

Effects of Demonstration and Discussion Strategies on Secondary School Students' Achievement and Retention in Biology in Mubi Educational Zone, Adamawa State

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I. INTRODUCTION

Biology is an integral part of science that focuses on living things (plants and animals). It is a branch of science that forms a foundation for science that is needed to contribute immensely to the technological growth of the nation. This includes medicine, forestry, nursing, agriculture, biotechnology and so on. Biology is therefore a discipline that has to be properly handled and taught to school children to equip them with the critical needs for technological growth in the society. As one of the basic sciences, Biology is necessary for school children to gain entrance unto tertiary education for specialization in the sciences, engineering and technology. In view of this relevance, it is pertinent to promote the study and practice of Biology to all students.

Education in Biology has its foundation in area of the biological sciences. It is studied in senior secondary schools to equip students with useful concepts, principles and theories that will enable them gain understanding of the environment and living systems. Generally, learning activities in Biology can take place inside and outside the classroom setting or in the laboratory. The laboratory work can include that practical demonstration of the teacher to the students on a given learning area or engaging experimental activities that students carry out to study nature. However, some of the practical demonstrations can only be effective when the facilities are available for carrying out experiments through an investigation.

The teaching and learning of Biology could involve a variety of instructional processes including activities such as demonstration and discussion. Demonstration is a teaching strategy in which a teacher makes a presentation of the lesson by displaying various activities that the class will observe. These activities could include drawing sketches, displaying a chart, a video presentation, or displaying some concrete objects. The students are given an opportunity to see, observe, listen and even interpret the message. They are made to observe and derive their own understanding from what the teacher demonstrates. It is a strategy that prepares students to

perform what the teacher may present to them in the class. A student may also perform a demonstration which the rest of the class is made to see. This is where the students demonstrate their special skills so that other members of the class can benefit from that experience. The proper use of demonstration can make students to develop motivation for learning because it will generate interest for more students to exhibit their skills. This makes the strategy important to be applied in the teaching and learning of Biology. It is likely that this strategy could make senior secondary school students learn through discovery and thereby improve the students' learning achievement.

The discussion teaching strategy is another teaching approach in which students are given opportunity to interact, share ideas, share their opinions and express themselves while the teacher coordinates the points expressed. The teacher allows the students to provide the information required for developing meaning. Classroom discussion is thus a teaching strategy that involves active participation of the learner in the learning process. It does not leave the students to passively receive knowledge. It allows for the role of the teacher to be that of guiding the classroom learning process. This approach is intended to facilitate the development of meaning in the learning of concepts and principles. When properly used, discussion becomes a dependable source of enhancing students' comprehension of science. This makes it suitable as a means of improving students' acquisition of knowledge of Biology when teachers use it in their instruction. Classroom discussion can therefore be one means by which the science teacher can promote effective learning so as to avert mass failure among the students.

Plant Biology is a part of the senior secondary school curriculum that exposes students to a broad understanding of Biology concepts relating to plant science. A full understanding of such concepts would require the proper teaching methods and strategies employed by the Biology teachers. Moreover, the use instructional materials play a very essential role in facilitating classroom discussion and demonstration that teachers may want to employ in teaching.

The absence of adequate instructional materials cannot aid important teaching strategies like demonstration and class discussion to aid instruction. A meaningful learning of the sciences including Biology results from instruction that allows for students to have practical experience of the concepts taught to them.

The achievement of students in science subjects has variously been reported as very poor (Crouch, Fagen, Manzur & Watkin, 2007; Erinosh, 2013). Among the causes of this poor achievement is the teachers' method of teaching. Omosewo (2009) noted that many teachers handling science subjects in most secondary schools specialized in science do not have a science education training. These teachers who have no adequate training therefore lack appropriate instructional strategies often use the lecture method. It is said that the use of the lecture method of teaching could be the cause for poor achievement of students in examination and particularly in Biology (Dawaki, 2012; Ingersoll, 2002).

The Mubi Educational Zone is a part of Adamawa State comprising of five Local Government Areas. This includes Madagali, Michika, Mubi North, Mubi South and Maiha. There are 56 public secondary schools in the zone. A total of 8,665 students are enrolled in these schools on a yearly basis. Biology is a compulsory subject for all senior secondary school students in Nigeria. The achievement of students in Biology in Adamawa State, including Mubi Educational Zone, has been poor as evidenced in the result of West African Examination Council (WAEC) from 2010 - 2016 (See Table 1).

The level performance in the external examinations is generally unsatisfactory over several years. The effect of this is that many students are denied university education into the science based disciplines because Biology is a basic requirement. It also affects parents adversely because many would want their children to be doctors, engineers, scientists or any of the science-based specializations such as technology. The WAEC analysis of students' performance in Biology over some years is here presented in Table 1 of Education, Yola, Adamawa State (2016).

The summary depicts the state of students' learning success in Adamawa State across the years under consideration. An undesirable state of failure of the students can be observed in the report. This unsatisfactory rate of students' performance in the external examinations continues to be a worry to parents, community members and even school managers. The poor rate of students' academic performance may be due to inadequate science instruction resources or even the inappropriate teaching methods being used by the teachers.

