

# Improving Students' Retention Of Biology Concepts In Onitsha Education Zone: Effects Of Sequential Usage Of Three Teaching

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*Abstract: The study is concerned with improving students' retention of biology concept through sequential usage of three teaching methods. Four research questions guided the study and four null hypotheses were tested. The quasi-experimental design, specifically the pretest posttest non randomized group design was used. The population of the study was 2,646 senior secondary school year two biology students, out of which a sample of 154 students were involved in the study. The instrument for data collection was Biology Retention Test (BRT) validated by three experts. The reliability of the instrument was established using Kuder-Richardson Formula 20 which yielded coefficient of internal consistency of 0.94. Data obtained were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The results showed that there is no significant difference between the mean retention scores of students in the experimental groups. No significant difference exists between the mean retention scores of the male and female students in the three groups. There was also no significant interaction effect of gender and sequential usage of the teaching methods on retention scores in biology. The researcher recommended that students should be given opportunity to attempt to conduct experiment imitating the skills model by their teacher in other to ensure meaningful learning and retention of learning materials.*

*Keywords: biology, retention, demonstration, laboratory, lecture*

## I. INTRODUCTION

There is a consensus among science educators that biology is an important and useful subject for development in every country. It is a key to technology along with other sciences. Despite the importance and popularity of biology among Nigerian students, it is very disappointing to note that students' performance in the subject at both internal and external examinations has remained consistently poor (Osuafor & Okonkwo, 2013). Okoro (2011) asserted that for some years the percentage of students who obtained credit pass in biology at West African Senior School Certificate Examination (WASSCE) in Nigeria has been low and their performance is poor. However, WAEC chief examiner's report 2015 stated that there is an improvement in the subject but the performance of students is still not at its' best which is in line with the WAEC statistical evidence from Onitsha education zone of Anambra State. One of the problems that

may have contributed to poor retention has been the problem of retaining and remembering what was taught.

Retention is the act of retaining or an ability to recall or recognize what has been learnt or experienced over a long period of time. Okoye (2003) referred to retention as the process of maintaining the availability of new meanings or some part of them. It may be suggested that the amount of the original meaning that will be retained at any given point in time is a variable quantity. However, the problem of retention is believed to be highly correlated with the method of teaching adopted by the teacher which could facilitate better understanding of the concept and remembrance. Frequent reviews and tests, elaborated feedback and active involvement of students in learning projects have all been associated with longer retention. Cope (2011) stated that active participation during instruction increases learning and retention. Lecturing is still a common way for instructors to communicate information, however, it does not allow for much interaction

between learners and teacher and as a result, the instructor may falsely assume that the students fully understood the concepts that he presented. In other words, students learn more efficiently by participating in instruction. To further support this idea, Iji, (2002) and Chiason (2008), stated that retention in biology is not acquired by mere rote learning but through appropriate instructional delivery approach. Therefore, using a variety of teaching methods in an organized manner can significantly improve learning and retention in students of all age.

In recent years, researchers' attention has turned to investigating the effect of some innovative teaching methods that will enhance students' retention in biology without investigating if there is a way the traditional methods can be combined or manipulated to enhance students' retention in biology. One such way is through the sequential usage of three teaching methods for lesson presentation. The study examined the sequential usage of lecture, demonstration method and laboratory students' experiment presented in three different sequences.

Lecture method is primarily didactic presentation of information, usually to a large group and often with the use of audio-visual aids to transmit information (Zakariya, 2004). It can be an effective means of providing new information and clarifying existing information to a large heterogeneous group in a short period of time. The benefits of Lecture method according to Petrina (2007) includes: usefulness for covering underlying concepts, principles, and systems, a good means to set the stage and lay the necessary groundwork and parameters for a subsequent activity, stimulation of learners' interest in future study and may be recorded for future use.

