

Improving Some Nigeria Secondary Students' Achievement In Geometry: A Field Report On Team Teaching Approach

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Abstract: This study examined the effect of team teaching on the achievement of students in geometry and how this effect varies across gender. The study used a non equivalent pre-test post-test control group quasi experimental design. Intact classes were therefore assigned to the experimental and control groups. The population consisted of 7184 SS one students out of which a sample of 288 students was selected from four secondary schools. Two of the selected schools were assigned as experimental group while the other two were the control group. Geometry Construction Achievement Test (GCAT) was the main instrument used for data collection and it is a 30 items multiple choice objective test with four options (A, B, C & D). ANCOVA was used to analyse data to test for the 2 hypotheses. The result reveals that there was a significant difference between the mean achievement of the group taught Geometry using team approach and the group that interacted with their class teachers only ($F_{1, 287} = 117.961$, $p < 0.05$). However, male and female students taught Geometry using team teaching approach did not differ in their mean achievement significantly ($F_{1, 287} = 9.690$, $p > 0.05$). There was a significant interaction effect of gender and method on students' achievement in geometry ($F_{1, 287} = 6.551$, $p < 0.05$). The theoretical assumption that team teaching enhances students' academic achievement has been tested and the findings have given practical support to the earliest proposition. Since the result in Nigeria especially geometry is along the pattern of the earlier findings in other countries and subjects, it implies that its use did not discriminate along subject, culture and location. It is recommended among others that adequate teaching and learning materials be made available for teachers who will be encouraged to use team teaching. That effort should however not be dissipated on gender rather on appropriate method such as team teaching since it has comparable effect across gender when used.

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Introduction

Teachers of Mathematics at all levels can hardly say that it is well with the teaching and learning of mathematics. A study conducted by Maduabum and Odili (2006) indicated a low achievement in mathematics. According to the study, students sitting for West African Examinations Council (WAEC) mathematics between 1991 and 2002 did not attain 38% pass at credit level in Nigeria. The WEAC Chief Examiners' Report (2005) also confirmed the poor achievement and went on to lament that this poor achievement has resulted in students' low interest in the subject.

The problem may not be unconnected to the fact that mathematics teaching in Nigeria still follows the traditional pattern even when the traditional method is neither promoting students' interest nor achievement in the subject (Iji, 2002). This ugly situation thus demands for training more mathematics teachers and/or introducing new teaching methods.

For many individuals, one way to address this dilemma may be to give a trial to team teaching model as an alternative method of teaching that go beyond the

traditional model of one teacher, one class. Gyuse (2006) supported this notion by highlighting some professional decisions in effective teaching to include a shift from turn-teaching to team-teaching.

The concept of team teaching was introduced in 1963 by William Alexander, known as the father of the American middle school. He proposed the middle school concept where a team of three to five teachers would be assigned to 75 to 150 pupils organized either on a single grade or multi grade basis. This became the beginning of the idea of team teaching. Today, team teaching has been successfully used at all levels of education and across disciplines though such records are scarce in mathematics especially geometry in Nigeria.

Team teaching is generally considered to be an instruction delivered by two or more qualified instructors who, together, make presentations to an audience. Bess (2000) defines team teaching as a process in which all team members are equally involved and responsible for student instruction, assessment and the setting and meeting of learning objectives. Other authors suggest that team teaching is

a model that involves two or more instructors collaborating in the planning and delivery of a course (Davis, 1995; Zhang & Keim, 1993).

Team teaching exposes students to a variety of teaching styles and approaches, which increases the potential for the team to meet the various learning styles of students (Brandenburg, 1997). However, these very advantages may for some students be disadvantages. Some students may experience feelings of frustration and confusion when exposed to a variety of different teaching styles and viewpoints within the same subject (Goetz, 2000). Despite the tendency for these problems to arise sometimes through a lack of collaboration and cohesiveness within a team, there could be potential pedagogical advantages for those willing to adopt this teaching method in mathematics. Beyond the advantage of creating additional time for other academic activities, team teaching can foster a teacher's professional development (McKee & Day, 1992), overcome isolation that is inherent in more traditional forms of teaching (Goetz, 2000) and can aid in improving morale within a school and deepen friendships between staff members (Buckley, 2000). For students, mathematics team teaching can help them benefit through the opportunity to receive instruction from experts in specific areas of mathematics and give them exposure to alternate perspectives on issues (Buckley, 2000).

