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Effect of Use of Instructional Materials on Biology Student Cognitive Achievement in Biology in Lagos State Nigeria

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Abstract

This study examines the impact of instructional materials on Biology students' cognitive achievement in Lagos State, Nigeria, using a quasi-experimental design with 140 SS1 students from public secondary schools. Results revealed that students taught with instructional materials (mean post-test score = 24.76) significantly outperformed those taught conventionally (mean = 18.51), with notable pre-test to post-test gains (11.19 vs. 10.54). Gender analysis showed no significant difference in achievement, underscoring universal efficacy. The findings affirm that instructional materials enhance engagement, comprehension, and retention, advocating their prioritized integration in science education to address resource gaps and improve academic outcomes. Stakeholders are urged to invest in teacher training and material provision to bolster Biology education in Nigerian schools.

Keywords: Instructional materials, Cognitive achievement, Biology education, Quasi-experimental, Lagos State

INTRODUCTION

The integration of instructional materials into science pedagogy has been widely recognized as a cornerstone for enhancing cognitive achievement in Biology education. Scholars such as Obanya (2001) posit that instructional materials, or "didactic tools," are indispensable for rendering abstract scientific concepts tangible and accessible to learners. These resources, as defined by Abdullahi (2003), encompass both locally improvised and imported aids designed to amplify lesson efficacy when strategically employed. Their utility extends beyond mere knowledge transmission; they serve as conduits for fostering critical skills, attitudes, and values essential for holistic learning (Isola, 2010). Agina (2005) further refines this definition, characterizing instructional materials as multisensory tools—concrete or digital—that stimulate auditory, visual, or tactile engagement, thereby bridging the gap between theoretical instruction and experiential understanding. Agwu (2001) underscores their role in capturing student attention, emphasizing that materials like charts, audiovisual aids, and specimens must be contextually relevant and timed to align with lesson objectives. Collectively, these definitions coalesce around a shared premise: instructional materials are not supplementary but foundational to effective pedagogy.

The pedagogical significance of these materials is further elucidated by Savoury (2001), who argues that their systematic integration into lesson planning can counteract student disengagement. By aligning materials with core lesson activities, educators cultivate immersive learning environments that foster curiosity, critical thinking, and sustained participation. This aligns with Clark's (2005) assertion that active learner involvement, facilitated by well-curated resources, empowers students to articulate ideas, challenge assumptions, and take ownership of their intellectual growth. Such participatory dynamics not only elevate academic performance but also nurture self-efficacy, a precursor to lifelong learning.

However, the theoretical advocacy for instructional materials starkly contrasts with their practical implementation in many Nigerian secondary schools. In Ikeja Local Government Area of Lagos State, for instance, educators often grapple with systemic challenges—limited access to quality materials, inadequate training, and infrastructural deficits—that hinder their effective deployment. Sasson (2007) frames this discrepancy as a "negative state of events," wherein the absence of these resources obstructs the attainment of educational goals. Kothari (2001) corroborates this, noting that instructional materials are pivotal for consolidating

knowledge, enhancing retention, and fostering collaborative learning. Yet, their underutilization in Ikeja's classrooms persists, exacerbating a documented decline in students' academic performance in Biology.

This decline raises critical questions about the nexus between resource availability and learning outcomes. While studies globally affirm the transformative potential of instructional materials—particularly in science education—their impact within Lagos's unique socio-educational context remains underexplored. Existing literature predominantly focuses on material design or theoretical frameworks, with scant attention to implementation barriers or gender-disaggregated effects. This gap underscores the urgency of contextualized research to inform policy and practice.

The problem is further compounded by a lack of empirical data on how instructional materials influence learner participation, a variable closely tied to academic achievement. Participation, as conceptualized in this study, transcends passive attendance; it encompasses collaborative problem-solving, idea-sharing, and proactive engagement in Biology lessons. Kothari (2001) identifies instructional materials as catalysts for such dynamics, arguing that they democratize classroom interactions by providing visual and tactile anchors for diverse learners. However, in Ikeja's resource-constrained settings, educators often resort to rote methods, inadvertently stifling creativity and critical discourse.

Against this backdrop, this study investigates the interplay between instructional material usage, student participation, and cognitive achievement in Biology. It addresses three underexplored dimensions: (1) the extent to which material availability correlates with improved academic performance, (2) gender-specific responses to material-enhanced pedagogy, and (3) the role of teacher preparedness in optimizing resource utility. By situating the inquiry within Lagos State, the research responds to calls for context-specific solutions to Nigeria's educational challenges.