However, lecture method according to Kalra (2008) places the burden of promoting learning fully on the teacher, unless it is integrated with other techniques. It establishes a "tell me" mind-set in learners and may be presented at the teacher's level of understanding rather than at the learners', offers limited opportunities for assessment and feedback, can become a crutch for teachers who do not really know the material thoroughly, can lead to learner overload as it is common for teachers to include too much information in too short a time frame and it provides little opportunity for learners independent thinking. It can also lead to boredom; have very limited effectiveness in teaching anything other than knowledge (Miles, 2015). Thus, the limit of using lecture methods suggested that other methods of teaching must be employed before or after using lecture method if students must retain what was learnt. One such method that may go hand in hand is demonstration method.

Demonstration method of instruction involves performing an activity so that learners can observe how it is done in order to help prepare learner to transfer theory to practical application or perform other activity/skill orientated tasks (McKee, Williamson & Ruebush, 2007). Some of the benefits of demonstration are that it; promotes self-confidence in the learner, provides opportunity for targeted questions and answers, allows attention to be focused on specific details rather than general theories (Gehlen-Bauum, 2014). However, demonstration method has some disadvantages such as: being of limited value for people who do not learn best by observing others, may not be appropriate for the different learning rates

of the participants, requires that demonstrators have specialized expertise if highly technical tasks are involved. The key to successful demonstration involves: being able to do well what you want to demonstrate, carefully planning the demonstration, keeping the demonstration simple and the explanation thorough enough to meet your objectives, augmenting the demonstration with other visual aids and giving learners an opportunity to practice what has been demonstrated.

In laboratory method, students are given opportunity in the laboratory to practice through experimentation, the concept learnt. The method according to Hattie (2009) can benefit the students by increasing retention, facilitating development of science process skills, improved understanding and proper conceptualization. It can also arouse motivation and sustains interest in the learners. It is thought that some of the challenges to this method of teaching is that it requires a lot of time and rarely fit into school timetable schedules, it can pose dangers for students especially where it involves harmful chemicals, it can be expensive to manage as the laboratory may cost quite a fortune. Petrina (2007) noted that to ensure proper laboratory students' experiment, teachers should plan the experiment in sequential order, make available laboratory tools to all students, and keep students informed of the necessary precautions required in the laboratory.

A combination of these three different teaching methods presents the student with the advantages of the three methods of teaching. It however presents the teacher with the problem of what different sequences may prove most effective for enhancing students' retention of biology concepts. An empirical study was therefore needed to ascertain which sequence of presentation of the three teaching methods will be most effective.

#### PURPOSE OF THE STUDY

The purpose of this study was to investigate the improvement in students' retention of biology concept through sequential usage of three teaching methods.. Specifically, the study determined the:

- ✓ Mean gain retention scores of biology students exposed to lecture, demonstration and laboratory methods of teaching presented in three different sequences.
- ✓ Difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Lecture- Demonstration-laboratory students' Experiment (LDE).
- ✓ Difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Demonstration- laboratory students' Experiment- Lecture (DEL).

#### RESEARCH QUESTIONS

- The following research questions guided the study.
- ✓ What are the mean gain retention scores of biology students exposed to lecture, demonstration and laboratory methods of teaching presented in three different sequences?

- ✓ What is the difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Lecture-Demonstration- laboratory students' Experiment (LDE)?
- ✓ What is the difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Demonstration-laboratory students' Experiment- Lecture (DEL)?
- ✓ What is the difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of laboratory students' Experiment- Lecture- Demonstration (ELD)?

## HYPOTHESES

The following hypotheses were tested at 0.05 level of significance:

- ✓ There is no significant difference in the mean gain retention scores of biology students exposed to lecture, demonstration, laboratory methods of teaching presented in three different sequences.
- ✓ There is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Lecture-Demonstration- laboratory students' Experiment (LDE)
- ✓ There is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Demonstration-laboratory students' Experiment- Lecture (DEL)
- ✓ There is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of laboratory students' Experiment- Lecture- Demonstration (ELD).

