



Effect of Collaborative Learning Method on Academic Achievement of Secondary School Biology Students in Abia State

Pius, Samuel & Anidu, I. Chibuzor

Department of Science Education,
Michael Okpara University of Agriculture, Umudike, Abia State

Corresponding author: piusam2017@gmail.com

Abstract

This study investigated the effect of collaborative learning on academic achievement of secondary school Biology students in Abia State. Two research questions and two null hypotheses guided the study. Quasi experimental research design was adopted for this study. The population of the study comprised 13,306 SSII Biology students (6,415 males and 6,891 females) in 2020/2021 academic session. A sample of 84 SSII Biology students consisting of 38 males and 46 females was drawn in multi stages using purposive and simple random sampling techniques. Biology Achievement Test (BAT) adapted from past WAEC questions was used for data collection. The instrument was subjected to reliability test using Kuder Richardson 20 (KR₂₀) test statistics, and a reliability coefficient of 0.78 was obtained. Mean and standard deviation were used to answer the research questions while the null hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Findings from the study showed that students taught Biology using collaborative learning method achieved higher than those taught with lecture method. Furthermore, there was no significant difference in the academic achievement of male and female students exposed to collaborative learning method. Based on the findings of the study, it was recommended that Biology teachers should use collaborative learning method in the process of teaching and learning for high academic achievement.

Key Words: Collaborative Learning, Academic Achievement, Biology, Students

Introduction

Biology is one of the science subjects offered at the post basic level of education in Nigeria. It provides knowledge about organisms and their environment. It is the study of plants and animals and their interactions with their physical environment (Ozoemezin, 2015). Michael (2012) posited that Biology is the study of life. From the foregoing, Biology can be said to be the study of organisms and the relationship with their environment. Freeman *et al.* (2019) stated that Biology has numerous branches which include genetics, biochemistry, molecular biology, cell biology, histology, physiology, anatomy, microbiology and ecology. The knowledge of these branches helps in the study of very important fields in the society such as medicine, nursing, agriculture, pharmacy among others. The foundations of these disciplines are given at the senior secondary school Biology as stipulated in the objectives of Biology curriculum.

The objectives of Biology curriculum at senior secondary school compiled by Nigerian Educational Research and Development Council, Federal Republic of Nigeria (FRN, 2009) are to prepare students to acquire:

1. adequate laboratory and field skills in Biology;
2. meaningful and relevant knowledge in Biology;
3. ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture; and
4. reasonable and functional scientific knowledge.

These objectives explicitly show the importance of the subject. Agboghroma and Oyovwi (2015) opined that Biology provides a platform for teaching students to develop the ability to apply science concepts and principles in solving everyday life problems. Based on these assertions on the importance of Biology, there is need for it to be properly taught in secondary schools to improve students' achievement and create an atmosphere that will enable them to respond positively in the subject (Paul, 2016).

Academic achievement refers to outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically, in school, college and university (Steinmayr *et al.*, 2017). Similarly, Saima and Sufiana (2017) stated that academic achievement is the progress students make in relation to set goals and objectives. Academic achievement therefore is the accomplishment in a particular subject area indicated by grades, marks or scores.

Academic achievement of Nigerian students in Biology has not been stable in recent years in standardized examinations such as West African Senior School Certificate Examination (WASSCE). The analysis of Biology



students' achievement in WASSCE (2015 – 2019) shows that only 47.39%, 46.89%, 44.93%, 50.52% and 46.48% passed Biology at credit level in 2015, 2016, 2017, 2018 and 2019 respectively (WAEC, 2019). This further indicates that for the period of five years, the pass rate of Biology students in WASSCE remains 47.24%. This is below average and it calls for concern among Biology educators. A research by Nwakolo *et al.* (2019) on comparative effects of individualized and cooperative video based instructional strategies on secondary school students' achievement in Biology indicates that there is poor academic achievement among Biology students in Benue state. The researchers further stated that academic achievement is independent of gender.

