

## **INFLUENCE OF GENDER ON ACHIEVEMENT OF SENIOR SECONDARY TWO STUDENTS EXPOSED TO SEQUENTIAL TEACHING METHODS IN BIOLOGY IN JOS-SOUTH, PLATEAU STATE, NIGERIA.**

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### **Abstract**

*The study investigated the influence of gender on achievement of senior secondary two students exposed to sequential teaching methods in Biology in Jos-South Plateau state, Nigeria. The study employed the non- equivalent pre-test, post-test quasi-experimental research design. The sample comprised 118 (47 male and 71 female) SS2 students offering Biology from four co-educational public secondary schools in Jos-South Local Government Area of Plateau State. Three research questions and three null hypotheses guided the study. The Biology Achievement Test (BAT) with reliability index 0.924 was used as an instrument for data collection. Research questions were answered using mean and standard deviation while hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Results revealed that sequential teaching methods improved the achievement of male and female senior secondary students in Biology. Based on the findings of the study, it was recommended that Biology teachers should teach their students with sequential teaching methods to enhance male and female students' achievement in the subject.*

***Keywords: Achievement, Biology, Gender, Sequential Teaching Methods,***

### **INTRODUCTION**

Science is one of the school subjects that exposes learners to activities which provide them with desirable knowledge and appropriate life-long skills that enable them handle their problems in the society. According to Agbama and Omoifo (2021) Science is a process of generating idea and knowledge about natural phenomenon in our natural environment. Science consists of three main areas, namely Physics, Chemistry and Biology. Biology is the study of plants and animals. To Michael (2015), Biology refers to the study of life. The knowledge of Biology is applicable in solving personal and societal problems relating to health, population growth through planned-parenthood, environmental pollution and food shortage and the importance of Biology can be seen in areas such as medicine, disease control, animal breeding, environmental studies. The six themes in the senior secondary school Biology curriculum cut across various topics among which are the digestive and respiratory systems.

Digestive system refers to the complex process by which the body breaks down food, absorb food nutrients, and expel any remaining waste out of the body. Respiratory system is a complex network of organs and structures used for gaseous exchange in animals and plants. The human digestive and respiratory systems have been perceived among other topics like genetics, cell metabolism, and growth to be difficult by students (Chukwuemeka & Dorgu, 2019). Several reasons have been advanced for the topics as being seen as difficult, some of which are the abstract and bulky nature of the topics, students' studying and learning habits and poor or ineffective teaching methods used by some Biology teachers which could in the long run affect students' achievement in the subject (Salleh, Ahmad & Setyan, 2021).

Academic achievement may be seen as a measure of output and the main changes in knowledge, skills and attitude of individuals as a result of experiences acquired from school. The Chief Examiners' reports in the West African Senior Secondary Certificate Examinations from 2013 to 2017 and 2019 revealed that students' achievement in Biology was poor and particularly, in questions pertaining to the human digestive and respiratory systems. The report clearly showed

that the percentage of students who failed Biology in the West African Senior Secondary Certificate Examinations were 61.5%, 61.2%, 59.7%, 62.4% and 66.6%, representing the year 2013, 2014, 2015, 2016 and 2017 respectively. A similar challenge of poor achievement in Biology was also reported in the study area in the year 2018 and 2019 representing 85.9% and 87.8% of failure in Biology respectively.

The report from the Chief Examiners in the West African Senior Secondary Certificate Examinations for the year 2019 revealed that majority of the students failed to state the respiratory surfaces of the listed organisms. However, some students who could state the respiratory surfaces, lost marks due to wrong spellings. Hence, spellings, drawings amongst others were perceived to be challenging for the students in the examinations which eventually translated to their poor achievement in Biology. Underachievement in Biology has been observed between both male and female students at the senior secondary school level of education in Nigeria.

