

**EFFECTS OF COMPUTER-ASSISTED AND GUIDED-DISCOVERY INSTRUCTIONAL STRATEGIES ON SECONDARY SCHOOL STUDENTS' PERFORMANCE AND RETENTION IN BIOLOGY IN TARABA STATE, NIGERIA**

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**ABSTRACT**

*This study investigated the Effect of Computer-Assisted and Guided Discovery Instructional Strategies on Secondary School Students' Performance and Retention in Biology in Taraba State, Nigeria. The nature of the Computer-Assisted Instruction used was the Power-point Presentation. The pre-test, post-test, post-post-test Quasi experimental design was used for the study. The population of the study was 1,290 SSII biology students. Multistage sampling was adopted to determine the schools. Two government owned co-educational schools of SSII classes were purposively selected. This was followed by the sampling of one intact classroom from each of the sampled schools using random sampling making a total of 2 intact classrooms. One of the two intact classes was designated experimental group with 75 students while the other class was designated control group with 55 students. A sample size of 160 students SSII students were drawn from the two intact classes. Two objectives, two research questions and two hypotheses were raised to guide the study. The instrument for data collection was Biology Performance Test (BPT). BPT has a reliability coefficient of 0.81. Mean and standard deviation were used to answer the research questions while the hypotheses were tested using ANCOVA at 0.05 level of significance. Results obtained indicated that a significant difference exists in the mean performance scores of students taught skeletal systems using CAI (30.27) and those taught using GDI (24.68) as well the mean retention scores of students in CAI (28.62) and GDI (21.55). It was concluded that Computer-Assisted Instruction is more effective than guided discovery strategy in promoting students' performance and retention in biology. It was recommended that teachers of biology should adopt Computer-Assisted Instruction as a teaching Strategy to promote students' performance and retention, and Government and School authorities should seek to provide adequate, well-equipped Computer laboratory for the effective teaching of Biology in order to boost students' performance and retention.*

**Key words: Computer-Power Point strategy, Guided Discovery strategy, Skeletal systems, performance, Retention,**

**INTRODUCTION**

The impact of science and technology on modern life is undeniable. Every aspect of our lives, from the devices we use to the food we eat, is influenced by scientific and technological advancements (Ahmed, 2023). The increasing use of technology in education has transformed the way we learn, making it more accessible and engaging (Wekesa & Amadalo, 2013). Computer-Assisted Instruction (CAI) packages have become essential tools in the teaching and learning process, enabling students to acquire knowledge more effectively (Keziah, 2011) in science subjects such as biology.

Biology, a fundamental science subject, has significantly contributed to our understanding of the world and our bodies (UNESCO, 2013). Its applications in genetics, genetic engineering, and biotechnology have improved healthcare, food security, and environmental conservation (FRN, 2013). The Nigerian secondary school curriculum recognizes the importance of biology in scientific and economic development, emphasizing the need for students to acquire relevant knowledge and skills (National Policy on Education, 2019).

The use of Information and Communication Technology (ICT) in teaching biology enhances students' understanding of complex concepts through interactive and engaging multimedia resources (Wekesa & Amadalo, 2013). The National Policy on Education encourages the use of discovery approaches, including demonstration, practical work, and project-based learning, to promote effective learning (FRN, 2013).

To achieve these objectives, educators must adopt innovative teaching strategies and resources, including audio-visual and media materials, to sustain students' attention and interest (Onasanya et al., 2011). The integration of technology in education is crucial for national development, as it enhances educational advancement and technological progress (Egbodo, 2016).

In Taraba State, there has been a growing concern about the poor performance of students in science subjects, including biology (Nwazor, 2011). The introduction of computer-Assisted Instruction aims to address this issue, but its impact on students' performance needs to be thoroughly examined. Performance in education refers to the ability of students to achieve academic goals as measured by standardized tests, assessments, and other evaluative tools. Academic performance is a critical indicator of the effectiveness of educational systems and teaching methodologies, and it has been linked to various factors including socio-economic background, instructional strategies, and student motivation (Adeyemi, 2018). Globally, the emphasis on academic performance has intensified due to its impact on individual career prospects and national development. Understanding the multifaceted nature of performance in education is essential for devising strategies that can enhance learning outcomes across different contexts (UNESCO, 2022).