Gender refers to whether one is born male or female. Bello and Famakinwa (2014) defined gender as the social and cultural construct, characteristics, behaviours and role which society ascribes to males and females. Our physical characteristics such as penis and vagina determine male or female respectively (Federal Ministry of Education, 2016). Some studies show that gender influences academic achievement. Amedu (2015) in a study on performance of male and female students taught Biology with jigsaw instructional strategy stated that males performed higher than the females in biological associations. Aniodoh and Egbo (2013) reported significant differences between male and female students taught ecology with collaborative strategies in favour of females. However, Udosoro (2011) stated that gender has no significant effect on achievement in science. The researcher further stated that generally, the academic achievement of students in Nigeria is low. Adegun and Adegun (2013) attributed students' poor achievement in sciences to poor teaching methods which fail to inspire students' learning.

Teaching method is a process or a way of operation or teaching adopted to bring about the attainment of curricular objectives (Maikano *et al.*, 2012). There are different methods used in teaching Biology in secondary schools. Dorgu (2015) classified teaching methods into teacher centered and learner centered methods. An example of teacher centered method is lecture method, while learner centered methods comprises discussion, field trip, role playing, project, collaborative learning and individualized approach among others.

Collaborative learning is an instruction that involves students working in teams to accomplish a common goal (Johnson & Johnson, 2009). For Gokhale (2015), collaborative learning refers to an instructional method in which students at various performance levels work together in small groups toward a common goal. He further states that the students are responsible for one another's learning as well as their own. Thus, the success of one student helps other students to be successful. Collaborative learning can be said to be a teaching method in which learners study in groups; thus, learning from each other. Srinivas (2010) posited that collaborative learning method comprises strategies such as think – pair – share, three – step – interview, number heads and jigsaw. In this study, collaborative learning was used as the experimental method while lecture was used as a control method.

Lecture method according to Akpoghol *et al.* (2013) is one of the conventional methods of teaching which involves oral presentation of ideas. The researchers further stated that the teacher does most of the activities in form of talking while the students are passive listeners or slightly involved. Major *et al.* (2015) stated that lecture method helps the teacher to teach a large group of learners at the same time, cover a wide topic within a short time and students are provided with facts so as to save their time and effort. Lecture method enables the teacher to give uniform information to the learners as they are taught using the same technique and material at the same time. There are different forms of lecture method which include formal lecture, Socratic lecture, semi formal lecture, lecture discussion, and interactive lecture (Major *et al.*, 2015).

There are divergent views on the effects of the various teaching and learning methods on the academic achievement of learners in different subjects. Effect of collaborative concept mapping instructional strategy on secondary school students' achievement in difficult Biology concepts in Taraba state was investigated by Kyado *et al.* (2019). The findings revealed that students exposed to collaborative concept mapping instructional strategy attained significantly higher mean achievement scores in biology achievement test (BAT) than those exposed to lecture teaching method. It was also revealed that there was no significant difference in achievement between male and female students taught using collaborative concept mapping instructional strategy. Another research was carried out by Yemi and Adebimpe (2017) on impact of group learning strategy on performance in Ecology among senior secondary school students in Gusau, Zamfara State, Nigeria. The findings showed that students exposed to group learning performed higher than those taught with lecture method. There was no significant difference in the performance between male and female students taught using group learning strategy. Many studies have been conducted on various teaching methods in some states in Nigeria, but none has been seen to give a conclusive end to the poor academic achievement in Biology, hence the necessity for this research.



Purpose of the Study

The purpose of the study was to determine the effect of collaborative learning on the academic achievement of secondary school Biology students in Abia State, Nigeria. Specifically, the study sought to:

1. determine the mean achievement scores of students taught Biology with collaborative learning and lecture method.
2. ascertain the mean achievement scores of male and female students taught Biology with collaborative learning method.

Research Questions

The following research questions were posed for the study.

1. What are the mean achievement scores of students taught Biology with collaborative learning and lecture method?
2. What are the mean achievement scores of male and female Biology students exposed to collaborative learning method?

Hypotheses

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

H₀₁: There is no significant difference in the mean achievement scores of students taught Biology with collaborative learning and lecture method.

H₀₃: There is no significant difference in the mean achievement scores of male and female students taught Biology with collaborative learning method.

Research Method

The design adopted for this study was quasi- experimental research design. Specifically, non equivalent control design which uses intact classes was adopted. This design was considered appropriate because it establishes a cause - effect relationship between the independent and dependent variables (Nworgu, 2015).

The design is illustrated below:

N	O ₁	X ₁	O ₂
N	O ₁	X ₂	O ₂

Where

N = Sample size for each group

O₁ = Pretest (test before treatment)

X₁ = Treatment for the experimental group with collaborative learning.