Different teaching methods have been advanced for teaching Biology in secondary schools and some of the teaching methods are demonstration method, think-pair share method, scaffolding method, laboratory method, and expository method. Studies by Fauzi, Rosyida, Rohma & Khoiroh (2021) have shown that some teaching methods used by some Biology teachers, still make learning of the perceived difficult topics abstract since the processes are largely invisible for students. Hence, the only alternative for students, then, is to learn the said topics through rote memorization of facts from Biology textbooks. This suggests that the teaching methods might not have been effectively yielding the right results in the subject, and there is the need, to adopt other methods to assist students to learn. It is in view of this, that Wafula, Mondoh and Wasike (2017) recommended the formulation of new policy guidelines, laying emphasis on use of sequential teaching methods, as a means to improve learners conceptual understanding of knowledge in Biology, especially with concepts that concerned with physiological processes or mechanisms such as 'enzyme action'.

Sequential teaching methods refers to methods of teaching that embrace the use of teaching methods in different sequences, to facilitate students' mastery on the same concepts in Biology. Dajal, Apochi and Paul-Fiase (2022) described sequential teaching methods as the process of imparting knowledge to learners using different instructional methods in logical order such that it provides a concrete basis for promoting critical thinking skills. One of the goals of teachers is to sequence instruction effectively in a manner that will improve the academic achievement of the students (Zabanal, 2020). Hence, the use of a variety of methods could help ensure that all students have equal opportunities to learn. What will be the most effective sequence of the use of such methods? What will be the effect of sequencing the instructional methods on students' achievement in Biology? This study embraces sequential teaching methods as the use of the following teaching methods: (Expository method, Computer Aided Instruction and Practical method), in different sequences to facilitate male and female students' understanding of a concept in Biology.

Gender is linked to differences between males and females and the implication of these differences on their life pursuits, academics inclusive (Ngwu, Allah & Emmadiole, 2020). These differences could be biological, psychological, social and decision making differences. Gender is an important factor to be considered in the sciences. However, issues pertaining to gender in sciences have been inconclusive due to divergent findings. It is on this premise that the current study is poised to investigate the influence of gender on achievement of senior secondary two students exposed to sequential teaching methods in Biology in Jos-south Plateau state, Nigeria.

## **STATEMENT OF THE PROBLEM**

Achievement of senior secondary students in Biology has dwindled with little or no appreciable improvement from 2013 to 2017 and has raised concerns for both government and the society. Despite the importance of Biology to national development, literature evidenced poor and dwindling achievement of students in the subject nationwide in public examinations such as the West African Senior Secondary Certificate Examinations over the years. A number of factors have been advanced for the dwindling achievement of the Biology students in the public examinations.

The factors are not limited to abstract and bulky nature of some topics, students' study habits and ineffective teaching methods used by some Biology teachers.

The Chief Examiners' reports of the West African Senior Secondary Certificate Examinations in 2021, attributed the poor achievement of students in Biology practical to candidates' unfamiliarity with the use of simple laboratory equipment, inadequate exposure to laboratory techniques, lack of observational skills, inability to draw and label diagrams correctly, inability to spell some Biology terms correctly, among others. Thus, students' inability to gain mastery of the basic skills needed for the understanding biological concepts may not be unconnected to the teaching methods adopted by Biology teachers. Participatory and oriented teaching methods have been recommended by the Federal Government FRN (2014) for the teaching of Biology in secondary schools. Unfortunately, this has not been the case, as students are often unfamiliar with some of the biological processes as evidenced in the results of the standardized examinations and this could in turn lead to underachievement of male and female students in the subject area.

Studies by Emeofe and Achufusi-Aka (2021) showed that the sequential teaching methods (problem-based learning, co-operative learning and lecture sequence), gave the teaching and learning of Physics a constructivist, collaborative and contextualized learning and teaching approach and this fostered the academic achievement among students in the classroom. The researchers also discovered that male students' academic achievement in Physics in the different three teaching sequences was higher than female students although the differences were not significant. Wafula, Mondoh and Wasike (2017) have shown that sequential teaching methods could help improve students' understanding of physiological processes or mechanisms and this can in a long run improve the students' attitude towards the subject. In Biology, however, there has not been enough empirical evidences in the State to explain this. It is against this backdrop that the fundamental problem of this study can be located in this broad question? What therefore is the effect of sequential teaching methods on the attitude and achievement of senior secondary two students in Biology in Plateau State, Nigeria?