According to the Federal Government of Nigeria (2004), the desire to achieve maximum productivity in all spheres of the national development starts from the provision of education. This is because education creates the bedrock for a clear direction for advancement in societal development

and formation of the makers of society. This is thus a strong reminder that developing science in the children will require the delivery of Biology in schools. Thus, education and particularly science education remains a national imperative. The use of modern techniques and technologies in science instruction will be advocated as a means to improve students' achievement of science at all levels of education. However, the development of science education cannot be enhanced unless there is awareness of appropriate ways to improve the learning environment and the practices that teachers would use to foster learning.

The Mubi Educational Zone of Adamawa State has been characteristic of being rural in nature. There is the traditional belief that children do not interfere when adults are talking. This position makes the learning environment one in which children are not expected to question whatever the teacher brings into the lesson. It is a tradition that has filtered into the practices in many classrooms where the students simply look up to receive the teacher's message without asking questions or making contributions to the teacher's delivery. It is a common practice of the lecture method of instruction and seems to dominate many class sessions even in Biology lessons in the zone. The learners are usually expected to be mere listeners and imitators during such sessions. It remains to question whether this practice is the cause of the students' poor academic performance in Biology in the schools. Are the Biology teachers actually using methods and strategies of teaching that would enable the learners to understand and master the topics they are taught? Are there better ways that could be more suitable for enabling the students to be more successful in their achievement of the topics and concepts they are taught? These are some of the issues that make it necessary to take another look at the matter of providing Biology instruction in schools in the Mubi Educational Zone. When this is investigated, it can assist the identification of measures to put in place so as to make the students' learning more productive.

An effective teaching and learning of Biology could involve a variety of instructional processes including discussion and demonstration. Demonstration is a teaching strategy in which a teacher makes a presentation of the lesson by displaying various activities that the class will observe. These activities could include drawing sketching, displaying a chart, a video presentation, or displaying some concrete objects and specimens. The students are given an opportunity to see, observe, listen and even interpret the message. Studies show that when students are made to observe and derive their own understanding from what the teacher demonstrates they achieve better and retain the knowledge. It is a strategy that prepares students to perform what the teacher may present to them in the class. A student may also perform a demonstration which the rest of the class are made to see. This is where the students demonstrate their special skills so that other members of the class can benefit from that experience. The proper use of demonstration can make students to develop motivation for

learning because it will generate interest for more students to exhibit their skills. This makes the strategy important to apply it in the teaching and learning of Biology.

The discussion instructional strategy is another teaching approach in which students are given opportunity to interact, share ideas, share their opinions they will individually express themselves. The teacher's role in a discussion driven lessons becomes that of coordinating the points expressed. The students provide the information required for developing meaning. The classroom discussion is thus a teaching strategy that involves active participation of the learner in the learning process. It does not leave the students to passively receive knowledge. It allows for students to be carried along as they learn from contributions of their colleagues and what they themselves offer in the process. It can therefore be argued that where the performance of learners faces continued challenges, those methods and teaching strategies that engage learners to be actively involved should be encouraged by the teachers. The teaching and learning of Biology in the Mubi Educational Zone has experienced such difficulties over several years. It is the cause for searching new ways of handling the subject so that the students' learning and achievement are improved.

The Mubi Educational Zone in Adamawa State comprises five Local Government Areas with 56 public secondary schools. Students in all the schools offer Biology at the senior secondary school level in external examinations. The schools are spread across the Madagali, Michika, Mubi North, Mubi South and Maiha Local Government Areas. A total of 8,665 students are enrol in the schools on a yearly basis. The achievement of students in Biology in Adamawa State, including Mubi Educational Zone, has been generally poor as evidenced in the result of West African Examination Council (WAEC) from 2010 - 2016 (See Table1). This may be due to many factors including the teachers' use of teaching methods not suitable to the learners or the teachers not employing instructional strategies suitable to the students.

The state of poor students' performance in Biology clearly brings about a concern from parents and the society at large. When the secondary school students continue to record massive failure rather than success in the external examinations, there will be far reaching effects on specializations they desire for further studies. A massive failure in Biology will deny them to specialize in science disciplines or follow science and technology careers which require a credit pass in Biology. There is no room for admission into the science fields, medical, pharmaceutical or agricultural careers without passing Biology at credit level in the Senior Secondary School Certificate Examination. Moreover, if the zone is to be properly represented in the career opportunities of the nation, then the children must learn and perform well in Biology. Thus, to make the students learn Biology effectively they must be taught by the teachers using appropriate teaching methods and strategies that lead to a

credit level success in their examinations. This is a challenge that seeks urgent solution in the zone.

The challenge to reversing the undesirable trend of persistent failure among students requires finding ways of making students learn Biology effectively. A consistent state of failure among the students is harmful to the future of the learners because it prevents their participation in desired fields of science and technology that help building their society. The demonstration and discussion strategies are explored in this study in the attempt to search for new ways of teaching Biology to secondary school students and enable them achieve success.

