EFFECT OF COLLABORATIVE LEARNING AND PEER TUTORING INSTRUCTIONAL TECHNIQUES ON STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY

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Abstract
This study investigated the effect of collaborative learning instructional technique and peer tutoring instructional technique on students' academic achievement in Biology. Three research questions and three hypotheses guided the study. The design was quasi-experimental specifically non-equivalent control group design. The population of the study comprised of 2518 SS1 students in Nsukka Local Government Area of Enugu State. A sample size of one hundred and thirty-one (131) SSI Biology students was used for the study. Two intact classes were selected from the two purposely sampled schools. Among the two schools, each class were treated using cooperative and peer tutoring instructional techniques respectively. The two experimental groups were exposed to pre-test and post-test respectively. The research questions were answered using mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the hypotheses, at 0.05 level of significance. Results obtained revealed that there was significant difference in the mean achievement scores of students taught Biology using collaborative learning and peer-tutoring technique in favour of the collaborative learning group. Gender had no significant influence on students' achievement in Biology. Also, the interaction of instructional techniques and gender had no significant effect on students' achievement in Biology. Based on the findings of this study, it was concluded that collaborative learning was more effective in enhancing students' achievement in Biology in senior secondary schools.

Keywords: Collaborative, peer tutoring, techniques, biology, academic achievement,

Introduction

Science is the body of knowledge acquired through discoveries about things. Science is described as a systematic and logical approach to discovering how things in the universe work (Nwosu, 2015). Science aims at obtaining measurable results through testing and analysis, a process known as the scientific method. One important fact about scientific process is that it focuses not only on extracting knowledge about the world opinion or preference (Ullah, Tabassum & Kaleem, 2018), but subsequently designed to challenge ideas through research. Biology is one of those science subjects taught in secondary school, where knowledge is acquired through scientific process.

Biology is the study of life and interaction in the environment. Biology could be described as a life science that enables individuals to live effectively in any environment they find themselves (Aninweze, 2014). That is why Biology is an indispensable body of knowledge students must be armed with in order to thrive in any environment. Many career fields are open to students with good knowledge of Biology as it encompasses various fields in science such as veterinary medicine, medicine, biochemistry, microbiology among others. Venturing into these related require basic knowledge and higher achievement in Biology. Attaining high achievement could be harnessed by different factors and most importantly through instructional

delivery processes. That is why Bichi, Ibrahim and Ibrahim (2019) affirmed that instructional technique could be far reaching in enhancing learning outcomes such as academic achievement. Hence, various researchers as well as educational associations such as Science Teachers Association of Nigeria (STAN), have been working tirelessly to bring in pedagogical reforms that will encourage the use of instructional technique that are useful for enhancing students' knowledge, active participation and skills development and especially achievement in Biology. Based on this, there is advocacy for positive achievement in Biology by exploring various instructional techniques which studies has found that innovative instructional techniques have principles that would improve academic achievement in Biology. Innovative instructional techniques are proactive approaches incorporated into old teaching methods into a classroom (Brown & Green, 2021). Innovative instructional technique involves creativity on the part of the teacher as teachers sometimes re-organize the educational process at any point when the need arises. Example of innovative teaching approach include collaborative learning, inquiry-based learning, project-based learning, blended learning, peer tutoring, among others. This study focused on collaborative and peer tutoring instructional technique for teaching Biology.

Collaboration is a situation where two or more people jointly learn or attempt to achieve something together. At all levels, educational reforms highlight the requirement to use collaborative learning as a teaching and learning strategy based on the active and main role of learners (Gisbert, 2018). Collaborative learning is commonly illustrated when groups of students work together to search for understanding, meaning, or solutions or to create an artifact or product of their learning. Collaborative learning could therefore be seen as students attempt to learn through shared ideas. To this end, collaborative learning redefines the traditional student-teacher relationship to student-student relationship in the classroom. Ivan (2023) noted that collaborative learning helps students to understand concepts presented to them, reframing ideas, listening to each other's viewpoint. Through this, learners could be able to gain more understanding as a group than as individual as they are able to scaffold each other during learning. Collaborative activities done in the classroom avails students a higher likelihood that they will remember the information greater than if they had just read the content (Atman & Durak, 2022). Based on this, it could be seen that collaborative learning could be of help to students working on certain topics they perceived difficult by cognitively rehearsing their own viewpoint and the efforts to grasp their opponent's argument.