### **PURPOSE OF THE STUDY**

The purpose of the study was to investigate the influence of gender on achievement of senior secondary two students exposed to sequential teaching methods in Biology in Jos-South Plateau state, Nigeria. The specific objectives of the study were to:

1. determine the pre-test and post-test achievement mean scores of SS 2 Biology students in the three experimental groups and the control group.
2. determine the post-test achievement mean scores of SS 2 Biology students in the three experimental groups based on gender.
3. determine which sequence is the most effective in teaching SS 2 Biology students in the three experimental groups.

### **RESEARCH QUESTIONS**

1. What are the pre-test and post-test achievement mean scores of SS 2 Biology students in the three experimental groups and the control group?
2. What are the post-test achievement mean scores of SS 2 Biology students in the three experimental groups based on gender?
3. Which of the sequence is the most effective in teaching SS 2 Biology students in the three experimental groups?

### **HYPOTHESES**

The following null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the pre-test and post-test Biology achievement mean scores of SS 2 students in the three experimental groups and the control group.

2. There is no significant difference between the post-test Biology achievement mean scores of SS 2 male and female students in the three experimental groups
3. There is no significant difference between the post-test Biology achievement mean scores of SS 2 students in the three experimental groups.

## METHODOLOGY

The study employed the non- equivalent pre-test, post-test quasi-experimental research design. The population of the study comprised the 485 (264 male and 221 female) SS 2 students offering Biology in the 13 co-educational public secondary schools that met the criteria of the population. The sample for the study comprised 118 (47 male and 71 female) SS2 students offering Biology from four co-educational public secondary schools in Jos-South Local Government Area of Plateau State. Simple random sampling technique through lottery method was used to select four schools and also to select one intact class from the two arms of the SS2 Biology students in each of the four sampled schools to make up the sample of the students for the study.

The instruments used for collecting data from the sample was the Biology Achievement Test (BAT). The BAT consisted of 50 multiple choice test items adapted from **1998-2022** WAEC past questions on the concepts of human digestive system and the human respiratory system obtained from the senior secondary two Biology curriculum. Each BAT item had four options, A to D. The contents validity of BAT were subjected to the scrutiny and judgment of three experts as regards quality, appropriateness, relevance, comprehensiveness and adequacy. Two of the experts were in Science Education unit, Science and Technology Education Department and one in Research Measurement and Evaluation unit, Education Foundations Department, both from the Faculty of Education, University of Jos.

In order to ensure relevance and accuracy of the instrument, BAT was administered to a pilot sample of 107 SS2 Biology students in two co-educational public secondary schools in Jos- South Local Government Area which had similar characteristics with the sample of the main study. The reliability index for BAT was determined as 0.924 using Kuder Richardson formula 21 ( $KR_{21}$ ) and considered acceptable.

The experimental groups were taught Biology by the research assistants using the sequential teaching method (Expository method, Computer-Aided Instruction and Practical Biology) in three different sequences as follows; Group I (Expository method -Computer-Aided Instruction- Practical), Group II (Computer-Aided Instruction- Practical- Expository method) and Group III (Practical-Expository method- Computer-Aided Instruction). The Biology teacher explained the concepts of the human digestive and respiratory system using the expository method of teaching. Computer-Aided Instruction involved using monitor to project videos on the human digestive and respiratory system while the students watched and observed videos projected by the Biology teacher. The Practical in the study focused on the sub- topics of mechanism of breathing in human and enzyme activity of ptyalin on starch and these experiments were carried out by students.

Eight Biology teachers that is, two from each of the sampled schools were employed as research assistants for the study. Six research assistants were trained for the experimental groups while the other two research assistants were not trained are for the control group. Two hours training session per day was given to the assistants who taught the three experimental groups and the training lasted for five days after school hours in one of the schools at the Jos South Local Government Area of Plateau State. The control group (Group IV) was taught the same concepts in Biology as the experimental groups using the sequential teaching methods (Lecture- Lecture- Lecture) with the contents and the objectives of the lessons the same as those of the experimental groups, however, with a different lesson plan. After six weeks treatment, post-test of BAT was administered to the experimental groups and the control group. The scoring procedure of the BAT was based on the students' response to the multiple- choice items. Each BAT item has four options; A to D, where only one option is the correct answer while others are distracters and each option was scored 2 marks. Since there are 50 questions, the maximum mark obtainable is 100 marks

while the minimum mark obtainable is 0. The scores obtained from the test were categorized as high, average and low achievement scores representing 70%, 50-69% and 0-49% respectively. Research questions were answered using mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test all the hypotheses at 0.05 level of significance.

