

IMPROVING STUDENTS' ACHIEVEMENT IN BIOLOGY: THE USE OF PEER TUTORING

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ABSTRACT: *The study was carried out to determine the effects of peer tutoring on students' achievement in Biology. The study used two modes of peer tutoring such as Class Wide Peer Tutoring (CWPT) and Reciprocal Peer Tutoring (RPT). To guide the study, three research questions were posed and three hypotheses were formulated and tested at 5% probability level. Quasi-experimental design was adopted for the study. Specifically, pretest- posttest non-equivalent control groups design was used for the study. The study was carried out in Onitsha Education Zone of Anambra State. Six out of the 32 co-educational schools in Onitsha education zone were used for the study. A total sample of one hundred and eighty (180) SSII Biology students of 2018/2019 was used for the study. The sample was drawn using stratified random sampling and simple random sampling techniques. Two instruments, a Biology Achievement Test (BAT) and a Biology Interest Scale (BIS) were used for data collection. The BAT consist of 30 multiple choice test items which were drawn from the content covered which include; adaptation, conservation of natural resources, pollution and its control and association. The instrument was trial tested on 30 students, the reliability of BAT was determined using Kuder-Richardson (K-R20) and yielded an internal consistency index of 0.83. Mean and Standard deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used in testing the null hypotheses. The findings among other things show that there was a significance different in the mean achievement score of students taught Biology using CWPT than those taught with RPT.*

KEYWORDS: biology, peer tutoring strategy, students' achievement

INTRODUCTION

Science is the study of nature. Science can be defined as a dynamic and objective process of seeking knowledge, an enterprise involving people searching, investigating and seeking verification of natural phenomena. Hazim (2015) defined science as a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. This view justifies the fact that science revolves about organization of knowledge, in

terms of giving clear focus on activities in universe which can come in terms of acquisition of a particular knowledge or teaching. With science, the pursuit of knowledge and understanding of the natural and social world can be achieved by following a systematic methodology based on evidence (Heintz, 2009). Science covers various subjects such as Physics, Chemistry, Mathematics, Basic science, Agriculture and Biology.

Biology as a branch natural science that deals with the study of living organisms, the structures, functions, evolutions, distribution and interrelationships. This implies that with biology living things are better understood. Odigie (2001) opined that biology is the basic subject for many fields of learning that contribute immensely to the technological growth of the nation. This includes medicine, forestry, agriculture, biotechnology, nursing and other biology related courses. It is taught in senior secondary schools as one of the science subjects stipulated in the National Policy of Education. It is expected that when biology is exposed to senior secondary school students, they will be acquainted with: important and relevant information in biology; application of scientific knowledge to daily life activities in matters of personal and community health and agriculture; sufficient laboratory and field skills in biology; reasonable and functional scientific attitude (Federal Ministry of Education (FME), 2004). These objectives, when accurately tie together will raise attainment of knowledge, skills and desirable attitudes germane for personal and societal development. However, it appears that students are yet to fully gain from those objectives resulting in their poor achievements in biology examinations.

This is captured in the West African School Certificate Examination (WASCE) as reported by West African Examination Council (WAEC) chief examiners report (2015). Also Auwalu, Muhammad and Mohd (2014); Adewale, Ogunshola and Nzewuihe (2016); Ihekwoaba, Chinweuba-eze and Nduji (2020), asserted that students achieves poorly in biology. In a quest to unknot the causes behind this poor achievement, Dhurumraj (2015) suggested that the poor achievement of students in mathematics could be attributed to lack of resources, language of learning and teaching (LOLT), the socio-economic status of learners, parents' involvement, large classes, the developmental level of learners, and the curriculum. Also, Komba (2013) identified the following factors as causes of poor achievement of students in biology such as lack of teachers, unconducive teaching and learning environment and poor teaching and learning materials. Diaanh (2013) pointed out that the poor achievement of students may be due to poor coverage of biology textbooks, lack of interest among biology students and inadequate laboratory facilities.

