Efficacy of Peer Tutoring and Gender on Students' Achievement in Biology

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Abstract— The study was designed to investigate the efficacy of peer tutoring and gender on students' achievement in biology in Aguata Education zone of Anambra state, Nigeria. Two research questions and three hypotheses guided the study. The study adopted Quasi-experimental design. Specifically the design is a pretest-posttest non equivalent control group design. The instrument used is Biology Achievement test (BAT). The population of the study comprised 1731 SS11 students. The sample size for this study was 228 SS11 students from two co-educational secondary schools in the zone. Mean and standard deviation was used to analyze the research questions while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The results among others showed that students taught biology using peer tutoring performed significantly higher in BAT than those taught biology using the conventional lecture method. The result further revealed that male students slightly performed better than female students. Based on these, the researchers made some recommendations.

Index Terms—academic achievement, biology, gender, instructional strategy, lecture method, peer tutoring, self-regulated learning

1 INTRODUCTION

Prior to the introduction of the formal system of education in Nigeria by the colonial masters, there were methods of teaching or imparting knowledge, skills and attitudes in the traditional society. These methods were not highly popularized until the introduction of formal system of education in Nigeria in 1843 (Jekayinfa and Kolawole, 2008). The advent of education gave rise to school classrooms where students grapple with the realities of the complex teaching-learning situation.

Teaching is regarded as the art of imparting knowledge, skills and attitudes in a person in order to bring about a desired change in behaviour that is relatively permanent. According to Smith, (2011), teaching can be seen as the process of carrying out those activities that experience has shown to be effective in getting students to learn.

From his own perspective, Olinya (2007) described teaching as an articulated attempt by the teacher to help students acquire skills, attitude, knowledge, idea to better their worth in life. This means that the teachers' task is to create or influence desirable positive changes in behaviour and academic achievement of the students. In other worlds, one teaches when the life of the learner has been academically affected.

In view of this, the success of any teaching effort is measured by the degree to which the teacher is able to achieve the desired objectives. To achieve these objectives of teaching, the teacher must know the types of learning outcomes expected from the learners and the best methods to employ that will bring about such changes in students' behaviour and academic achievements. Thus, teaching is the only gateway through which the aims and objectives of science education can be achieved using different instructional methods consistent with the nature of science.

In Nigeria, the education system is guided by the National Policy on Education which provides for formal as well as non-formal modes of delivery (NERDC, 2004). One of the guiding principles of education in Nigeria is to equip every citizen with such knowledge, skills, attitudes and values that

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will enable him derive maximum benefits from the membership of his society, to live a fulfilling life and contribute towards the development and welfare of the community (NERDC, 2004). In tandem with the above principles, the policy stipulated the following goals of science education:

- *Cultivate inquiring, knowing and rational mind for the conduct of good life and democracy;*
- *produce scientists for national development;*
- *service studies in technology and the cause of technological development;*
- *provide knowledge and understanding of the complexity of the physical world, the forms and conduct of life.*

To achieve these goals, science teachers need to adopt certain techniques and teaching approaches in science and science-related courses. Such approaches include: Lecture method, demonstration, peer tutoring, laboratory method, concept mapping, cooperative learning, use of analogy, field trip, problem solving approach, project and discussion etc. All these are in attempt to enhance students' academic achievement in science education.

Over the years, most teachers adopted conventional method popularly called lecture method which is an oral presentation of ideas, concepts and principles to the students. Usually in teaching with lecture method, the teacher stands in the front of the classroom and dictates information relevant to the course content. Ezeani (2001) remarked that, the students only listen and take down notes and are not encouraged to ask questions. Similarly, Nworgu (2009) considered lecture method "as a one way flow of communication from teacher to the students .It is teach – centered or teacher –dominated approach because most of the talking is carried out by the teacher while the students remain as passive listeners often taking down notes. Considering the above scenario, lecture method is concerned with how much ground is covered by the teacher before an examination, and this makes it seemingly attractive to the teacher considering the examination oriented nature of our education system. Therefore, most science classrooms today are characterized by lecture method due to the fact that it leads generally to adequate coverage of the syllabus. In other words, teachers' decision to use lecture method is not predicated on its effectiveness in enhancing academic achievement or consideration for the gender of the students the lesson is meant for.