Goetz (2000) classified team teaching models into two categories. The first category involves a combination of models according to the personalities, philosophies or strengths of the team teachers as well as the personalities and strengths of the learners. This classification involves two or more instructors teaching the same students at the same time within the same classroom. The second Category consists of a variety of team teaching models, in which the instructors work together but do not necessarily teach the same group of students.

The Centre for the Enhancement of Learning and Teaching (1998) however opined that there is no single best model of team teaching. Particular team teaching models can be described as weak or strong depending on the degree of collaboration and integration between team members and the level of their engagement in the teaching and learning process. Weak forms of team teaching are those where there is little evidence of collaboration and/or involvement by team members in the planning, management and delivery of a course. At the other strong end of the team teaching are those models where team members are both intimately and equally involved in all aspects of the planning, management as well as delivery of content.

Interest for this research was triggered by the researchers concern about students' poor academic

performance in General mathematics and geometry in particular over the years. WAEC Chief Examiners' report (2009) clearly lamented on poor performance of the candidates in geometrical aspects of the question. Worse still only very few candidates attempted questions on geometry. The focus of this work therefore is to determine if the teaming of Mathematics Teachers in teaching geometric construction will have a positive influence on students' achievement in geometry. Also the researchers wish to determine if such performance could be influenced by gender.

At the moment, the extent to which knowledge is dependent on gender appears not to be resolved yet. Some authorities believe good teaching methods should break the boundaries of gender (Eze, 2000). Others though believe to an extent that, knowledge is still gender related (Callagher, 1992). It is with this in mind that the researchers wish to find out if using team teaching method in teaching geometric construction will influence students' achievement in geometry and whether such influence is gender dependent.

Theoretical Basis for the Study

Three forms of constructivist theories are considered very relevant to the present study. They are the social constructivist theory, the Bandura's learning theory and that of Vigotsky. The social constructivist theory is a learning approach which argues that individuals learn best when they actively construct knowledge and understanding through interacting with others (Santrock, 2004). Emphasis is therefore given to interactions rather than actions of individuals. One of the strongest proponents of this theory is Piaget. This theory emphasises social context of learning and that knowledge is mutually built and constructed (Bearing & Dorvan, 2002 as cited in Santrock, 2004). Involvement with others creates opportunities for students to evaluate and refine their understanding as they are exposed to the thinking of others. Experience is therefore found to provide important mechanism for developing the students' thinking since they are exposed to a variety of opportunities to pick and drop whatever knowledge comes their way (Johnson & Johnson, 2003).

Another strong proponent of social constructivist theory is Vygotsky. Vygotsky (1978) acknowledges the conceptual shift from individual to collaboration and social interaction which could be found in team teaching (Rogoff, 1998 cited in Santrock, 2004). This theory is seen to be strongly linked to the present study on the grounds that students will learn best as they actively construct knowledge through their interactions with different mathematics teachers which team teaching readily provides.

Albert Bandura is considered a leading proponent of the social learning theory which again focuses on the learning that occurs within social context (Bandura, 1977, 1986). He personally observed that people learn from one another through concepts as observation learning, imitation learning and modeling. Bandura (1977) established attention, retention, reproduction and motivation as necessary components of modeling process. According to Bandura, if one is going to learn anything the person has to pay attention. Thus anything that puts a damper on attention decreases learning. Secondly, one must be able to retain, that is, remembering what one has paid attention to and translate it into actual behaviour. He equally postulated that one can not do anything unless such a person is motivated by an interest. The fact that the learner has choice makes the entire idea interesting and learner oriented.

A close examination of Bandura's propositions suggests that they are traditionally considered to be necessary ingredients required for team teaching also. For instance, team teaching provides the learner with a couple of models to choose who to learn from and makes learning more active as more than one teacher is involved at a time.

Research Questions

The following research questions guided the study:

1. To what extent do the mean achievement scores of students taught geometry using team teaching differ from those taught using the conventional method?
2. To what extent do the mean achievement scores of male and female students taught using team teaching differ?

Hypotheses

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

Ho1: There is no significant difference in the mean achievement scores of students taught geometry using team teaching and those taught using the conventional method.

Ho2: There is no significant difference in the mean achievement scores of male and female students taught geometry using team teaching.

Ho3: There is no significant interaction effect of gender and method on students' achievement in geometry.

Research Method

Design

The study used a quasi-experimental design. It was a non equivalent pre-test post-test control group design. This design was adopted because it was not possible to completely randomize the subjects into the experimental and control groups. Emaikwu (2008) gave this as a condition for using quasi experimental

design. Intact classes were therefore assigned to the experimental and control conditions.