The most important factor that generally influences students' achievement in science especially in biology is the teacher, teaching method and techniques used. This is because teachers can use their occupational skills to manipulate all other factors and channel them towards enhancing student's participation, interest and achievement in the subject (Cimer, 2015). Research finding showed that most biology teachers are still struggling on how to effectively utilize some teaching methods and strategies identified to be effective through research in biology education (Capa, 2012). Majority of biology teachers still adopt conventional methods of instruction such as lecture method, where the teacher does most of the talking during the teaching and learning process, instead of using the instructional methods that have been pointed out as being effective in improving student's

achievement and interest. Among the methods reported to be effective is constructivist method (Ibe, Nwosu, Obi & Nwoye, 2016).

Constructivism is the process by which students construct their own understanding by reflecting on their personal experiences, and by relating the new knowledge with what they already know. It has two major types such as cognitive and social constructivism. Cognitive constructivism focuses on mental processes rather than observable behavior. But for the purpose of this study, the main focus will be on social constructivism which refers to the process in which peers conceptualize ideas and thoughts through interaction with other peers and the teacher guides the activities of peers in a social way (Prowel & Kalina, 2009). Therefore, seeing from the above idea, peer tutoring can be said to be among the social constructivist approaches which involve peers interacting with each other and with the teacher who serves as a facilitator of learning. Thus, this study seeks to find out if peer tutoring will also be effective in improving student's achievement in biology.

Peer tutoring is an instructional strategy that consists of pairing students together to learn or practice an academic task. It can also be regarded as the process between two or more students in a group, where one of the student's acts as a tutor for the other group-mate(s). Conrad (2008) viewed peer-tutoring as an organized learning experience in which one student serves as the teacher or tutor, and one is the learner or tutee. Peer tutoring gives students an opportunity to use their knowledge in a meaningful and social experience. In this same vein, Howard, Heron, Elis and Cooke (1986) asserted that tutors reinforce their own learning by reviewing and reformulating their knowledge. Tutees gain one-on-one attention and both tutors and tutees gain self-confidence. There are mainly two types of peer tutoring, namely, incidental peer tutoring (IPT) and structured peer tutoring (SPT). Incidental peer tutoring often takes place, either at school or while students are playing after school or when they are socializing. Whenever children are cooperating, playing or studying and one guides the others, such is regarded as incidental peer tutoring. Structured peer tutoring on the other hand refers to peer tutoring implemented in specific cases and for specific subject, following a well-structured plan prepared by the teacher. Structured peer tutoring is spontaneously used by experienced teachers who are able to plan well in advance and are familiar on how to combine tutors and tutees appropriately in order to have good result. Varieties of the SPT exist, these include Cross-Age Peer Tutoring (CAPT), Peer Assisted Learning Strategies (PALS), Reciprocal Peer Tutoring (RPT), same- Age Peer Tutoring (SAPT)) and Class Wide Peer Tutoring (CWPT) (Peter, 2016). However, for the purpose of the study we would only consider RPT and CWPT.

In CWPT, the entire class is divided into pairs or small groups of two to five students with differing ability levels where the entire classroom of students is actively engaged in the process of learning and practicing basic academic skills simultaneously in a systematic and fun way. Those students with high ability level which was gotten from the pretest serves as tutors or leaders while other students' serves as tutees. This involves highly structured procedures, direct rehearsals and competitive teams. While RPT involves grouping of students into two or more students and the students alternates the roles of tutors and tutees in a group. The students work together to prompt, monitor, and evaluates each other, while working towards group goals. Though, CWPT and RPT have some research evidence in support of its potential effectiveness in improving students'

achievement in some western countries and in other subjects' areas (Kadzdan, 1999 & Fisher, 2001; Allen, 2003; Cahoon & Fuchs, 2003). Studies are yet to be conducted in Anambra state, Nigeria based on the use of CWPT and RPT on students' achievement in biology. Nevertheless, students' achievement in biology could be influenced by gender, hence the infusion of gender as a moderating variable in this study.

