

Need For Collaborative Learning Approach (C.L.A) in Secondary Schools for Effective Science and Mathematics Education in Oju Local Government Area of Benue State

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Abstract

The researchers investigated the need for collaborative interaction in problem solving learning context by secondary school students for effective Science and Mathematics Education. A quasi-experimental design was adopted. The population of the study consisted of 862 S.S.1 Science and Mathematics students in 10 senior secondary schools in Oju local government area of Benue State. Out of this, 252 students were selected through simple random sampling. The instrument for data collection was Science and Mathematics Achievements Test (SMAT) consisting of 25 structured items based on the topics taught at that level. The validation of the instrument was established by three experts. The reliability was determined using cronbach Alpha method which gave a value of 0.72. Two Research Questions and two Null Hypotheses guided the study. Mean and Standard deviation were used to answer the Research Questions. Analysis of covariance (ANCOVA) was used to test the Null Hypotheses at 0.05 level of significance. The findings among other things were that the students taught science and mathematics with Collaborative Learning Approach achieved better than those taught using the conventional or lecture method. Some recommendations were made based on the findings. One of such is that Collaborative Learning Approach should be incorporated into Science and Mathematics curriculum for pre-service teachers of Science and Mathematics in order to popularize its use among teachers.

Keywords: Collaborative Learning Approach, Mathematics Education, Secondary Schools

Introduction

Science and Mathematics are very important in the development of every nation including Nigeria. These are subjects taught at both junior and senior secondary school levels in Nigeria. In spite of such a position of science and mathematics among other disciplines like medicine and engineering reveal that academic achievement of students in Science and Mathematics at the Senior Secondary Certificate Examination (SSCE) is consistently poor and very unimpressive (Njoku 2000). Many factors have been advanced at contributing to this state of affairs. Some of these factors include inadequate equipment (Eniayeju 2010) poor teaching method (Mbakwem 2007).

In view of this development, Professional bodies such as Science Teachers Association of Nigeria (STAN) and Mathematics & Association of Nigeria (MAN) often hold workshops, seminars and conferences for science and mathematics teachers with a view to improving the

teaching methods of Science and Mathematics. This is with a view to making science and mathematics interesting to the students and to be meaningful to the learners. It is imperative for the learners to be involved in sourcing information and generating solutions to problems which they encounter in their daily activities. As a result of this, Orji (2002) advocated the use of more effective methods of teaching science and mathematics. A skillful teacher should know what method he adopts at a particular lesson in order to enhance teaching and learning. Some of these teaching methods include lecture method, demonstration method, but a collaborative Learning Approach is identified for this study. Collaborative problem based learning involves students own problems and is an effective way of promoting students centered learning in the classroom (Omeh and Okaton 2011). This is because learning is based on what the students are interested in. The students acquire new knowledge through the process of problem solving and seek to apply these in their search for answers to their problems. Motivation for learning is high as students take ownership of the problems as they diligently pursue answers which they find meaningful.

According to the researchers, Collaborative learning is the heart of problem based learning in teaching science and mathematics. It holds great promises for increasing the effectiveness of science and mathematics education by improving students' comprehension, thinking skills, motivation and retention of information. Collaborative learning is an instructional method that makes use of small heterogeneous group of students who work together to achieve common learning goal. Collaborative learning has been considered relevant and fruitful (Iyekekpolo 2007) Collaborative Learning is a teaching strategy involving students participation in small group learning activities that promotes positive interactions. Tinzman (1999) defined collaborative learning as a teaching arrangement in which small heterogeneous group of students work together to achieve educational goals. Collaborative interaction in Problem Based Learning Context is used as the basis for curriculum design to promote reform and achievement of Science and Mathematics education in secondary schools (Omeh & Okaton, 2011). It is a task centred activity requiring students' interactions in small group as the structure and contents are organized (Omeh & Okaton, 2011). Orji (2002) reported that new learning and thinking curricular requires collaborative method. According to the researcher, effective communication and collaboration are essential to becoming a successful learner. Again, it is primarily through dialogue and examining different perspectives that students become knowledgeable, strategies and self determined.

Collaborative learning has been proven to be effective for all types of students (Odili, 2006) including academically gifted, mainstream students and science and mathematics learners because it promotes learning, poor interaction, which helps the development of languages and the learning of concepts and contents. It fosters respect and friendship among diverse group of students. In fact, the more diversity in a team, the higher the benefits for each student. Peers learn to depend on each other in positive way for a variety of learning tasks. It is based on these that the researchers decided to use collaborative learning in Science and Mathematics and find whether it will enhance students academic achievement in these subjects areas.