Ekundayo (2022) notes that student retention remains a vital concern in education, as it significantly impacts students' capacity to complete their academic programs successfully. Research has consistently shown that student retention is influenced by various factors, including academic preparedness, social integration, and institutional commitment.

### **Statement of the Problem**

Despite the importance of Biology in understanding life sciences and its applications in various fields, students' performance and retention in the subject remain a concern in Nigerian secondary schools, particularly in Taraba State as the traditional teaching methods often fail to engage students effectively leading to poor academic performance and low retention of biological concepts. The challenges faced by biology students in Taraba State secondary schools include limited access to up-to-date learning resources and laboratory equipment resulting in students' difficulty in visualizing and understanding complex biological processes and inadequate development of their critical thinking and problem-solving skills.

Computer-Assisted Instruction and Guided Discovery have demonstrated great improvement in science education as well as other educational contexts, but their effectiveness in the specific context of Taraba State secondary schools remains understudied. It is against this background that this study seeks to investigate the impact of Computer-Assisted Instruction and Guided Discovery Instructional Strategies on Secondary School Students' Performance and retention in biology in Karim-lamido Education Zone, Taraba state, Nigeria.

### **Purpose of the Study**

1. Determine the effect of Computer-Assisted Instruction on Secondary School Students' Performance in Biology and those taught the same concepts using Guided Discovery in Karim-lamido Education Zone.
2. Examine the effect of Assisted Instruction and Guided Discovery instructional strategies on secondary school student's Retention in Biology in Karim-lamido Education Zone.

### **Research Questions**

The following research questions were raised to guide the study:

- i. What are the Mean Performance scores of students taught Biology using Computer-Assisted Instruction and those exposed to the same concept using Guided Discovery strategies?
- ii. What are the Mean Retention scores of students taught Biology using Computer-Assisted Instruction and those exposed to Guided Discovery strategies?

### **Hypotheses**

The following hypotheses were formulated and tested at 0.05 level of significance:

**H<sub>01</sub>:** There is no significant difference in the mean performance scores of students taught Biology using Computer-Assisted Instruction and those exposed to the same concepts using Guided Discovery Strategies.

**H<sub>02</sub>:** There is no significant difference in the mean retention scores of students taught Biology using Computer-Assisted Instruction and those exposed to the same concepts using Guided Discovery Strategies.

### **Research Methods**

The study employed a quasi-experimental design with pretest, posttest, post-posttest experimental and control groups. In the design, both the experimental and the control groups were pre-tested to ensure group equivalence, thereafter exposed to treatment for 4 weeks, and at the end of which a post-test was administered to determine students' performance, and two weeks later, a post-post-test was administered to determine their retention level. The study was conducted in Karim-lamido Local Government Area, Taraba State, Nigeria. The targeted population for this study consisted of 1,290 Secondary school students of Biology (SS2 Biology students), 728 male and 562 female, in Karim Lamido Local Government Area of Taraba State (according to Taraba State Ministry of Education). The sample size was 130 SSII students. The multi-stage random sampling technique was used in forming the sample for the study. Two public secondary schools with well-equipped computer laboratories, qualified teachers, and laboratory assistants were purposively selected from the local government to participate in this research, ensuring a conducive environment for reliable data collection and accurate results. One of the schools was designated as the experimental group (CAI) while the other one was designated as the control group (GDI). The purposive sampling technique was used in selecting the sample size.

The instrument that was used for collecting data is the Biology Performance Test (BPT). BPT has a reliability coefficient of 0.81 after pilot testing. The Biology Performance Test (BPT) consists of 50 multiple-choice items adapted from past examination questions of the West African Secondary School Certificate Examination (WASSCE) and Secondary School Certificate Examination (SSCE). Each item of the instrument was a multiple-choice question with four options (A-D) as possible answers to the question. This was administered to the experimental and control groups as a pretest, posttest, and post-posttest. To reduce the effect of posttest on post- posttest, the questions were reshuffled and administered in a different random order in the post-posttest. The instrument was validated by three science education experts from Taraba State University, Jalingo, who reviewed its content and provided feedback that was incorporated to enhance its accuracy and validity. A reliability index of 0.81 was obtained using Kuder-Richardson's (KR-20) formula. The instruments were administered to the subjects accordingly before and after the treatment. Two intact classes were used for four weeks, with one class taught using the Guided Discovery strategy and the other using the Computer-Assisted Instructional strategy, having the same content topics, length of time, lesson plans, instructional materials, class schedule, and duration. The study consisted of three phases: pre-test administration, four-week treatment phase, and post-test administration and two weeks after the post-test, post-posttest was given with the researcher supervising the administration of instruments in both schools. The data collected in this study was

