

## **Effect of Laboratory Method on Students' Achievement And Retention In Senior Secondary Schools Biology In Kogi East Senatorial Zone**

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**Abstract:** *The study was conducted to determine the effect of laboratory method of teaching on senior secondary school students' achievement and retention in Biology in Kogi East Senatorial Zone. The effect of gender was also examined. The study has four research objectives, answered four research questions and tested four null hypotheses. A quasi experimental design of non equivalent group was adopted. Students Biology Achievement Test (SBAT) was developed and administered to 365 samples drawn from 14,920 populations of Senior Secondary School II students using Taro Yamen. The instrument (SBAT) was validated by three experts and its reliability coefficient was established as 0.87 using test retest method. The experimental group was taught using laboratory method of teaching while the control group was taught using traditional method of teaching as the study lasted for three weeks. Data for the research questions were analyzed using descriptive statistics of means and standard deviation, while the null hypotheses formulated were tested at 0.05 level of significant using ANCOVA. Results of the study revealed significant difference of the achievement, retention and interaction effect between teaching method and the gender of student in the mean gain achievement scores of students taught using laboratory method of teaching and their counterparts taught using traditional method of teaching. The study revealed significant difference in the academic achievement and retention of male and female school students exposed to laboratory method of teaching. The study concluded that laboratory method of teaching is an effective approach of teaching biology at the senior secondary school level. The study recommended that school authority should ensure that teachers should use laboratory method of teaching some basic concepts in biology as it is the most effective teaching method.*

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### **I. Introduction**

The future of every nation including Nigeria lies in the quality of education given to the citizenry. For every developing nation to attain and sustain national development, a well planned and implemented science and technology education remains the only essential tool for her national development (Tafi, 2016). This is because individuals who acquire scientific and technological literacy, think innovatively and rationally, thus enabling them to conduct themselves within the global acceptable standard. Science is therefore an integral part of every educational endeavour. This was the main idea why the Federal Republic of Nigeria in her National Policy on Education (FRN, 2004) emphasized the teaching and learning of science at all levels of educational system across the country.

Biology as a natural science subject, deals with contents from microscopic organisms to the biosphere in general, encompassing the earth's surface and all living things (Okwo and Tartiyus, 2004). Looking at the fundamental characteristics and importance of biology, it is today viewed as a standard subject of instruction at all levels of our educational systems, from pre-primary to tertiary. It is the only core science subject at Secondary School Certificate Examination (SSCE), whose study is very relevant to man's successful living (Akindele, 2009). Araoye (2009) opined that exposure to biology education offers the learners a wide range of relevance to all aspects of life. The ideal behind biology as a course of study is to produce knowledgeable, highly motivated, professional and effective teachers of biology who will be able to develop in students, an appreciation and understanding of biological process and principles (NCCE, 2008)

Biology as a subject discipline is quite popular at all levels of Nigerian education. It has a large student enrolment than any other science subject especially at the upper basic level of the Nigerian education (Ofoegbu, 2003). This has been attributed to several factors including the students' perception of the subject as simple and non-availability of other science subjects in some schools such that biology is made compulsory for both science

and non-science students. In spite of the popularity of biology among students, the failure rate has remained very high (Akubuilu, 2004). Yearly reports of chief examiner of West African Examination Council confirm poor achievement of candidates in Biology. There is an indication also that a good number of candidates could not do well in practical examinations like in Biology because they lack the basic skills for carrying out simple experiments. The poor achievement in Biology by the students in National Examination Council (NECO) and West African Senior School Certificate Examination (WASSCE) over the years has generated a great concern such that Federal Government of Nigeria in recent time organized for a probe of the results in WAEC and NECO (Umoh, 2010). It is important to trace the achievement of students in both WAEC and NECO in this study due to the fact that Biology is the bedrock of all sciences. The achievement of students in Physics, Chemistry and Biology as linked by Biology was identified by separate three committees of Science Teachers' Association of Nigeria (STAN) that was formed in 1968 to review a strong and solid science foundation respectively, in first two years of the then five year secondary education system (NTI, 2011).