Statement of the Problem

A method of teaching known as lecture method is the commonest method used in Science and Mathematics classroom in most Senior Secondary Schools in Oju Local Government Area of Benue State. Lecture based method is a kind of verbal presentation of subject matter with the students at the receiving end. Lecture method can be regarded as a process whereby the teacher delivers verbally a prepared body of knowledge to his students who listen to him

and take notes. In most cases, teachers are not duty bound to entertain questions except for clarification of points. It is teacher centered activity and there is little or no room for interaction in the classrooms. The teacher gives out all the facts, knowledge and information he wants the learners to know and transfer without bothering if they are actively participating in the lesson and contributing to the success of it or not.

Chief examiner's report from the West African Examination Council (2011) has shown a consistent poor performance of students in Science and Mathematics in the West African Senior Secondary Certificate Examination. This has made researchers to seek for ways to improve performance in these subjects. For instance, Nwakonobi (2008), pointed out that complaints abound from students, teachers, parents and even the Federal Ministry of Education about the inability of students to perform credibly in Science and Mathematics. This research work therefore is another effort to investigate the effect of the collaborative learning approach on the students' achievement in Science and Mathematics. Put in question form, how will the use of collaborative learning approach enhance achievement in science and mathematics?

Significant of the Study

The secondary system is of strategic importance in the overall educational development. Since the stability and quality of higher education are built on the foundation laid at the secondary school, it will not be an overstatement to say that Science and Mathematics play a vital role in Nation Building. Science and Mathematics Education in particular is a veritable tool for global sustainable economic development. This study may be significant and beneficial to Teachers, Students, Educational Administration and all Stakeholders in Education.

Purpose of the Study

The researchers' general purpose is to find out if the Collaborative Learning Approach could have a positive effect on students' academic achievement in science and mathematics. Specifically the study is aimed at

- (i) Determining the differences in the mean achievement scores of senior secondary school students taught science and mathematics with the collaborative learning approach and those with the conventional method.
- (ii) Determining the difference in the mean achievement scores of male and female students taught science and mathematics with the collaborative learning approach.

Research Questions

The following Research Questions guided the study

- What difference exists in the academic achievement of Science and Mathematics students taught with the collaborative learning approach and those taught using the conventional method?
- What is the difference between male and female students mean achievement scores taught using the collaborative learning approach?

Hypotheses: The following Null Hypotheses formulated were tested at 0.05 level of significance.

- **H01:** There is no significant difference in the Mean achievement Scores of students taught Science and Mathematics with the collaborative learning approach and those taught with the conventional method.

- **HO2:** There is no significant difference in the mean achievement scores of male and female students taught Science and Mathematics with the Collaborative Learning Approach.

Methodology

The Quasi-experimental Research Design was adopted for this study. This is considered more appropriate because the study seeks to establish the cause and effect relationship between the variables of teaching method and academic achievement in Science and Mathematics. The population for this study is all the Science and Mathematics students in senior secondary schools in Oju Local Government area of Benue State. This is estimated to be about 862. Four senior secondary schools were randomly selected. The schools selected were coeducational. The sample size of 252 students were used for the study as intact classes for the experimental and control groups. The instrument for data collection was a Science and Mathematics Achievement Test (SMAT). This was made up of 25 multiple choice questions each with four options, only one correct option. The SMAT was derived from the topics in the SS1 syllabus. Both the experimental and control groups were taught for 2 weeks. The instrument was validated by three experts in Science and Mathematics, Test and measurement at the Benue State University Makurdi. These experts were requested to assess the instrument in terms of content coverage, relevance of the items to the research questions and hypotheses. The language used in developing the items, adequacy of the items to the level of the respondents and appropriateness of the arrangement. The reliability of the instrument was established using Cronbach alpha method and it gave a coefficient value of 0.72. The face-to-face method of administration of the instrument was adopted by the researchers to ensure a 100 percent return. The experimental group consists of 123 SS1 students. The control group (129) were taught using lecture method. Data collected were analyzed using mean and standard deviation to answer the Research Questions while ANCOVA was used to test the Null Hypotheses at 0.05 level of significance.

Discussion of Findings

In the bid to answer research questions 1 and 2, data collected were analyzed and presented in Tables 1 and 2 respectively. Table 3 and 4 showed the analysis of covariance (ANCOVA) for testing the Null Hypotheses 1 and 2 at 0.05 level of significance

Table 1: Mean and Standard Deviation Obtained from Pretest and Post-test Score of Science and Mathematics Students for the Experimental and Control Group Taught Using Both Methods.

Group	No. of Students	Pretest (x)	Post-test (x)	Standard Deviation	Mean Difference
Experimental	123	17.72	38.49	7.01	20.77
Control	129	15.65	15.71	6.07	0.06
Total	252				

From table 1, students taught using collaborative learning approach achieved higher score with mean gain 20.71 than those students taught using lecture method. This result shows that

students exposed to the Collaborative Learning Approach achieved better than those with Lecture method.

