



EFFECTS OF COMPUTER-BASED INSTRUCTIONAL STRATEGY ON STUDENTS' LEARNING OUTCOMES IN BIOLOGY IN SENIOR SECONDARY SCHOOLS IN EKITI STATE

BY

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Abstract

This study investigated the effects of Computer-Based Instructional Strategy on students' learning outcomes in Biology in senior secondary schools in Ekiti State. The study examined the effects of CBIS on students' performance, attitude and retention in comparison with the conventional teaching method. The study adopted quasi-experimental research design. The population comprised 12,690 (SSII) students from 206 public secondary schools, with a sample of 159 SS II students selected using multistage sampling procedure. Data were collected using Biology Performance Test (BPT) and Students Attitudinal Questionnaire in Biology (SAQB). The instruments were validated by experts in Tests, Measurement, and Evaluation as well as Biology Science Education, and were found to be reliable. The reliability coefficient of the instruments was 0.87, while the internal consistency of the SAQB was 0.88. Ten weeks were used altogether for the whole study. Data collected were analyzed using mean, standard deviation, bar chart and t-test at 0.05 level of significance. Findings revealed that students exposed to CBIS outperformed those taught using the conventional method. It is recommended that teachers should be trained on the use of CBIS in order to enhance students' learning outcome.

Keywords: Computer-Based Instruction, Retention Ability, Performance, Attitude, Location

Introduction

The growth and progress of a nation depend majorly on advancements in education and technology. For a long time, it seems technology have not been fully adopted into Nigerian secondary schools to enhance their teaching and learning practices. Olaniyi and Ajayi (2020) observed that most secondary schools still lack adequate supply of computer gadgets and regular supply of electricity to operate the available few where they exist. Therefore, there is need for adequate supply of gadgets and regular supply of electricity which could increase the quality of education.

Education is an empowering process that involves the inculcation of valuable knowledge and skills to individuals, enabling them to become self-sufficient members of the society. It embodies both the act of teaching and learning, with the aim of developing positive qualities and

inner potential. Through education, individuals gain essential knowledge, skills, understanding, attitudes, interests, and critical thinking abilities that are crucial for survival and contributing to the progress of the society. A person who is educated has the ability to think positively and make valuable decisions in life. In order for education to be relevant in a person's life, retention ability is crucial in order to put to use what had been learnt. According to Olaniyi and Ajayi (2020), student's interest and retention could be aroused and retained through the use of multimedia instruction approach.

The major national goals of Nigeria National Policy on Education according to the National Policy on Education (NPE, 2014), are the building of a free and democratic society, a just and egalitarian society, a united, strong and self-reliant nation; a good and dynamic economy, a

land full of bright opportunities for all citizens. For personal empowerment and societal advancement, there is need for functional education for the promotion of a progressive and united Nigeria. Therefore, school programmes need to be relevant, practical and comprehensive hence, education should be based on the development of individual into a sound and effective citizen. Relevant and appropriate skills should be acquired which will enhance the development of mental, physical and social abilities through education, which is the process of facilitating learning or the acquisition of knowledge, skills, values, beliefs, and habit which brings positive changes in human life and behaviour.

Science education as part of education focuses on the inculcation of scientific knowledge in the individuals and the acquisition of desirable scientific knowledge. It enhances the use of observation and experimentation to describe and explain a phenomenon. The aim of science education also includes increasing the benefits science could offer and using such benefits to strengthen technology. Science education also aims at providing people with the knowledge needed for societal development, to ensure the means of physical survival, to develop a cohort of trained scientists necessary for national development and to promote technological advancement. These goals are further enhanced by the integration of Information and Communication Technology (ICT) in the school curriculum, which seems to play an important role in promoting technological growth.

Biology, as a branch of science, has been defined as one of the natural disciplines that focus on living things. Biology is concerned with the study of life, no wonder it is usually referred to as the study of life. Biology also investigates the structures, functions, growth, origin, evolution, distribution, inter-relationships, and adaptations of living species, among other things. Biology frequently overlaps with other sciences such as, Biochemistry, which combines Biology and Chemistry, and Astrobiology, which combines Biology and Astronomy (Omotayo & Osuala 2023).

Biology is inherently interdisciplinary, forging connections with diverse scientific domains. Modern biological research frequently integrates principles from Chemistry, Physics, Mathematics, and Computer Science. For instance, computational Biology utilizes mathematical models and algorithms to analyze biological data, fostering a deeper understanding of complex biological phenomena (Aluru, 2021). The field

of Biology is characterized by specialized branches that cater for specific areas of study. Examples include; genetics, a pivotal branch, which explores heredity and variation, unraveling the molecular mechanisms underlying inheritance (Pierce, 2021); microbiology which investigates microorganisms, shedding light on their roles in health, disease, and environmental processes (Tortora, Funke & Case, 2019).