Ultimately, the study seeks to bridge the chasm between theoretical advocacy and classroom reality. Its findings aim to equip stakeholders—policymakers, educators, and curriculum designers—with evidence-based strategies to revitalize Biology education. By elucidating the mechanisms through which instructional materials enhance learning, the research contributes to global discourse on equitable science education while addressing localized gaps in resource allocation and pedagogical training.

Research Questions

(1) Do students perform better taught with instructional materials than those taught without instructional materials?

(2) Is there any difference between pre-test scores and post-test scores of students taught with instructional material?

(3) Is there any difference between the pre-test and post-test scores of male and female students taught with instructional materials?

Research Hypotheses

In addition to the research questions, the following hypotheses were formulated and tested.

H_{o1}: There is no significant difference between students taught with instructional materials and those taught without instructional materials.

H_{o2}: There is no significant difference between pre-test scores and post – test scores of students taught with instructional materials.

H_{o3}: There is no significant difference between post – test scores of male and female students taught with instructional materials.

Significance of the Study

The study findings will enable the stakeholders realize the importance of instructional materials in participation in Biology lesson activities. The teacher trainees will be guided by the study findings to choose the most efficient instructional materials in Biology classroom activities. Also guided by the study, the parents will be able to choose secondary schools with the best instructional materials when finding schools for their children/wards during entrance examinations. The findings of the study will also form a basis for further research on the role played by instructional materials on participation in secondary schools Biology classroom.

Limitations of the Study

The generalizations made with respect to this study are however subject to the following limitations:

1. Since different teachers were used for different groups, it could be assumed that they might not have been of equal attributes in terms of cognitive, personality and affective

functioning. This might have introduced error in the study.

2. There was also the problem of absenteeism among the students. The fact that some students skipped classes may have influenced their performance.

3. The study is only restricted to only SSI students in secondary schools in Ikeja local Government area of Lagos State. This will make the scope of generalizations fairly narrow.

Purpose of the Study

The study is design to investigate and throw more light on effective use of instructional materials on student's cognitive achievement in Biology. The study is aim to trace and evaluate some of the reasons while most students perform poorly in Biology in senior secondary schools.

Scope of the Study

The study was guided by the following objectives:

1.) To identify why instructional materials are not effectively used during teaching/learning Biology in science classroom.

2.) To establish the importance of grouping of learners on participation in science classroom.

3.) To verify the extent to which availability and adequacy of instructional Materials improve pupils' participation in Biology lesson.

4.) To study the effect of management of records on the improvement in pupils' participation in Biology lesson

METHODOLOGY

This chapter discusses the method and procedure that we will be employed in the study. It is presented under the following sub-headings: Research Design, area of study, population of the study, sample and sampling technique, instrument for data collection, validation of instrument, reliability of instrument, experimental procedure and method of data analysis.

Research Design

The design for the study is quasi-experimental design. Specifically, the study applied non-equivalent control group design. A quasi-experimental design is a type of experimental design that does not provide for full control of extraneous variable, primarily because of the lack of

random assignment of subjects to groups (Ali, 2006). Quasi-experimental design is considered appropriate for the study because intact classes were used to avoid disruption of normal class lessons. The pre-test was used to partial out initial differences in the two groups and to control selection bias, which is a trait to internal validity.

This study was conducted in some secondary schools in Ikeja Local Government Area of Lagos state There are 12 public secondary schools that were used for the study in the area and within the 12 schools 8 are co-educational schools.

Population of the study

The population of the study consists of all the 2,034 SS1 Biology students from the 8 co-educational schools in Ikeja Local Government Area of Lagos State (Lagos State Teaching Service Board, 2015/2016 session academic records). SS1 was used because the topics taught fell under the SS1 Biology curriculum. Co- educational schools were used because the researcher wants to find out if effective use of instructional materials would have any influence on the achievement of students in Biology based on their gender. Also, SS I students are not in final examination class, so they are more favorably disposed to be involved in the study.

Sample and Sampling Technique

The sample size of this study is 140 students from two intact classes in public co-educational schools in Ikeja Local Government Area of Lagos State. To produce the sample, simple random sampling technique will be used to select four schools from Ikeja Local Government Area of Lagos State Four intact classes from the eight co – educational schools were randomly selected by balloting to represent the experimental and control groups. The experimental group was taught using instructional material and the control group was taught without instructional materials.