X₂ = Control group with lecture method

O₂ = Post –test (test after treatment)

The population of the study was 13,306 Senior Secondary Two (SS2) Biology students in 162 public schools in the three education zones of Abia state; 6,112 students in Aba zone, 3,857 in Umuahia zone and 3,335 in Ohafia zone (SEMB, 2021). This population comprises 6,415 males and 6,891 females. The sample size was 84 SS2 Biology students which comprises 38 males and 46 females. The sample size was drawn in multi stages using simple random sampling and purposive sampling techniques.

The first stage was the selection of one education zone from the three education zones in Abia State. Simple random sampling technique by balloting was used to sample Umuahia education zone from Aba, Umuahia and Ohafia education zones.

The second stage involved the sampling of two Local Government Areas from the four LGAs that made up Umuahia education zone (Ikwuano, Umunneochi, Umuahia North and Umuahia South). Simple random sampling technique (balloting) was adopted to sample Ikwuano and Umuahia North LGAs for the study. This was because one secondary school was sampled from each LGA for each teaching method.

The third phase was the purposive sampling of the 24 public co – educational secondary schools in the two sampled LGAs from 46 public secondary schools in Umuahia education zone. This was because gender was a moderator variable in the study.

The fourth stage was the sampling of one co-educational secondary school from each of the sampled LGAs. Simple random sampling technique was adopted to sample Ibeku High School from Umuahia North LGA and Ikwuano Secondary School, Ariam from Ikwuano LGA. This gave a total of two secondary schools for the study. This was because each school was used for each teaching method (two schools for two teaching methods).

Senior Secondary School Two (SS 2) intact classes were purposively sampled from the two schools; one school for experimental group, and one school for the control group. There were 52 students in the experimental group (Ibeku High School) of which 25 students were males while 27 students were females. On the other hand, the control group (Ikwuano Secondary School, Ariam) had 32 students which consisted of 13 males and 19 females. The two classes had only one stream each, hence the use of different schools for each teaching method.

The instrument used to collect data for the study was Biology Achievement Test (BAT) adapted from West African Senior School Certificate Examination (WASSCE) past questions in Biology. The questions were adapted from WASSCE past questions of 10 consecutive years (2010 -2019). The BAT comprised 50 items multiple choice test based on the topics in ecological management such as biological associations, adaptation, tolerance and pollution. The Biology Achievement Test was a multiple choice test with response options A - D. Every correct answer had two (2) points, while incorrect answer had zero point. Therefore, the maximum obtainable score is 100. The 50 questions were administered to the sampled students in each school as pre test (test before experiment). Immediately after the treatment, the questions were reshuffled and administered as post test. The Biology Achievement Test was validated by three experts; One from Measurement and Evaluation, and two from Biology Education, all in the Department of Science Education, Michael Okpara University of Agriculture, Umudike. The Biology Achievement Test (BAT) was trial tested on 30 SS2 Biology students of Lokpanta Secondary School in Umunneochi Local Government Area of Abia State. This was to determine the internal consistency of the instrument. The data obtained from trial testing were subjected to reliability test using Kuder Richardson 20 (KR₂₀) test statistics and a reliability index of 0.78 was obtained. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. This implies that any p-value that is less than 0.05 is significant and therefore the null hypothesis is rejected. On the other hand, any p-value that is equal to or greater than 0.05, is not significant and the hypothesis is not rejected.

Results

Table 1: The Mean Achievement Scores of Students Taught Biology with Collaborative Learning and Lecture Method

Method	N	Pretest		Post-test		Mean
		Mean	SD	Mean	SD	Diff.
Collaborative learning	52	29.92	9.15	56.85	10.53	26.93
Lecture method	32	31.25	9.24	44.81	14.19	13.56

The result in Table 1 shows that collaborative learning method with mean difference of 26.93 is more effective in the improvement of students' academic achievement in Biology than lecture method with mean difference of 13.56. The standard deviation values are far from the mean which indicates that the scores are widely spread.

Table 2: Analysis of Covariance of the Mean Achievement Scores of Students Taught Biology with Collaborative Learning and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2896.913 ^a	2	965.638	7.689	.000
Intercept	21622.860	1	21622.860	172.179	.000
Pretest	12.536	1	12.536	.100	.753
Learning Method	2896.632	2	1448.316	11.533	.000
Error	13939.818	80	125.584		
Total	333648.000	84			
Corrected Total	16836.730	83			

The result in Table 2 shows that there is a significant difference in the mean achievement scores of students taught Biology with collaborative learning and lecture method with p-value of 0.000 at 0.05 level of significance.