Statement of the Problem

The academic achievement of students in Biology in senior secondary schools in the Mubi Educational Zone of Adamawa State has remained poor over the years as evidenced in the results of the West African Examinations Council from 2010 to 2016 (See Table1). This is a problem posing a source of concern to education stakeholders especially the students, parents, science education experts and the society at large. Although many factors may lead to low achievement of the students in science, it is evident that the use of inappropriate instructional strategies is a major contributing factor. It is yet to be established as to whether teachers of Biology in the schools use teaching strategies that are appropriate to the students' modes of learning. An effective teaching and learning environment leads to success of students and thus prevent massive failure. The use of demonstration and discussion instructional strategies are ways of teaching science that would engage students to be actively involved through interacting, exploring and sharing views to construct their own meaning. Therefore, an attempt was made in this study to explore the effects of demonstration and discussion instructional strategies on students' academic achievement in Biology in secondary schools in the study area. This was with the view to improving the students' academic achievement in Biology in the schools.

Purpose of the Study

The purpose of this study was to determine the effects of demonstration and discussion teaching strategies on students' academic achievement in Biology in senior secondary schools. The specific objectives were to:

1. determine the achievement scores of students taught Biology using demonstration, discussion teaching strategies and the conventional method;
2. compare the retention rates of students taught Biology using demonstration, discussion strategies and conventional methods; and
3. Determine gender differences in academic achievement of students taught Biology using the demonstration and discussion strategies.

Research Question

What is the lay-out of the students' achievement scores in the pre-test, post-test and retention level for the experimental and control groups?

Research Hypotheses

In this study, there were three hypotheses were tested to guide the research work. These hypotheses tested were as follows:

H₀₁: There is no significance difference in the academic achievement of students taught Biology by use of demonstration, discussion strategies and the conventional teaching method.

H₀₂: There is no significance difference in the retention rates of students taught Biology by use of demonstration, discussion strategies and the conventional teaching method.

H₀₃: There is no significance difference in the academic achievement of students taught Biology using demonstration and discussion strategies based on gender.

Research Design

The research design adopted for this study was the pre-test, post test, control group quasi experimental design. The design involved Senior Secondary School students at the SS II level in the selected school. Intact classes of the SS II students from two schools in each Local Government Area in the Mubi Educational Zone provided samples for the study. This research design was considered appropriate for the study and is represented as follows:

O ₁	X ₁	O ₂	O ₃
O ₄	X ₂	O ₅	O ₆
O ₇	X ₃	O ₈	O ₉

where X₁, and X₂ are respectively the instructional strategies of Demonstration and Discussion, while X₃ is the Conventional Method of teaching. O₁, O₄ and O₇ are the observed performance scores in Pre-Test for the instructional groups X₁, X₂ and X₃ respectively. Similarly, O₂, O₅ and O₈ are the Post Test scores observed for the instructional treatments given to X₁, X₂ and X₃ respectively. Finally, O₃, O₆ and O₉ represent the Retention Test scores observed in respect of the instructional treatments X₁, X₂ and X₃ given to the students exposed to Demonstration Strategy (X₁); Discussion Strategy (X₂) and Conventional Method (X₃). The independent variable in the study was the instructional treatment, X_n. The dependent variable was the students' Biology academic achievement.

Population of the Study

The population of this study comprised all the Senior Secondary School students offering Biology in the Mubi Education Zone of Adamawa State, Nigeria. The Zone comprises Maiha, Mubi North, Mubi South, Madagali and Michika Local Government Areas. These students come from the 56 public senior secondary schools in the zone. A total of around 8,665 students attend these schools on a yearly basis.

Sample and Sampling Techniques

A sample of 240 students drawn from the population was used for this study. Multistage sampling technique was used in obtaining the samples for this study. Stage1 involved taking two out of the five Local Government Areas in the Mubi Educational Zone to provide the sample of students. The purposive selection fell on schools from Mubi North and Maiha Local Government Areas. Stage2 involved selecting three public senior secondary schools from each of the Mubi North and Maiha Local Government Areas using balloting. In Stage 3, from each of the sampled schools, 40 students was selected using simple random sampling technique from the intact class used in the study. The total population of 240 students made up the samples constituting both the experimental and control groups from six schools.

Research Instrument

The instrument used for data collection for this study was the Biology Achievement Test (BAT). The instrument was constructed by the researcher based on the topics to be taught in the study period. The instrument was used for the two experimental groups and the control group. It is what was used for the pre-test, post test and the retention test.

The content was selected for this study was based on the plant science (Botany) content of the SSCE curriculum for Biology. The instrument was categorised into theory and objective parts. The essay part contained five questions to answer four. Each of the four essay items earns 15 marks to give a total of 60 marks for the essay section. The objective part of the instrument had 40 items to answer all. The 40 objective items will earn 1 mark each to give a total of 40 marks for the objective test items. The overall obtainable mark for the test (BAT) was 100 percent.

A marking scheme was drawn for the theory while a Key was produced for the objective type items. An Item Specification table was drawn for the instrument covering various learning objectives to be achieved assessed in the curriculum. This is presented in Table 2.

Table 2: Table of Specifications of Cognitive Objectives Plant Biology Curriculum for SS II

Topic	Comprehension	Cognitive Objectives	Analysis	Synthesis	Application	Total
1. Seed Germination 30%	4	4	1	1	2	12
2. Tropism, Diffusion and Osmosis 30%	4	4	1	1	2	12
3. Absorption of Water and Mineral Salts 20%	2	2	1	1	2	8
4. Transpiration in Plants 20%	2	2	1	1	2	8
Total 100%	12	12	4	4	8	40

Table 2 shows 40 items used for testing knowledge, comprehension, analysis, synthesis and application which included seed and seed germination, tropism, diffusion, and osmosis, absorption of water mineral salts and transpiration in plant. These are presented in the table.