Instrument for data collection

The instrument for data collection for this study is Biology Achievement Test (BAT). Some items for the BAT was constructed by the researcher and some were adopted from West African Examination Council (WAEC) and it consists of twenty (20) multiple choice questions, based on the Secondary School Biology Syllabus in Ecology. The BAT was Developed from the above topics by first constructing the blue print for the different content Specified above. The objective of the topics in SS1 biology curriculum served as a guide for

Developing the questions. The items in the BAT were structured to cover lower order questions. The Biology Achievement Test will be used to assess the students' achievement in biology.

Validation of Instrument

The twenty-item Biology Achievement Test (BAT), which consists of section A and B items, was face and content validated by two experts, one from Science Education Department, National Open University of Nigeria and one from the Department of mathematics University of Lagos Nigeria. These experts scrutinized the instrument in terms of: clarity of instruction to the subject, proper wording of the items, appropriateness and adequacy of the items for the study, structure and adequate timing. The comments and recommendations of these experts helped to modify the items in the instrument.

Reliability of the instrument

The reliability of BAT was determined using Kuder-Richardson 21, by administering the instrument to 30 SS1 biology students in two different schools in Ikeja local government of Lagos state Nigeria Education Zone, a reliability coefficient of 0.87 was determined.

Experimental Procedure

The researcher trained the research assistants which comprised of the classroom teachers of the schools that were used for the study. The researcher trained the biology teachers using the lesson plans prepared by the researcher. The teachers were trained on how to effectively use the instructional materials, which were used for teaching the students in the experimental group while the teachers for the control group used the conventional material. Students in the treatment and control group will receive the same instruction using the same length of time(period). Each of the school was taught using double periods every week for four weeks. After the training, the researcher assessed the research assistants (teachers) by allowing them to demonstrate what they have been taught in the training for 30 minutes. Student's instructional materials were used to teach the experimental group while the conventional instructional materials were used to teach the control group. The class teacher or research assistants will carry on with the experiment based on the earlier discussion. Pretest was administered to the students before the commencement of the experiment. The researcher also monitored the assistants during the experiment. The regular biology teachers were used during the instruction, two instructional materials were employed, namely the effective use of instructional materials and conventional instructional materials. Intact classes were used

in both schools. Students in the treatment and control group received the same content area of instructional materials using the length of time, students in each school were taught double periods a week and each of the content lasted for 80 minutes, and four weeks was used for the study. At the end of the experiment, the subjects for both the treatment and control groups were given the BAT by their teachers after which the researcher collected the scripts and both the treatment and control groups were scored and their scores were used for the analysis.

Control of Extraneous Variables

The following measures was taken to control the extraneous variables likely to adversely affect the conduct of the experiment and the results obtained thereof.

Teacher variables*:* To control the error that might arise as a result of teacher difference on the students' achievement. The researcher trained the biology teacher of the schools that were chosen for the study using the lesson plan prepared by the researcher. One of the teachers was in charge of the experimental group and one for the control group. The researcher assessed the research assistants by allowing them to demonstrate what they have been taught at the training. This was done to control the differences that may arise as a result of teacher's variable.

Pre-test Sensitization

Since the same items were used for pre-testing and post-testing, students may be very familiar with the test instrument thereby introducing error into the study. To minimize pretest sensitization therefore, the test items were reshuffled after the pre-test.

School variables*:* Co-educational schools were used because gender is a variable in the study.

Subject Interaction*:* four schools that were used for the study are far from each other to avoid interaction and contamination. Schools similar in many characteristics were used for both the experimental and control groups. Intact groups were used for the study to avoid the disruption of the administrative set up of the school.

Inter Group Variable*:* To eliminate the error of non-equivalence arising from nonrandomization of the students, the researcher used Analysis of Covariance (ANCOVA) for data analysis.

Method of data collection

Treatment and control groups were used for the experiment. At the end of the treatment session posttest was administered to the students. Data collected from both the treatment and control groups were used for analysis according to the research questions and hypotheses.

Method of Data Analysis

Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

RESULTS

This chapter presented results of data analysis based on three research questions and Three null hypotheses that guided the study. Results were presented individually in tables for the three research questions and collectively in a table for the three hypotheses.

Research Question 1: Do students perform better taught with instructional materials than those taught without instructional materials?