## II. METHOD

### RESEARCH DESIGN

The design of this study is quasi-experimental. Specifically, the pretest post-test non-equivalent group design was used. According to Nworgu (2015), random assignment of subjects to experimental and control groups is not possible in this design. In the study, the subjects were treated in three different groups using three different instructional methods (Lecture, Demonstration, and Laboratory students' experiment) in different sequence.

### AREA OF THE STUDY

The area of study was Onitsha Education Zone of Anambra State. Onitsha Education Zone comprises of three Local Government Areas. They are Onitsha North, Onitsha South and Ogbaru local government area respectively. This study covered all the three local government areas in the zone. There are 32 state-owned secondary schools in this zone. Most people living in Onitsha Education zone are traders, a few Civil servants, teachers, and students.

### POPULATION OF THE STUDY

The population of the study was made of 2,646 senior secondary school year two (SS2) biology students (1465 males and 1181 females) found in the 19 state-owned co-educational schools within Onitsha education zone of Anambra State. (Source: Planning, Research and Statistics Department, Post-Primary Education Board, Onitsha, 2016).

### SAMPLE AND SAMPLING TECHNIQUE

The sample for the study comprised 154 senior secondary year two (SS2) biology students. The sampling technique used was multistage procedure: First the schools were stratified according to the three local government area in Onitsha education zone to ensure that each local government area in Onitsha education zone was covered. Co-educational schools only, in each local government area were purposively selected. This was to provide classes where boys and girls worked side by side under the same teacher, with the same classroom condition. For an in-depth study and to avoid interclass discussion, three co-educational schools were selected, each from the three different local government area in Onitsha education zone using simple random sampling (balloting with replacement). From the three schools selected, one intact class each from the three schools was chosen. The intact classes were also chosen by simple random sampling (balloting with replacement) The selected intact classes were assigned to experimental group 1, 2, and 3 by selecting them at random (Balloting without replacement) after they were listed in folded pieces of paper.

### INSTRUMENT FOR DATA COLLECTION

Biology Retention Test (BRT) developed by the researcher was used as instrument for the study. The BAT questions were constructed based on the two topics used in the research. The test was made up of 20 multiple choice questions drawn using a table of specification to make sure that the content areas taught were adequately covered. Each question had four options from which the students had to select the correct answer. Each correct answer earns the students five marks. The lesson plans were designed using three different sequence of instruction with lecture, demonstration and laboratory methods of instruction for each lesson in the different experimental groups. The lesson period will last for six weeks.

### VALIDATION OF THE INSTRUMENT

The lesson packages and BRT were given to three experts. Two lecturers in Science Education Department of Nnamdi Azikiwe University, Awka and Delta State University, Abraka and an experienced biology teacher in Ideke secondary school, Okoti for validation. They were requested to validate the instructional package, the lesson contents in line with the BAT items. The validators were required to retain, delete or modify items in the BAT based on the plausibility of the distractors, the clarity of sentence and question items in line with the objectives of the lesson.

### RELIABILITY OF THE INSTRUMENT

The reliability of the instrument BRT was established using the Kuder-Richardson formula twenty (KR-20) method. This method was chosen because it is the most suitable reliability estimate for objective test items that are of heterogeneous difficulty level and dichotomously scored. The instrument consequently was administered to 40 Biology students outside the area of study and the obtained scores were tested for reliability using the formula. The coefficient of reliability obtained was 0.94. The reliability index of 0.94 indicated that the instrument is reliable.

### EXPERIMENTAL PROCEDURE

The procedure for the experiment was in two stages; the first stage involved training the research assistants that were used during the experiment while the second stage involved teaching the students.

### TRAINING OF RESEARCH ASSISTANTS

The regular biology classroom teachers were trained as follows:

*DAY ONE:* the teachers were familiarized with the objectives of the study, and given the lesson plans and retention test. They were instructed on how to use the plan.

