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EFFECT OF PEER TEACHING AND DISCUSSION METHODS ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY

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Abstract

The study investigated the effect of peer teaching and discussion method on secondary school students' academic achievement in Biology in Enugu North Local Government Area of Enugu State. The study employed a quasi-experimental 2 x 2 factorial research design which helped the researcher to determine the main effects of two treatments in one single experiment., specifically the Pre-test, Post-test, Non-equivalent control group design was used. Four research questions were formulated to guide the study. The population size was 1780 SS II students and the sample size of 122 (52 males and 71 females) students. The main instruments for the study was Biology Achievement Test (BAT) and the students annual result for SS I. BAT consist objectives and essay sections, the reliability of the objective items was established using Kudder-Richardson formula 20 (K-R 20) and an index of 0.85 was obtained while interrater consistency of the essay items was 0.87 using Kendell. Mean and Standard deviation was used to answer the research questions. The results indicated that there was a significant difference in the mean achievement scores of students taught biology with peer-teaching method than those taught using discussion method with those taught using peer teaching method having a higher mean gain. The high ability students outperformed their medium and low ability students. This shows that student ability levels has effects on their academic achievement in biology There was no statistically significant difference in the mean achievement scores of male and female students. There was no statistically significant interaction effect of methods and gender on students' achievement in biology. It was recommended among others that government agency whose responsibility is to design and revise the curriculum for secondary schools should incorporate the use of peer teaching method in teaching the students.

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Introduction

Biology is a branch of natural science that deals with the scientific study of living things. It is concerned with the study of man and his environments. Biology occupies a unique position in the secondary school education curriculum because of its importance as science of life. In Nigeria, the Secondary School Biology Curriculum is designed to continue students' investigation into natural phenomena, deepen students' understanding and interest in biological sciences. Comparative Education Study and Adaptation centre, CESAC (2004) maintained that biology provides an avenue for teaching students the ability to apply scientific knowledge to everyday life. Biology is an important science subject and stands as the bedrock to the learning of other science courses like Medicine, Pharmacy, Nursing, Biochemistry, Genetics and Agriculture that are of great economic importance to the nation. Besides the importance of biology as the science of life, it is one of the science subjects that attract the greatest patronage of both science-oriented and arts-based students (Nwachukwu and Nwosu, 2007). For this reason, biology has a very high enrolment of students in the external examination (West African Examination Council, 2012).

Despite the importance of biology as a school subject, available statistics from the West African Examinations Council (WAEC, 2009-2013) consistently reported that candidates achieve poorly in the examination especially in such topics like cell and its environment, cell divisions, ecology among others.

Teaching biology in Nigerian secondary school is very vital. More so is the teacher effectiveness in determining whether the students learn in the biology classroom (Onyegegbu 2018). Teaching involves more than transmitting facts and information that form the basis for further learning. Learning also involves more than the ability to recall information. It is more important than ever that biology teachers help students know how to learn. The new era in education, is concerned with developing higher order thinking skills. Skills that prepare students for the 21st century careers involve more than memorization. Critical thinking, inquiry method, collaboration and problem solving are key to learning. The way to help biology students in Nigerian secondary schools to gain these skills is by creating the lesson and laying more emphases on the process of incorporating active learning opportunities for students in the classroom.

Research studies in Nigeria, have long shown that too many biology classroom teachings in the secondary schools reinforce learning as a spectator sport and are characterized by low-level lecture methods and assignments, rather than diverse instructional strategies that actively engage students in deeper learning. According to Onyegegbu (2008), engaging and exciting students in biology is the key to learning. When students participate and get involved, they are excited and are fully interested to pursue knowledge, prepare for life after secondary school and career ready. Instructional strategies are becoming increasingly diverse as teachers should learn to tap into students' interest, retention and ability to help them absorb their biology achievement and improve their chances in higher institutions and career pursuit. In world of fast technology development, it becomes absolutely necessary that secondary school biology teachers in Nigeria engage their students in displaying creativity, problem solving and skills to learn the biology content essential to succeed in life. According to Ezenwosu, and Loretta (2013) the conventional teaching approach usually involve teacher starting the lesson by introducing the topic or concept, explaining it and then give some works examples. Lastly, the teacher gives home work to the students. In this kind of learning situation, students are not able to construct their own understanding since they are not actively participating in the teaching and learning process. Students are not able to think creatively, innovatively and critically since they perceivably received what have been

taught without active participation. One major way of achieving all these and to having a lively biology classroom is to incorporate Active Learning opportunities for the students through peer teaching and discussion learning approaches.