Collaborative learning activities can include collaborative writing, group projects, joint problem solving, debates, study teams, and other activities. Considering the principles of collaborative instructional technique, it could assist students to have active control over their learning and create both academic and social relationships and to accomplish common goals (Molla & Muche, 2018). There are numerous studies done in collaborative instructional technique. For instance, Adeoye and Igbinedion (2018); Adejimi, Nzabalirwa, and Shivoga (2021) these studies are of the view that collaborative instructional technique enhances student's achievement in science. However, the results of these studies are contrary to the results of Aiken and Dicken (2023) study that found that collaborative learning can lead to conflicts within the group due to contrasting personalities which can disrupt learning and could also affect achievement. Based on this, the present study determined the effectiveness of collaborative instructional technique when compared with peer tutoring instructional technique on students' achievement in Biology.

In the classroom, peer-tutoring is an instruction that takes place among peer, usually those that have higher learning ability. Peer-tutoring occur between a group of two or more students, where the tutor is more knowledgeable than the tutee (Bombardelli, 2016). Similarly, Animola (2019) listed some benefits of peer tutoring such as it can have a positive effect on students' attitudes about what they're learning and the learning process in general; improve students' concept of self and having a better attitude toward learning; breaking down barriers

that might exist for some otherwise disengaged students. Slavin, (2014) also identified several approaches to peer tutoring including, one-to-one tutoring, group tutoring, and peer-led study groups. The most suitable approach will depend on the needs and preferences of the students involved, as well as the goals and objectives of the tutoring program. It is therefore pertinent for instructors to carefully plan peer tutoring programs in order to ensure maximum learning goal achievement. The effectiveness of peer tutoring can therefore be enhanced by providing tutors with appropriate training and support. Topping (2017) emphasizes the importance of training in order to develop effective tutor-student relationships and maximize learning outcomes. That is to say, peer tutoring is an effective and beneficial educational strategy that involves students supporting each other in their learning. It is noteworthy that studies have been carried out on peer tutoring (Agu, 2018; Aniaku, Ibe, Aham, Ugwu, and Nzewi, 2021 are of the view that peer tutoring enhance students' achievement in sciences. On the other hand, Baser (2020), Ajayi, Akintoye, Akindoju, and Onowugbeda (2023) in their own study stated that sometimes peers may lack the knowledge and professionalism an experienced adult can provide during peer tutoring. Consequently, to streamline these controversies, the researcher compared peer tutoring and collaborative instructional techniques to find out their effectiveness in enhancing students' achievement in Biology.

Student achievement refers to the degree to which a learner has met their immediate or long-term educational objectives. Achievement is an accomplished effort, or a standardized set of experiences student acquire at the end of learning. It connotes final accomplishment of something noteworthy, after many efforts (Ugwu, 2023). Academic achievement also refers to a result-oriented construct that shows the extent of students' attainment in a learning task (Oyovwi, 2019). It also relates to student performance in School learning activities and can be explained as something students gain at school, college university, in class, in laboratory and field work (Ezenwosu & Nworgu, 2013). In view of the dwindling achievement of student in Biology, according to WAEC Chief Examiners report (2018) and (Lalrinmawia & Fanai (2020) the study therefore explored other instructional technique such as collaborative and peer tutoring instructional that could enhance student achievement in the subject and reduce gender inequalities in Biology education. The goal is to support learning process by introducing such instructional techniques so as to nurture the level of academic achievement in academic tasks in Biology. This suggests that the more the students are involved in activities throughout the instructional processes, the better they are able to attain knowledge, cultivate relevant skills and the likelihood of greater academic achievement in Biology. This idea is considered also on the fact that students taught Biology comprised of different gender. Hence, gender is a very important variable in studying biology.

