

# **EFFECTS OF TWO PRACTICAL STRATEGIES ON ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL BIOLOGY STUDENTS IN GOMBE STATE**

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## **Abstract**

*The study investigated the effects of laboratory work and field work practical teaching strategies on academic achievement of senior secondary school biology students. It also investigated the effects of attitude and gender on the measure outcome. A quasi-experiment pre-test post-test control group design was adopted in which treatment (at four levels) was crossed with attitude (at two levels) and gender (at two levels). Sample consisted of 146 SS2 biology (86 males and 60 females) drawn from four intact classes randomly selected from four senior secondary schools. Biology Achievement Test (BAT), Practical Skill Test (PST) in practical biology, attitude questionnaires in practical biology were the instruments used for data collection, seven hypotheses were tested at 0.05 level of significance. Data collected were analyzed using analysis of covariance (ANCOVA), Multiple Classification Analysis (MCA) and sheffee test. Only treatment had significant main effects on academic achievement with the combined group exhibiting the test performance, followed by the laboratory work group and then the field work group and lastly the modified lecture group which served as control. There were no main interaction effects of gender and attitude. Recommendations were made based on findings for the need for employment of these tested strategies for regular practical classes in biology at the senior secondary school level.*

## **Keywords:**

*Laboratory work, Field work, Academic Achievement, Practical Biology*

## **Introduction**

Practical biology are activities carried out in the biology laboratories where students were expected to be involved in handling, observing and manipulation of practical equipment and materials in order to learned biology. Practical work or

classes have been identified as an integral and necessary aspect of teaching and learning of biological concepts (Bajah, 2014). It is defined as any teaching and learning activity which involves observation of real objects and phenomena in biology (Isah, 2015). The opportunity to interact with real objects and get involved in practicals is a necessary physical and mental activity that reinforces the knowledge of learners and consequently leads to the development of necessary basic practical skills (Ige, 2009). It is however, disheartening to note that the current neglect of practical lessons in teaching and learning process in biology in most senior secondary schools in Gombe State is alarming (Ministry of Education, Gombe State 2017). It was observed that biology teachers often abandoned the practical biology classes and concentrate on teaching theoretically the biology content areas. Various studies have emphasized the importance of acquisition of practical skills and their effect on the academic achievement of the students. The performance of biology students that sat for practical biology examinations in their senior school certificate examination was very low (West African Examinations Council Chief Examiners Report, (WAEC) 2016 and 2017).

Researchers have also observed that many biology teachers only engaged their students in skeletal practical lessons when preparing for the commencement of the WAEC or NECO practical biology examination (Mary, 2017). However, practical biology is classified as a core practical activity by the National Policy on Education and it is also contained in the WAEC or NECO syllabus. One of the objectives of practical biology classes as stipulated in the senior secondary school curricula is to enable biology students acquire laboratory and field skills, basic knowledge and practical skills in biology. Therefore, the importance of acquiring practical biology skills and competencies cannot be over emphasized. Research findings in respect of attitude and gender and their effects on academic achievement skill remain inconclusive. Some researchers reported significant effects of gender on academic achievement with male's performance better than their female's counterparts (Okebukola, 2016). Others reported non-significant gender diffidence (Muhammad, 2016). There is therefore the need to further examine possible effects of gender on academic achievement in practical biology when they are exposed to different practical strategies. Equally important is the possible relationship between attitude and their academic achievement in practical biology classes. Some researchers reported low positive correlation between attitude and academic achievement (Morgan, 2015) while Simpson and Oliver (2016) reported that attitude is a strong predictor of achievement in biology. This uncertain finding of the studies prompted the need to investigate the effects of these four practical strategies on students' academic achievement in biology in Gombe State.

## Statement of the Problem.

Based on the conceptual background, practical biology is an integral part of the senior secondary school biology curriculum. It involves observations (seeing, smelling, feeling, tasting, hearing, measuring, classifying, analyzing, etc). Practical biology lessons were meant to lead to the development of basic practical skills by the students. It was observed that many biology teachers in the senior secondary schools have neglected practical biology lessons in the teaching and learning process. It was reported that many biology teachers abandoned practical biology lessons because many of them are not qualified or lack the basic practical skills needed to conduct practical biology lessons successfully. The inability of the teachers to carry out a successful practical biology lesson affects the performance of the students in their practical biology examinations in NECO and WAEC. This study therefore seeks to investigate the effects of laboratory work and field work as practical strategies on academic achievement in senior secondary school biology. It also investigated the moderating effects of gender and attitude to biology on students' academic achievement.