Thus, the null hypothesis which states that there is no significant difference in the mean achievement scores of students taught Biology with collaborative learning and lecture method is rejected.

Table 3: The Mean Achievement Scores of Male and Female Biology Students Exposed to Collaborative Learning Method

Collaborative learning	N	Pretest		Post-test		Mean
		Mean	SD	Mean	SD	Diff.
Male	25	30.48	9.92	55.36	10.83	24.88
Female	27	29.41	8.54	58.22	10.25	28.81

Table 3 shows that female students had higher mean difference of 28.81 than the male students with mean difference of 24.88 when taught Biology with collaborative learning method. The standard deviation values are still far from the mean, thus showing that the scores are widely spread in the two groups.

Table 4: Analysis of Covariance of the Mean Achievement Scores of Male and Female Students Taught Biology with Collaborative Learning Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1121.956 ^a	2	560.978	6.070	.004
Intercept	7733.459	1	7733.459	83.673	.000
Pretest	1015.613	1	1015.613	10.989	.002
Gender	148.316	1	148.316	1.605	.211
Error	4528.813	49	92.425		
Total	173688.000	52			
Corrected Total	5650.769	51			

The result in Table 4.4 shows that there is no significant difference in the mean achievement scores of male and female students taught Biology with collaborative learning instructional method with p-value of 0.21 at 0.05 level of significance. Thus, the null hypothesis which states that there is no significant difference in the mean achievement scores of male and female students taught Biology with collaborative learning method is not rejected.

Discussion

Results show that students taught Biology with collaborative learning method achieved significantly higher than those exposed to lecture method. The higher achievement of students taught with collaborative method could be as a result of the freedom they had in learning from each other and being 'experts' in the learning content since each student must have enough knowledge on an aspect of the topic to be able to explain to other members of the group. The success of one student helps others to be successful as stated by Gokhale (2015). The findings of this study are in agreement with the findings of Kyado *et al.* (2019) who reported that students exposed to collaborative concept mapping instructional strategy attained significantly higher mean achievement scores in Biology than those exposed to lecture method.

Furthermore, the findings of this research showed that the academic achievement of Biology students taught with collaborative learning method is gender friendly. This is because there is no significant difference in the academic achievement of male and female students exposed to collaborative learning method. This could be due to the fact that the students learned in mixed groups of males and females. So, they made sure that all participants understood well irrespective of gender. Also, there is no scientifically proven difference in the intellectual capacity of male and female students. This finding refutes the report of Amedu (2015) that male students had greater mean score than their female counterparts when taught with jigsaw strategy. However, this finding is in agreement with the submission of Yemi and Adebimpe (2017) who reported that there is no significant difference in the performance of male and female students taught Biology with group learning strategy. Similarly, Kyado *et al.* (2019) found out



that there was no significant difference in the achievement of male and female students taught Biology using collaborative concept mapping instructional strategy.

Conclusion

One of the major components of teaching and learning process is the method of teaching adopted by the teacher. It is therefore important to use better methods that can involve the learners as stated by Bonwell and Eison (2019) “tell me and I forget, show me and I will remember, involve me I will understand”. The findings of this study showed that collaborative learning method enhanced Biology students’ academic achievement than lecture method. Furthermore, academic achievement of male and female Biology students exposed to collaborative learning method has no significant difference, hence collaborative learning method is gender friendly. The findings of this study therefore show the indispensability of collaborative learning method in teaching secondary school Biology.

Recommendations

Based on the findings of this study, the following recommendations were made:

- 1 Biology teachers of Abia State should use collaborative learning method in the process of teaching and learning since it is proven by the findings of this study to be more effective in enhancing academic achievement.
- 2 It should not be assumed that any gender achieves better in Biology and as such, teachers should encourage both male and female students to study Biology together as there is no significant difference in the achievement of both gender when taught with collaborative learning method.