Validity of the Instrument

To ascertain content and construct validity, experts in Biology from the Department of Science Education and another from the Botany Department, Adamawa State University, Mubi, were consulted. They determined the level of knowledge of the concept in plant Biology in line with the SSCE syllabus adopted for the study. Comments and suggestions of the experts consulted were used in compiling the final drafts of the instrument.

Reliability of the Instrument

Reliability of the Biology Achievement Test (BAT) was determined when the instrument was pilot tested on 30 students in one of the senior secondary schools in Mubi Educational Zone. The school was not part of those used to get samples for the study. Students' scores obtained from the pilot testing of the instruments were subjected to Spearman's Brown statistic using split-half method. This produced a reliability index of 0.77 which indicated that the instrument was adequate to be used for the study.

II. METHOD OF DATA COLLECTION

The data for the study was obtained from the Biology Achievement Test (BAT) administered on the students in the pre-test, post-test and retention test. The students were first given a pre-test to find out their level of knowledge of Biology aspect. Three schools from each local government area used were selected. Two of the schools were used for each experimental treatment and two other schools provided the control group. This conventional method was by instruction according to the desire of the Biology teacher.

The Biology teachers who were also the research assistants in each school were trained in one week of the instructional period. The training involved administration, collection and marking of the test scripts using marking scheme prepared for the study. The results of the various tests provided data that were used for analysis.

Table 3: Schedule and Stages of Treatment Procedures for Teaching Biology

Week	Activity Carried Out	Stage
1-2	Training of Research Assistants	Preliminary and Pre-treatment
3-4	Teaching of Seed Germination	Treatment
5	Teaching of Tropism, Diffusion and Osmosis	Treatment
6	Teaching Absorption of Water and Mineral Salts	Treatment
7	Teaching of Transpiration in Plant	Treatment
8	Administration of Post-Test	Post treatment

Treatment Procedures to Collect Data

Biology teachers in the schools were engaged in the study to serve as research assistants. They were given an orientation on the mode of giving instruction designed for the study. The orientation was mainly how to teach the curriculum in line with the Demonstration and Discussion instructional strategies. This session lasted for one week. The training also involved the use of the lesson procedural steps for Demonstration and Discussion instructional strategies designed for the study. There was no orientation for the conventional teaching approach group. The teacher was expected to use his/her own mode of teaching Biology in the school. Teachers involved with this method of instruction were to use their usual teaching methods in the school.

Pre-Test Stage: The selected classes in the sampled schools were revisited for the teacher orientation process. The visit was done in the first week of the study. The students of each class were informed that the purpose of the visit was to conduct a test which was to be followed by a teaching session to be undertaken on the following week.

Treatment Stage: From the 2nd to the 7th week, students in both the experimental and control groups were taught the same topics in the study. The topics taught were: seed and seed germination, tropism, absorption of water and mineral salts, transpiration in plant and diffusion and osmosis in plants. Lesson plans were drawn for steps to follow on the two Demonstration and Discussion strategies on the various topics. These were used to teach the classes assigned to the experimental treatment. The Group I (X_1) class in each school

were taught using Demonstration strategy of instruction. The Group II (X_2) class was taught using Discussion strategy of instruction. Group III (X_3) classes were taught using Conventional method of teaching. Each lesson period lasted 40 minutes as allowed in the school.

Post Test Stage: students in class were administered the BAT again to each class, one week after the last lesson in each class of the control and experimental groups in the six different schools. The tests were conducted at the end of the 8th week. The students were reminded on the need to follow the instructions on the question paper. The test scripts were collected, marked and recorded with the help of the research assistants.

Retention Test Stage: The stage retention test came two weeks after the post test stage. It was undertaken to analyse how much of the learning students could recall after the programme was over. This stage was treated in a way that the students had no idea of taking the examination again. It was the same BAT taken in the Pre-Test and Post Test that was re-administered to measure the achievement scores of the students. The test scripts were also collected, marked and recorded with the help of the research assistants.

Method of Data Analysis

The data collected was analysed using statistical analysis. Analysis of Variance (ANOVA) was used in testing hypothesis one that is, to analyse the achievement of post-test scores of the three groups taught demonstration, discussion and the conventional methods. Hypothesis two was analysed using (ANOVA) that is to compare the retention rate among the three groups taught demonstration, discussion and the conventional methods, paired samples t-test was used to test the hypothesis three which is to detect the differences between male and female students achievement scores in two experimental groups (those taught demonstration and discussion methods). Significant level of 0.05 was used to test all the hypotheses. The four hypotheses posed for the study were tested using the Statistical Package for Social Science (SPSS).

III. RESULTS

The students' pre-test scores of students in the experimental and control groups were analyzed to ascertain the entry behavior of students in the experimental and control groups before the treatment. The pre-test scores in the two experimental (Demonstration and Discussion Methods) and the Conventional groups were analyzed using One Way Analysis of Variance (ANOVA). The descriptive statistics and ANOVA results are presented in Tables 4 and 5.