Students' abysmal performance in Biology examination has been linked to so many factors like the availability of the needed teaching and learning resources and facilities. This performance can also be linked to the method of teaching. According to Ada (2006), teaching method is a mode of organization of the instructional content, materials, the manner of presentation to the learner and the activities that learners and teachers carryout. There are a number of methods of teaching which are available for the teacher's use in teaching Biology. These methods are classified under two major groups; traditional and contemporary methods. The traditional method popularly called teacher- centred is where the teacher dominates in teaching and learning process. Examples are Lecture method, demonstration method, and descriptive method among others. Contemporary teaching method is also referred to as students-centered teaching approach. Here students are actively involved in knowledge generation. Examples are Laboratory method, computer based approach, concept mapping, and cooperative learning among others.

Agwagah (2008) viewed that the traditional methods are guilty of imposing poor concept formation and reducing the interest and retention and thereby leading to poor achievement among science students. This then calls for the use of the laboratory teaching method which is one of the contemporary teaching methods that could help to increase students' achievement and promotes retention of psychomotor skills in Biology. Laboratory method of teaching according to Akuto, Aduloju and Odeh (2012) is a process where the students are in direct contact with the concept or processes they are learning. This includes; any activity involving students in real situations using genuine materials and properly working equipments. The authors added that the use of laboratory method of teaching aids the development of visual, perceptual and manipulative skills and also makes learning permanent (retention) among students.

According to Joshi (2008) Laboratory method of teaching is a unique way of instruction and it forms an integral part of effective science teaching. In this method, the teacher does not take recourse to lecturing nor to demonstration of experiment. Rather, the students are encouraged to derive the laws and principles of science themselves by actually performing the experiments. The students are given all necessary materials and equipments in the laboratory along with their proper instructions for carrying out their experiments with their own initiative and effort. The observations are recorded and the results are inferred. It helps the students to understand complex abstract ideas and gives students an opportunity to participate in the process and have an appreciation for the methods of science. He viewed that the knowledge and skills gained through laboratory method is more lasting and permanent as they learn by their own experience, observation, testing and verification.

### **Statement of the Problem**

In any teaching and learning process, the cardinal objective is to see that the learner should be able to perform tasks and if possible transfer the experience in solving problems in a new situation. This objective is hardly been achieved over the years. The rate of failure in local and external examination in Biology in recent times is a matter of concern; many suggested that this ugly trend might have been the poor foundation of students in Biology. This may also be connected to the method of teaching used by the science teachers, because a good learning is a product of a good method of teaching. This persistent poor achievement in Biology process skills acquisition exhibited by science students in practical examination leaves no doubt about the ineffectiveness of the teaching method used by science teachers for teaching this subject. Students may have seen Biology as abstract and meaningless concepts. Students neither understand the basic concepts nor the underlying process that gave rise to the Biology concepts. This may be because the teaching methods used by the teacher were teacher's centred and does not allow students' participation, therefore imposing poor concept formation and reducing interest of the students in Biology. This makes students resort to learning by memorization, which results in consistent mass failure. It is against this backdrop that this study is necessitated to investigate the effect of laboratory method of teaching on senior secondary school students' achievement and retention in Biology in Kogi East Senatorial Zone.

**Research Questions**

The following research questions are raised to guide the study.

What is the mean achievement scores of the students taught Biology using Laboratory method of teaching and those taught using traditional teaching method?

What is the mean achievement scores of male and female students taught Biology using laboratory teaching method?

What are the mean retention scores of students taught Biology using laboratory teaching method and those taught using traditional method?

What are the mean retention scores of male and female students taught using laboratory teaching method?

**Statement of Hypotheses**

The following null hypotheses will be tested at 0.05 level of significance:

**H01:** There is no significant difference between the mean achievement scores of students taught Biology using laboratory teaching method and those taught using traditional teaching methods.