*DAY TWO:* the experiments were carried out by the teachers and the researcher to acquaint them with the use of the tools involved.

*DAY THREE:* the teachers perform a mock teaching with the lesson plan carrying out the practical involved to make sure they have mastered the plan.

### TEACHING THE STUDENTS

The procedure for the treatment involved exposing the students to the biological concepts of diffusion and osmosis using a combination of three instructional approach presented in different sequences. The research have three groups of students, each had three lessons which lasted six weeks. The various sequence that was used for teaching are: for experimental group 1, Lecture, Demonstration, and Laboratory students' experiment (LDE), for group 2, Demonstration, Laboratory students' experiment and Lecture (DEL), and for group 3, Laboratory students' experiment, Lecture and Demonstration (ELD). For each lesson which lasted for 120 minutes (one double period in one week and single period in the following week), these sequences were followed in each treatment group. After the treatment, the students were given a posttest immediately after the treatment and a retention test after four weeks. The posttest was the same as the retention test except for the reshuffling of questions in their serial numbering and answer options.

### CONTROL OF EXTRANEOUS VARIABLES

✓ *EXPERIMENTER BIAS:* The researcher did not teach the research subjects. This was done by their regular

classroom teachers of the participant classes but under the supervision of the researcher.

- ✓ *TEACHER VARIABLE:* the lesson contents are the same and prepared by the researcher. The teachers that will be used as research assistants in the study were trained for three days and asked to perform a mock teaching to make sure they have mastered the instruction approach for the experiment.
- ✓ *CLASS INTERACTION:* To solve the problem of interclass discussion among students, one intact class only was used in each school. Also, only one school was chosen from each L.G.A. in the zone used
- ✓ *INITIAL GROUP DIFFERENCE:* Due to the nature of the administrative set up in the schools, there was non-randomization of the research subjects because the students were already organized in classes. ANCOVA was used for data analysis in this respect.
- ✓ *EFFECT OF PRE-TEST ON POST-TEST:* The research lasted for six weeks and it is expected that this period is long enough as not to permit the pre-test to affect the post-test scores. Also, the BAT items were re-arranged starting with even numbers from the bottom before administering it to the students as post-test.
- ✓ *EFFECT OF POST-TEST ON RETENTION TEST:* The BAT items were again reshuffled starting with odd numbers from the bottom to reduce the effect of posttest on retention. The time for the retention test administration was four weeks after the posttest.
- ✓ *HAWTHORNE EFFECT:* This is the idea that students may adopt behavioural dispositions that could affect the outcome of the study if they get the idea that they are being used in an experiment. This variable was controlled by using the regular biology teachers of the schools used in the experiment as research assistants.

### METHOD OF DATA ANALYSIS

The research questions were answered using mean. The hypotheses were tested at 0.05 level of significance using Analysis of covariance (ANCOVA). In the cases where there are significant effects of the treatment, a post-Hoc test using the Scheffe's method was used to determine the direction of the significance. The decision rule is: reject null hypothesis if probability value (P-value) is lesser than 0.05, otherwise do not reject the null hypotheses.

### III. RESULT

*RESEARCH QUESTION 1:* What are the mean gain retention scores of biology students exposed to lecture, demonstration and laboratory methods of teaching presented in three different sequences?

Groups	N	Mean Posttest	Mean retention	Retained Mean
LDE	54	51.76	45.37	6.39
DEL	47	64.79	51.87	12.92
ELD	53	55.28	47.08	8.20

Table 1: Mean gain retention scores of the treatment groups

Table 1 shows that the group taught using the sequence of DEL with a retained mean score of 12.92 retained the learning material more, compared to the group with the sequence of LDE (6.39) with a retained mean difference of 6.53. Also the DEL group showed higher retention of 12.92 as against the ELD (8.20) sequence group with a retained mean difference of 4.72. The ELD sequence group however retained the learning material more than those in the sequence group of LDE with a mean retained difference of 1.81.