Discussion methods are a variety of forums for open-ended, collaborative exchange of ideas among a teacher and students or among students for the purpose of furthering students thinking, learning, problem solving, understanding, or literary appreciation. Participants present multiple points of view, respond to the ideas of others, and reflect on their own ideas in an effort to build their knowledge, understanding, or interpretation of the matter at hand. Discussions may occur among members of a small group or whole class and be teacher-led or student-led. A defining feature of discussion is that students have considerable agency in the construction of knowledge, understanding, or interpretation. In other words, they have considerable "interpretive authority" for evaluating the plausibility or validity of participant's responses.

To further buttress(support or strengthen) on the above statement, Ezengwu (2013) stated that majority of teachers in the field still employ conventional methods in the classroom teaching, these methods though not without some advantages are found to be didactic, stereotype, ineffective and non-result oriented. The Biological Sciences Advisory Committee (BIO AC) (2013) argued that to continue to progress in biology achievement, we must improve the quality of biology teaching discussion methods received by all secondary students. Although there are factors that affect a student's biology learning, such factors are unqualified biology teacher (Inappropriate training background of science teachers especially biology teachers and qualification of biology teachers are the major factor that militate against effective teaching of biology because some biology teachers in some senior secondary school did not undergo enough training to enable them get skills, qualities and enough knowledge of the subject matter and how to impact the knowledge to the students.) and poor method of teaching biology in senior secondary school (For teaching to be effectives one must use different methods of teaching. Teaching is effective if only it produces or yields the desired results, the ability of the teacher to adapt to different situations and produce a desired result in the classroom are a mark of teaching effectiveness.)

Peer teaching is not a new idea, it is possibly as old as any form of collaborative or community action and has probably always taken place implicitly or vicariously (Topping 2013). But in a changing Higher Education landscape, more formalised and even assessed forms of peer teaching are becoming ever more popular. Indeed Peer teaching schemes appear to becoming strategized; developing to meet calls for accountability, better assessment, and improved outcomes for students.

Peer teaching is a very old practice traceable back at least as far as the ancient Greeks. Archaic Definitions of peer teaching perceived the peer teacher as a surrogate teacher in a linear model of the transmission of knowledge from teacher to tutor (students who teach) to tutee (students who received the teaching from the tutor). Later it was realised that the peer teaching interaction was qualitatively different from that between a teacher and a student, and involved different advantage and disadvantages.

Peer teaching is an instructional strategy that consists of pairing students together to learn or practice an academic task. The pairs of students can be of the same or differing ability and/or age range. Peer teaching encompasses a variety of instructional approaches including Cross-Age Teaching, Peer-Assisted Learning Strategies (PALS), and Reciprocal Peer Teaching (RPT). Variations exist among instructional approaches. However, the underlying theory is consistent: peer interaction can have a powerful influence on academic motivation and achievement. The research base also suggests that socialization experiences that occur during peer teaching can benefit both the tutor and tutee by motivating students to learn and increasing their social

standing among peers. When students understand the benefits of peer teaching and have the tools to become effective tutors and tutees, they make greater progress than those who are not given any instruction on how to work together (Fuchs, Fuchs, Hamlett, Phillips, Karns, & Dutka, 2013).

Peer teaching consists of students' partnership, linking high achieving students with lower achieving students or those with comparable achievement for structure reading and biology study seasons. Peer teaching refer to situation where one child provides instructional assistance and guidance to another child

Furthermore, Nathern and Liz (2012) as cited in Ezenwosu, and Loretta (2013) noted that peer teaching gives teachers the capability to accommodate a classroom with diverse learners to improve academic achievement across ability levels and content areas. Peers play a special role in children's development. Although children's relationship with their parents is more intense and enduring than relations with peers, interactions among age-mates are more free and egalitarian. The greater fluidity of peer relationships offers children the opportunity for a new kind of interpersonal experimentation and exploration.