## RESULTS

### Research Question One

What are the pre-test and post-test achievement mean scores of SS 2 Biology students in the three experimental groups and control group?

**Table 1**

**Pre-test and Post-test Achievement Mean Scores of SS2 Students in Biology in the Three Experimental Groups and Control Group**

Group	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Experimental I	39	29.23	5.78	67.28	8.24	38.05
Experimental II	30	30.20	5.95	55.80	10.23	25.6
Experimental III	19	33.37	6.04	65.58	8.02	32.21
Control	30	28.60	5.54	45.47	6.01	16.87

Table 1 presents the results on pre-test and post-test achievement mean scores of SS2 students in Biology in the three experimental groups and control group. The result for experimental group I showed that the pre-test achievement mean score was 29.23 with a standard deviation of 5.78, while the post-test achievement mean score was 67.28 and a standard deviation of 8.24 with a mean gain of 38.05. Thus, indicating that there was an improvement in the achievement of students after treatment using Expository method-Computer-Aided Instruction-Practical (ECP). Also, experimental group II showed a pre-test achievement mean score of 30.20 with a standard deviation of 5.95, while the post-test achievement mean score was 55.80 with a standard deviation of 10.23 with a mean gain of 25.6. Thus, indicating that there was an improvement in the achievement of students after treatment using Computer-Aided Instruction-Practical- Expository method (CPE). Experimental group III showed a pre-test achievement mean score of 33.37 with a standard deviation of 6.04, while the post-test achievement mean score was 65.58 with a standard deviation of 8.02 with a mean gain of 32.21. Thereby, indicating that there was an improvement in the achievement of students after treatment using Practical- Expository method -Computer-Aided Instruction (PEC).

For the control group, the achievement mean score was 28.60 and a standard deviation of 5.54 at the pre-test. At the post-test, the achievement mean score was 45.47 and a standard deviation of 6.01 with a mean gain of 16.87. The findings showed that the post-test achievement mean scores of the experimental group I, II and III were 67.28, 55.80 and 65.58 respectively while the post-test achievement mean score of the control group was 45.47. Thus, since the post-test achievement mean scores of the three experimental groups are between 50-69%, then the students in the experimental groups had average achievement score in Biology when exposed to sequential teaching methods. However, the findings showed that the students in the control group still had low achievement in Biology since their post-test achievement mean score was between 0-49%. This implies that all the sequential teaching methods increased students' achievement in Biology.

### Research Question Two

What are the post-test achievement mean scores of SS 2 Biology students in the three experimental groups based on gender?

**Table 2**  
**Post-test Achievement Mean Scores of SS2 Students in Biology in the Three Experimental Groups based on Gender**

Group	Gender	Post-test			
		N	Mean	SD	Mean Difference
Experimental I	Male	14	66.29	11.445	1.64
	Female	25	67.84	5.970	
Experimental II	Male	13	50.15	5.857	9.97
	Female	17	60.12	10.874	
Experimental III	Male	8	67.00	9.071	2.45
	Female	11	64.55	7.435	

Table 2 shows the results on the post-test achievement mean scores of SS2 male and female students' in Biology in the three experimental groups. The result for experimental group I showed that the achievement mean score for male was 66.29 with a standard deviation of 11.45, while

female achievement mean score was 67.84 with a standard deviation of 5.97 and a mean difference of 1.64. It means that female students achieved almost at the same level with the male students after treatment using Expository method -Computer-Aided Instruction-Practical (ECP). Also, experimental group II showed that the male achievement mean score was 50.15 with a standard deviation of 5.86, while female achievement mean score was 60.12 with a standard deviation of 10.87 with a mean difference of 9.97. Thus, indicating that there was an improvement in the achievement of male and female students after treatment using Computer-Aided Instruction-Practical- Expository method (CPE).