Table 1: Mean (x) and Standard Deviation (SD) on effect of use of Instructional materials on students' cognitive achievement in biology

MATERIAL	**N**	**PRETEST**		**POSTTEST**		**GAIN SCORE**
		$\overline{X}_1$	SD1	$\overline{X}_2$	SD2	$\overline{X}$
Improvised	67	10.57	4.4	24.76	21.76	11.19
Conventional	73	7.97	3.86	18.51	7.45	10.54

Table I showed that the mean scores for student taught biology using instructional materials was 21.76 while that of the students taught without instructional material was 18.51. Meanwhile the gain score for students taught using instructional material is 11.19 while that of students taught without instructional material is10.54. Students taught using instructional materials therefore, performed better than students taught without instructional materials in Biology.

Research Question 2: Is there any difference between pretest score and post test scores of students taught with instructional material?

Table 2: Mean (x) and Standard Deviation (SD) on the influence of pretest and post test on students' mean achievement scores in Biology when taught using student's instructional material.

MATERIAL	**N**	**PRE-TEST**		**POST-TEST**		**GAIN SCORE**
		$\overline{X}$1	SD1	$\overline{X}$2	SD2	$\overline{x}$
Pre-test	70	10.50	4.35	19.71	6.51	9.21
Post-test	70	7.93	3.72	20.41	6.77	12.48

Table 2 revealed achievement mean score of 19.71 for pretest score of students thought without instructional materials, while post test score of students thought with instructional materials had achievement mean scores of 20.41. However, pretest score of student had gain score of 9.21 while post test score of students thought with instructional materials had 12.48. Therefore students thought with instructional materials performed better than students thought without instructional materials in biology lesson.

Research Question 3: Is there any difference between the pre-test and post-test scores of male and female students taught with instructional material?

Table 3: Mean (X) and Standard Deviation (SD) on achievement scores by mode of method and gender when taught with instructional materials.

MODE	**IMPROVISED**			**CONVENTIONAL**		
	N	$\overline{X}$	SD	N	$\overline{X}$	SD
Pre-test						
Male	**55**	**10.95**	**4.24**	**26**	**7.88**	**3.90**
Female	**12**	**8.83**	**3.93**	**47**	**8.02**	**3.88**
Post-test						
Male	**55**	**21.56**	**4.26**	**26**	**17.04**	**7.52**
Female	**12**	**22.67**	**6.27**	**47**	**19.32**	**7.37**
Total Observed mean		**21.76**	**4.65**		**18.51**	**7.45**

Table 3, revealed mean score of 21.56 for male students who were taught with instructional materials, while their female counterparts had mean scores of 22.67. Male students who were

taught with conventional had mean scores of 17.04 while their female counterparts had mean score of 19.32. The results do not suggest ordinal interaction effect between mode of method and gender on students' achievement in biology. This was because at all the levels of gender, the mean scores were higher for students taught within instructional materials.

Hypotheses

The three hypotheses were tested using Analyses of Covariance. Summary of the analyses for the three hypotheses is shown in table 4.

Table 4: Analyses of Covariance of student's achievement scores by effective use of instructional materials and conventional instructional materials.

SOURCES OFVARIATION	**SUM OFSQUARES**	**DF**	**MEANSQUARE**	**F**	**SIG**
Covariates model	1550.852	**8**	193.856	5.987	.000
Intercept	4397.342	**1**	4397.342	135.811	.000
Pre-test	468.147	**1**	**468.147**	**14.459**	.000
Method	186.706	**1**	186.706	5.766	.018
Gender	69.301	**1**	69.301	2.140	.146
Instructional	213.85	**1**	213.85	6.605	**.011**
Method x Gender	6.494	**1**	6.494	**.201**	**.655**
Method x Instructional	59.124	**1**	59.124	1.826	**.179**
Gender x Instructional	17.938	**1**	17.938	.534	.458
Method x Gender x Instructional	121.523	**1**	121.523	3 .753	.055
Error	4241.570	131	32.378		
Total		140			
Corrected Total		139			

Ho1: there is no significant difference in the mean achievement scores of students taught biology using instructional material and those taught using conventional materials. Data in table 4 showed that there is a significant main effect for mode of instructional materials on student's achievement in biology f (1. 139) =5.766, p<.018. The null hypothesis therefore, was rejected indicating that there is significant difference in the mean achievement score of students taught biology using instructional materials and those taught using conventional

instructional materials. The mean achievement score for students taught with instructional material was 24.76, while that for conventional material was 18.51. The difference was in favor of students taught with instructional materials. The student's taught with instructional materials therefore, were superior to conventional material in Biology lesson.