Table 4: Descriptive Statistics of Students' Pre-Test Scores in Biology of the Demonstration, Discussion and Conventional Method Instructional Groups

Source	N	Mean	Std. Dev.	Std. Error.	95% Confidence Interval	
					Lower Bound	Upper Bound
Demonstration	80	22.44	9.28	1.038	20.37	24.50
Discussion	80	24.50	10.39	1.161	22.19	26.81
Conventional Method	80	23.16	6.59	0.737	21.70	24.63
Total	240	23.37				

Results in Table 4 give the descriptive analysis of students' pre-test scores in the two experimental groups and the control group at the commencement of the study. The analysis shows that the mean scores of students in the three groups were relatively close and clustered indicating that students in all the groups were of equal performance before instructional

treatment: i.e. Demonstration Teaching Group (Mean = 22.44); Discussion Teaching Method Group (Mean = 24.50) and Conventional Teaching Method Group (Mean = 23.16). To determine if the mean scores of the three groups were significantly different, the data were subjected to Analysis of Variance. The ANOVA result is presented in Table 5.

Table 5: One Way Analysis of Variance (ANOVA) of Students' Biology Pre-Test Scores in the Demonstration, Discussion and the Conventional Method Groups

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (2-Tailed)
Between Groups	175.158	2	87.579		
Within Groups	18768.575	237	79.192	1.106	.333
Total	18943.733	239			

Not Significant; $p > 0.05$.

Table 5 depicts the comparison of mean achievement scores of students in the two experimental and the control groups at the commencement of the study. The table reveals that there was no statistically significant difference in the academic achievement of students in Biology achievement test at the pre-test level ($F = 1.106$; $df = 2, 237$, $p > 0.05$). This implies that the students in the experimental groups (Demonstration and Discussion Strategies) and the control group (Conventional Method) had equal entry behavior prior to the instructional treatment.

Research Question: What is the lay-out of the students' achievement scores in the pre-test, post-test and retention level for the experimental and control groups?

The scores of students in the three treatment groups were collated. This gave a layout of the Pre-Test, Post Test and Retention Test outcomes (Table 6). The breakdown gave a picture of students' achievements before instructional treatment, after the treatment and in the post treatment period that was used to measure students' retention. A summary of the layout of students' achievement profile is presented in Table 6

Table 6: Layout of the Mean Achievement Scores of Students in Pre-Test, Post Test and Retention Test for the Demonstration, Discussion and Conventional Instruction Groups

Instructional Treatment	Pre- Test	Post Test	Retention Test
Demonstration Strategy (X_1)	22.44	52.9	56.89
Discussion Strategy (X_2)	24.50	50.6	51.33
Conventional Method (X_3)	23.16	27.36	29.81

Results in Table 6 give a summary of the students' academic achievement in Biology from the three instructional treatments in the study. The highest post test mean score came from the Demonstration strategy (52.90) and the lowest from the Conventional Teaching Method (27.36). Similarly, the Retention score was highest for the Demonstration strategy (56.89) followed closely by the Discussion strategy (51.33). The least retention score came from the Conventional Method group. It is observed that the Demonstration strategy recorded higher achievement scores than the Discussion treatment in both the post test and retention test measurements. In general, the achievement scores under the Demonstration and Discussion strategies were both greater than those in the Conventional treatment in Post Test (27.36) and Retention (29.81). To find out if the differences in students' achievement scores were statistically significant, the results were subjected to inferential statistics analysis.

Hypothesis Testing

The hypotheses in the study were tested at 0.05 level of statistical significance to determine if differences in mean achievement scores of the students were significant. The hypotheses were tested accordingly which yielded results as presented in sections that follow.

H_{01} : There is no significance difference in academic achievement of students taught Biology using demonstration, discussion strategies and the conventional teaching method.

To test this hypothesis, the post test mean scores of students' achievement in the two experimental groups (Demonstration and Discussion Instructional Strategies) were compared with the control (Conventional Teaching Method) using ANOVA analysis on the SPSS software. The descriptive analysis is presented in Table 7.

Table 7: Summary of Descriptive Statistics of Students' Post Test Achievement Scores in Biology from Demonstration, Discussion and the Conventional Method

Source	N	Mean	Std. Dev.	Std. Error.	95% Confidence Interval	
					Lower Bound	Upper Bound
Demonstration	80	52.90	17.88	2.508	46.93	54.89
Discussion	80	50.60	14.66	2.239	45.44	51.96
Conventional Method	80	27.36	10.82	2.509	23.89	28.71
Total	240	41.97				

Table 7 gives a descriptive summary of the mean achievement scores of the students in Biology from the three instructional treatments. The table reveals that students in the experimental groups, Demonstration(X_1) and Discussion(X_2), gained the highest mean scores as compared to their counterparts in the control group, Conventional Method (X_3). Students exposed

to Biology using the Demonstration strategy(X_1 ; with Mean = 52.90) and those to Discussion strategy (X_2 ; with Mean = 50.60) made higher scores than students in the Conventional Method treatment, (X_3 ;with Mean = 27.36). To determine if these mean score differences were significant, the ANOVA was applied. The result is summarized in Table 8.

Table 8: One Way Analysis of Variance (ANOVA) of Students' Post Test Achievement Scores in Demonstration, Discussion and Conventional Method Treatments

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (2-tailed)
Between Groups	29,664.808	2	14,832.404		
Within Groups	51,489.988	237	217.257	68.271	.000*
Total	81,154.796	239			

*Significant; $p < 0.05$.