**H02:** There is no significant difference between the mean achievement scores of male and female students taught Biology using laboratory teaching method.

**H03:** There is no significant difference between the mean retention scores of students taught Biology using laboratory teaching method and those taught using traditional teaching method.

**H04:** There is no significant difference in the mean retention scores of male and female students taught Biology with the laboratory method.

**II. Methodology**

A quasi experimental design of non equivalent group was adopted. Students Biology Achievement Test (SBAT) was developed and administered to 366 samples drawn from 14,920 populations of Senior Secondary School II students using Taro Yamen. The instrument (SBAT) was validated by three experts and its reliability coefficient was established as 0.87 using test retest method. The experimental group was taught using laboratory method of teaching while the control group was taught using traditional method of teaching as the study lasted for three weeks. Data for the research questions were analyzed using descriptive statistics of means and standard deviation, while the null hypotheses formulated were tested at 0.05 level of significant using ANCOVA.

**III. Results And Discussion**

This chapter presents results of the data analysis and discusses the findings of the research. It was carried out under descriptive analysis, testing of hypothesis, and discussion of findings.

**Research Question 1**

What is the mean achievement scores of the students taught Biology using Laboratory method of teaching and those taught using Traditional method?

**Table 1: Mean Achievement Scores and Standard Deviation of Students taught Biology with Laboratory Method and those taught with Traditional Method**

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Traditional Method	184	58.18	8.204	54.09	9.331
Laboratory Method	181	58.71	9.064	65.94	7.952
Mean Diff.		0.53		11.85	
N Total	365				

Source: Field work (2017).

The result of the mean achievement scores of the students taught Biology using Laboratory method of teaching and those taught using Traditional method is presented in table 1. The result showed that in the pre-test, the control group (traditional method) had a mean score of 58.18, while the experiment group (laboratory method) had a mean score of 58.71. The mean score difference between the two groups is 0.53 and this shows that both groups were at the same cognitive level. The result also showed that in the post-test, the control group had a mean score of 54.09, while the experimental group had a mean score of 65.94. The mean score difference between the two group is 11.85 and this shows that the experimental group had a higher mean achievement score.

**Research Question 2**

What is the mean achievement scores of the male and female students taught Biology using Laboratory method of teaching?

**Table 2: Mean Achievement Scores and Standard Deviation of Male and Female Students taught Biology with Laboratory Method**

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Male	98	62.42	7.376	66.38	8.191
Female	83	53.32	8.597	65.29	7.599
Mean Diff.		9.1		1.09	
N Total	181				

Source: Field work (2017).

The result of mean achievement scores of the male and female students taught Biology using Laboratory method of teaching is shown in table 2. The result showed that in the pre-test, the male students had a mean score of 62.42 and a standard deviation of 7.376, while the female students had a mean score of 53.32 and a standard deviation of 8.597. The mean score difference between the two group is 11.85 and this shows that both groups were at different cognitive level before the application of treatment. The result also showed that in the post-test, the male students had a mean score of 66.38 and a standard deviation of 8.191, while their female counterpart had a mean score 65.29 and a standard deviation of 7.599. The mean difference between the two groups is 1.09 and this shows that both groups were almost at the same cognitive level after the application of treatment.

**Research Question 3**

What are the mean retention scores of the students taught Biology using Laboratory method of teaching and those taught using Traditional method?

**Table 3: Mean Retention Scores and Standard Deviation of Students taught Biology with Laboratory Method and those taught with Traditional Method**

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Traditional Method	184	59.32	6.312	51.33	9.875
Laboratory Method	181	61.29	6.885	65.31	6.665
Mean Diff.		1.97		13.98	
N Total	365				

Source: Field work (2017).

The result in table 3 shows the mean retention scores of the students taught Biology using Laboratory method of teaching and those taught using Traditional method. The result showed that in the pre-test, the control group had a mean retention score of 59.32, while the experiment group had a mean retention score of 61.29. The mean difference between the two groups is 1.97 and this shows that both groups were almost at the same cognitive level before the application of treatment. The result also showed that in the post-test, the control group had a mean retention score of 51.33, while the experimental group had a mean retention score of 65.31. The mean score difference between the two group is 13.98 and this shows that the experimental group had a higher mean retention score.