## Purpose of the Study

The main purpose of the study is to determine the effects of laboratory and field work practical strategies on the academic achievement of senior secondary school biology students. Specifically, the objectives of the study are as follows:

- 1) Determine the effects of laboratory work practical instructional strategy on academic achievement of senior secondary school biology students.
- 2) Determine the effects of field work practical instructional strategy on academic achievement of senior secondary school biology students.

## Research Questions

1. What is the effect of laboratory work practical instructional strategy on academic achievement of senior secondary school biology students?
2. What is the effect of field work practical instructional strategy on academic achievement of senior secondary school biology students?

## Hypotheses

- H<sub>01</sub>:** There is no significant main effect of treatment on academic achievement in practical biology
- H<sub>02</sub>:** There is no significant main effect of gender on academic achievement in practical biology.
- H<sub>03</sub>:** There is no significant main effect of attitude on academic achievement in practical biology
- H<sub>04</sub>:** There is no significant interaction effect of treatment and gender on their academic achievement in Biology

- H<sub>05</sub>:** There is no significant interaction effect of treatment and attitude on academic achievement in biology.
- H<sub>06</sub>:** There is no significant interaction effect of attitude and gender on academic achievement in biology.
- H<sub>07</sub>:** There is no significant interaction effect of treatment, attitude and gender on academic achievement.

## **Methodology**

### **Research Design**

The study adopted a pretest post-test non-equivalent control group quasi-experimental design in which 4x2x2 factorial matrix was adopted with measurement (at four levels) with gender as two levels (male and female) and attitude at two levels (positive and negative). The design is suitable because there was no random sampling of the students used for the study rather intact classes were used.

### **Population and Sample**

The target population for the study was all senior secondary school biology (SS II) students in all the senior secondary schools in Kwami Local government Area of Gombe State Nigeria. Four senior secondary schools were selected through random sampling by balloting. One intact SS II class was randomly selected from the available streams of classes in the four senior secondary schools selected. A total number of 146 senior secondary school biology students formed the study sample.

### **Research Instruments**

Three research instruments were used in this study for data collection namely: Biology Achievement Test (BAT), Biology Attitude Questionnaires (BSAQ) and Practical Test in Practical Biology (PTPB).

#### **Biology Achievement Test (BAT).**

This was a 50-item multiple choice test with 10 fill in the blank spaces to yield sixty marks. It covers practical biology achievement test carried out. It had a reliability coefficient of 0.78 using test-retest person product moment correlation.

#### **Biology Attitude Questionnaire (BSAQ)**

This was used to assess attitude to practical biology. It consists of 50 –items drawn on a 4-point modified likert scale. Positive items (25) were graded on points (S.A=4, A=3, SLA=2, SD=1). The reverse was the case for (25) negative worded items. The cronchbach coefficient was measured at 0.72.

### **Practical Test in Practical Biology (PTPB)**

This is a written practical test to assess practical knowledge of practical biology activities carried out. It consisted of 40-short response questions from five areas of practical biology activities. namely: Examining Algae, bryophytes and pteridophytes. The total obtainable score was 100 marks. The research instruments were face and content validated by experts from department of biological science and Department of of Education Gombe State University and biology supervisors of the Ministry of Education Gombe state. Its reliability coefficient was 0.81test retest using Pearson product moment correlation.

### **Researchers' Instructional Guide for Practical Biology Lesson (RIGPBL)**

This was developed by the researcher as a procedure guide for both experimental treatments and control. It explained the steps typical of a lesson plan where students engage in activities peculiar to the instructional strategy used for treatment.i.e laboratory work, field work, combined laboratory and field work, and lecture teaching method four experts face and content validated the practical guide.

### **Procedure and Treatment.**

#### **(1). Experimental group 1 (LWS).**

This is the laboratory work strategy group. In this group, normal practical biology teaching and learning of the selected practical biology activities took place. The students were engaged on practical activities in the laboratory which include examining algae (spirogyra) bryophytes (Mosses), pteridophytes (Dryopterisfelix-mas) This group used magnifying instruments such as compound microscope and hand lens to view the structure of the plants in the biology laboratory.