Biology, as a dynamic scientific discipline, offers the foundational tools to unravel life's complexities. Its interdisciplinary breadth, diverse specialized fields, and practical applications underscore its pivotal role in advancing scientific knowledge and contributing to societal development. According to Ahmad, Abubakar, and Yau (2018), biology education significantly contributes to technological advancement and national development.

Biology education has remained one of the crucial subjects at secondary school levels in Nigeria education. It occupies a very important position in medical science and related disciplines and has therefore been made one of the compulsory subjects of instruction. This is because it provides learners with a broad range of knowledge that is relevant to various aspects of life and human development. Biology is also a pre-requisite to many fields of learning such as Pharmacy, Agricultural Science and Nursing among others. It contributes immensely to the scientific development of nations, it is a key part of life because it is needed by everyone for a successful living, it is a bedrock upon which scientific and technological advancement rest. As Akinwumi, Olojo, Falemu, and Olu-Ajayi (2024) emphasized, biology plays a pivotal role in nation-building, and integrating ICT into its instruction is essential for unlocking that role. Consequently, Biology occupies a unique position in the school curriculum.

Having seen the importance of Biology, it seems most students still regard and learn Biology in abstraction, no wonder their performance in the subject is unimpressive (Nuru, Adamu and Anthony, 2024). Students' low performance in science, particularly Biology, has been a major source of concern for all, particularly those in the main stream of science. Despite the significant role Biology occupies in our educational system, it has been observed that students perform poorly in the subject both in internal and external examinations. Over the years, examination bodies specifically WAEC chief examiners reports (2019, 2020, 2021,

2022, and 2023), have been reporting the poor performance of students in biology. It seems some students still consider Biology as voluminous and difficult to understand which has resulted in poor learning outcomes among students. Students seem to have difficulties in learning and understanding the basic biological concepts.

Table 1 shows the analysis of academic performance of secondary school students in Biology in West African Senior Secondary School Certificate Examination (WASSCE) in Ekiti State.

Table 1: Students' Performance in Biology in WASSCE between 2019 and 2023

Year of Exam	Total No. of Candidates	A1-B3	%	C4-C6	%	D7-E8	%	F9	%	% Pass	% Fail
2019	6691	744	11	3200	48	1657	25	1060	16	59	41
2020	6022	1622	27	3108	52	668	11	624	10	79	21
2021	5641	1120	20	3333	59	761	13	427	8	79	21
2022	2499	491	20	1509	60	185	7	314	13	80	20
2023	5563	824	15	3098	56	1069	19	572	10	71	29

Source: Ministry of Education, Planning, Research and Statistics Department, Ekiti State (2024).

Table 1 shows that while students' performance in Biology may initially seem promising, a more detailed analysis reveals an inconsistent pattern over the years. For example, in 2019, 59% of students attained grades between A1 and C6. This figure rose to 79% in both 2020 and 2021, and further increased to 80% in 2022. However, a decline was observed in 2023, with only 71% of students achieving grades within the A1–C6 range. Only a small proportion of students attained excellent grades (A1–B3), with percentages ranging from just 11% to 27%, while a relatively higher percentage consistently achieved credit-level passes (C4–C6). The data also shows that a notable number of students fall within the D7–F9 range. These lower grades could be due to a lack of adequate understanding or mastery of the subject, which may be attributed to ineffective teaching methods adopted by some Biology teachers. Unfortunately, students who fall into this category may be denied admission into higher institutions, as their grades do not meet the required standards. Furthermore, the inconsistency in failure rates across the five-year period emphasizes the urgent need for improved instructional strategies, continuous teacher development, and a stronger student support system. Without addressing these critical issues,

students may continue to underperform, and many could be denied access to higher education due to poor academic outcomes in Biology.

Based on the analysis shown above, there appears to be a need for improvement in the subject. There are various possible ways and approaches by which the problems militating against the teaching and learning of Biology in senior secondary schools could be solved. Amongst these are the use of Computer-Based instructional strategy, provision of relevant instructional teaching aids, use of appropriate and effective teaching method, provision of well-equipped laboratories, provision of suitable incentives for Biology teachers, and so on. Students seem not to have the right attitude towards the subject but it is believed that if the learning environment is conducive, motivational and attractive with all relevant instructional strategies, this might improve their performance in the subject and their participation in the class work might be encouraging and positive. The most important thing for a teacher is to get used to the teaching method that would help students achieve their learning objectives. If the talk and chalk mode of teaching seems insufficient in educating an individual, then one of the most effective things to do is to take advantage of instructional technologies, especially