Schools across the country are adopting and using student centered instruction rather than the discussion teaching method of instruction. This method of teaching has increased student achievement in all subjects of the elementary classroom, as well as the use of biology in everyday life.

According to research on same-age and cross-age peer teaching, significant gains were made in learners of all backgrounds (Cairo & Craig, 2011). Nebo (2012) stated that the discussion method of teaching has failed to recognize the uniqueness of the inquiry base nature of Biology and the learner's individuality thus failed to encourage creative thinking in the learner leading to poor achievement of students. Based on this, educators and scholars are challenged to seek for an intervention or innovative methods that would enhance academic achievement of students in Biology, the best method combine is the peer teaching and discussion method.

According to Benjamin (2010) the benefits of peer teaching is that a struggling student can benefit greatly from having to prepare and teach the topic that they are studying to a tutee from the same age group as them. The formal lines that exist between a teacher and a student aren't as defined with someone who is the same age as the person learning, and are therefore easier to cross and find common ground with that said student.

Therefore, students need to be able to master problem-solving skills. One way to achieve this goal is through peer assisted learning (also known as peer teaching), which, according to Calhoon (2013), is defined as students working together to teach one another. According to Summers (2013), this style of learning is correlated to social constructivism because students use their own knowledge to assist each other with assignments and class assessments.

Statement of the Problem

The yearning for quality and effective instruction delivery has been a long standing objective of science education. The emerging concern for the poor achievement of students in school science and its resultant consequence on the production and development of future scientist, engineers and technologies had led to the search for instructional strategies that promote effective and improved science learning. Consequently, science instruction has become a focus of research for two or more decades. Science knowledge is vast; its scope in each discipline is on the increase, science educators have come to realize that trying to teach science as a list of facts to be memorized rather than understood is a futile exercise. It was observed that there is a dearth of empirical focusing on instructional strategies that can enhance teaching and learning of concepts in science. To overcome the problem of underachievement of students in biology, researchers have advocated the use of innovative teaching methods as opposed to traditional methods of teaching biology, hence, the need to search for more effective instructional strategies that are likely to improve students' academic achievement in

secondary school biology. this study therefore seeks to find out the effect of peer teaching and discussion method on senior secondary school students' achievement in biology in Enugu North Local Government Area of Enugu State.

Purpose of the Study

The general objective of this research was to investigate the effect of peer teaching and discussion methods on Senior Secondary School Students' Academic achievement in Biology in Enugu North Local Government Area of Enugu State. Specifically, the study sought to determine:

1. Effects of peer-teaching and discussion method on students' mean achievement scores in Biology?
2. Effects of peer-teaching and discussion method on academic achievement of students' in Biology across ability levels.
3. Influence of gender on students mean achievement scores in Biology when taught using peer teaching and discussion method.
4. Interaction effect of gender and teaching method on the mean achievement scores of students in biology.

Research Questions

The study was guided by the following research questions:

1. What are the effects of peer-teaching and discussion method on students mean achievement scores of students in Biology?
2. What are the mean achievement scores of students taught Biology using peer teaching and those taught using discussion method across ability levels?
3. What is the mean achievement scores of male and female students taught Biology using peer teaching and those taught using discussion method.
4. What is the interaction effect of gender and teaching methods on students' academic achievement in biology?

Method

The design for this study was a quasi-experimental 2 x 2 factorial research design. The design was represented after Fraenkel and Wallen (2003) who noted that a quasi-experimental factorial design is a quasi-experimental design modified to permit the investigation of additional independent variables. Consequently, the design is 2 x 2 pretest-posttest non-equivalent control group design. A pre-test, post-test, non-equivalent control group design entails the use of non-randomized group where the researcher cannot randomly sample and assign subject because intact class were used to administer the treatment.