Gender is a set of characteristics distinguishing between males and females, partiality in the case of man and woman. Gender is a social or cultural construct, attribute and roles being given by the society and it varies from place to place or culture to culture (Okeke, 2004; Nduji & Madu, 2020). It is not like sex, which is biologically and universally determined. Various researchers in the field of science education (such as: Madu, 2004; Agomuoh, 2010; Okoyefi & Nzewi, 2013; Ihekwoaba 2020) have revealed that gender issue affects student achievement in sciences. In the same light, some studies showed that male students performed better than female students in science among the Malaysian foundation gifted students (Azman, Kamarudin & Maaulot, 2018); female students performed higher than their male counterparts in computer science (Adigun, Onihunwa, Irunokhai, Sada & Olubunmi, 2015). It is obvious that the above studies did not consider the use biology students, thus, the researchers' infusion of gender as a moderating variable so as to ascertain its influence on biology student when taught with RPT and CWPT. Also, could the use of peer tutoring therefore be effective in improving students' achievement and interest, gender notwithstanding?

Statement of the Problem

In spite of the fact that there are large students' enrolment in biology, students' achievement in the subject is poor. Student's achievement in Biology in examinations is on the decline as stated by WAEC Chief Examiner. Student's poor achievement in biology could be attributed to so many factors such as poor classroom management, lack of adequate instructional materials, lack of adequate laboratory activities, lack of interest among the students, poor teaching methods and strategies employed in teaching biology by the secondary school teachers and lack of competent biology teachers. Biology as a subject is vast and activity based; it therefore needs a powerful teaching method that can take care of learning styles and ability levels of the students. In order to overcome the problems of poor achievement by students in biology, some researchers have suggested the use of diverse instructional strategies which may be of help. Such strategies include constructivist approach and computer assisted instructions. Could peer tutoring instructional strategy of social constructivism approach therefore be effective in improving students' achievement in Biology? The problem of this study therefore is to find out if the use of peer tutoring could improve the achievement and interest of senior secondary school Biology students in Onitsha Education Zone.

The purpose of the study is to determine if student's achievement and interest in biology can be improved using peer tutoring. Specifically, the purpose of the study is to investigate the:

1. achievement scores of students in biology when exposed to RPT strategy and those exposed to CWPT strategy.
2. achievement score of male and female students in biology.

3. interaction effect of instructional strategies and gender on students' achievement.

The following research questions guided the study.

1. What are the mean achievement scores of students in biology when exposed to RPT strategy and those exposed to CWPT strategy?
2. What are the mean achievement scores of male and female students in biology?
3. What are the interaction effect of instructional strategies and gender on students' achievement?

The following null hypotheses were formulated and tested at 0.05 level of significance

1. There is no significant difference in the mean achievement scores of students in biology when exposed to RPT and those exposed to CWPT strategies.
2. There is no significant difference in the mean achievement scores of male and female students in biology.
3. There is no significant interaction effect of instructional strategies and gender on students' achievement in biology.

METHOD

The design adopted for this study is quasi experimental design, specifically the non-equivalent control group design. The population of this study comprises 6, 270 SSII students in all the secondary schools in Onitsha Education Zone of Anambra State (Post Primary Schools Commission, Onitsha, PPSCO. 2018). This consists of 3,518 female and 2,752 male students. This population comprised the whole students in the thirty-two secondary (32) schools in the zone. The choice of year two senior secondary school students was because the topics (pollution and its control, conservation of natural resources adaptation and association) used for the study falls within the scheme of work of the targeted class, and they are more stable for the study since SS3 are examination class which may not be available during the study. The sample of the study consists of 180 SSII biology students who were selected using stratified random sampling technique and simple random sampling technique. Stratified random sampling was used to draw two co-educational schools from each of the three local government Areas; namely Onitsha North, Onitsha South and Ogbaru, making it a total of 6 secondary schools. Co-educational schools were used to take care of gender variable in the study. The researcher randomly assigned 3 schools to the experimental group and the other 3 to the control group and in each school, an intact class was used. Each intact class contain 30 students making the sample size to be 180.

The instrument for data collection was Biology Achievement Test (BAT) developed by the researchers. BAT is a 30 multiple- choice objective test. Each item has four options lettered A-D. The items were scored by assigning one (1) mark to each correct item which gave a total score of (30) marks. The draft of BAT was given to three experts; two in measurement and evaluation and one in Biology option all in the department of science education university of Nigeria, Nsukka, for face validation. The reliability coefficient for BAT was determined with Kuder- Richardson formula (K-R20) method which gave the coefficient of internal consistency of 0.83.