In recent times, gender related issues in science education have received serious attention. Gender is the state of being male or female in relation to the social and cultural roles that are considered appropriate for men and women (Ugwu, 2023). Many researchers have observed from their various research works that boys tend to do better than girls in science subjects (Jones & Smith, 2019; Benson, 2023). They are of the view that girls showed lukewarm attitudes to science subjects which affected their performance; poor use of gender friendly instructional techniques; some negative attitude of parents to women education, among others. That is to say that gender stereotypes and expectations stemming from socio-cultural orientations can deeply influence females' academic achievement. According to a study by Brown & Green (2021), students who feel that their gender does not "fit" with what society considers proper for their gender may have academic difficulties. This is as a result of gender friendly instructional techniques not adequately used by teachers during teaching and learning process.

There has been a controversy among scholars on influence of gender on students' academic achievement. Ekineh and Adolphus (2019); Hussaini and Abdullahi (2024) reported

that there was no significant difference in the achievement of boys and girls in Biology. While other Scholars Parajuli and Thapa (2017), Ugwu (2023) and Benson (2023) reported that there was significant difference in the achievement of male and female students in biology. These contrasting reports on gender differences on students' achievement in Biology, inspired the researcher to investigate the effect of collaborative learning and peer tutoring instructional techniques on students' academic achievement in Biology for effective academic reform.

Purpose of the Study

The study determined the effect of collaborative learning and peer tutoring instructional technique on students' academic achievement in Biology. Specifically, the study determined the;

1. effect of collaborative learning and peer-tutoring instructional technique on students' mean achievement in Biology.
2. influence of gender on students' mean academic achievement in Biology.
3. the interaction effect of instructional technique and gender on students' mean academic achievement in biology.

Research Questions

The study answers the following research questions;

1. What are the mean academic achievement scores of students taught biology using collaborative learning and those taught using peer-tutoring instructional techniques?
2. What is the influence of gender on students' mean academic achievement scores in biology?
3. What is the interaction effect of teaching technique and gender on students' academic achievement in Biology?

Hypotheses

Ho_1: There is no significant difference in the meant achievement scores of students taught Biology using collaborative learning and those taught using peer-tutorial instructional techniques.

Ho_2: There is no significant gender influence on the mean achievement scores of students in Biology.

Ho_3: There is no significant interaction effect of teaching technique and gender on students mean achievement scores in Biology.

Methodology

This study adopted quasi-experimental research design. Specifically, a pre-test post-test non-equivalent group design. The study was carried out in Nsukka Local Government Area of Enugu State. The sample of the study consisted of 131 SS1 Biology students drawn using purposive sampling technique from the population of the 2518 SS1 Biology students for 2022/2023 academic session of all the 25 government owned co-educational schools out of the whole 32 schools in Nsukka Local Government Area of Enugu state. Instrument used for data collection include the Biology Achievement Test (BAT). The BAT consisted of 30 multiple choice test items which were developed by the researcher. The BAT items were drawn from topic "Microorganisms around us". The '30' multiple questions have 4 options (A-D) and each correctly answered question was awarded two marks. Incorrect answers attracted no mark. The sub-topics consist of, microorganisms in air and water, microorganisms in our bodies and food, carriers of microorganisms, harmful and beneficial effects of microorganisms. The test items covered six objectives in the domain of revised Bloom's taxonomy which are; remembering, understanding, applying, analyzing, creating and evaluating. The number of items assigned to