Table 8 shows the ANOVA analysis of students achievement means scores in the experimental and control groups. The analysis indicates that there is a statistically significant difference in the mean scores of students taught Biology by demonstration, discussion and conventional teaching methods ($F = 68.27$, $df = 2, 237$; $p < 0.05$). This would imply that students in the experimental groups (demonstration and

discussion) methods performed significantly differently from those taught Biology by use of the Conventional Method. In order to know which treatment significantly differs from the other, a post hoc analysis was carried out using the Scheffe test of multiple comparisons. The post hoc analysis result is as presented in Table 9.

Table 9: Scheffe Post Hoc Multiple Comparisons of Students' Post Test Achievement Scores in the Demonstration, Discussion and Conventional Treatments

Independent Variable Teaching Strategy (I)	Independent Variable Teaching Strategy (J)	Mean Difference (I-J)	Sig. (2-Tailed)
Demonstration (52.90)	Discussion (50.60)	2.30	.638
	Conventional Method (27.36)	25.54	.000*
Discussion (50.60)	Demonstration (52.90)	-2.30	.638
	Conventional Method (27.36)	23.24	.000*
Conventional Method (27.36)	Discussion (50.60)	-23.24	.000*
	Demonstration (52.90)	-25.54	.000*

*Significant; $p < 0.05$.

The results in Table 9 indicate that there is a significant difference in the mean scores of students taught Biology using Demonstration and the Conventional Methods ($p < 0.05$). Similarly, there is a significant difference between the achievement scores of students taught Biology using the Discussion strategy and those taught by using the Conventional Method ($p < 0.05$). However, there is no significant difference in achievement scores of students taught by use of the Demonstration strategy and those taught by use of the Discussion strategy

($p > 0.05$).

The Scheffe post hoc test shows that there were variations in the achievements coming from the instructional

treatment differences. From the performance outcome in Table 5, it can be seen that the Demonstration group had the highest post test mean score (52.90) followed by the Discussion treatment (50.60) which was also greater than the Conventional method (27.36).

H_{02} : There is no significance difference in the retention rates of students taught Biology by use of demonstration, discussion strategies and the conventional teaching method.

This hypothesis was tested by analyzing the retention scores of students exposed to Biology instruction by use of Demonstration, Discussion strategies and the Conventional Method instructional treatment. This analysis was carried out by using the one way Analysis of Variance statistics. The descriptive analysis is as presented in Table 10.

Table 10: Descriptive Statistics of Students' Retention Scores in Demonstration, Discussion Strategies and the Conventional Method Instructional Treatments

Source	N	Mean	Std. Dev.	95% Confidence Interval		
				Std. Error.	Lower Bound	Upper Bound
Demonstration Strategy	80	56.86	13.50	1.509	53.58	59.59
Discussion Strategy	80	51.33	13.64	1.524	47.42	53.48
Conventional Method	80	29.81	10.35	1.209	24.89	29.71
Total	240	46.00				

Table 10 shows a descriptive analysis of students' retention scores in the experimental and control groups. The results show a higher mean score difference in favour of students in the two experimental groups where Demonstration had Retention Mean = 56.89 and Discussion had Mean =

51.33. Students exposed to the Conventional method instruction had the least mean score (29.81). The ANOVA was applied to determine whether the students' retention scores in the three instructional treatments were significantly different. The result is presented in Table 11.

Table 11: Summary of One Way ANOVA of Students' Retention Scores in Demonstration, Discussion and the Conventional Method Instructional Treatments

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (2-Tailed)
Between Groups	28,883.058	2	14,441.529		
Within Groups	37,546.675	237	158.425	91.157	.000*
Total	66,429.733	239			

*Significant; $p < 0.05$.

Table 11 shows that there is a statistically significant difference in the retention scores of students taught Biology using the Demonstration, Discussion and the Conventional Method ($F = 91.157$; $df = 2, 237$; $p < 0.05$). This result implies that students in the three instructional treatments achieved significantly different retention in Biology based on

the instructional treatment. A post hoc test (Scheffe) was performed to find out which group varied significantly from the other in the students' retention scores. The multiple comparisons of the achievement scores are presented in Table 12.

Table 12: Tukey Post Hoc (HSD) Multiple Comparisons of Students' Retention Scores in Demonstration, Discussion and the Conventional Method Instructional Treatments

Independent Variable Teaching Strategy (I)	Independent Variable Teaching Strategy (J)	Mean Difference (I-J)	Sig. (2-Tailed)
Demonstration (56.89)	Discussion (51.33)	5.56	.009*
	Conventional Method (29.81)	27.08	.000*
Discussion (51.33)	Demonstration (56.89)	-5.56	.009*
	Conventional Method (29.81)	21.52	.000*
Conventional Method (29.81)	Discussion (51.33)	-21.52	.000*
	Demonstration (56.89)	-27.08	.000*

Table 12 shows that there is a significant difference in the retention scores of students taught Biology using the Demonstration strategy as compared to those taught using the Conventional Method ($p < 0.05$). Similarly, there is a significant difference in the retention scores of students taught Biology using the Discussion strategy when compared to those taught using the Conventional Method ($p < 0.05$). There is also a significant difference in the retention scores of students taught Biology using the instructional strategies of Demonstration and Discussion ($p < 0.05$). The post hoc test thus revealed that the Demonstration and Discussion strategies each produced a statistically significant higher level of students' retention than the Conventional treatment ($p < 0.05$).