#### **(2). Experimental group 2 (FWS).**

This is field work strategy (FWS) group. In this group, normal practical biology lessons activities of same selected practical biology activities also took place. However, this group participated in field work observation activities outside the classroom which included visiting a site where the selected plants are found, example; streams/pounds. The were asked to identify the specimen, use hand trowel to pick some specimen, observe the specimen using compound microscope and hand lens.

#### **(3). Experimental group 3 (CBS).**

This is the combined strategy group which completed the same normal practical neology activities but they were involved in both laboratory work and field work. i.e. They were involved in laboratory work activities in some of the practical biology activities(e.g. spirogyra and bryophytes) in the laboratory while field work activities in some of the practical biology activities (example in pteridophytes).

### **Control group**

This is modified lecture strategy group. It involved normal practical biology activities in which the teacher did most of the activities including demonstration with a compound microscope.

Administration of instruments SAQPB, BAT and PTPB were administered in that order as pretest in the first week. The treatment in the four groups lasted for six weeks with biology teachers using the instructional guide. The administration of post-test was carried out two days after treatment. SAQPB, BAT and PTPB were administered in the same order

### **Data Analysis**

Data obtained was analyzed using Analysis of covariance (ANCOVA) to test the post experimental difference between the experimental group and control group. Multiple classification analysis (MCA) was carried out where such differences occurred and there significance. Post hoc using scheffee multiple range test is used to determine the source and degree of differences.

**Table 1: Summary of Analysis of covariance (ANCOVA) of Subjects Post-test Academic Achievement Score by Treatment, Attitude and Gender**

Source of Variation (Pretest)	Sum of Square	df	Mean Squares	f	p
Variation (Pretest)	8639.426	1	8639.426	93.907	
Main Effects	2202.778	5	440.556	2.39	
Treatment	1971.868	3	657.289	7.144	
Attitude	30.08	1	30.08	.326	
Gender	200.9	1	200.9	2.183	
2 way Interaction	867.224	7	123.889	1.346	
Treatment and Gender	173.494	3	57.831	6.628	
Treatment and Attitude	568.048	3	189.349	2.058	
Attitude and Gender	8.854	1	8.854	0.096	
3 way Interaction	642.81	3	214.270	2.329	
Treatment, Attitude and Gender	642.81	3	214.270	2.329	
Residual	10680.246	115	92.871		
<b>Total</b>	<b>26622.76</b>	<b>131</b>	<b>203.227</b>		

## Results

Table 1 shows a significant main effect of treatment ( $F=7.1441$ ;  $p<.05$ ) on academic achievement. Therefore  $H_{01}$  is rejected. No significant main effects of attitude and gender were obtained ( $F=.325$ ;  $p<.05$ ,  $f=2.183$ ;  $p<.05$ ). There was significant interaction effect of treatment and gender ( $F=6.60$   $P<.05$ ) Therefore  $H_{04}$  was rejected while  $H_{05}$ ,  $H_{06}$  and  $H_{07}$  are accepted. To ensure further clarification, Multiple Classification Analysis (MCA) was carried out and results are presented in Table 2

Table 2: Multiple Classification Analysis

Teaching Level of Significance Strategies 1.	Teaching Strategies (J)	Mean difference (I – J)	
CBS	FWS	3.6	0.00
	LWS	8.2	0.00
	MLS	22.1	0.00
FWS	CBS	-0.6	.48
	LWS	7.6	0.00
	MLS	21.5	0.00
LWS	CBS	-8.2	.28
	FWS	-4.6	.34
	MLS	13.9	0.00
MLS	CBS	-22.1	81.9
	FWS	-18.5	72.5
	LWS	-13.9	86.1
MULTIPLE R			
<b>CBS</b>	=	67.8	
<b>FWS</b>	=	64.2	
<b>LWS</b>	=	59.6	
<b>MLS</b>	=	45.7	



Table 2: Multiple Classification Analysis

Teaching Strategies	N	Grand mean=59.33 Unadjusted deviation	esa	Adjusted for individual covariance	Beta
LWS	36	.27		.16	
FWS	34	4.87		.12	
			17.01		
CBS	38	8.47		.8	
MLS	38	-13.63		.3	
Multiple R					1.38
Adjusted R <sub>2</sub>					1.90

Multiple Classification Analysis revealed that treatments account for the higher adjusted mean scores 0.27, 4.87 and 8.47 which is greater than the adjusted mean score of MLS which is -13.63. A better value of 1.90 indicates that the two teaching strategies FWS and CBS combine to produce significant effect on dependent variable.