The population of the study was all the SSII students in 6 secondary schools in Enugu North Local Government Area of Enugu State. The population of the study consists 1780 senior secondary (SS II) biology students in the state owned public senior secondary schools in the area.(Statistics and records unit of PPSMB Enugu state, 2021/2022 academic year) A simply random sampling technique was used to select four secondary schools out of Six (6) senior secondary schools in Enugu North Local Government Area of Enugu State. The criteria for choosing the four schools were that each school must have two biology teachers teaching SS2 and must be single sex schools to avoid exchange of ideas or interaction between male and female students within a school, thereby affecting gender. Purpose sampling technique was therefore used to draw four single sex schools (2 male and 2 female schools). A total of 122 senior secondary 2 biology students consisting of 52 males and 71 females constitute the sample.

The intact classes from the schools were used for the experimental/treatment. The instrument used for the study was Biology Achievement test (BAT) and the students annual biology achievement test for SS I which was

obtained from the school principal was used to classify the students into low, medium and higher ability levels. BAT was developed by the researcher based on the biology topic taught. Validation was done by subjecting the instrument to both content and face validation. In the content validity, the researcher carefully prepared a test blue- print or table of specification where both the cognitive levels as well as the subject content were aligned on a two grid table. In the second stage of ensuring that the instrument was valid, the researcher consulted three experts, two from the Department of Science Education from the University of Nigeria, Nsukka and one from Measurement and Evaluation department of the same university. Two experienced Biology teachers from schools in the Enugu North Local Government Area were given the BAT for both face and content validation as well. A marking Scheme was prepared by the researcher and was equally validated by the experts. Their corrections and suggestions were strictly followed. The reliability of the instrument was ensured by carrying out a pilot study of the validated instrument in two schools (National Grammar School Nike and Trans- Ekulu Girls' Secondary School Enugu.) different from those used for the study. The reliability of the objective items was established at 0.85 using Kuder-Richardson (K-R 20) and the inter-rater consistency of the easy items was 0.87 (using Kendell).

Method of Data Collection

The first week, the researcher visits the sampled schools for introduction and the purpose of the study to take permission to use the schools, sampled the classes and the students to be involved in the study. Pre-test was then administered to all the students involved, both the control and experimental group by their regular biology teacher's; this is to avoid "Hawthorne effect" teaching started immediately after the pre-test in each of the classes. Two of the trained research assistants taught the experimental groups using peer teaching method, while the other two taught the control group using discussion method of teaching. The researcher monitored the teaching at all stages. Teaching lasted for four weeks at the end of which post test was administered to all the groups. The BAT was administered, as the post-test. Strict examination conditions were observed during post-testing. The research assistants marked and scored the scripts using the marking guide. The scores were collected and organized for data analysis.

Method of Data Analysis

The statistics used for data analysis was mean score and standard deviation scores to answer the research questions

Presentation and Analysis of Data

Research question 1: What are the mean achievement scores of students taught biology using peer teaching method and those taught using discussion method?

Table 1

Mean and Standard deviation of pretest posttest scores of students taught biology using peer teaching method and those taught using discussion method?

Variable	**Pre-test**			**Post-test**		
Methods of Teaching	N	X	SD	**X**	**SD**	**Mean gain**
Peer teaching method (E_1)	**69**	**9.16**	**4.29**	**17.80**	**7.05**	**8.64**
Discussion Method (E2)	**53**	**8.66**	**2.06**	**15.04**	**2.53**	**6.38**

Results in Table 1 show that the group taught biology using peer teaching method had a pretest mean of 9.16 with a standard deviation of 4.29 and a posttest mean of 17.80 with a standard deviation of 7.05. The difference between the pretest and posttest mean was 8.64. the group taught biology using discussion method had a pretest

mean of 8.66 with a standard deviation of 2.06 and a posttest mean of 15.04 with a standard deviation of 2.53. The difference between the pretest and posttest mean of 6.38. However, for each of the groups, the posttest mean were greater than the pretest means with the group taught using peer teaching method having a higher mean gain. This is an indication that peer teaching methods have more effect on students' achievement in biology than the discussion method.

Research Question 2: What are the mean achievement scores of students taught biology using peer teaching method and those taught using discussion method across ability levels?

Table 2

Mean and Standard deviation of pretest and posttest scores of students taught biology using peer teaching method and those taught using discussion method across ability levels?