The result of experimental group III showed a male achievement mean score of 67.00 with a standard deviation of 9.07, while female achievement mean score was 64.55 with a standard deviation of 7.44 with a mean difference of 2.45, indicating that there was improvement in the achievement of students after treatments using Practical-Expository method -Computer-Aided Instruction (PEC). Thereby indicating that the female students in groups I and II (ECP & CPE) had a higher achievement mean scores (67.84 & 60.12) than their male counterparts. This implies that sequential teaching methods improved the achievement of male and female students in Biology in favour of the female students. However, male students in group III (PEC) achieved better than their female counterparts.

### Research Question Three

Which of the sequence is the most effective in teaching SS 2 Biology students in the three experimental groups?

**Table 3**  
**Post-test Achievement Mean Scores of SS2 Students in Biology in the Three Experimental Groups**

Group	Pre-test			Post-test		Mean Gain
	N	Mean	SD	Mean	SD	
Experimental I	39	29.23	5.78	67.28	8.24	38.05
Experimental II	30	30.20	5.95	55.80	10.23	25.6
Experimental III	19	33.37	6.04	65.58	8.02	32.21

Table 3 presents the results on post-test achievement mean scores of SS2 students in Biology in the three experimental groups. The result for experimental group I (ECP) showed that the pre-test

achievement mean score was 29.23 while the post-test achievement mean score was 67.28 with a mean gain of 38.05. Also, experimental group II (CPE) showed a pre-test achievement mean score of 30.20, while the post-test achievement mean score was 55.80 with a mean gain of 25.6. Experimental group III (PEC) showed a pre-test achievement mean score of 33.37, while the post-test achievement mean score was 65.58 with a mean gain of 32.21. Thus, there was an improvement in the achievement of students after treatment using the three sequences although the mean gain of the sequence Expository method-Computer-Aided Instruction-Practical (ECP) was the highest. The result also showed that the mean gain of the achievement score in the sequence Practical- Expository method -Computer-Aided Instruction (PEC) was higher than the Computer-Aided Instruction-Practical- Expository method (CPE). Thus, the ECP sequence is the most effective in teaching SS 2 Biology students in the three experimental groups since it had the highest achievement mean difference score.

### Hypotheses One

There is no significant difference between the pre-test and post-test Biology achievement mean scores of SS 2 students in the three experimental groups and control group.

**Table 4**  
**ANCOVA Results on Post-test Achievement Mean Scores of Three Experimental Groups and Control Group**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12588.987 <sup>a</sup>	4	3147.247	78.955	.000	.736
Intercept	3699.147	1	3699.147	92.801	.000	.451
Covariate	3314.495	1	3314.495	83.151	.000	.424
Group	8145.413	3	2715.138	68.115	.000	.644
Error	4504.301	113	39.861			
Total	421504.000	118				
Corrected Total	17093.288	117				

a. R Squared = .736 (Adjusted R Squared = .727)

Table 4 shows that  $F(3,113) = 68.12$ ,  $p < 0.05$ , since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected. Thus, indicating that there was a significant difference between the post-test Biology achievement scores of SS2 students in the three experimental groups and control group. The result further revealed an adjusted R-squared value of .727. This means that 72.7% of the variation in the dependent variable which is achievement is explained by variation in the treatment of sequential teaching methods, while the remaining are due to other factors not included in this study. This implies that sequential teaching methods improved students' achievement in Biology in the three experimental groups than those in the control group.

### Hypotheses Two

There is no significant difference between the post-test Biology achievement mean scores of SS 2 male and female students in the three experimental groups.