Experimental Procedure

The study lasted for six (6) weeks. Six biology teachers or research assistants were used from the sampled schools. This was done to control Hawthorn effect (i.e. students' faking their behavior) and teachers' variable. However, the first four days were used for training the six biology teachers. The three biology teachers in the experimental schools were trained on the use of CWPT whereas the three biology teachers in the control schools were trained on the use of RPT. The researcher visited the schools for two weeks so as to monitor the research assistants progress, one week for the three experimental schools and the remaining one week for the three control schools. Teachers in the experimental schools were trained on how to group the students based on their ability levels, how to organize the sub topics and how to assign them to the tutor's using the lesson plan. After the training, the Biology Achievement Test (BAT) was administered to the students of both schools as pre-test. The pre-test was marked and scored in order to get the achievement of students. From the students' scores the researchers, with the help of the teachers selected those students that have high scores and they were used as peer tutors in the experimental schools. Thereafter, the main teaching commenced. Teaching in the experimental group was done using (CWPT) and students were first of all grouped into average of 5 students in a group with a group leader in each group who served as peer tutor. Teachers had a pre-discussion class with the peer tutors a day before the main teaching, where sub units of the new concepts were assigned to these peer tutors to read up. In each lesson, after introducing the topic, the teacher called upon the first peer tutor to take up the first sub unit of the concept and explain to the tutees. The teacher did same to the other tutors while teachers moderates the entire activities of the lesson appropriately. This continued until the concept was exhausted. In the control schools, teaching was done using RPT where students alternate between the roles of tutor and tutees. The class was grouped into 5 groups and students discussed by themselves and selects their group representative, then at each stage, the teacher calls on them one after the other to teach until the topic was exhausted. At the end of the experiment, a post-test for BAT were administered to the students. Data for pre-test and post-test were recorded separately for each of the students in the experimental schools and control schools and were used for analysis according to the demands of the research questions and hypotheses.

Mean and Standard Deviation was used to answer all the research questions while Analysis of Covariance (ANCOVA) was also used to test all the null hypotheses at 0.05 level of significance.

Results

Research Question 1: What are the mean achievement scores of students in biology when exposed to RPT strategy and those exposed to CWPT strategy?

Table 1: Mean and Standard Deviation of Pre and Post Achievement Scores of Students' Taught Biology using RPT and CWPT Strategies

Strategies	N	Pretest		Posttest		Mean Gain
		\bar{x}	SD	\bar{x}	SD	
RPT Strategy	90	32.57	9.28	51.24	5.50	18.67
CWPT Strategy	90	33.17	7.80	55.66	5.39	22.49

NB: CWPT = class wide peer tutoring strategy; RPT = reciprocal peer tutoring.

Results in Table 1 show that the group taught biology using RPT strategy had a pre-achievement mean score of 32.57 with a standard deviation of 9.28 and a post achievement mean score of 51.24 with a standard deviation of 5.50. The group taught biology using CWPT strategy had a pre-achievement mean score of 33.17 with a standard deviation of 7.80 and a post-achievement mean score of 55.66 with a standard deviation of 5.39. The group taught with CWPT strategy made a mean gain of 22.49 more than the group taught with RPT strategies that has a mean gain of 18.69. To ascertain whether the result is real or as a result of errors in the cause of research, then the result was subject to inferential testing as shown below.

Hypothesis 1: There is no significant difference in the mean achievement scores of students in biology when exposed to RPT and those exposed to CWPT strategies.