Variable			**Pretest**		**posttest**		
Methods of teaching	**Ability Level**	**N**	**($\bar{X}$)**	**SD**	**(X)**	**SD**	**Mean gain**
Peer teaching	High Ability	23	13.13	4.18	25.13	4.39	12.00
	Average Ability	27	7.85	2.86	15.96	5.16	8.11
	Low Ability	19	6.21	2.12	11.53	3.22	5.32
Discussion	High Ability	13	9.08	1.61	17.15	2.79	8.07
	Average Ability	23	9.35	1.92	14.65	2.01	5.30
	Low Ability	17	7.41	2.06	13.94	2.07	6.53

Results in Table 2 shows the effect of students' ability level on their achievement. Result shows that the high ability students under peer teaching method had a pre-test mean of 13.13 with a standard deviation of 4.18 and a post-test mean of 25.13 with a standard deviation of 4.39. the difference between the pre-test and post-test means was 12.00. the medium ability students under peer teaching method had a pre-test mean of 7.85 with a standard deviation of 2.86 and a post-test mean of 15.96 with a standard deviation of 5.16. The difference between the pre-test and post-test means was 8.11. The low ability students under peer teaching method had a pre-test mean of 6.21 with a standard deviation of 2.12 and a post-test mean of 11.53 with a standard deviation of 3.22. The difference between the pre-test and post-test means for the low ability students was 5.32. Results also shows that the high ability students under discussion method had a pre-test mean of 9.08 with a standard deviation of 1.61 and a post-test mean of 17.15 with the standard deviation of 2.79. The difference between the pre-test and post-test means was 8.07. The medium ability students under discussion method had a pre-test mean of 9.35 with a standard deviation of 1.92 and a post-test mean of 14.65 with a standard deviation of 2.01. The difference between the pre-test and post-test mean was 5.30. The low ability students under discussion method had a pre-test mean of 7.41 with a standard deviation of 2.06 and a post-test mean of 13.94 with a standard deviation of 2.07. The difference between the pre-test and post-test means was 6.53. However, for each of the groups, the post-test means were greater than the pre-test means with the high ability students having a higher mean gain followed by the average ability students and lastly the low ability students. This is an indication that students' ability levels have effects on their achievement in biology.

Research Question 3: What are the mean achievement scores male and female students taught biology using peer teaching method?

Table 3

Mean and Standard deviation of pretest and posttest scores of male and female students taught biology using peer teaching method

Variable		Pretest		Posttest		
Gender	N	X	SD	X	SD	Mean gain
Male	51	8.06	3.98	15.29	5.06	7.23
Female	71	9.58	2.97	17.54	5.99	7.90

Results in Table 3 shows the influence of gender on students' academic achievement in biology when taught using peer teaching method. Result shows that the male students had a pre-test mean of 8.06 with a standard deviation of 3.98 and a post-test mean of 15.29 with a standard deviation of 5.06. The difference between the pre-test mean for the male students was 7.23. The female students had a pre-test mean of 9.58 with a standard deviation of 2.97 and a post-test mean of 17.54 with a standard deviation of 5.99. The difference between the pre-test and post-test mean was 7.96. However, for each of the groups (male and female), the post-test means were greater than the pre-test means with the female students having a higher mean gain. This is an indication that gender may have some effects on students' academic achievement in biology.

Research Question 4: What is the interaction effect of methods and gender on students' academic achievement in biology?

Table 4

Mean and Standard deviation of pretest and posttest scores of the interaction effect of methods and gender on students' academic achievement in biology.