Ho2: there is no significant difference in the mean achievement scores of pretest and posttest scores of students taught biology using instructional materials and those taught without instructional material.

Table 4 revealed significant main effect of instructional materials on students achievement in biology f (1.139) = 6.605, p> .011. The null hypothesis was therefore, rejected indicating that there is significant difference in the mean achievement scores of pretest and posttest students taught with instructional materials and those taught without instructional materials in biology.

Ho3: the interaction effect of method and gender on students' mean achievement scores in biology is not statistically significant.

Data in table 4 indicated non-significant interaction effect of method and gender on students achievement in biology f (1.139) = .201, p>.655. The null hypothesis was therefore, not rejected. The interaction effect of method and gender on students mean achievement scores in Biology was, therefore, not statistically significant.

DISCUSSION

Discussion of the findings is presented under the following subheadings:

(a). Do students perform better taught with instructional materials than those taught without instructional materials in Biology

(b). Is there any difference between pretest score and posttest score of students' mean achievement scores in biology when taught using instructional material

(c). Is there any difference between the pretest and post test score of male and female students taught with instructional material

Do students perform better taught with instructional materials than those taught without instructional materials on students means achievement scores in Biology?

Students taught with instructional materials performed better than students taught without instructional materials. When the students were taught with instructional materials, they understand the subject better than when taught without the use of instructional materials. The use of instructional materials were more effective because the students performed better when taught with instructional materials than those taught without instructional materials.

Is there any difference between pretest score and post test score of students taught with instructional material?

The finding of the study showed that students taught with instructional materials performed better than those taught without instructional materials. This could be as a result of the fact that students taught with instructional materials were able to see and understand the subject better than ordinary presentation of the lesson without instructional materials, effective use of instructional materials have more advantage on students cognitive achievement in Biology and thereby enables the retention of the lesson, which helped them to be more conversant with it and thereby, improving their academic achievement in Biology. This finding is supported by the findings of Bolick (2003) and Ajayi (2006) which shows that the effective use of instructional materials have more impact on students academics achievement in Biology lesson.

Is there any difference between pretest and posttest score of male and female students taught with instructional material

The results do not suggest ordinal interaction effect between mode of method and

Gender on students' achievement in biology. This was because at all the levels of gender, the mean scores were higher for students taught with instructional material. This finding is in line with the findings of Miriogu (2012), Madu (2004), and Agomuoh (2010) who found no interaction effect of gender and instructional treatment.

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CONCLUSION

From the results obtained in the study on the effects of use of instructional materials on Biology students cognitive achievement, it was found that students taught

biology using instructional materials performed better than students taught without instructional materials; male students did not perform better than their female counterparts in Biology; students taught with instructional materials performed better than students taught without instructional materials, in the pretest and posttest score we observe that students performed better when taught with instructional materials in biology lesson; The results do not suggest ordinal interaction effect between mode of method and gender on students' achievement in biology. This was because at all the levels of gender, the mean scores were higher for students taught with instructional material; the result suggests ordinal interaction effects between modes of method and instructional materials on students' achievement in Biology; this was because at all the levels of instructional materials, the mean scores were higher for student's taught with instructional material compared to students taught without instructional materials with lower mean scores; there was significant difference in the mean score of students taught with instructional material and those taught without instructional materials; there was no significant difference in the mean achievement scores of male and female students in Biology; there was significant difference in the mean achievement scores of pre-test and post-test of students taught with instructional materials in biology lesson.

Recommendations

Based on the findings of this study, and their implications, the following

recommendations are made.

a. The teaching of Biology in secondary school should be conducted in a manner that students will effectively understand and learn the concept taught. It should be practical as the use of instructional materials has play greater role in students' achievement.
b. Teacher should try to improvise instructional materials and encourage students to do the same. This will gives students enough understanding of Biology concepts.
c. There should be cordial relationship between policy makers and schools for the provision of essential resource materials, like laboratory, glass wares, reagents, microscope, burner, etc.

d. It is suggested that regular meaningful workshop on effective use of instructional materials technique for Science teachers should be conducted to improve and update their competence in teaching.

e. At the local education authority level, effort should be made from time to time to organize workshops for Biology teachers on needs for the use of instructional materials. This is to compliment the efforts of the Millennium Development Goals (MDGs) for re-training of Science teachers.

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