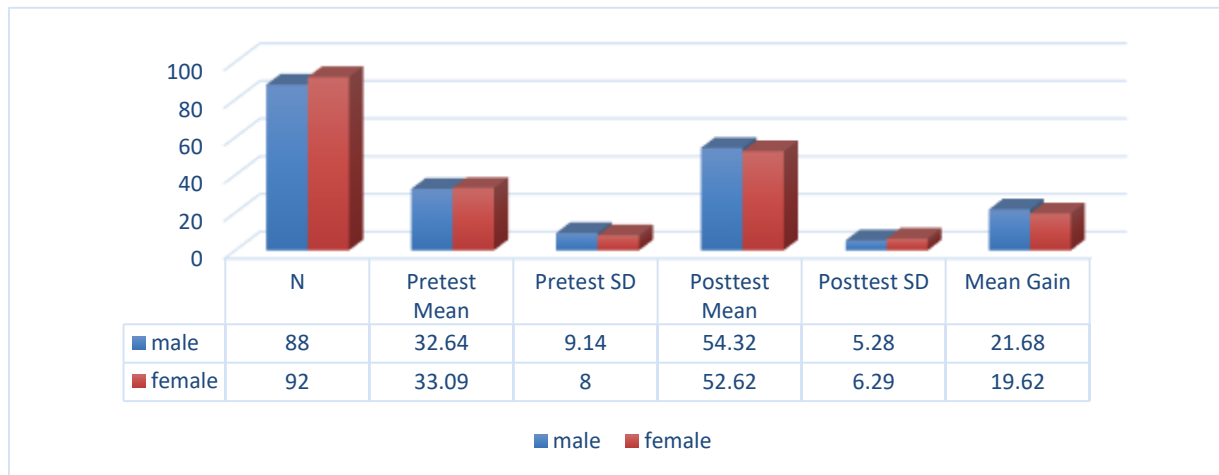
Table 2: Analysis of Covariance (ANCOVA) of the significant difference in the mean achievement of biology students taught using RPT and those taught with CWPT Strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1084.969 ^a	4	271.242	9.371	.000
Intercept	33722.582	1	33722.582	1165.010	.000
Pretest	15.602	1	15.602	.539	.464
Gender	159.495	1	159.495	5.510	.020
Strategies	922.083	1	922.083	31.855	.000
Gender * Strategies	34.196	1	34.196	1.181	.279
Error	5065.581	175	28.946		
Total	520393.000	180			
Corrected Total	6150.550	179			

The result in Table 2 shows that an F-ratio of 31.86 was obtained with associated probability value of 0.00 for the two groups. Since the associated probability value of 0.00 was less than 0.05 set as bench mark, the null hypothesis (H_{01}) which stated that there is no significant difference in the mean achievement scores of students in biology when exposed to RPT and those exposed to CWPT strategies is rejected.

Research Question 3: What are the mean achievement scores of male and female students in biology?

Figure 1: Mean and Standard Deviation of Pretest and Posttest of Male and Female Students' Achievement in Biology



Results in Figure 1 show that the male group taught Biology had a pre-achievement mean score of 32.64 with a standard deviation of 9.14 and a post-achievement mean score of 54.32 with a standard deviation of 5.28. The female group had a pre-achievement mean score of 33.09 with a standard deviation of 8.00 and a post-achievement mean score of 52.62 with a standard deviation of 6.29. Male students have mean gain of 21.63 higher than female students who have mean gain of 19.62. To ascertain whether the result is real or as a result of errors in the cause of research, then the result was subject to inferential testing as shown below

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students in Biology.

The result in **Table 2**, an F-ratio of 5.51 was obtained with associated probability value of 0.02 the male and female students. Since the associated probability value 0.02 was less than 0.05 set as bench mark, the null hypothesis which stated that there is no significant difference in the mean achievement scores of male and female students in Biology is rejected.

Research Question 3: What are the interaction effect of instructional strategies and gender on students' achievement?

Table 3: Mean and Standard Deviation of Respondents on the Interaction Effect of Instructional Strategies and Gender on Students' Achievement