Table 2: Mean Difference of Pretest and Post-test Scores of Male and Female SS1 Science and Mathematics Students Taught Using Collaborative Learning Approach

Group	No. of Students	Mean of Pretest (x)	Mean of Post-test (x)	Standard Deviation	Mean Difference
Male	46	14.17	41.13	7.21	26.96
Female	59	14.53	41.61	7.19	27.08
Total	123				

Table 2 indicates that the male and female students taught using collaborative learning approach achieved almost the same score as seen from the mean differences of 26.96 and 27.08 respectively.

Table 3: Analysis of Covariance for Null Hypotheses 1. Academic Achievement of Science and Mathematics Students Taught Using the two Different Methods

Source of variance	Sum of Squares	Df	Mean of sum of square of (Ms)	Cal. Value of F	Critical value
Between Group	11,715.79	1	11,715.79		
Within Group	137,588.03	250	597.23		
Total	149,303.82	251			

N= 252. Probability= $p < 0.05$. Critical value=4.38, Cal. value=19.62

Table 3 indicates that there is significant different between the mean achievement scores of students taught using lecture method and those taught using collaborative learning approach as shown by the F calculated 19.62 which is greater than the F critical 4.38 with a degree of freedom of 1 and 250 respectively at 0.05 level of significance. Null Hypotheses 1 is therefore rejected. Therefore there is significant difference in the mean achievement scores of students taught using collaborative learning approach and those taught with lecture method.

Table 4: Analysis of Variance (ANOVA) for Null Hypotheses 2. Comparing the Academic Achievement of Students Taught Using Collaborative Learning Approach

Source of variance	Sum of Squares (SS)	Df	Mean of sum of square (ms)	F cal	F critical
Between Group	76.48	1	96.48		
Within Group	1,298,679.36	121			
Total	1,298,755.85	122	10,733.52		

N =252, Probability = $P < 0.05$, F.cal =0.0071, F.critical =3.92

Table 4 indicates that there is no significant difference between the mean achievement scores of male and female Science and Mathematics students taught using collaborative learning approach. Since the $F_{\text{calculated}} 0.0071$ is less than $F_{\text{critical}} 3.92$, the Null Hypotheses is accepted. There is no significant difference between the male and female students' scores, when taught Science and Mathematics using the Collaborative Learning Approach. The need for Collaborative Learning Approach in the secondary schools as a way forward for effective teaching and learning of Science and Mathematics cannot be over emphasized. The findings shown in table 1 and 3 are that students taught Science and Mathematics using Collaborative Learning Approach achieved higher than those taught using Lecture Method. Lecture Method gained 20.71 as against 0.06 as shown in table 1. The $F_{\text{calculated}}$ was 19.62 which is greater than F_{critical} of 4.38 as in table 3. This gains support from Piaget (1968) who discussed in his findings that Collaborative Learning Approach promotes cognitive growth. The findings also gain support from Baines, Blatchford and Kutnick (2003) who emphasized the need for collaborative learning in secondary schools since students at this level more likely engage in peer interaction than any other level. The finding provide answers to both research question 1 and Null Hypotheses1, so significant difference exists in the mean achievement scores of students taught science and mathematics using the collaborative learning approach and those taught using lecture method. Palionscar and Brown in their findings reported that the sense of cooperation that is fastened in collaborative work makes assessment less threatening than in lecture method experience with group evaluation.

Table 2 and 4 revealed that male and female students taught using collaborative learning approach achieved almost the same. This can be seen in the mean difference of 26.96 and 27.08 respectively as indicated in table 2 and $F_{\text{calculated}}$ value of 0.071 which is less than the F_{critical} value 3.92 as in table 4. This finding is in line with Omeh and Okaton (2011). These researchers found out that equal performance among students reflect the important of active participation of every individual in the collaborative learning approach. Based on the findings, one can safely say that there is a need for collaborative learning approach for effective teaching and learning of Science and Mathematics for higher achievement in secondary schools.

Conclusion

The importance of Collaborative Learning Approach in learning Science and Mathematics has been portrayed by the findings of this study. Emphasis has been laid on the poor achievement of students in Science and Mathematics. Science and Mathematics are paramount in determining certain courses in tertiary institutions. Thus, they should be taught in such a way that students should achieve highly academically. Findings of this study revealed that Collaborative Learning Approach makes more positive influence on students' cognitive achievement than the lecture method. This means that if every individual is provided with an equal opportunity and anchored to participate actively in the classroom all the imposed barriers in science and mathematics achievement will be removed accordingly.

Recommendations

Based on the findings, the following recommendations are made.

1. The Federal and State ministries of Education should organize conferences, workshops and seminars for all science and mathematics teachers in the country on the use of collaborative learning approach in the teaching and learning of science and mathematics in secondary schools.

2. Educational technology and experts in Problem Based Learning should join hands together to develop text and websites on Problem Based Learning for use at the secondary school level.
3. Collaborative Learning Approach should be incorporated into science and mathematics curriculum for pre-service teachers of science and mathematics in order to popularize its use among teachers.
4. Science and Mathematics teachers should be encouraged to use Collaborative Learning Approach as an alternative to the Lecture method.

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