Gender in this context can be referred to as the categorization of people into two namely, "male and "female" through interaction with caretakers, socialization in childhood, peers pressure in adolescence, and gendered work and family roles of which women and men are socially constructed to be different in behaviour, attitudes, and emotions (Borgatta and Montgomery 2000). Gender from the above, is the societal meaning assigned to male and female with a particular role that each should play. This is verifiable because, there is a general belief among Nigerians that males are superior to females in terms of physical physique, cognition, logical reasoning and even in academic achievement (Anigbogu, 2002). In Nigeria, also, it is believed that physics, mathematics are male dominated subjects (Anigbogu, 2002). On the contrary, Ozofor, (2001) found that females achieve better than males in mathematics. Other researchers Idoko (2002) and Nworgu (2003) reported no gender differentiation in some of the biology courses. Consequently, gender differentiations that exist in some science related subjects, which lead to variation in academic achievement of male and female students remain an issue of concern to researchers. Nevertheless, there are probably hundreds of factors that may affect academic achievement of students independent of gender. Such factors may include social, economic, medical/health, familial, relationships between teachers and students, and school expectation.

Hence, academic achievement can be described as something students achieve at school, college or university, in class, in a laboratory, library or fieldwork. It is commonly measured using examination or continuous assessment but there is no general agreement on how best it can be measured since teachers employ different teaching methods. However, despite the various methods of science teaching employed in teaching science courses and biology in particular, both in secondary

schools and tertiary institution, students achievement and interest in biology continue to deteriorate yearly (Adegbule,1990: Maria, 2001; Mbajiorgu, 2002). Consequently, this gap pose a threat to the number of students that gain admission into Nigeria universities to run programmes in the field of biotechnology, molecular biology, pharmacy, medicine and genetic engineering (Ogbonna, 2009). In a quest to unravel the reasons behind these poor academic achievements, Adeyegbe (1993) observed that Nigeria students especially in biology demonstrate poor mastering and retention of scientific concepts which affect their academic achievement.

Ezeugwu (2009), in his own study identified the following factors as being responsible for poor academic achievement namely teachers' qualification, time allotted to biology in the timetable, teaching method, inadequate laboratory facilities. Furthermore, WAEC Chief Examiners' Report (2011) has attributed the poor academic achievement of students in the West African Senior School Certificate Examination (WASSCE) and other external examinations in the country to shallow knowledge of the subject matter, disregard for rubrics and incorrect interpretation of questions. The report also identified other causes of mass failure to include, poor command of the English Language, lack of Mathematics and manipulative skills, poor knowledge of examination techniques, illegible handwriting, spelling errors, among others. Therefore, to enhance students' academic achievement in future examinations, the study recommended that governments and private owners of schools should employ qualified hands to teach various science subjects. In line with this, it is only a qualified teacher with effective teaching method that can remedy students' poor academic achievement in biology and other science subjects. However, in an attempt to encourage learning in science and biology in particular, the problem of mastery of subject matter, skills and interest in scientific concepts could be addressed through the use of students' interactive teaching method facilitated by the teacher.

One of such interactive methods that may enhance students' interest in science learning is peer tutoring. Peer tutoring is an instructional strategy that encourages students' partnership, linking high achieving students with lower achieving ones for structured reading, discussion and information exchange among students during science lesson (Rohrbeck, Ginsburg block, Fontuzzo and Miller ;2003). Furthermore, the study noted that peer tutoring is a 'systematic peer mediated teaching strategy". Using this method, the science teacher after presenting a topic to a group of learners by direct interaction, permits the brighter students to interact with their less bright counterparts.

According to Golding, Lisa and Tennant, (2006) peer tutoring is a process by which pupils, with guidance from their teacher, helps by teaching one or more peers to learn skills or concepts. This means that this approach focuses on peers to solve problem, and it can be effective in fostering creativity, experimentation, problem-solving skills and learning of deep concepts.

Furthermore, Nathern and Liz (2007) noted that peer tutoring gives teachers the capability to accommodate a classroom with diverse learners to improve academic achievement across ability levels and content areas. Similarly, Miller and Miller (1995) posit that peer tutoring is an economically and educationally effective intervention for slow learners and high achievers that can benefit both the tutor and tutee, socially and educationally by motivating them to learn. It means that when peer tutoring is carefully guided by a teacher, the interaction among individuals and groups in the classroom will deepen the understanding of scientific concepts among the students. It is on this premise that the researchers decided to explore the efficacy of peer tutoring when incorporated into the teaching and learning of biology in secondary schools, may help to improve students' academic achievement.