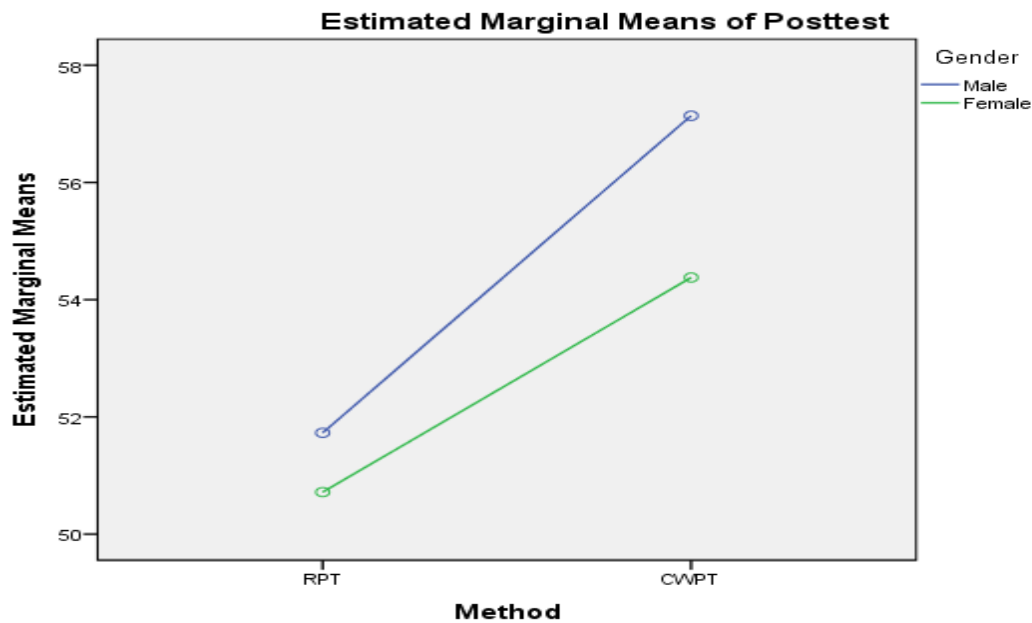
Strategies	Gender	N	Pretest		Posttest		Mean Gain
			\bar{x}	SD	\bar{x}	SD	
RPT	Male	46	31.93	10.24	51.76	3.83	19.83
	Female	44	33.23	8.23	50.70	6.83	17.47
CWPT	Male	42	33.40	7.80	57.12	5.26	23.72
	Female	48	32.96	7.87	54.38	5.22	21.42

Results in Table 3 show the interaction effect of instructional strategies and gender on students' achievement in Biology. Results show that the male students taught Biology using RPT had a pre-achievement mean score of 31.93 with a standard deviation of 10.24 and a post mean score of 51.76 with a standard deviation of 3.83; the female students taught Biology using RPT had a pre-achievement mean score of 33.23 with a standard deviation of 8.23 and a post achievement mean score of 50.70 with a standard deviation of 6.83. While the male students taught Biology using CWPT had a pre-achievement mean score of 33.40 with a standard deviation of 7.80 and a post-achievement mean score of 57.12 with a standard deviation of 5.26. The female students taught Biology using CWPT had a pre achievement mean score of 32.96 with a standard deviation of 7.87 and a post-achievement mean score of 54.38 with a standard deviation of 5.22. The difference between the pretest and posttest achievement mean score for the female student taught Biology using CWPT was 21.42.

Hypothesis 3: There is no significant interaction effect of instructional strategies and gender on students' achievement in Biology.

The result in Table 2 shows that with respect to the interaction effect of instructional strategies and gender on students' achievement in Biology, an F-ratio of 1.18 was obtained with associated probability value of 0.28. Since the associated probability value of 0.28 was greater than 0.05 set as bench mark, the null hypothesis which stated that there is no significant interaction effect of instructional strategies and gender on students' achievement in Biology is not rejected.

Figure 2 revealed that strategies and gender do not interact to affect students' achievement in Biology. This is noticed when the strategies (RPT and CWPT) lines drawn against gender (male and female) do no intercept at any point. The graph is shown below.



Covariates appearing in the model are evaluated at the following values: Pretest = 32.87

Figure 2: Graph showing the interaction effect of instructional strategies and gender on students' achievement in biology.

Summary of the Findings

From the data analysis and interpretation of the results, the following findings emerged;

1. CWPT strategy improved students' achievement in Biology more than RPT strategy.
2. There was a significant difference in the mean achievement score of students taught biology using RPT and CWPT strategies, with those taught using CWPT strategy having higher mean gain score.
3. Male students performed better than the female students.
4. There was a significant difference in the mean achievement scores of male and female students in biology with the male group having higher mean gain.
5. There was no significant interaction effect of strategies and gender on students' achievement in biology.