The Combined Strategy Group (CBS) had the highest adjusted mean score of 67.8 followed by field work strategy group (FWS) with a adjusted mean score of 64.2, this was followed by Laboratory work strategy group (LWS) with an adjusted mean score of 59.6 and Finally the control group i.e modified lecture group strategy (MLS) with 45.7. To determine the pair that contributed to the significant variation at 0.05 alpha level, a post Hoc analysis was carried out using scheffee Test.

Table 3: Scheffe Multiple Range Analysis for Academic Achievement

Teaching Significance Strategies 1.	Teaching Strategies (J)	Mean difference	Std error	
LWS	FWS	-4.6	.41	
.00				
	CBS	-8.2	.78	
.00				
	MLS	+13.9	.81	.00
CBS	LWS	+8.2	.98	.00
	FWS	+3.6	.40	.00
	MLS	+22.1	.92	.00
FWS	CBS	-3.6	.40	.13
	LWS	+4.6	.41	.24
	MLS	+18.5	.85	.00
MLS	LWS	-13.9	.81	.28
	FWS	-18.5	.85	.27
	LWS	-22.1	.92	.31

Mean difference is significant at 0.05 level of significance.

### **Keys**

LWS = laboratory work strategy CBS = combine strategies FWS = Fieldwork strategies MLS = modified lecture method

The mean difference between LWS and FWS is very small. The performance of the MLS group was however, very low compared to that of the LWS and FWS and CBS group. This was expected become MLS only promotes rote learning. (Carrallo and Schaler, 1994).

The results showed a non-significant main effect of attitude and gender on academic achievement. This implies that attitude (positive or negative) and gender (male or female) was not critical in determining the academic achievement of students in practical Biology. This agrees with the result of Mohammed and Mary (2016). There were also no interaction effects of attitude and gender on academic achievement.

## Conclusion

Based on the result of the data analysis and findings of this study, the following conclusions are made;

1. That biology student's performed better in terms of academic achievement learning teaching strategies involving laboratory and field work singly or in pairs in practical biology.
2. That interaction effect of treatment and gender play a significant role in terms of student's academic achievement in practical biology.
3. That there was no interaction effect of the treatment, gender and attitude on academic achievement of the student.

## Recommendations

Based on the foregoing findings, it is recommended that our education reforms should focus on making sure that our biology teachers jointly and compulsorily incorporate both laboratory work and field work into practical biology lessons since the study has shown that the two strategies improved the academic performance of students. To achieve this, all institutions of higher learning as well as post primary science secondary school teachers should be well trained to be able to implement these teaching strategies in practical biology lessons.

Since attitude and gender have no significant main effect on student's academic achievement in practical biology lessons, further studies should be carried out on other student's variable such as retention.

## References

- Bajah, A. (2014). Survey of Biology Teachers Attitude Towards Practical Biology in Senior Secondary Schools. *Journal of Research on Science Teaching* 4, Pp. 101-109.
- Ige, R.A (2017).The Current State of Practical Lessons in Science Teaching in Nigeria. *Journal of Research in Curriculum Studies*, 9, Pp. 11-18.
- Isah, M.S (2015) Factors Affecting Student's Performance in Practical Biology in Senior Secondary Schools in Yobe State, Nigeria. *Journal of Educational Studies*, 12, (4) Pp. 88-98
- Mary, E.S (2017).An Assessment of the Performance of Remedial Students of Gombe State University 2011-2016.*Gombe Journal of Education*, 1, (1) Pp. 23-32.
- Morgan, J.A (2015).Relationship between Students Attitude towards Practical Biology and Their Academic Achievement. *Journal of Research on Science Teaching*, 43, (7) Pp. 14-22.

- Muhammad,D.K. (2017). Effects of Three Difference Teaching Strategies on Academic Achievement of Senior Secondary School Biology Students in Gombe State, Nigeria.Journal of Educational Foundations, 7 (1). Okebukola, Pp. (2016)
- Principles and Policies Guiding Reforms in Biology Teaching in Senior Secondary Schools in Nigeria Journal of Educational Psychology and Counseling, 5, (6) Pp. 45-53.
- West African Examination Council Chief Examiners Report, 2016 and 2017.