a particular sub-topic was determined using Table of specification in order to guarantee proper distribution of the test items throughout the topic chosen for the study. Each correct item has 2 marks giving a maximum of 60 marks. The instrument was content validated using test blueprint by three experts in the department of science education, university of Nigeria Nsukka (two from measurement and evaluation and a professional biology lecturer). The instrument was trial tested on twenty (20) SS1 Biology students. Kuder-Richardson 20 (KR-20) formular was used to obtain the reliability coefficient of BAT with a coefficient of 0.79. Two schools were used for the experiment. One school was assigned to collaborative teaching method while the other was assigned to peer tutoring teaching. The regular Biology teachers were trained based on the instructional principle and guide for each teaching method. They were also trained on the method of data collection. Before the commencement of treatment, students were given pre-test. Treatment lasted for four weeks, at which point post-test was administered. From the data collected, research questions were answered using mean and standard deviation, while the hypothesis were analyzed using analysis of covariance (ANCOVA).

Results

Research Question One: what are the mean academic achievement scores of secondary school students taught Biology using collaborative learning and those taught using peer-tutoring instructional techniques?

Table 1: Pre/Post-test Mean Achievement Scores of Collaborative and Peer-tutoring Groups in Biology

Methods	n	Pre-Achievement		Post-Achievement		Mean Gain
		Mean	SD	Mean	SD	
Collaborative techniques	69	8.19	4.96	21.46	4.35	13.27
Peer-tutoring techniques	62	7.94	4.67	16.63	4.00	8.69

Table 1 shows that the students who were taught Biology using collaborative learning method obtained a pre-test mean achievement score (M = 8.19, SD = 4.96) and a post-test mean achievement score (M = 21.46, SD = 4.35), whereas the students who were taught Biology using peer-tutoring method had a pre-test mean achievement score (M = 7.94, SD = 4.67) and a post-test mean achievement score of (M = 16.63, SD = 4.00). The mean gains of 13.27and 8.69for the students in the collaborative and peer-tutoring groups respectively implied that the students in the collaborative group had a higher mean achievement at the post-test than those taught using peer-tutoring method. More so, the post-test standard deviations of 4.35and 4.00for the students in the collaborative and peer-tutoring groups respectively, indicate that achievement scores of the students taught using peer-tutoring method varied more from their mean than those students in the taught using collaborative instructional technique.

H_{01}: There is no significant difference in the mean achievement scores of secondary school students taught Biology using collaborative instructional technique and those taught using peer-tutoring instructional technique.

Table 2: Summary of Analysis of Covariance (ANCOVA) of Students' Post Academic Achievement Score by Instructional Technique and Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	η^2	Decision
Corrected Model	776.706a	4	194.18	10.85	0.00	0.26	
Intercept	12668.21	1	12668.21	708.08	0.00	0.85	
Pre-Achievement	2.50	1	2.50	0.14	0.71	0.00	
Teaching Method	767.19	1	767.19	42.88	0.00	0.25	Sig.
Gender	5.10	1	5.10	0.29	0.59	0.00	Not Sig.
Teaching Method * Gender	4.94	1	4.94	0.28	0.60	0.00	Not Sig.
Error	2254.26	126	17.89				
Total	51200.00	131					
Corrected Total	3030.96	130					

a. R Squared = .400 (Adjusted R Squared = .385)

Key: η^2 *=Partial Eta Squared, Sig.=Significant, Not Sig.=Not Significant*

Results shown on Table 2 indicate that instructional technique had significant effect on students' achievement in Biology ($F(1,126) = 42.88, p = 0.00 < 0.05, \eta^2 = 0.25$*)*. Since the associated probability value of 0.00 is lower than the 0.05 level of significance, the null hypothesis was therefore rejected. Furthermore, the effect size ($\eta^2 = 0.25$) indicates that 25 percent variance in students' achievement in Biology was attributed to the instructional technique. Consequently, students taught using collaborative instructional technique significantly outperformed their counterparts taught using peer-tutoring instructional technique.

Research Question Two: What is the influence of gender on students' mean achievement score in Biology?