**Research Question 4**

What are the mean retention scores of the male and female students taught Biology using Laboratory method of teaching?

**Table 4: Mean Retention Scores and Standard Deviation of Male and Female Students taught Biology with Laboratory Method**

Groups	N		Pre-test		Post-test
		Mean	SD	Mean	SD
Male	98	62.10	7.844	66.61	7.395
Female	83	59.64	5.761	63.42	4.898
Mean Diff.		2.46		3.19	
N Total	181				

**Source: Field work (2017).**

The result of mean retention scores of the male and female students taught Biology using Laboratory method of teaching is shown in table 4. The result showed that in the pre-test, the male students had a mean retention score of 62.10 and a standard deviation of 7.844, while the female students had a mean retention score of 59.64 and a standard deviation of 5.761. The mean difference between the two groups is 2.46 and this shows that both groups were almost at different cognitive level before the application of treatment. The result also showed that in the post-test, the male students had a mean retention score of 66.61 and a standard deviation of 7.395, while their female counters part had a mean retention score of 63.43 and a standard deviation of 4.898. The mean difference between the two groups is 3.19 and this shows that the male students had a higher retention score.

**Research Hypothesis 1**

There is no significant difference between the mean achievement scores of students taught Biology using laboratory teaching method and those taught using traditional teaching methods.

**Table 5: Analysis of Covariance of Academic Achievement Scores of Students taught Biology with Laboratory Method and those taught with Traditional Method**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13911.983a	2	6955.991	92.723	.000
Intercept	24980.293	1	24980.293	332.987	.000
PreTest	222.518	1	222.518	2.966	.086

Source: Field work (2017).

The result of the Analysis of Variance in Table 5 shows that the P-value of 0.00 is less than the 0.05 level of significant at 1 degree of freedom. This shows that the test is significant. This implies that there is a statistical significant difference in the mean achievement scores of students taught Biology using laboratory teaching method and those taught using traditional teaching methods. Therefore the null hypothesis of no significant difference is rejected.

**Research Hypothesis 2**

There is no significant difference between the mean achievement scores of male and female students taught Biology using laboratory teaching method.

**Table 6: Analysis of Covariance of Academic Achievement Scores of Male and Female Students taught Biology with Laboratory Method**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	141.703a	2	70.851	1.122	.328
Intercept	12787.290	1	12787.290	202.468	.000
PreTestExp	87.312	1	87.312	1.382	.241
<b>Gender</b>	<b>3.178</b>	<b>1</b>	<b>3.178</b>	<b>.050</b>	<b>.823</b>
Error	11873.544	188	63.157		
Total	842428.000	191			
Corrected Total	12015.246	190			

Source: Field work (2017).

The result of the Analysis of Variance in Table 6 shows that the P-value of 0.823 is greater than the 0.05 level of significant at 1 degree of freedom. This shows that the test is not significant. This implies that there is no statistical significant difference in the mean achievement scores of male and female students taught Biology using laboratory teaching method. Therefore the null hypothesis of no significant difference is not rejected.

**Research Hypothesis 3**

There is no significant difference between the mean retention scores of students taught Biology using laboratory teaching method and those taught using traditional teaching method.

**Table 7: Analysis of Covariance of Academic Retention Scores of Students taught Biology with Laboratory Method and those taught with Traditional Method**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19458.763a	2	9729.381	137.703	.000
Intercept	11015.644	1	11015.644	155.908	.000
PreTest	405.163	1	405.163	5.734	.017
<b>Groups</b>	<b>17830.980</b>	<b>1</b>	<b>17830.980</b>	<b>252.368</b>	<b>.000</b>
Error	27343.381	387	70.655		
Total	1366662.000	390			
Corrected Total	46802.144	389			

Source: Field work (2017).