H_{03} : There is no significant difference in the academic achievement of students taught Biology using demonstration and discussion strategies based on gender.

The hypothesis sought to determine if there was a significant difference in the academic achievements of students taught Biology using Demonstration and Discussion strategies based on whether they were male or female. The students' post test mean scores (Male = 51.88; Female = 50.49) in the two groups comprising 95 males and 65 females, were compared using a t-Test analysis. The post test mean scores of students exposed to Demonstration and those to the Discussion strategies indicate that the performances had only a slight difference. The Independent Samples t-Test statistic was used to determine if the scores were statistically different (See Table)

Table 13: Independent Samples t-Test Analysis of Combined Male Students’ Post Test Scores against Combined Females’ Scores in Demonstration and Discussion Strategies

Source	Mean	Mean Difference	Std. Dev.	df	t	Sig. (2-Tailed)
Male	51.88		17.66			
		0.91		158	-0.458	.662
Female	50.97		14.29			

Not Significant; $p > 0.05$.

The analysis in Table 13 reveals that there is no significant difference in the mean scores of students taught Biology using discussion and demonstration strategies based on gender of the students ($t = 0.458$, $df = 158$; $p > 0.05$). The result shows that male and female students in the discussion and demonstration strategies did not differ significantly in achievement after the instructional treatment. Thus, gender is not a determinant of performance when these instructional strategies are used for teaching Biology.

The gender influence of the students’ academic achievements under the respective instructional strategy treatments is presented in Table 14. The mean scores of the male and female students under application of the Demonstration instructional strategy in Biology was the same for both genders (52.38). However, there was a mean score difference of 1.82 between male (51.38) and female (49.56) students in the Discussion instructional strategy. This difference was marginal and not statistically significant. Overall, the mean score of all the Male students from the combined Demonstration and Discussion instructional strategies (51.88) produced just a slim difference with that of all the Female students (50.97) under the similar consideration. The mean difference of 0.91 in favour of the males was not statistically significant ($p > 0.05$). The summary of this analysis is given in Table 14.

Table 14: Summary of Mean Achievement Scores of Students Taught Biology Using Demonstration and Discussion Instructional Strategies by Gender

S/N	Source	Gender	
		Male	Female
1.	Demonstration		
	n	47	33
	Mean Score	52.38	52.38
2.	Discussion		
	N	48	32
	Mean Score	51.38	49.56
3.	Demonstration + Discussion		
	n	95	65
	Mean Score	51.88	50.97

The data distribution is graphically illustrated (See Fig. 1) with the following noted:

FDE, MDE Represent Female and Male Students in Demonstration Strategy, respectively;

FDI, MDI Represent Female and Male Students in Discussion Strategy respectively;

FDD, MDD Represent the Combined Female Students in Demonstration and Discussion Instructional Strategies and that of the Males accordingly;

n Represents the Sample Population.

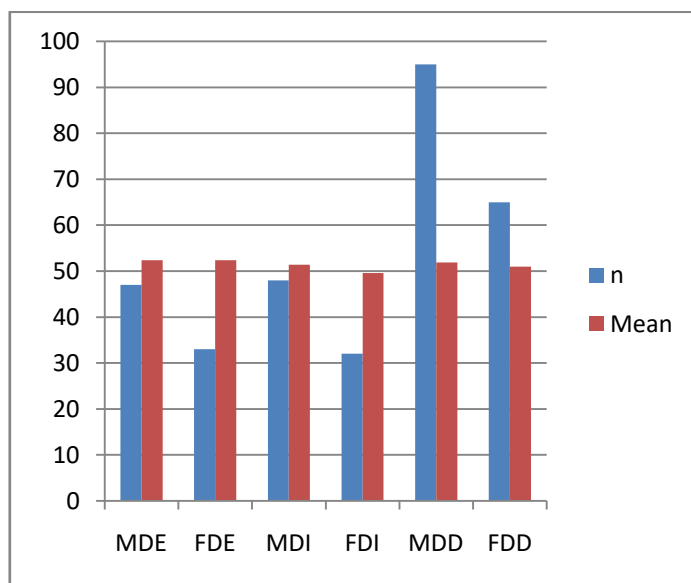


Fig. 1: Graphical Representation of Mean Scores of Students in Biology Based on Instructional Treatment and Gender.

The t-Test of differences between the male and female students’ performances in the instructional treatments was carried out in order to establish if those differences observed were statistically significant. The result is summarized in Table 15. This showed that there was no significant difference in achievement score means based on gender ($p > 0.05$).

Table 15: t-Test Analysis of Male and Female Students' Academic Achievement in Biology when Exposed to Demonstration and Discussion Instructional Strategies

Instructional Strategy	Mean Score	Mean Difference	Std. Deviation	Std. Error Mean	df	T	Sig. (2-Tailed)
Males	51.88	0.91	17.6817	0.638	158	0.453	.638
Females	50.97						

Not Significant; $p > 0.05$.

IV. DISCUSSION

The findings of this study are discussed in accordance with results of testing and analyses of the hypotheses. The discussion presented is in reflection of the objectives of the study and in line with the hypotheses tested. In the rest of this section the outcome of analysis on a given hypothesis will be discussed in relation with existing knowledge and research findings.