the Computer-Based Instructional strategy (CBIS). Computer literacy is very much needed for teachers as well as learners. Abidoeye (2015) opined that the information technology revolution has led to rapid development and expansion across a wide range of areas in the modern world. Educational institutions may benefit from recognizing the potential advantages of recent changes to enhance the teaching and learning environment and respond to the growing demand for education and training. Educators globally appear to be continually exploring strategies to enhance student engagement and improve learning outcomes, making the search for more effective instructional methods an ongoing area of interest. Integrating computers as an instructional strategy could help foster a more interactive environment between teachers and students. Computers have the potential to support self-directed learning and may offer engaging opportunities for learners, including those with learning difficulties. While teachers traditionally play a central role in instruction, Computer-Based Learning environments might enhance communication and collaboration between teachers and learners through the use of technology.

Computer-Based Instructional strategy (CBIS) is a modern teaching-learning strategy in which the topics to be taught are carefully planned and written in a computer in order to facilitate communication between the teacher and the learners. It is an interactive instructional technique whereby a computer is used to present the instructional materials and monitor the learning that takes place. Therefore, Computer-Based instructional strategy will provide an interesting and appropriate environment for teaching and learning. It is assumed that Computer-Based instructional strategy may support students in developing their practical problem-solving skills and enhance learning. While traditional face-to-face learning environments have existed for centuries, Computer-Based Learning has gradually expanded with the advent of new technologies that have opened up greater possibilities for communication and interaction.

Computer-Based instructional strategy is considered to play a vital role in education by potentially enhancing teaching and learning and helping students to acquire relevant skills and competencies. Computer-Based learning offers a diverse set of tools that can be used to support a variety of learning experiences. One such tool

is PowerPoint aided instruction, which allows for the organized and visual presentation of content. PowerPoint, as a slide show tool, would enable students and teachers to incorporate text, video, audio, and images into classroom presentations, thereby potentially facilitating enhanced learners' engagement. In classroom teaching, the interactive features of PowerPoint, such as animations, transitions, embedded quizzes, and multimedia content, can contribute to making lessons more accessible, dynamic, and engaging. These features would allow teachers to present complex concepts in a simplified and visually appealing manner, while also encouraging student participation. Furthermore, the use of PowerPoint in Computer-Based Instructional Strategy (CBIS) may support inquiry-based learning, where students are guided to explore concepts, ask questions, and investigate topics, ultimately improving their understanding and critical thinking skills. This seems to significantly boost students' motivation and engagement, enhancing a more positive attitude toward Biology.

Students might show more positive attitude after being exposed to self-learning strategy such as Computer-Based Instructional strategy. Attitude is likely to affect people in everything they do, hence, attitude may determine students' behaviour. It has been observed that a number of factors might affect students' attitude which may include the attitude of teachers, content difficulties, career interest, absence of practical demonstrations and instructional techniques among others.

According to Akinwumi, Falemu and Olu-Ajayi (2023), it is generally believed that students' attitude towards a subject determines their success in that subject. In other words, a favourable attitude results in good achievement in a subject. A student's successful experience may make him to develop a positive attitude towards learning a subject while his failure may make him exhibit a poor attitude towards the learning of the subject. However, a study by Obeka (2018) shows that different teaching methods can influence students' attitudes, with some strategies being more effective than others in fostering positive attitudes towards a subject. The attitude of students towards Biology could be either positive or negative depending on age, previous experience, and availability of textbooks, classroom activities, Laboratory activities, academic performance and general philosophy

of the students (Achor, Imoko & Uloko, 2017; Ojo & Ogbeba, 2019).

Also, the influence of urban-rural settings may also extend to Biology, as is often the case with other science subjects. This factor could potentially shape students' academic performance in science, including Biology. Students in rural areas are often perceived to face economic challenges and traditional societal norms, with limited access to basic social amenities. In such settings, the standard of living might influence both teaching and learning experiences. Urban schools, by contrast, tend to have relatively better infrastructure, access to electricity, a higher number of qualified teachers, and improved learning facilities. These advantages may make urban schools more attractive to both academically inclined students and committed educators. Based on the researcher's observations, students in urban areas appear to perform better academically compared to their rural counterparts, though this trend may be influenced by several socio-economic and institutional factors. Enriched environment could result to better understanding of the subject taught and hence enhance better performance of student which could bring about different positive responses and behaviours from the learners.