analyzed using descriptive statistics (Mean and Standard Deviation) to answer the research questions, and Analysis of Covariance (ANCOVA) was employed to test the hypotheses at a 0.05 significance level.

**RESULTS**

**Research Question One:** What are the mean performance scores of students taught biology using computer-Assisted and those exposed to the same concepts using guided discovery strategy?

**Table 1: Mean performance score of students exposed to computer-Assisted and those exposed to guided discovery strategies**

Group	N	Pretest		Posttest		Mean Gain
		Mean	Std. Dev	Mean	Std. Dev	
Computer-power point	75	18.73	2.38	30.27	3.029	11.54
Guided Discovery strategy	55	17.61	2.301	24.68	4.211	7.07
Mean Differences		1.12		5.59		4.47

Table 1 shows the mean scores and standard deviations in the performance scores of students taught biology using Computer-Assisted and those taught using Guided Discovery strategies. It is observed that the mean scores of students in the Computer Assisted group is 18.73 in pretest and 30.27 in posttest, while their standard deviations are 2.38 and 3.029 for performance test. Students in the Guided Discovery strategy group have the mean scores of 17.61 and 24.68 in pretest and posttest respectively and standard deviations of 2.30 and 4.21. It was further observed that the mean gain scores for Computer-Assisted and Guided Discovery strategy are 11.54 and 7.07 respectively. This implies that the use of Computer-Assisted favoured students more than Guided Discovery strategy.

**Research Question Two:** What are the mean retention scores of students taught biology using computer-Assisted and those exposed to guided discovery strategies?

**Table 2: Mean retention score of students exposed to computer-Assisted and those exposed to guided discovery strategies**

Group	N	Posttest		Retention		Mean Gain
		Mean	Std. Dev	Mean	Std. Dev	
Computer-power point	75	30.27	3.029	28.62	2.870	1.65
Guided Discovery strategy	55	24.68	4.211	21.55	3.143	3.13
Mean Differences		5.59		7.07		1.48

Table 2 shows the mean retention scores and standard deviations of students taught Biology using Computer-Assisted compared to those using Guided Discovery strategies. It is observed that the mean retention scores of students in the Computer-Assisted group is 30.27 in posttest and 28.62 in post-posttest, while their standard deviations are 3.029 and 2.87 for retention test. Students in the Guided Discovery strategy group have the mean retention scores of 24.68 and 21.55 in posttest and post-posttest respectively and standard deviations of 4.21 and 3.143. It was further observed that the mean difference in retention for Computer-Assisted Strategy group and Guided Discovery strategy is 1.48. This suggests that the students in the Computer-Assisted group retained knowledge of what they were taught higher than their counterparts in the Guided Discovery strategy.

**Hypothesis One:** There is no significant difference in the mean performance scores of students taught biology using computer-Assisted and those exposed to guided discovery strategies.

**Table 3: ANCOVA for Mean performance score of students taught Biology using Computer-Assisted and those exposed to Guided Discovery Strategies**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
<b>Corrected Model</b>	1573.121 <sup>a</sup>	2	786.560	63.251	.000	.417
<b>Intercept</b>	1160.120	1	1160.120	93.291	.000	.345
<b>Pretest</b>	168.189	1	168.189	13.525	.000	.071
<b>Treatment</b>	<b>1116.393</b>	<b>1</b>	<b>1116.393</b>	<b>89.775</b>	<b>.000</b>	<b>.337</b>
<b>Error</b>	2201.079	177	12.435			
<b>Total</b>	140560.000	180				
<b>Corrected Total</b>	3774.200	179				

a. R Squared = .417 (Adjusted R Squared = .410)