Table 3: Pre/Post-test Mean Academic Achievement Scores of Male and Female Biology Students

Gender	N	Pre-Achievement		Post-Achievement		Mean Gain
		Mean	SD	Mean	SD	
Male	58	8.03	4.66	19.45	4.92	11.42
Female	73	8.10	4.95	18.96	4.77	10.86

Table 3 shows that the male students had a pre-test mean achievement score of (*M* = 8.03, *SD* = 4.66) and a post-test mean achievement score of (*M* = 19.45, *SD* = 19.45). On the other hand, female students had a pre-test mean achievement score of (*M* = 8.10, *SD* = 4.95) and a post-test mean achievement score of (*M* = 18.96, *SD* = 4.77). The mean gains of 11.42and 10.86 for the male and female groups respectively imply that the male students had a slightly higher mean achievement at the post-test than their female counterparts. Furthermore, the post-test standard deviations of 4.92 and 4.77 for the male and female students indicate that the achievement scores of the male students varied more than their female counterparts.

H_{02}: There is no significant influence of gender on students' mean academic achievement score in Biology.

Results shown on Table 2 indicate that gender had no significant influence on students' achievement in Biology ($F(1,131) = 0.29, p = 0.59 > 0.05, \eta^2 = 0.00$). Since the associated probability value of 0.59 was higher than the 0.05 level of significance was therefore accepted. Furthermore, the effect size ($\eta^2 = 0.00$) indicates that the percent variance in students' achievement in Biology that could be attributed to students' gender was negligible. Consequently, students' gender was not a determinant of students' academic achievement in Biology.

Ho$_3$: There is no significant interaction effect of instructional techniques and gender on students' Academic Achievement in Biology

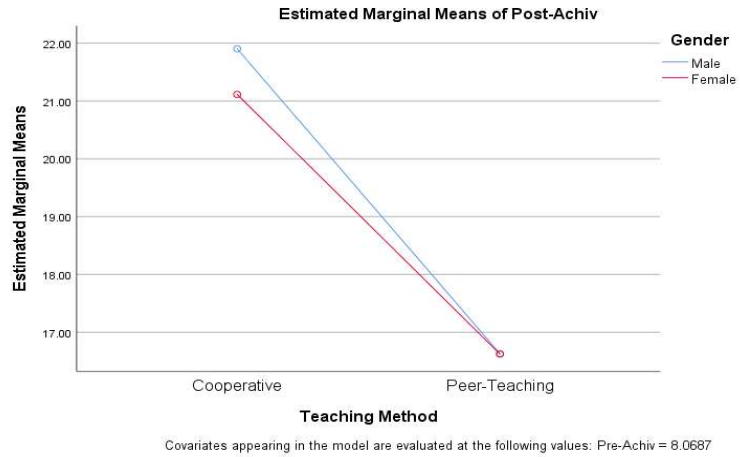

Figure 2: Graph of Interaction Effect of Instructional Technique and Gender on Students' Achievement in Biology

Results shown on Table 2 and Figure 2 indicate that the interaction of teaching method and gender had no significant effect on students' achievement in Biology ($F(1,131) = 0.28, p = 0.60 > 0.05, \eta^2 = 0.00$). Since the associated probability value of 0.60 was higher than the 0.05 level of significance stated for testing the null hypotheses, the null hypothesis three (H_{03}) that there is no significant interaction effect of teaching method and gender on students' Academic Achievement in Biology was therefore upheld. Furthermore, the effect size ($\eta^2 = 0.00$) indicates that the variance in students' achievement in Biologythat could be attributed to joint effect of teaching method and gender was negligible. The inference drawn, therefore, is that the interaction of teaching method and gender does not significantly determine students' achievement in Biology. However, only the teaching method alone is sufficient to improve students' achievement in Biology.

