p>0.05$). This established the homogeneity of the group before being exposed to treatment. The table further shows that upon exposure to

treatment in the groups, there was a significant difference in the mean achievement score of secondary school students taught biology using the ICT and those taught using the traditional method ($F_{(1,85)}=133.062$, $p<0.05$). Hence, hypothesis 1 is rejected. This indicates that a significant difference exists between the mean achievement score of secondary school students

taught biology using the ICT and those taught using the traditional method. To determine the magnitude of the effect of treatment on students'

performance in Biology, the Estimated Marginal Mean was computed, and the result is presented in table 4.

Table 4: Estimated Marginal Means of Posttest for the Strategies

Strategies	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
ICT Enhanced	19.128 ^a	.349	18.435	19.821
Conventional	13.453 ^a	.347	12.764	14.143

a. Covariates appearing in the model are evaluated at the following values: pretest = 6.4111.

As shown in Table 4, the Estimated Marginal Mean (EMM) of students' academic performance in Biology in the ICT enhanced and conventional group are 19.128 and 13.453, respectively; it indicates that the ICT enhanced has a higher EEM

than the conventional group.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students taught biology using the ICT.

Table 5: t-test comparison of the mean achievement scores of male and female students taught biology using the ICT

Gender	N	Mean	SD	Df	t-value	P
Male	20	21.10	3.49	43	5.173	.000
Female	25	17.16	1.37			

According to table 5, the male students had a mean achievement score of 21.10 and a standard deviation of 3.49, while their female counterparts had a mean achievement score of 17.16 and a standard deviation of 1.37. The table revealed t-value as 5.173 at 0.05 significant level: ($t = 5.173$; $df = 43$; $P < 0.05$). Hypothesis 2 is therefore rejected. This shows a significant difference in the mean achievement scores of male and female students taught biology using the ICT.

Hypothesis 3: There is no significant interaction effect of methods and Gender on students' achievement.

As revealed in table 3, there was a significant interaction effect of methods and Gender on students' achievement ($F_{(1,85)} = 14.379$, $p < 0.05$). Hence, hypothesis 3 is rejected. This indicates that there is a significant interaction effect of methods and Gender on students' achievement. This is further depicted in figure 1.

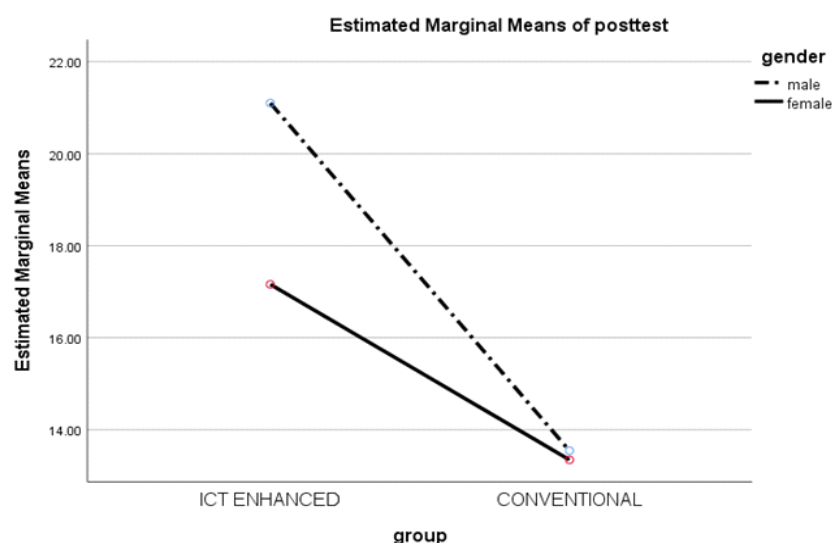


Figure 1: Interaction of strategies and Gender

Discussion

The findings of this study revealed that there was a significant difference between the mean achievement scores of secondary school students taught Biology using ICT and those taught using the traditional method. The students who received ICT-based instruction achieved higher mean scores than their peers taught through conventional approaches. This suggests that the integration of ICT tools in Biology lessons can improve students' academic performance.

This result supports the findings of Muriithi, Bett, and Yego (2020), who reported that using ICT in science instruction enhanced learners' understanding, promoted active engagement, and improved retention of knowledge. Similarly, Oluwatobi and Salami (2021) found that ICT-based teaching strategies helped students develop stronger problem-solving skills and boosted their academic outcomes compared to traditional methods. The positive impact seen in this study could be due to the interactive opportunities that ICT provides, allowing meaningful engagement between the teacher, learner, and digital resources.

Furthermore, the study revealed that there was a significant difference in the mean achievement scores of male and female students taught Biology using ICT. Male students performed better than female students in the ICT-based instructional setting. This difference may be linked to the greater confidence and interest that male students often have in working with computers and related technologies.

This finding is consistent with the work of Adeleke and Adebayo (2020), who found that male students demonstrated higher levels of computer self-efficacy and more positive attitudes towards ICT use in learning than female students. In contrast, this result differs from the findings of Eze and Ezeudu (2019), who reported no significant gender differences in students' achievement in science subjects when innovative teaching methods were applied.

The study also showed a significant interaction effect between teaching methods and gender on students' achievement in Biology. This suggests that gender-related factors can influence how students benefit from ICT-based instruction over time. This view aligns with the observation

of Okafor and Okoli (2021), who argued that persistent gender gaps in access to ICT resources and confidence in using them can contribute to performance differences between male and female learners.

Overall, these findings highlight the need for teachers and policymakers to consider gender-sensitive strategies when implementing ICT in science classrooms. Providing targeted support and training for female students could help reduce these disparities and ensure that all learners benefit equally from modern instructional technologies.

Conclusion

When it comes to teaching and learning, ICT plays a vital role. ICT tools for instructional activities make teaching-learning fascinating, encouraging both physical and online interactions among teachers and students. Based on the findings of this study, it is concluded that ICT-based instruction plays a significant role in harnessing the academic achievement of students in Biology. It was also concluded that gender disparity exists in students' academic achievement in Biology when exposed to ICT-based instruction. However, this disparity could be owed to the inquisitive nature of men in using the ICT tools.

Recommendations

The following recommendations were made based on the findings of this study.

1. Teachers should fully adopt ICT in teaching
Biology teachers are encouraged to use ICT regularly when planning and delivering lessons, as it helps students understand concepts better and stay engaged.
2. Organise training for teachers
The government and school authorities should organise workshops and seminars to train Biology teachers on how to use ICT tools effectively in the classroom.
3. Support female students to use ICT
Special programmes should be created by government and non-government organisations to provide free ICT gadgets

for female students. This will help them feel more confident and reduce the gap between boys and girls in using technology.

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