Table 3 is one-way ANCOVA between groups' analysis of covariance to compare the effect of Computer-Assisted and Guided Discovery strategies on students' performance in biology. The result  $F(1, 177) = 89.775, P = .000 < 0.05$  shows that the two groups differ significantly. Thus, the null hypothesis is rejected. Therefore, there is significant difference between the performances mean scores of students taught Biology with computer-Assisted strategy compared to those taught using Guided Discovery strategy. The effect size (eta square = .337) indicates that 33.7% of the difference in the mean score is based on the treatment used.

**Hypothesis Two:** There is no significant difference in the mean retention scores of students taught biology using computer-Assisted strategy and those exposed to guided discovery strategy.

**Table 4: ANCOVA for Mean retention score of Students taught Biology using Computer-Assisted and those exposed to Guided Discovery Strategies**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
<b>Corrected Model</b>	2879.206 <sup>a</sup>	2	1439.603	261.025	.000	.747
<b>Intercept</b>	367.061	1	367.061	66.555	.000	.273
<b>Posttest</b>	631.156	1	631.156	114.440	.000	.393
<b>Treatment</b>	<b>494.541</b>	<b>1</b>	<b>494.541</b>	<b>89.669</b>	<b>.000</b>	<b>.336</b>
<b>Error</b>	976.189	177	5.515			
<b>Total</b>	118213.000	180				
<b>Corrected Total</b>	3855.394	179				

3. R Squared = .747 (Adjusted R Squared = .744)

Table 4 is one-way ANCOVA between groups' analysis of covariance to compare the effect of Computer-Assisted and Guided Discovery strategies on students' retention. The result  $F(1, 177) = 89.669, P = .000 < 0.05$  shows that the two groups differ significantly. Thus, the null hypothesis is rejected. Therefore, there is a significant difference between the mean retention scores of students taught Biology with computer-Assisted strategy and those taught using Guided Discovery strategy. The effect size (eta square = .336) indicates that 33.6% of the difference in the mean score is based on the treatment used.

### Discussion of findings

The present study investigated the effectiveness of computer-Assisted and guided discovery strategies on students' performance and retention in biology. The results showed that students taught using computer-Assisted strategy performed significantly better than those taught using guided discovery strategy. This finding is consistent with other studies that have reported the

effectiveness of technology-based instructional methods in promoting students' learning outcomes. The findings of the study agree with the findings of Wekesa and Amadalo (2013) who concluded in a study that the increasing use of technology in education has transformed the way we learn, making it more accessible and engaging. Also, Keziah (2011) asserts that Computer-Assisted Instruction (CAI) packages have become essential tools in the teaching and learning process, enabling students to acquire knowledge more effectively in science subjects such as biology. The findings of the study also agree with the findings of Egbodo (2016) who found that students who received instruction using multimedia presentations outperformed those who received traditional instruction. This explains why Onasanya et al., (2011) earlier noted that educators must adopt innovative teaching strategies and resources, including audio-visual and media materials to sustain students' attention, interest and performance. (Nwazor, 2011) also found that the growing concern of poor performance of students in science subjects, including biology can be ameliorated through the introduction of computer-Assisted Instruction (CAI) and that its impact on students' performance needs to be thoroughly examined.

Similarly, a study by Adeyemi (2020) reported that students who used interactive multimedia modules showed significant improvement in their understanding of biological concepts compared to those who used traditional textbooks. This implies that guided discovery strategy may be more effective in promoting deep learning and understanding of scientific concepts, whereas the present study found that computer-Assisted strategy was more effective in promoting students' performance and retention than the Guided discovery strategy

### **CONCLUSION**

The study concludes that Computer-Assisted Strategy is more effective than Guided Discovery Strategy in promoting students' performance and retention in biology.

### **RECOMMENDATIONS**

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

1. Teachers of biology should consider using Computer-Assisted strategy as a teaching Strategy to promote students' performance and retention
2. Government and School authorities should seek to provide adequate and well-equipped Computer laboratory for the effective teaching of Biology so as to boost students' performance and retention.

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