Table 1 Tabular Representation of the Research Design

Group	Pre-Test	Treatment	Post-Test
Experimental Group	T1	X1	T2
Control Group	T1	X0	T2

T1 (pre-test) appeared for both experimental and control groups which meant that both groups took pre-GCAT. X1 for experimental group and X0 for control group meant only the experimental group received the treatment which was team teaching while the control group only interacted with the teacher using the conventional method. T2 for both groups also indicate that both groups took the post-GCAT.

Population and Sample

The population for this study consisted of 7184 SS one students (4417 boys and 2767 girls) drawn from 90 government controlled secondary schools in the Education zone B of Benue State. A sample of 288 students was drawn from four secondary schools. Two of the selected schools were assigned to be experimental group while the other two were the control group. Having identified all coeducational schools, hart and draw method was applied to select any 4 schools. Similarly the same method was applied in each sampled school to obtain an arm in SS 1 for use in the study where there is more than arm. Having obtained an arm in each of the 4 sampled schools, there were then assigned as intact classes to experimental and control groups.

Instrumentation, Validation and Administration

The instrument used by the researchers was the Geometric Construction Achievement Test (GCAT). Geometric Construction Achievement Test (GCAT) was a 30 items multiple choice objective test with four options (A, B, C & D). GCAT was based on the senior secondary school mathematics curriculum content and the questions were of the Senior Secondary School Certificate Examination (SSSCE) standard.

The initial GCAT was 50 items which later was reduced to 30 in the process of face validation by 3 experts and item analysis to determine its difficulty, discrimination and distractive power of each item. Using trial test data, it was subjected to Kuder Richardson 21 analysis and the reliability index of the instrument was found to be 0.82.

Pre-GCAT was administered before the treatment. The treatment lasted for 6 weeks during which the research assistants (2 per class) used the lesson plans prepared

together to teach the experimental group. Each control group was taught by a single teacher. The teachers in the control group used conventional teaching method which they are used to. The post GCAT was administered after the treatment. GCAT was scored over 100%. The scores from the pre GCAT served as covariates for the post test during the analysis of data.

Results

The results of the study are presented according to the research questions and hypotheses.

Research Question 1

To what extent do the mean achievement scores of students taught geometry using team teaching differ from those taught using the conventional method?

Table 2 Mean Achievement and Standard Deviation Scores of Students in Experimental and Control Groups.

Group	Cases, N	Pre-GCAT		Post-GCAT		Mean Diff
		Mean	Std Dev	Mean	Std Dev	
Experimental	145	25.78	8.16	52.09	14.19	26.24
Control	143	24.53	7.67	36.13	11.86	11.60
Mean Difference		1.25		15.96		14.64

Results in Table 2 revealed that both the experimental and control groups improved in their performance after the treatment however, students in the experimental group gained by mean achievement difference of 26.31 while those in the control group gained by 11.60 which is considerably low if compared with the experimental group. The difference in mean

achievement of the two groups was 15.96 in favour of the experimental group.

Research Question 2

To what extent do the mean achievement scores of male and female students taught using team teaching differ?

Table 3 Mean achievement scores and standard deviation of male and female students.

Group	Sex	Cases, N	Pre-GCAT		Post-GCAT		Mean Diff
			Mean	Std Dev	Mean	Std Dev	
Experimental	Male	78	25.63	7.76	55.37	13.63	29.74
	Female	67	25.95	8.60	48.08	13.74	22.13
	Mean Difference		0.32		7.29		7.61

Diff = difference

The results from Table 3 showed a pre-GCAT/post-GCAT mean difference of 29.74 for male and 22.13 for female in the experimental group, which seem to be high gains in the achievement level of both sexes though the males gained more.

Hypothesis

Ho1: There is no significant difference in the mean achievement scores of students taught geometry using team teaching and those taught using conventional method.

Table 4: 2-Way ANCOVA on Post-Achievement Scores of Students in Geometry

Source of Variation	Sum of Squares	df	Mean Squares	F	Sig	Eta sq	Remarks
Corrected model	27636.382	4	6909.095	63.620	.000	.47	Sig
Intercept	16928.143	1	16928.143	155.877	.000	.36	Sig
Pre-GCAT	9393.296	1	9393.296	86.495	.000	.23	Sig
Sex	1050.365	1	1052.365	9.690	.093	.03	Not Sig
Method	12810.488	1	12810.488	117.961	.000	.29	Sig
Sex* Method	711.470	1	711.470	6.551	.011	.02	Sig
Error	30733.618	283	108.599				
Total	628682.000	288					
Corrected Total	628682.000	287					

Results of Table 4 show the critical value for method as 0.001 which fell within the acceptance region of 0.05. This indicates that method was a significant factor on students' achievement in geometry at $P < 0.05$. The null hypothesis of no significant difference in the mean achievement scores of students taught using team teaching technique and those taught using conventional method is therefore rejected. Hence, the use of team teaching method enhanced achievement in geometry ($F_{1, 287} = 117.961$, $p < 0.05$).