Purpose of the Study

The main purpose of this study is to investigate the effects of Computer-Based Instructional Strategy on students' learning outcomes in Biology in senior secondary schools. The study will also:

- i. determine the effects of Computer-Based Instructional strategy on students' attitude towards Biology.
- ii. determine the performance of senior secondary school student in Biology with the use of Computer-Based instructional strategy
- iii. find out the effects of Computer-Based Instructional strategy on students' retention in Biology.
- iv. examine the influence of school location on the performance of students in Biology.

Research Questions

The following research questions were raised to guide the study:

1. To what extent do students' exposure to Computer-Based Instructional strategy influence their performance in Biology?

2. To what extent do students' exposure to Computer-Based Instructional strategy influence their attitude towards Biology?

Research Hypotheses

The following null research hypotheses were formulated and will be analyzed in this study:

1. There is no significant difference in the pre-test performance of students in the experimental and control groups.
2. There is no significant difference in the attitudinal scores of students in the experimental and control groups before the treatment.
3. There is no significant difference in the post-test performance of students in the experimental and control groups.
4. There is no significant difference in the attitudinal scores of students in the experimental and control groups after treatment.
5. There is no significant difference in the retention ability of students exposed to Computer-Based Instructional Strategy.
6. There is no significant difference in the performance of students in rural and urban schools after being exposed to Computer-Based Instructional strategy.

Methodology

The study adopted quasi-experimental research design. The population for the study consisted of all the 12,690 Senior Secondary School two (SSII) students offering Biology in all the 206 public secondary schools in the sixteen Local Government Areas of Ekiti State. The sample for the study consisted of 159 SSS II students offering Biology selected using multistage sampling procedure. In the first stage, simple random sampling technique was used to select one of the three senatorial districts in the state. In the second stage, simple random sampling technique was used to select two Local Government Areas from the selected senatorial district. The third stage involved the selection of four schools from the selected Local Government Areas using stratified random sampling technique based on location, urban and rural categories. From the urban stratum, two schools with functional projectors were purposively selected because they met the requirements for implementing the Computer-Based Instructional Strategy. From the rural stratum, two schools without projectors were also purposively selected to serve as schools using the conventional method. The four schools that were selected were randomly assigned to experimental and



control groups respectively. In the final stage, students in their intact classes from each of the four schools selected served as the sample for the study.

Two research instruments tagged “Biology Performance Test (BPT)” and “Student’s Attitudinal Questionnaire in Biology (SAQB)” were used for data collection, both were constructed by the researcher. The Biology Performance Test (BPT) consisted of two sections: A and B. Section A consisted of respondents’ biodata while section B contained 20 multiple choice items with four options. Correct option for each item of the instrument was scored 1, while each incorrect response was scored 0. The BPT was used as pre-test and post-test for both the experimental and control groups respectively. Student’s Attitudinal Questionnaire in Biology (SAQB) also consisted of two sections: A and B. Section A consisted of respondents’ biodata while section B contained 20-item statements which were used to gather information on disposition of the students towards the learning of Biology. It was structured on 4- point Likert rating scale, ranging from Strongly Agree (SA)= 4points, Agree (A) = 3points, Disagree (D) = 2points and Strongly Disagree (SD)= 1point.

The instruments were validated by an expert in Test and Measurement, two secondary school Biology teachers, and finally the researcher’s supervisor to ascertain that the instruments measured what they were supposed to measure. The reliability of the instruments was determined using the test-retest method. The scores obtained from the BPT were analyzed using Pearson’s Product Moment Correlation statistics which yielded a reliability coefficient of 0.87, indicating a high level of reliability while the internal consistency of the SAQB was determined using Cronbach’s Alpha statistics, which yielded a reliability coefficient of 0.88 at 0.05 level of significance.

The research procedure occurred in three stages, namely: the pre-treatment stage (one week), the treatment stage (six weeks) and the post-treatment stage (one week). During the pre-treatment stage, the researcher visited the schools to obtain permission and approval from the principals to use their schools, teachers and

students for the research before the commencement of the experiment. After this, the instruments BPT and SAQB were administered as pre-test to ensure that the groups were homogenous before the treatment began. During the treatment stage, which lasted for six weeks, the students in the experimental group were exposed to the selected concepts in Biology using PowerPoint and Video aided Instruction while the students in the control group were taught the same concepts using the regular chalk-talk teaching method. The treatment was systematically administered by the researcher with the help of research assistants. At the beginning of the week that followed the treatment stage period, Biology Performance Test (BPT) was administered, as post-test to measure the performance of the sampled students in each of the experimental and control groups in the schools chosen. The Student’s Attitudinal Questionnaire in Biology (SAQB) was also administered to determine the students’ attitude towards Biology after treatment. This stage lasted for a period of one week. After two weeks, the items of the Biology Performance Test (BPT) that was used for both pre-test and post-test was re-administered on the students in both experimental and control groups respectively. The scores and responses to the instruments were collated as the retention scores. Data collected were analyzed using descriptive and inferential statistics. Descriptive statistics such as mean, standard deviation and bar chart were used to answer the research questions raised while all hypotheses generated were tested at 0.05 level of significance using t-test.