**Table 5**  
**ANCOVA Results on Achievement Mean Scores of Male and Female SS2 Students in Biology in the Three Experimental Groups**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2783.761 <sup>a</sup>	2	1391.880	18.532	.000	.304

Intercept	4258.553	1	4258.553	56.699	.000	.400
Covariate	2407.994	1	2407.994	32.060	.000	.274
Gender	206.549	1	206.549	2.750	.101	.031
Error	6384.239	85	75.109			
Total	358440.000	88				
Corrected Total	9168.000	87				

a. R Squared = .304 (Adjusted R Squared = .287)

Analysis of Covariance (ANCOVA) was conducted to determine if there was a significant effect of gender on achievement of SS2 students taught Biology using sequential teaching methods. Table 5 shows that the main effect of gender  $F(2,85) = 2.75$ ,  $p > 0.05$ , since the p-value of 0.101 is greater than 0.05 level of significance, the null hypothesis was retained, indicating that there was no significant difference between the post-test achievement mean scores of male and female students in Biology taught using sequential teaching methods. The result further revealed an adjusted R-squared value of .287. This means that 28.7% of the variation in the dependent variable, namely, achievement in Biology is explained by gender while the remaining are due to other factors not included in this study. This implies that there is no significant difference between the post-test Biology achievement mean scores of SS2 male and female students in the three experimental groups.

### Hypothesis Three

There is no significant difference between the post-test Biology achievement mean scores of SS 2 students in the three experimental groups.

**Table 6**

### Scheffe PostHoc of the Differences in SS2 Students' Achievement Mean Scores in Biology by Methods

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	Lower Bound	Upper Bound
ECP	CPE	12.382*	1.536	.000	9.338	15.426
	PEC	5.547*	1.816	.003	1.949	9.144
	LLL	21.229*	1.535	.000	18.189	24.270
CPE	ECP	-12.382*	1.536	.000	-15.426	-9.338
	PEC	-6.836*	1.879	.000	-10.559	-3.113
	LLL	8.847*	1.638	.000	5.601	12.093
PEC	ECP	-5.547*	1.816	.003	-9.144	-1.949
	CPE	6.836*	1.879	.000	3.113	10.559
	LLL	15.683*	1.914	.000	11.891	19.474
LLL	ECP	-21.229*	1.535	.000	-24.270	-18.189
	CPE	-8.847*	1.638	.000	-12.093	-5.601
	PEC	-15.683*	1.914	.000	-19.474	-11.891

Table 6 shows that a significant difference exists between the achievement scores of students taught Biology using the sequential teaching method (CPE, ECP & PEC) and Lecture method (LLL) with the students taught Biology using sequential teaching methods having achieved better than those taught using lecture method. However, it further showed that there is a significant difference between the achievement scores of students taught using CPE, ECP and PEC. Hence, the three sequences are equally effective. However, the most effective sequence is ECP since it had the highest achievement mean score.

## DISCUSSION

The study investigated the influence of gender on achievement of senior secondary two students exposed to sequential teaching methods in Biology in Jos-South Plateau state, Nigeria. The

findings from research question one revealed that students taught Biology using sequential teaching methods achieved higher significant achievement scores than those taught Biology using lecture method. This finding is in agreement with Wafula, Mondoh and Wasike (2017) who reported that sequential teaching methods is an effective method of teaching because it helps students acquire useful knowledge. This perhaps can be adjudged to the fact that repetition of a concept using different means of expression, representation and engagement could challenge learners appropriately for learning.

Findings from research question two revealed that sequential teaching methods were effective in improving students' achievement across gender. This indicates that there was improvement in the achievement of students after treatment using Practical-Expository method-Computer-Aided Instruction (PEC). Thereby indicating that the female students in groups I and II (ECP & CPE) had a higher achievement mean scores (67.84 & 60.12) than their male counterparts. This implies that sequential teaching methods increased male and female students' achievement in Biology with the female students achieving better than the male students although, male students in group III (PEC) achieved better than female students.

The results from research question three showed that the students taught Biology using the sequence Expository method-Computer-Aided Instruction-Practical (ECP) had the highest achievement scores than those taught Biology using the other two sequences (PEC and CPE). This finding is in line with Olanrewaju, Chollom and Ozoji (2024) who disclosed that the Lecture-Computer Aided Instruction-Practical (LCP) sequence was the most effective sequence of the CPL and PLC sequence. This could be adjudged to the fact that beginning a lesson by explaining could help the students understand the basics of the lesson.