Ho2: There is no significant difference in the mean achievement scores of male and female students taught using team teaching.

Results from Table 4 again indicated that sex is not a significant factor in students' achievement in geometric construction when taught using team teaching ($F_{1, 287} = 9.690$, $p > 0.05$). Thus the hypothesis of no significant difference in the mean achievement scores of male and female students at 0.05 level of significance is not rejected.

Ho3: There is no significant interaction effect of gender and method on students' achievement in geometry. Again, result in Table 4 reveals that there is a significant interaction effect of gender and method on students' achievement in geometry ($F_{1, 287} = 6.551$, $p < 0.05$). The null hypothesis that there is no significant interaction effect of gender and method on students' achievement in geometry is therefore rejected.

Discussion of Findings

A 2 by 2 Analyses of Covariance was conducted to test the effectiveness of team teaching method in teaching geometry. The independent variable was the method of teaching. The dependent variable was the scores on GCAT. Scores from Pre-GCAT was used as covariate while gender served as moderator variable.

It was found that students in the experimental group had a higher post-test mean achievement score in geometry than their control group counterparts. This result is further confirmed by the results of Table 4 which indicates that method is a significant factor in the achievement of students in geometry. This is shown by rejection of the null hypothesis of no significant difference in the achievement of students taught using team teaching and those taught using conventional lecture method.

This finding supports the earlier findings of Gbodi and Laleye (2006), Iji and Harbor-Peters (2005), Sanni and Ochepe (2002), Galadima (2002), and Ajai (2008) which all showed that students demonstrated greater understanding of mathematical concepts and improved performance when taught via strategies that are interactive and could arouse their interest. The findings also agree with Mbakwem (2007) and Uwameiye and Rukayat (2008) who found that students taught via team teaching perform better than those taught via conventional method. This implies that team teaching technique can be adopted as a strategy for effective teaching of mathematical concepts.

The findings in Table 3 showed that male students in the experimental group gained in achievement more than their female counterparts with a post-GCAT mean of 55.37 for male and 48.08 for female. This difference was however not significant as shown by Table 4. Results from Table 4 revealed that there is no significant difference in the mean achievement scores of male and female students exposed to team teaching.

This finding that students did not gain significantly different in terms of sex is at variance with Jahun and Momoh (2001) and Alio and Harbor-Peters (2000). This appears to be corroborated by the saying of Mbakwem (2007) that the extent to which instruction and learning strategy is dependent on gender appears not to have been resolved. Some studies,

for example, Eze (2000) observed that the relative effectiveness of strategy of instruction on achievement is not based on gender factor. This notion agrees with the findings of Gbodi and Laleye (2006), Olagunju (2001), and Ajai (2008) yet, some other studies indicate gender differences in the effect of strategy of instruction on students' academic achievement (Callagher, 1992). However, if gender differences exist in mathematics in terms of achievement, team teaching has proven to be a good strategy to close the gap.

It was equally found that the interaction of gender and method had a significant effect on students' achievement in geometry. This implies that gender and method of instruction had some forms of interference in this study and the combined effect on their achievement was significant. This appears surprising as it was not both variables that had significant effect on the students' achievement in geometry. This result calls for caution especially in coeducational classes where such methods are employed to teach.

Conclusion

The study has provided empirical basis for maximizing classroom teaching and learning of mathematics especially geometry. This is evident by the fact that the group taught by team teaching performed significantly higher than the group that interacted with their class teacher only. Gender is found not be a factor where method applied carried both sexes along. The theoretical assumption that team teaching enhances students' academic achievement has been tested and the findings have given practical support to the earliest proposition.

Recommendations

Based on findings of this study, the researchers recommend that:

1. In view of the large student population and inadequate number of qualified teaching staff, particularly in secondary schools, teachers should be encouraged to employ team teaching approach in their classroom teaching and learning. The ministry of education, stake holders and private school proprietors could effectively implement this.
2. Curriculum experts and textbook author should be encouraged by Federal and State Ministries of Education to incorporate team teaching as an innovative and efficacious method in curriculum and in textbooks also.

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