Variable			Pretest		Posttest		
Teaching Methods	Gender	N	X	SD	X	SD	Mean gain
Peer Teaching	Male	30	8.30	4.87	16.13	6.02	7.83
	Female	39	9.82	3.72	19.08	7.57	9.26
Discussion Method	Male	21	7.71	2.22	14.10	2.99	6.39
	Female	32	9.28	1.71	15.66	1.99	6.38

Results in Table 4 shows the interaction effect of methods and gender on students' academic achievement in biology. Result showed that the male students taught biology using peer teaching method had a pretest mean of 8.30 with a standard deviation of 4.87 and a posttest mean of 16.13 with a standard deviation of 6.02. The difference between the pretest and posttest mean for the male group peer teaching method was 7.83. The female students taught biology using peer teaching method had a pretest mean of 9.82 with a standard deviation of 3.72 and a posttest mean of 19.08 with a standard deviation of 3.57. The difference between the pretest and posttest means for female group was 9.26. Result in table 4 also shows that the male students taught biology using discussion method had a pretest mean of 7.71 with a standard deviation of 2.22 and a posttest mean of 14.10 with a standard deviation of 2.99. The difference between the pretest and posttest means for the male group was 6.39. The female students taught biology using discussion method had a pretest mean of 9.28 with a standard deviation of 1.71 and a posttest mean of 15.66 with a standard deviation of 1.99. The difference between the pretest and posttest mean for female group was 6.38. However, for each of the groups, the posttest means were greater than the pretest means. This is an indication that the interaction between method and gender appears not to have some effects on students' academic achievement in biology. This is because the achievement of male

and female students appears to be the same.

Discussion

Findings in Table I revealed that there was significant difference in the mean achievement scores of students taught biology using peer teaching method and those taught using discussion method with those taught using peer teaching having a higher mean gain. This shows that peer teaching method has more effect on students' academic achievement in biology than the discussion method. This result upholds the findings of Ra'ed Abdelkarim & Reem Abuiyada (2010) that peer teaching strategy is an active tool to increase the mathematical achievement of the undergraduate students in Oman.

The data presented in table 2 showed that there was a significant difference in the mean achievement scores of students taught biology using peer teaching method and those taught using discussion method across ability levels with the high ability level students having a higher mean gain. This shows that students' ability level has effects on their academic achievement in biology. This is in agreement with Ezenwosu & Loretta (2013) who conducted a study on the efficacy of peer tutoring and gender on students' achievement in biology, they found out that student exposed to peer tutoring performed better than those with lecture method.

Finding in Table 3 showed that there was no statistically significant difference in the mean achievement scores of male and female students. This means that gender was not a significant factor in determining students' achievement in biology. This finding is in disagreement with Njoku & Ezinwa (2014) who carried out a study on the comparative effects of peer teaching and lecture method on students' achievement and interest in some difficult concepts in chemistry which showed that there was statistically significant difference in the mean achievement scores of male and female students in chemistry in favour of the males.

Finally result in Table 4 showed that there was no statistically significant difference in the mean scores of gender and method used for teaching. This means that there was no statistically significant interaction effect of methods and gender on students' achievement in biology.

Conclusion

From the results obtained, the research concluded that peer teaching instructional method is one of the effective methods of teaching, and that tutees/students respond better to their peers than to their teachers and tend to obtain companionship from the students that tutor them. Tutees also receive more teaching, and individualized instruction than in classroom setting. Therefore if peer teaching is effectively utilized, it will produce great positive impact on participants. It makes for better understanding of the topics; helps tackle difficult problems and topical issues as well as encourage reading habit and optimal use of time by students. Efforts need to be channelled to enhance its efficiency and effectiveness in our secondary schools. Therefore, it could be concluded that peer teaching and discussion teaching methods are good instructional methods for teaching biology.

Recommendations

The following recommendations based on the findings were made:

i. Teachers occasionally should give students topics to go and make inquiry about, so that before the teacher teaches a new concept, students will be able to explain in their own terms what they know about the new concepts. That is, students' explanation will be regarded as hypothesis to be discussed and tested. If the teacher can create an atmosphere in the classroom of a kind in which the students can express themselves without bordering about making mistakes, their hypotheses can be used to illustrate their concepts.

ii. Government agencies whose responsibility is to design and revise the curriculum for secondary schools should incorporate the use of peer tutoring and discussion method in teaching

iii. The tutor and tutee's relationship is on-going, developmental and reciprocal; it also motivates individuals who want to learn and grow cognitively. To realize the program benefits of peer tutoring, tutors require strong interpersonal skills, including: relationship building, communication and team-building; tutees should practice their skill in giving corrective feedback to tutors.

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