Results

Research Question 1: To what extent do students’ exposure to Computer-Based Instructional strategy influence their performance in Biology?

In answering this research question, mean and standard deviation of the scores of students exposed to Computer-Based Instructional Strategy and conventional method of teaching Biology before and after treatment were computed and compared. The result is shown in Table 2 and Figure i.

Table 2: Performance Mean Scores and Standard Deviation of Students before and after the treatment

Group	N	Pretest		Posttest		Mean Difference
		Mean	SD	Mean	SD	
Experimental	88	5.72	1.73	9.26	2.91	3.54

Control	71	5.45	1.96	6.31	2.67	0.86
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As shown in Table 2 above, prior to the treatment, the experimental group recorded a pretest mean score of 5.72 with a standard deviation of 1.73, while the control group had a slightly lower mean score of 5.45 and a standard deviation of 1.96. Based on the relatively close mean scores, it appears that the groups are homogenous prior to the treatment. After exposure to Computer-Based Instructional Strategy, the experimental group achieved a higher performance mean score of 9.26 with a standard deviation of 2.91, while the control group had performance mean score of 6.31 with a standard deviation of 2.67. This suggests that Computer-Based Instructional Strategy appears to enhance students' performance and understanding of Biology more than the conventional method. Students' performance in Biology before and after treatment is presented in Figure i.

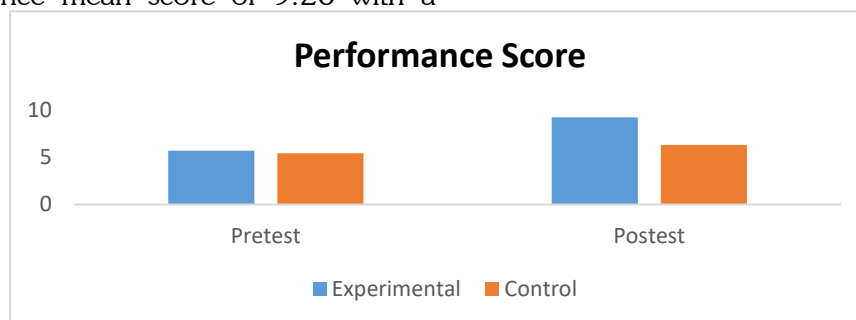


Figure i: Bar Chart Representation of Performance Mean Scores of Students in Experimental and Control groups respectively.

Question 2: To what extent do students' exposure to Computer-Based Instructional strategy influence their attitude towards Biology?

experimental and control groups were computed and compared. The result is as shown in Table 3 and Figure ii.

In order to answer this question, the pretest and posttest mean attitude scores of students in the

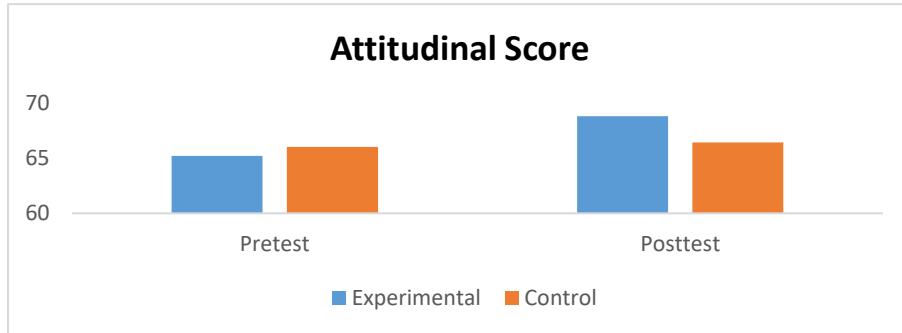
Table 3: Attitudinal Mean Scores and Standard Deviation of Students in Experimental and Control groups respectively

Group	N	Pretest		Posttest		Mean Difference
		Mean	SD	Mean	SD	
Experimental	88	65.20	9.38	68.81	7.03	3.61
Control	71	66.03	7.40	66.44	7.53	0.41

Table 3 above shows that prior to treatment, the students in the experimental group had a pre-attitudinal mean score of 65.20 with standard deviation of 9.38, while students in the control group recorded pretest mean attitude score of 66.03 and standard deviation of 7.40. On exposure to Computer-Based Instructional Strategy, students in the experimental group had a higher post attitudinal mean score of 68.81,

while the students in the control group had post attitudinal mean score of 66.44. This shows that the use of CBIS appears to be more effective than the conventional method in fostering a more favourable and positive attitude towards the study of Biology. Students' attitude towards Biology before and after treatment is represented in Figure ii.