1.1 Purpose of the study

The main purpose of this study was to empirically investigate the effect of peer tutoring and gender on student's academic achievement in biology. Specifically, the study sought to examine

1. The academic achievements of students taught biolo-

gy using peer tutoring and conventional/traditional lecture method.

2 Determine the academic achievement of male and female students.

3. Determine the interaction effect between method and gender on students' academic achievement in biology.

1.2 Research Questions

This study was guided by the following research questions:

1. What is the effect of using peer tutoring approach relative to the conventional lecture method of instruction on students' academic achievement in biology?
2. What is the influence of gender on the academic achievement of students in biology?

1.3 Hypotheses

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

$H0_1$ There would be no significant difference between the mean achievement score of students taught biology using peer tutoring and their counterpart using conventional lecture methods.

$H0_2$ There would be no significant difference between the mean achievement score of male and female students in biology.

$H0_3$ There is no significant interaction effect between peer tutoring and gender on students mean achievement score in biology

2 METHODOLOGY

2.1 Design of the study

The design adopted for this study is the non-equivalent control group design. This design was used because the experiment took place in normal school setting where randomization or assignment of subjects to experimental and control groups is not possible (Nworgu, 2006).

2.2 Population of the study

The population of this study comprised 1731 year two senior secondary students in Aguata education Zone of Anambra state (PPSSCA, 2012). This population size comprised 1008 female and 723 male students from the whole students in the forty-seven (47) public secondary schools in the zone, excluding private secondary schools in order to work with schools with same characteristic in terms of space, laboratory equipments and teachers' qualification so as to reduce disparities between the control and experimental groups. Out of the forty seven secondary schools, 39 are co-educational, 3 are all-male and 5 are all-female secondary schools.

2.3 Sample and sampling technique

The sample used for this study comprised 228 students in senior secondary (SS11) from two co-educational secondary schools in Aguata Education Zone. Purposive sampling technique was employed to sample two co-educational secondary schools. From each school chosen, all the streams or arms in SS11 were used. The selection of the schools was based on the following criteria:

- Schools that have biology teachers.
- Schools with biology laboratory.
- Teachers with not less than four years teaching experience.
- Teachers with B.Sc(Ed) teaching qualification in biology.

The rational for purposively sampling of the two schools with these criteria was to ensure that, both schools were identical in terms of their characteristics and free of any variation in structure and methods of teaching.

2.4 Instrument for Data Collection

The instrument for collecting data for the study was the Biology Achievement Test (BAT). The BAT is a 50- item four option multiple choice test which was developed by the researchers from the three (3) content areas in the SS11 senior secondary school science curriculum namely (1) Digestive Sys-

tem (2) Excretory Mechanism and (3) Respiratory System.

2.5 Experimental Procedure

Prior to the commencement of the experimental intervention, pre-test was administered to the various groups. Lesson plans covering the topics was prepared and face validated by specialists based on each method.

The actual experiment lasted for four weeks. The experiment was carried out during the normal biology periods which are four periods per week. During the 1st 2nd weeks, the students in each group were taught digestive system and mechanism for six (6) periods. The biology teachers who were involved in the teaching administered the post-test that is Biology Achievement Test to students in the same groups at the end of the experimental session.

2.6 Method of Data Analysis

The data were analysed using mean, standard deviation and Analysis of Covariance (ANCOVA). ANCOVA was used to statistically control effects of initial group differences between the intact groups since randomization was not possible.

3 Results

TABLE 1
MEAN ACHIEVEMENT & STANDARD DEVIATION SCORES FOR EXPERIMENTAL AND CONTROL GROUPS

		Pretest		Posttest	
Treatment	N	Mean	SD	Mean	SD
Experimental	110	35.13	9.12	61.65	9.31
Control	118	34.12	8.01	52.78	9.81
Total	228	34.61	8.56	57.06	1.05

Table 1 shows that the mean achievement scores of students taught biology using peer tutoring (Experimental group) was 35.13% (SD=9.12) in the pretest and 61.65 in the post test was 61.65% (SD=9.31). On the other hand, the students taught biology using conventional lecture method (Control group) had mean achievement score of 34.12% (SD=8.01) in the pretest and 52.78% (SD=9.81) in their post test. This by implication showed that the mean achievement score of students taught biology using peer tutoring approach was higher than those taught biology using the conventional lecture method.