**RESEARCH QUESTION 2:** What is the difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of lecture-demonstration and laboratory students' experiment (LDE)?

Gender	N	Mean post-test	Mean Retention	Retained Mean	Retained Mean diff
Male	27	50.37	42.03	8.34	
Female	27	53.15	48.70	4.45	3.89

Table 2: Mean gain retention scores of male and female students taught using LDE sequence

Table 2 shows that the mean gain retention scores of the male students exposed to the teaching sequence of LDE is 8.34 while the females had a mean gain retention score of 4.45. The difference in their retained mean scores is 3.89 in favour of the males.

**RESEARCH QUESTION 3:** What is the difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Demonstration-laboratory students' Experiment- Lecture (DEL)?

Gender	N	Mean pre-test	Mean post-test	Mean gain score	Mean diff
Male	34	66.77	53.18	13.59	
Female	13	59.62	48.46	11.16	2.43

Table 3: Mean gain retention scores of male and female students taught using DEL sequence

Table 3 shows that the mean gain retention score of the male students exposed to the teaching sequence of DEL is 13.59 while the females had a mean gain retention score of 11.16. The difference in their retained mean scores is 2.43 in favour of the males.

**RESEARCH QUESTION 4:** What is the difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of laboratory students' Experiment, Lecture and Demonstration (ELD)?

Gender	N	Mean pre-test	Mean post-test	Mean gain score	Mean diff
Male	37	55.81	45.81	10.00	
Female	16	54.06	50.00	4.06	5.94

Table 4: Mean gain retention scores of male and female students taught using ELD sequence

Table 4 shows that the mean gain retention score of the male students exposed to the teaching sequence of ELD is 10 while the females had a mean gain retention score of 4.06. The difference in their retained mean scores is 5.94 in favour of the males.

**HYPOTHESIS 1:** There is no significant difference in the mean gain retention scores of biology students exposed to lecture, demonstration and laboratory methods of teaching presented in three different sequences.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15996.364 <sup>a</sup>	3	5332.121	39.812	.000
Intercept	11.069	1	11.069	.083	.774
Pretest	14873.415	1	14873.415	111.050	.000
Method	375.499	2	187.750	1.402	.249
Error	20090.110	150	133.934		
Total	390039.000	154			
Corrected Total	36086.474	153			

Table 5: Analysis of Covariance of students' mean gain retention scores in biology by method

Table 5 shows that there was no significant main effect of the treatment which accounted for 43 percent of the variance in the retention scores of the students,  $F(2, 150) = 1.402$ ,  $P(0.249) > 0.05$ . Thus, the null hypothesis was not rejected. Therefore, there is no significant difference in the mean gain retention scores of biology students exposed to lecture, demonstration and laboratory methods of teaching presented three different sequences.

**HYPOTHESIS 2:** There is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of lecture-demonstration and laboratory students' experiment (LDE).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3857.358 <sup>a</sup>	2	1928.679	15.167	.000
Intercept	56.550	1	56.550	.445	.508
Pretest	3257.358	1	3257.358	25.616	.000
Gender	270.629	1	270.629	2.128	.151
Error	6485.235	51	127.161		
Total	121500.000	54			
Corrected Total	10342.593	53			

Table 7: Analysis of Covariance for mean gain retention score of male and female students in LDE sequence

Table 15 shows that there was no significant effect of the treatment which accounted for 35 percent of the variance in the retention scores of the male and female students exposed to the teaching sequence of lecture-demonstration and laboratory students' experiment (LDE),  $F(1, 51) = 2.128$ ,  $P(0.151) > 0.05$ . Thus, the null hypothesis was not rejected. Therefore, there is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of lecture-demonstration and laboratory students' experiment (LDE).