Figure ii: Bar Chart Representation of Attitudinal Mean Scores of Students in Experimental and Control Groups respectively.



Testing of Hypotheses

Hypothesis 1: There is no significant difference in the pre-test performance of students in the experimental and control groups.

In order to test Hypothesis 1, the mean scores of students in experimental group and control group were computed and compared for statistical significance using t-test at 0.05 level. The result is presented in Table 4.

Table 4: t-test summary of Pre-test Scores of Students in Experimental and Control Groups

Group	N	Mean	SD	df	t	p
Experimental	88	5.72	1.73	157	0.91	0.37
Control	71	5.45	1.96			

p<0.05 (Not Significant)

From Table 4, p-value is greater than 0.05, hence, the hypothesis is not rejected. This indicates that there was no significant difference in the pretest performance mean scores of students in the experimental and control groups. Therefore, the hypothesis that says there is no

significant difference in the pre-test performance of students in the experimental and control groups respectively was not rejected. This shows that the two groups were homogeneous at the commencement of the experiment.

Hypothesis 2: There is no significant difference in the attitudinal scores of students in the experimental and control groups before the treatment.

To test Hypothesis 2, pre-attitudinal mean scores of students in experimental group and those in the control group were computed and compared for statistical significance using t-test at 0.05 level. The result is presented in Table 5.

Table 5: t-test summary of the Pre-attitudinal Scores of Students in the Experimental and Control Groups

Group	N	Mean	SD	df	t	p
Experimental	88	65.20	9.38	157	-0.62	0.54
Control	71	66.03	7.40			

p<0.05 (Not Significant)

The result in Table 5 above shows that since the p-value is greater than 0.05, the hypothesis is therefore not rejected. This indicates that there was no significant difference in the pre-

attitudinal mean scores of students in the experimental and control groups respectively. This shows that the two groups were statistically

equivalent in terms of their attitude towards Biology at the commencement of the study.

Hypothesis 3: There is no significant difference in the post-test performance of students in the experimental and control groups respectively.

Table 6: t-test summary of Post-test Mean Scores of Students in Experimental and Control Groups respectively

Group	N	Mean	SD	df	t	p
Experimental	88	9.26	2.91	157	6.94	.000
Control	71	6.23	2.51			

P<0.05 (Significant result)

Result from Table 6 above shows that the p-value is less than 0.05, hence, the hypothesis is rejected. This indicates that there was a statistically significant difference in the post-test mean scores of students in the experimental and control groups. Notably, students in the experimental group achieved significantly higher post-test performance scores in Biology than their counterparts in the control group. This outcome suggests that the improvement in students' performance can be attributed to the instructional treatment, as the experimental group recorded superior post-test outcomes despite their relatively lower initial pre-test mean

To test Hypothesis 3, the post-test mean scores of students in experimental group and those in the control group were computed and compared for statistical significance using t-test at 0.05 level. The result is presented in Table 6.

score. This result further shows that the treatment is effective in enhancing students' performance in Biology.

Hypothesis 4: There is no significant difference in the attitudinal scores of students in the experimental and control groups after treatment.

To test Hypothesis 4, the post-test attitudinal mean scores of students in experimental group and those in the control group were computed and compared for statistical significance using t-test at 0.05 level. The result is presented in Table 7.

Table 7: t-test summary of the Post-attitudinal Mean Scores of Students in the Experimental and Control Groups respectively

Group	N	Mean	SD	df	t	p
Experimental	88	68.81	7.03	157	2.05	0.04
Control	71	66.44	7.53			

p>0.05 (Significant result)

From Table 7 above, the p-value 0.04 is less than 0.05, thus, the hypothesis is rejected. This implies that there was significant difference in the attitude of students exposed to Computer-Based Instructional Strategy and those exposed to conventional method in Biology. Although the control group demonstrated a more positive attitude towards Biology at the pre-test stage, the post-test results showed an impressive improvement in the attitude of students in the experimental group following exposure to the Computer-Based Instructional Strategy, while the attitude of students in the control group only

improved slightly. This improvement suggests that the treatment had a positive influence on students' attitude towards Biology by making learning more engaging and interesting.

Hypothesis 5: There is no significant difference in the retention ability of students exposed to Computer-Based Instructional Strategy.