TABLE 2
MEAN ACHIEVEMENT SCORES OF STUDENTS' IN BIOLOGY BY GENDER

			Pretest	
	Gender	No of Students	Mean	SD
Experimental	Male	41	35.95	1.02
	Female	69	34.64	8.45
Control	Male	46	35.00	7.80
	Female	72	33.56	8.16
Total		228	34.61	8.56

Table 2 shows the mean achievement scores of male students in the Experimental group in the pretest and post test were 35.95% (SD=1.02) and 61.76% (SD=9.90) respectively whereas those of the female students were 34.64% (SD=8.45) and 61.59% (SD=9.02) respectively.

For the control group, the mean achievement scores of male students in the pre-test and post-test were 35.00% (SD=7.80) and 52.61% (SD=11.01) respectively whereas those of the female were 33.56% (SD=8.16) and 52.89% (SD=9.70) respectively. The female students in the control group performed slightly higher than their male counterpart.

TABLE 3
ANALYSIS OF COVARIANCE FOR THE EFFECT OF TEACHING METHOD ON STUDENTS' ACHIEVEMENT IN BIOLOGY

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	6566.237	4	1641.559	19.642	.000
Intercept	25766.759	1	25766.759	308.312	.000
Pretest	2079.363	1	2079.363	24.881	.000
Treatment	3925.154	1	3925.154	46.966	.000
	16.080	1	16.080	.192	.661
Treatment *Gender	3.204	1	3.204	.038	.845
Error	18636.904	223	83.574		
Total	767572.000	228			
Corrected Total	25203.140	227			

The data in table 3 shows that the probability value associated with the calculated value of F (46.966) for the effect of method on the achievement of students in biology is less than 0.05. Hence there is a significant difference in the mean achievement scores of students taught biology using peer tutoring approach and those taught using conventional lecture method in favour of the students taught using peer tutoring.

The probability value associated with the effect of gender (F=0.192) and the interaction effect (F=0.038) is less than 0.05. Therefore the effect due to gender and method x gender interaction were not significant.

4 DISCUSSION

The results of this study showed that students taught biology using peer tutoring performed significantly better than those taught biology using conventional lecture method. The superior achievement produced by peer tutoring can be attributed to the fact that it gives students the opportunity to explain their thought process in such a way that the other students will understand. This result showed that biology students' achievement to a large extent depends on instructional strategy applied by biology teachers. Furthermore, the finding is consistent with that of Ezeugwu (2009) which found that teachers' teaching methods to a greater extent have facilitative effects on student's academic achievement in biology.

In the same vein, Spencer (2006) in a study titled peer tutoring and students with emotional or behavioral disorders, using strict methodological criteria discovered in the 38 research studies, "that peer tutoring is an effective instructional strategy", in that they get a deeper understanding of the concept themselves which better their academic achievement. Therefore, peer tutoring helps students to develop a deeper understanding of the concepts themselves since it is an interactive method in its application and which in turn results in higher academic achievement. Peer tutoring involves some elements of self-regulated learning. According to Schraw and Brooks (2003) self-regulated learning prepares student to be mentally alert by giving them opportunities to plan, monitor and evaluate their learning activities both in school and outside the school. This approach greatly affect students' academic achievement in school by providing the cooperative learning skills and pleasant classroom atmosphere devoid of emotional instability which could result from harshness that may be exhibited by some teachers. In such an environment students engage in activities that enhance their interest and are intrinsically motivated.

The influence of gender on student academic achievement in biology was not significant. Consequently, with proper observation and mentoring by teachers and peers, both male and female students can perform significantly well in biology.

There was no significant method x gender interaction on the students' achievement in biology. This implies that relative efficacy of peer tutoring was consistent across gender groups.

5 CONCLUSION

Evidence from this study tend to support the fact that peer tutoring has a comparative advantage over the conventional lecture method in facilitating students academic achievement in biology. However, the evidence does not lend credence to gender differential in students' achievement in biology. The relative efficacy of peer tutoring was consistent across gender groups.

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