The findings from hypothesis one showed that sequential teaching methods were found to be effective in improving the achievement of secondary school Biology students as indicated in the result. There was significant difference between the post-test achievement scores of students in Biology in the three experimental groups and the control group. This is in line with the finding of Dajal, Apochi and Paul-Fiase (2022) who found that students taught Biology using sequential teaching methods achieved significantly higher than those taught using conventional method. However, the finding of this study negates that of Azubuike and Mumuni (2018), who asserted that there was no significant difference in the mean scores of students.

The findings from hypothesis two indicated that there was no significant difference the achievement of male and female students in Biology. This finding is congruent with Mbaegbu, Osuafor and Akachukwu (2020) who reported that no significant difference existed between the mean achievement scores of male and female students in the three sequences of Laboratory Students' Experiment and Lecture sequence (DEL); Lecture-Demonstration- laboratory students' Experiment (LDE) and Laboratory Students' Experiment- Lecture- Demonstration (ELD). Hence, the teaching method is gender friendly. The finding is also in line with Dajal, Apochi and Paul-Fiase (2022) who pointed that male and female students taught Biology using sequential teaching methods performed better equally since there was no significant difference in their mean achievement scores. However, the study is at variance with Wafula, Mondoh and Wasike (2017) who found that gender had significant effect on retention with female learners scoring higher than their male counterparts. The present finding has shown that the era of gender disparity in science is gradually closing up as science subjects will no longer be perceived as subjects for the male folks. This stemmed from the result which showed that the mean scores of male and female students in Biology, not being significantly different in achievement.

The findings from hypothesis three indicated that there was significant difference between the achievement scores of students taught Biology using ECP, CPE and PEC sequence with the ECP sequence, the most effective sequence, although the PEC and CPE sequences were equally effective. This finding is also in consonance with the finding of Gongden and Delmang (2016) who reported that there was statistically significant difference in the post-test mean scores of the students in the three groups with the sequence used for group A, Lecture – Analogy – Discussion, proved more

effective than the sequence B: Analogy – Discussion – Lecture, which was better than C, Discussion – Lecture – Analogy. Hence, examining the most effective sequence in this study (ECP) showed that, starting a lesson with expository method, introduces the concept to be taught such that it could increase students' craving to learn, after which the teacher employed computer aided instruction which fosters critical and higher order thinking; and the lesson terminated with the students demonstrating what they have heard the teacher speak verbally and what they have watched.

The enhanced achievement in BAT of the students in group I (ECP) thus must have stemmed from the fact that the students were able to eventually work-the-talk after visualizing the concept on the computer. This is in consonance with the findings of Awiri, and Okoli (2021) who reported teachers' adoption of laboratory method (practical) at the end of the sequence is more like leading the students to verify what they already understood and for which they have the appropriate skills to do. Hence, trying the whole concept all over during practical enhances students' achievement of the concept taught. The introduction of computer aided instruction and practical after the lecture method was quite appropriate. This is because the expository method must have laid the foundation and basics of conceptual knowledge and mastery of the concept taught before the other teaching methods were used. Nevertheless, this finding contradicts that of Mbaegbu, Osuafor and Akachukwu (2020) who disclosed that a significant difference exists in the mean achievement scores of students in the experimental groups, in favour of demonstration-laboratory students' experiment and lecture sequence. (DEL).

## CONCLUSION

The result of the study indicated that sequential teaching methods was found to be effective in improving the achievement of secondary school Biology students in the experimental groups. Sequential teaching methods improved the achievement of male and female students in Biology in favour of the female students although, male students in group III (PEC) achieved better than their female counterpart. The findings of the study also showed that the sequence expository method- in group I was the most effective sequential teaching method than the other sequences.

## RECOMMENDATIONS

Based on the findings, it was recommended that

- i. Biology teachers should teach their students with sequential teaching methods to enhance male and female students' achievement in the subject.
- ii. Biology teachers should be exposed to workshops and seminars on how to effectively combine teaching methods in different sequences during a lesson especially in the sequence of expository method, computer aided instruction and practical method.
- iii. The time table committee of secondary schools should increase the time allotted to Biology lessons in the school time-table to accommodate the implementation of sequential teaching methods in order to improve students' attitude and achievement in Biology.

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