References

- Adegun, I. K. & Adegun, B. O. (2013). Students and teachers’ views of difficult areas in Mathematics syllabus: Basic requirement for science and engineering education. *Journal of Education and Practice*, 4(12), 235 – 243
- Agboghroma, U. E. & Oyovwi, S. C. (2015). Evaluating effects of students’ academic achievement on identified difficult concepts in senior secondary school Biology in Delta State. *Journal of Education and Practice*, 6(3) 53 – 57
- Akpoghol, T., Ezeudu, F. O., Adzape, J. N. & Otor, E. E. (2013). Effects of lecture method supplemented with music and computer animation on senior secondary school students’ academic achievement in electrochemistry. *Journal of Education and Practice*, 7(4), 75- 78
- Amedu, O. I. (2015). The effect of gender on the achievement of students in Biology using the jigsaw method. *Journal of Education and Practice*, 6(1), 176 – 179
- Aniodoh, N. A. & Egbo, C. N. (2013). Gender and performance in Physics in Anambra State. *Journal of Research and Method in Education*, 5, 13 – 21
- Bello, T. O. & Famakinwa, A. (2014). Effect of gender on Basic Science practical skills of lower primary school pupils. *Journal of Emerging Trends in Educational Research and Policy Studies*, 5(6), 679 - 683
- Dorgu, T. E. (2015). Different teaching methods: A panacea for effective curriculum implementation in the classroom. *International Journal of Secondary Education*, 3(6), 77 - 87
- Federal Ministry of Education (2016). *A handbook on adolescent reproductive health and HIV/AIDS education for trained teachers on family life and HIV education*. Arfh productions
- Federal Republic of Nigeria (2009). *Biology curriculum for senior secondary schools*. NERDC
- Freeman, S., Quillin, K., Allison, L. & Black, M. (2019). *Biological Science*. Pearson
- Gokhale, A. A. (2015). Collaborative learning and critical thinking. *Journal of Technology Education*, 7(1), 22 – 30
- Johnson, D. W. & Johnson, R.T. (2009). An educational psychology success story. Social interdependence theory and cooperative learning. *Educational Researcher*, 38, 365 – 379
- Kyado, J. J., Abah, C. O. & Samba, R. M. A. (2019). Effect of collaborative concept mapping instructional strategy on secondary students’ achievement in difficult Biology Concepts. *American Journal of Social Sciences and Humanities*, 2(3), 201 -212
- Maikano, P. N., Zuhumben, J. D., Gokum, K. D., Ajiji, I. A., Sabina, M. J. & Klactu, K. C. (2012). *Curriculum theory and development*. Chuks Dee Production.
- Major, C. H., Harris, M. S. & Zakrajsek, T. (2015). *Teaching for learning*. Centre for educational innovation. Lines

- Michael, M. C. (2012). *Essential Biology for senior secondary schools*. Tonad
- Nwakolo, B., Adejoh, M. J. & Okwara, O. K. (2019). Comparative effects of individualized and cooperative video based instructional strategies on secondary students' achievement in Biology in Makurdi metropolis, Benue State, Nigeria. *International Journal of Social Science and Human Research*, 2(1), 122 – 136
- Nworgu, B. G. (2015). *Educational Measurement and Evaluation: Theory and Practice*. University press
- Ozoemezinem, V. E. (2015). Effects of instructional materials on achievement and retention of Biology concepts among secondary school students in Delta State, Nigeria. *Unpublished M.Ed. Thesis, Ahmadu Bello University, Zaria*
- Paul, N. (2016). The importance of Biology education. *Journal of Biological Education*, 50(1), 7 – 9
- Saima, S. & Sufiana, K. (2017). Impact of ICT enriched modular approach on academic achievement of Biology students. *Journal of Research and Reflections in Education*, 11(1), 49 – 59
- Secondary Education Management Board (2021). Abia State Ministry of Education.
- Srinivas, H. (2010). Forms of collaborative learning. Retrieved from <https://brighthubeducation.com>
- Steinmayr, R., Meibner, A., Weidinger, A. F. & Wirthwein, L. (2017). *Academic achievement*. Routledge.
- Udosoro, U. J. (2011). The effects of gender and Mathematics ability on academic performance of students in Chemistry. *African Research Review*, 5(4), 201 – 213
- West African Examination Council (2019). Chief Examiner's Report. WAEC
- Yemi, A. O. & Adebimpe, A. D. (2017). Impact of group learning strategy on performance and retention in Ecology among senior secondary school students in Gusau, Zamfara State, Nigeria. *ATBU Journal of Science, Technology and Education*, 5(3), 34 - 45