**HYPOTHESIS 3:** There is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Demonstration-Laboratory students' experiment-lecture (DEL).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5127.970 <sup>a</sup>	2	2563.985	14.153	.000
Intercept	19.112	1	19.112	.105	.747
Pretest	4918.908	1	4918.908	27.152	.000
Gender	17.835	1	17.835	.098	.755

Error	7971.264	44	181.165
Total	139564.000	47	
Corrected Total	13099.234	46	

Table 8: Analysis of Covariance for mean gain retention scores of male and female students in DEL sequence

Table 16 shows that there was no significant effect of the treatment which accounted for 36 percent of the variance in the retention scores of the male and female students exposed to the teaching sequence of Demonstration-Laboratory students' experiment- lecture (DEL),  $F(1, 44) = 0.098$ ,  $P(0.755) > 0.05$ . Thus, the null hypothesis was not rejected. Therefore, there is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Demonstration-Laboratory students' experiment-lecture (DEL).

**HYPOTHESIS 4:** There is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Laboratory students' experiment, Lecture and Demonstration (ELD).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6535.918 <sup>a</sup>	2	3267.959	32.773	.000
Intercept	28.596	1	28.596	.287	.595
Pretest	6339.896	1	6339.896	63.580	.000
Gender	350.867	1	350.867	3.519	.067
Error	4985.780	50	99.716		
Total	128975.000	53			
Corrected Total	11521.698	52			

Table 9: Analysis of Covariance for mean retention score of male and female students in ELD sequence

Table 17 shows that there was no significant effect of the treatment which accounted for 55percent of the variance in the retention scores of the male and female students exposed to the teaching sequence of Laboratory students' experiment, Lecture and Demonstration (ELD),  $F(1, 50) = 3.519$ ,  $P(0.067) > 0.05$ . Thus, the null hypothesis was not rejected. Therefore, there is no significant difference in the mean gain retention scores of male and female students in biology exposed to the teaching sequence of Laboratory students' experiment, Lecture and Demonstration (ELD).

#### IV. DISCUSSION

The results of the study indicated that there was no significant mean effect of the treatment which accounted for 43 percent of the variance in the retention scores of the students. The study found no significant difference in the retention scores of the students in the different sequences of presentation owing to the fact that the students passed through the same cycle. Although the sequence varied, the student engaged in the same learning experience as others. The students in the DEL group however had a higher mean gain retention score than those in the other groups. The findings of this study contradicts that of Stavreva (2014) who studied the effects of usage of sequential teaching method on the academic achievement and retention level of students in area

of biological sciences or biochemistry. Stavreva found out that students in ELD had higher retention score than students in other groups taught using a different sequence.

The findings revealed that no significant difference was found in the mean retention scores of male and female students exposed to the teaching sequence of lecture-demonstration and laboratory students' experiment (LDE). The results also revealed there was no significant difference in the mean retention scores of male and female students in biology exposed to the teaching sequence of Demonstration-laboratory students' Experiment-Lecture (DEL) as well as in the mean retention scores of male and female students exposed to the teaching sequence of laboratory students' Experiment, Lecture and Demonstration (ELD). This finding supports Wandersee (1990) and Ezeudu (1995) who found no significant gender influence on mean retention scores of students. The finding contradicts the findings of Ezeudu (1997) and Nworgu (1990).

#### V. CONCLUSION

The findings of this study revealed significant positive effect of sequential usage of three teaching methods (LDE, DEL, ELD) on students' retention in biology in favour of the DEL sequence. The conclusion was that the sequential usage of demonstration-laboratory students' experiment-lecture was the most effective.

#### VI. RECOMMENDATIONS

The following recommendations are made based on the findings:

- ✓ Students should be given opportunity to attempt to conduct experiment imitating the skills model by their teacher in other to ensure meaningful learning and retention of learning materials.
- ✓ School laboratories should be equipped with adequate laboratory equipment to enable biology teachers and students to experiment concepts relating to biology to facilitate proper conception of biological phenomenon.

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