DISCUSSION

The result of the study shows that CWPT strategy improved students' achievement in Biology more than RPT strategy. In other words, teaching biology with CWPT strategy proved to be more effective. Further, the finding of the study showed that there was a significant difference in the mean achievement score of students taught biology when exposed to RPT and CWPT strategies with those taught using CWPT strategy having higher mean gain score. The finding of this study is in line with Greenwood, Terry and Arreaga-Mayer (1992), who discovered that students taught with CWPT made educationally important gains. The success of the students' exposed to CWPT in improving students' achievement over students exposed to RPT may have been as a result of

class wide peer tutoring, which involves highly structured procedures, direct rehearsals and competitive teams. These could explain the result of this study. Class wide peer tutoring strategy uses skills such as predicting, clarifying, questioning and summarizing, which potentially help students to understand what they read. The studies by Peter (2006), Najabat, Muhammad and Jaffar (2015), Olajide (2019) indicated an improvement on students' achievement when taught using peer tutoring. This students' improved achievement could be as a result of peer tutoring been used over conventional method as control. Similarly, this finding is in consonance with that of Irfan, U., Rabia, T. & Muhammad, K. (2018) who revealed that peer tutoring enhanced the academic achievement of students in the experimental group significantly as compared to the control group; hence, it was an effective method of instruction for teaching biology at secondary level.

Finding from the study reveals that male students performed better than the female students. Also, the finding of the study shows that there was a significant difference in the mean achievement scores of male and female students in biology with the male students having higher mean gain score. In other words, it implies that male achieved better than their female counterpart. This study is in line with Nwagbo and Okoro (2012) who discovered that the average scores of boys were consistently higher than that of girls on achievement of students in biology. Binod (2016) in an investigation discovered that there was significance difference on the level of thinking and achievement between male and female students. Binod's study is in agreement with the findings of this study. The study also corresponds with Ogundola, Agboola and Ogunmilade (2020) who found that there was significant difference in the mean achievement scores of male and female students in favor of male students. The significance difference in achievement of male students compared with the female students may be attributed to the belief some female students have that science is meant for the boys.

The findings of the study revealed that in all cases, the post achievement means scores were greater than the pre achievement means scores with the male students having a higher achievement mean gain score in both CWPT and RPT; and there was no significant interaction effect of strategies and gender on students' achievement in biology. The result of this study is consistent with Nwagbo and Okoro (2012) who found out that three interaction patterns cooperative, competitive and individualistic enhanced achievement of students in biology. This study also corresponds with the findings of Ezenwosu (2013) who found out that there was no significant interaction effect between peer tutoring and gender on students' achievement. Though the present study compared two modes of peer tutoring while the study by Ezenwosu used peer tutoring generally. The study by Nwagbo and Okoro, Ezenwosu are related to this study in that both studies showed significant interaction among the variables under study.

CONCLUSION

Based on the findings of the study, it is concluded that;

1. Although peer tutoring instructional strategy improved students learning in biology, the class wide peer tutoring proved to be significant in improving students' achievement in biology more than reciprocal peer tutoring.

2. There was a significant difference in the mean achievement scores of male and female students in Biology with the male students having higher mean gain scores.
3. There was no significant interaction effect of strategies and gender on students' achievement in Biology.

Recommendations

In the light of the findings and educational implications, the researcher makes the following recommendations:

1. CWPT strategy is effective in improving students' achievement in biology. Therefore, emphasis should be given to equipping students with the necessary skills in using the strategy.
2. Teacher preparation intuitions should incorporate class wide peer tutoring strategy in the relevant areas of their curriculum units and expose both the pre-service and in-service teachers to these techniques of teaching and learning. This would involve instructing teachers on the basic concepts of class wide peer tutoring, the designing and development, training programs and how best to train learners in the various types of learning strategies. This exposure will help to develop in the teachers the competencies necessary for helping the students to effectively use CWPT strategy.

Limitations of the Study

The generalization and conclusions of the result of this study is subject to some limitations:

1. The researcher used only six intact classes in the entire population and this may affect the generalization of this study to other areas.
2. There is need to replicate the study with a larger population and in different geographical areas.
3. Further studies should be carried out on finding out whether other modes of peer tutoring will bring about more improvement in students' achievement. Also, studies should be done in primary schools and tertiary intuitions using other modes of peer tutoring.

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