To test Hypothesis 5, the retention mean scores of students in experimental group were computed for statistical significance using t-test at 0.05 level. The result is presented in Table 8.

Table 8: t-test summary of the Retention Mean Scores of the Students in the Experimental and Control Groups

<i>Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Experimental	88	8.90	3.04	157	6.32	0.00
Control	71	6.00	2.66			

p>0.05 (Significant result)

The result in Table 8 shows that since the P-value 0.00 is less than 0.05, the hypothesis is rejected. This indicated that there was significant difference between the retention mean score of students exposed to Computer-Based Instructional Strategy and those exposed to conventional method in Biology. This result showed that the treatment had a significant effect on the retention of students in the experimental group compared to those in the control group.

Hypothesis 6: There is no significant difference in the performance of students in rural and urban schools after being exposed to Computer-Based Instructional strategy.

To test Hypothesis 6, the post-test mean scores of students taught with Computer-Based Instructional Strategy in urban and rural schools were computed and compared for statistical significance using t-test at 0.05 level. The result is presented in Table 9.

Table 9: t-test summary of the Post-test Mean Scores of the Students in the Experimental Groups based on Location

<i>Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Urban	65	8.26	2.87	86	-5.49	0.000
Rural	23	11.09	1.78			

p<0.05 (Significant result)

Results from Table 9 indicated that the p-value was less than the 0.05 level of significance; therefore, the null hypothesis was rejected. This finding revealed a statistically significant difference in the academic performance of students in rural and urban locations after exposure to the Computer-Based Instructional Strategy (CBIS). Contrary to general expectations, students in the experimental group from the rural area interestingly performed better than their counterparts in the urban area, despite both groups being exposed to the same instructional treatment. This outcome may be attributed to differences in students' prior exposure to computer-based facilities. Many rural schools lack adequate modern instructional technologies, and where such facilities exist, they are often underutilized. Consequently, students in the rural experimental group may have shown greater interest, enthusiasm, and receptiveness to the Computer-Based Instructional Strategy, which positively influenced their learning outcomes. In contrast, students in urban schools are more likely to be familiar with computer facilities, making the use of CBIS less novel and

less stimulating during the study. The findings of this study therefore indicate that school location significantly influenced students' academic performance following exposure to the Computer-Based Instructional Strategy, with rural students benefiting more from the intervention than their urban counterparts.

Discussion

Findings from this study revealed that both the experimental and control groups recorded low pre-test mean scores. This may be attributed to the continued reliance on conventional teaching methods commonly used in the teaching of science subjects, including Biology, which have been reported to be largely teacher-centred and less effective in promoting deep understanding of scientific concepts. This observation is consistent with the findings of Adebayo and Olatoye (2018), who noted that traditional instructional methods often fail to adequately engage students or address difficulties associated with abstract science concepts. The similarity in the pre-test mean scores of the two groups



further indicates that the students were comparable in terms of their baseline knowledge prior to the experimental treatment. This implies that any difference observed in performance at the post-test stage can be attributed to the instructional strategy employed rather than chance. This position aligns with the views of Adeyemi (2019) and Ogunleye and Babajide (2020), who emphasized the importance of establishing group equivalence in experimental studies to ensure the validity of treatment effects.

The experimental group recorded a higher post-test mean score than the control group. This finding suggests that CBIS is more effective in improving students' academic performance and understanding of Biology than the conventional teaching method. Similar findings have been reported by Ajayi, Lawal, and Adeyanju (2021) that computer-based and multimedia instructional strategies significantly enhanced students' achievement in science subjects. The improved performance of the experimental group may be attributed to the visual, interactive, and learner-centred nature of CBIS, which enables students to better comprehend abstract biological concepts. According to Oladipo and Akinyemi (2022), instructional strategies that incorporate visual representations and interactive elements help learners to actively construct knowledge, thereby leading to improved understanding and retention. This finding also supports the submission of Oyelekan, Olorundare, and Akande (2023) that technology-driven instructional approaches promote deeper learning and sustained interest in Biology among secondary school students. The findings of this study support the assertion that teaching approach plays a crucial role in shaping students' learning outcomes in Biology, aligning with the view of Yap (2016) that instructional strategies significantly influence students' attitudes and academic achievement in Biology.