Differences in Students' Academic Achievement in Biology Instruction Using the Demonstration, Discussion or Conventional Teaching Methods

This study investigated if there is difference in the academic achievement of Biology students taught using demonstration, discussion and conventional teaching Methods. The analysis of achievement scores of the students using one-way ANOVA revealed that there is a statistically significant difference in the mean scores of students taught Biology students demonstration, discussion and conventional teaching Methods ($F = 68.271$; $df = 2, 239$; $p < 0.05$). The result shows that students in the experimental groups (Demonstration and Discussion) instructional treatments performed better than those taught by the conventional method in Biology.

A Scheffe post hoc test of multiple comparisons was performed to locate the point of difference. The results indicate that there is a significant difference in the achievement scores of students taught Biology when comparisons are made between the instructional treatments. The findings of the study are in agreement with that of Randle and Hulde (2007), Odom, Staddard and Lanasa (2007) and Korwin and Jones (2000). The studies have all indicated that demonstration and discussion strategies significantly improve students' achievement when compared to conventional instruction.

Moreover, the present study has shown that there is a significant difference in the mean scores of students taught Biology using discussion strategy and those taught using the Conventional Method ($p < 0.05$). It however revealed that there is no significant difference in the mean scores of students taught Biology using demonstration and the discussion strategies ($p > 0.05$). This is consistent with the findings of studies by Odom, Staddard and Lanasa (2007) and Korwin and Jones (2000).

Students' Learning Retention from Biology Instruction Using Demonstration, Discussion Strategies and the Conventional Method

This study also evaluated the retention rates of students exposed to Biology by using demonstration, discussion and Conventional Methods. The result of the ANOVA indicated a statistically significant difference in the retention scores of students taught Biology using the demonstration strategy, discussion strategy and Conventional Method ($F = 91.157$, $df = 2, 237$; $p < 0.05$). The Scheffe post hoc test shows a significant difference in the retention scores of students taught Biology using demonstration and discussion strategies as compared to those taught by using the Conventional Method ($p < 0.05$).

The post hoc analysis also shows that there is a significant difference in students' retention scores between those taught Biology by using demonstration and those by use of the discussion strategy ($p < 0.05$). The findings are supported by similar studies on innovative methods that aid retention done by Hanry and Rillero (2004), Leedy and Ormrod (2005), Rutherford (2003) and Stohr (2008). However, the findings do not agree with those of Ndukwe (2000) and Eze (2004) which found that the difference in the mean post retention test scores was not significant.

Gender Performance Trends in the Teaching and Learning of Biology by Using the Demonstration and Discussion Instructional Strategies

In this study, a hypothesis was tested to determine if there was a significant difference in the mean achievement scores of students taught Biology using discussion and demonstration instructional strategies based on gender. The result reveals that there is no significant difference in the mean scores of students taught Biology using discussion and demonstration instructional strategies based on gender ($t = -0.458$, $df = 158$, $p > 0.05$), implying that male and female students in the demonstration and discussion strategies did not differ significantly in academic achievement. It could be deduced that gender is not a determinant of increased scores but other factors. This finding is in line with the one conducted by Akpokorie (2000) and Omajuwa (2011) which showed that no difference exists between the achievement of male and female students in a learner-centred approach to instruction.

In a similar consideration, Olagunju, (1998) and Eze (2004), argued in their studies that no significant difference exists between the achievement of boys and girls in the

learning of various science subjects when learner-centred instruction is applied. Nevertheless, other studies disagree with that position. The findings of Raimi and Adeoye (2002), Ajaja (2011) and Ige (2001) all of which found significant difference in achievement of students based on gender.

IV. CONCLUSION

The study has shown that the use of both the demonstration and discussion instructional strategies for teaching plant Biology improves students' academic achievement. They are able to upgrade the students' performance and thereby improve achievement in learning science. Moreover, these strategies can remove gender difference in students' learning of Biology in the secondary school. This also means that the two teaching methods also will go a long way to facilitate effective teaching and learning of Biology the secondary school.

Biology instruction in schools will be greatly improved if teachers use the demonstration and discussion strategies as part of their normal teaching. This is because these strategies improve students' retention of what they learn. When learners cannot retain what they are taught, their academic performance will remain poor. Teachers should therefore use the demonstration and discussion strategies to help students learn effectively and improve academic achievement in school.

V. RECOMMENDATIONS

The following recommendations are made based on the outcome of this study:

1. The teaching of Biology should be conducted in such a way that students should learn effectively by retaining the concepts presented to them. The adoption of both the demonstration or discussion strategies will add value to teaching output in schools.
2. The use of conventional lecture method for teaching Biology should be supported with the application of more learner-centred approaches that get the students actively engaged. This can be achieved when demonstration and discussion strategies are used during the science lessons.
3. There is need for periodical in-service training programmes that equip teachers to use more learner-centred approaches for science instruction. Workshops can be mounted which emphasize demonstration, discussion and other learner participating methods in teaching.
4. The provision of instructional materials in schools should be given consideration by education providers. Schools should constantly check the availability of relevant instructional materials and equipment in the institution. Only available materials can help teachers to effectively employ the demonstration and discussion instructional strategies for science instruction.

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