Discussion

The result presented in table 1 established that the use of collaborative instructional technique was significant on students' academic achievement in Biology. The post achievement mean scores of students taught using collaborative learning technique is higher than their counterpart. In addition, the associated probability value of 0.00 is lower than the 0.05 level of significance, which means that students taught Biology using the collaborative learning instructional technique performed better than students taught with peer tutoring instructional technique. Hence, collaborative learning instructional technique was able to provide a more reliable means of achieving high levels of reasoning, higher quality of problem-solving skills, understanding, comprehension, teamwork skills and retention. These could have contributed to the higher

achievement of the students taught using collaborative learning instructional technique. This confirms the point of Topping (2020) that, students' ability to brainstorm during learning avails them the opportunity to actively engage knowledge based on their experiences thereby encouraging high achievement. The result of the study is also in line with Ugwu, Jatau, and Gwamna (2020) who found that collaboration is more generative and exploratory. Students, who engage in discussions, collaborate in order to seek solution to a common problem by supporting each other. This view is also in line with the findings of Joel, David and Stephen (2018), that teaching methods used by teachers largely determine students' performance. The result implies that collaborative learning has proved to be a good instructional technique and have the potential to improve students' ability to learn, hence the positive achievement.

The finding also revealed that the male students had a slightly higher mean achievement than their female counterparts. However, result in table 2 indicated that gender has no significant influence on students' achievement in Biology. Results from the analysis further indicate that gender had no significant influence on students' achievement in Biology, since the associated probability value was higher than the level of significance. Furthermore, the effect size indicates that the percent variance in students' achievement in Biology that could be attributed to students' gender was negligible. Still, the interaction effect of instructional techniques and gender on students' mean achievement scores in Biology was not significant. This is in agreement with the finding of Benson (2023) that instructional techniques and gender could independently have effect on achievement in Biology but may not simultaneously have effect on achievement. This is because both the male and female students had positive achievement; therefore, achievement is not gender and instructional technique reliant. This may be due to the reason that the collaborative and peer tutoring instructional techniques delivered to the students enabled both the male and female students to be actively involved during the teaching and learning process. It was also revealed that the interaction of teaching method and gender had no significant influence on students' achievement in Biology. Furthermore, the effect size indicates that the variance in students' achievement in Biology that could be attributed to joint effect of teaching method and gender was negligible. The inference drawn, therefore, is that the interaction of teaching method and gender does not significantly determine students' achievement in Biology. However, only the teaching method alone is sufficient to improve students' achievement in Biology. This is in agreement with the findings of Obialor (2016) who found out that gender was not a significant factor on students' achievement in biology. The finding is also consistent with that of Adolphus and Omeodu (2016) who reported that gender does not significantly affect students' understanding in electromagnetic induction when taught with Collaboration Teaching Strategy and that the use of activity-oriented approaches like collaborative learning that encourages free integration among learners will reduce the gender gap in performance.

Conclusions

Based on the findings of the study and the interpretation of results, it is therefore concluded that collaborative learning proved to be more effective in enhancing student's achievement in Biology than peer tutoring. The difference in the mean achievement scores of male and female students in biology is not statistically significant. The interaction effect between collaborative and peer tutoring techniques and gender on students mean achievement scores in Biology is not statistically significant.

Educational implications

1. For the students, Learning through interaction if far reaching is enhancing knowledge and comprehension of subject contents that could enhance achievement in Biology

2. For the School Administrators, collaborative learning can create a positive and dynamic classroom environment, which can contribute to higher academic achievement in Biology and thereby leading to improved performance indicators for the school.
3. These findings may also have implications for teacher training, in terms of type of techniques and strategies that should be emphasized in pre-service and in-service teacher training programs.

Recommendation

Based on the findings of the study, the following recommendations were proposed;

1. Biology teachers should utilize collaborative learning technique in the teaching and learning of biology since it has been proven to enhance students' academic achievement.
2. Seminars and workshops should be set up by the individual schools to acquaint teachers with the acquisition of skills as well as importance of using collaborative learning instructional technique in classroom instruction.

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