One major observation from this study is the positive effect of CBIS on students' academic performance. The findings show that students exposed to CBIS performed better than their counterparts in the control group, suggesting that this instructional approach is more effective in facilitating students' understanding and mastery of Biology concepts than the traditional teaching method. This aligns with the findings of Ndagie, Oloruntimilehin, Awoniyi, and Adebola (2020), who reported that CBIS significantly enhances students' mastery of scientific concepts by challenging misconceptions

and reinforcing correct frameworks through interactive simulations. The researcher attributes the observed improvement in students' performance to the interactive and learner-centred nature of CBIS. The integration of animations, simulations, and multimedia presentations likely increased student engagement and enabled them to visualize abstract biological processes more clearly. This supports the submission of Azih, Anugwo, and Agbogo (2022), who noted that CBIS provides learners with structured, technology-driven instruction designed not only to transfer knowledge but also to foster interaction, motivation, and sustained engagement in the learning process.

The study further demonstrated that CBIS appears to be more effective than the conventional method in fostering a more positive attitude towards Biology. Although the control group initially demonstrated a more positive attitude towards Biology at the pre-test stage, the post-test results showed an improvement in the attitude of students in the experimental group following exposure to the Computer-Based Instructional Strategy, while just a slight improvement was observed among students in the control group. This pattern indicates that the treatment had a positive influence on students' attitude towards Biology, as reflected in increased interest and engagement in the learning process. This is in consonance with the submission of Jegede (2016) that teaching is made effective when the method used brings about a desirable change in the behaviour of the learners. The researcher believes that the use of Computer-Based instructional strategy will enable the students to understand Biology concepts effectively leading to a positive shift in their attitude towards Biology compared to the conventional methods. This finding is in consonance with the assertion of Ajayi (2016) that a positive attitude towards science significantly correlates with students' performance in the field.

Furthermore, the findings of the study indicate that students taught using the Computer-Based Instructional Strategy (CBIS) were able to recall learned biological concepts more effectively over time compared to those taught using the conventional method. This finding showed that there was a significant difference in the retention mean scores of the experimental and control groups, with the experimental group demonstrating higher retention ability. This suggests that the use of CBIS not only supports immediate learning but also facilitates long-term



memory and retention. This observation aligns with the findings of Ajayi (2025) that the incorporation of digital tools in education enhances students' retention of learned concepts. The use of platforms such as Google Classroom in teaching not only improves academic performance but also strengthens retention, as the interactive nature of such platforms allows for repeated exposure to content and sustained engagement. Similarly, Nwafor, Ekoyo, and Ezenwobodo (2023) observed that students who displayed interest and enthusiasm in science, particularly during practical activities, demonstrated greater conceptual understanding and improved retention of knowledge.

The results of this study showed a noticeable difference in the post-test mean scores of students exposed to the Computer-Based Instructional Strategy (CBIS) in rural and urban schools, and this difference was found to be statistically significant. Interestingly, and contrary to general expectations, students in the experimental group from the rural school performed better than their counterparts in the urban school. This finding appears surprising, as it contrasts with the commonly held view that urban schools tend to have an advantage over rural schools due to better facilities and availability of qualified teachers. Adesoji and Olatunbosun (2018) had earlier observed that school location could influence students' academic performance, noting that rural schools often face challenges such as inadequate facilities and teacher shortages, which may adversely affect students' motivation and academic achievement. While earlier studies, such as Ajayi and Ogunyemi (2015) reported no significant difference in the academic achievement of students from rural and urban areas, the findings of the present study suggest that exposure to CBIS can help reduce the challenges often associated with school location. In this study, students in the rural experimental group performed better than their counterparts in the urban group, indicating that effective use of innovative instructional strategies such as CBIS can enhance learning outcomes in rural schools. This result therefore suggests that school location alone may not be a major factor influencing students' academic performance when

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appropriate and technology-based instructional approaches are employed. The effective use of CBIS can help bridge, and even reverse, the perceived performance gap between rural and urban students.

To this end, the researcher also observed that adopting Computer-Based Instructional Strategy into the teaching and learning of Biology will significantly improve students' performance in Biology as well as enhance their active participation and interactions in the Biology classroom, which will result in good attitude towards Biology.

Conclusion

The study concluded that Computer-Based Instructional strategy led to improve students' learning outcomes in Biology in senior secondary schools. Specifically, the study concluded that students taught using Computer-Based Instructional strategy had better performance in Biology, positive attitude towards learning of Biology, and an improved retention, than those taught using the conventional method.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government should, on a large-scale, adopt CBIS as a strategic intervention to raise the quality of science education and tackle the persistent issue of poor academic achievement in both internal and external examinations.
2. Regular trainings, seminars and workshops should be organized to educate and sensitize the teachers on the benefits and usage of Computer-Based Instructional Strategy in teaching Biology.
3. Computer-Based Instructional strategy should be used to teach all categories of students in order to have better performance for all students in Biology in secondary schools.
4. Computer-Based Instructional strategy should be adopted by the teachers in order to enhance students' performance, attitude and retention in Biology in secondary schools.

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