The result of the Analysis of Variance in table 7 shows that the P-value of 0.00 is less than the 0.05 level of significant at 1 degree of freedom. This shows that the test is significant. This implies that there is a statistical significant difference in the mean retention scores of students taught Biology using laboratory teaching method and those taught using traditional teaching methods. Therefore the null hypothesis of no significant difference is rejected.

**Research Hypothesis 4**

There is no significant difference in the mean retention scores of male and female students taught Biology with the laboratory method.

**Table 8: Analysis of Covariance of Academic Retention Scores of Male and Female Students taught Biology with Laboratory Method**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1297.102a	2	648.551	17.068	.000
Intercept	4879.969	1	4879.969	128.426	.000
PreTestExp	828.233	1	828.233	21.797	.000
<b>Gender</b>	<b>239.781</b>	<b>1</b>	<b>239.781</b>	<b>6.310</b>	<b>.013</b>
Error	7143.673	188	37.998		
Total	823104.000	191			
Corrected Total	8440.775	190			

Source: Field work (2017).

The result of the Analysis of Variance in Table 8 shows that the P-value of 0.013 is less than the 0.05 level of significant at 1 degree of freedom. This shows that the test is significant. This implies that there is a statistical significant difference in the mean retention scores of male and female students taught Biology using laboratory teaching method. Therefore the null hypothesis of no significant difference is rejected.

#### **IV. Discussion of Findings**

The finding of the study revealed that a significant change was found in the academic achievement scores of students taught Biology using laboratory teaching method and those taught using the traditional method of teaching. The students taught using laboratory method of teaching performed better in achievement than those taught using traditional teaching methods. This implies that laboratory teaching method is a more efficient way of teaching Biology than the traditional teaching method. The finding of the study supports the study of Ozay and Ocak (2009) who recommended the use of laboratory method and demonstration method at the beginning of Science lesson to attract attention and motivate students. The finding is in agreement with Wambuğu and Changeiywo (2008) who viewed that teaching methods affect the academic achievement of students.

It was found by the study that male students performed well than the female students, although, the difference was not statistically significant. This finding is in agreement with Archer and Macrae in Iwuji (2012) who stated that males students appear to be higher in achievement than the females and also reported that boys are better at activities requiring manipulation (psychomotor skills) than girls, and that boys are more aggressive towards laboratory and project work. The finding is also in line with the view of Iwuji (2012) who stated that boys also perform better than girls in process of measuring and experimenting. The finding of the study is also supported by Oakley in Iwuji (2012) who opined that right from the childhood, a boy traditionally receives more training and encouragement for achievement than girls.

The result of the study shows that students taught Biology using laboratory teaching method had a better retention scores than those taught using traditional teaching methods. The result also shows statistical significant difference in the mean retention scores of students taught Biology using laboratory teaching method and those taught using traditional teaching methods. The finding is in collaboration with Bichi (2002) who reported that teaching in a practical class improves retention of skills of students. The finding of the study shows that the male students had a better retention score than their female counter part. The study also shows that there is a statistical significant difference between the mean retention scores of male and female students taught Biology using laboratory teaching method. The finding contradict the study of Ariyo (2011) who carried out a study to investigate the extent to which gender differences determines the academic achievements and retention of students in secondary school and found that no relationship between gender and academic retention.

#### **V. Conclusion**

It can be concluded that the method employ in teaching Biology has significant effects on students' achievement and retention as both male and female students gained significantly and retained more skills when taught using laboratory method of teaching. Therefore, it is an effective and result oriented method of teaching especially in pure science oriented subjects

#### **Recommendations**

Based on the findings of the study, the following actions are hereby recommended;The laboratory method of teaching is an effective approach; therefore it should be implemented for the teaching of Biology at all levels. Proprietors of schools should endeavour to provide and equipped science laboratory in their schools to enhance the teaching of Biology. Students should see laboratory as a best means/resource for learning of sciences that enhances skills acquisition which promotes retention of knowledge.

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