# IMPROVING THE TEACHING AND LEARNING OF SECONDARY SCHOOL MATHEMATICS THROUGH COLLABORATIVE APPROACH IN MUBI NORTH LOCAL GOVERNMENT AREA, ADAMAWA STATE

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## ABSTRACT

*This study was undertaken to investigate the effect of collaborative teaching and learning approach in mathematics. The research design adopted for the study is quasi experimental pre-test post-test control group design. The population of the study is made up of all SSI students in Mubi North Local Government Area. Four schools were selected through simple random sampling. Two out of the four schools were selected for experimental studies, while the remaining two, the control groups. The experimental group was tagged Group A, while the control group was also tagged B. Group A were taught using collaborative approach, while group B were taught using conventional method of teaching. The instruments used for data collection was the achievement test in mathematics (ATM) developed by the researcher. Data collected from the post-test was analysed using students t-test to test the significance difference of the mean scores obtained from the two groups which were tested at 0.05 level of significant. The result of the finding indicated a significant difference between the two groups in favour of group A which was taught using collaborative approach. On the other hand, there is significant inter-gender mean score difference of mathematics performance in favour of boys. In line with the findings, it was recommended among others that there should be government intervention and professional associations whose primary responsibility is to design and revise the curriculum for inclusion of collaborative learning approach in the teaching of senior secondary schools mathematics.*

Key words: collaborative, Leaning approach, mathematics teaching.

## INTRODUCTION

Mathematics education occupies a unique position among various science subjects offered at all levels of secondary education in Nigeria. This is because the study of mathematics involves pursuit of truth and objectivity in learners. Furthermore, mathematics is considered as a foundation of science and technology of nation building. That is why much emphasis is placed on the teaching and learning of the subject in a bid to achieve the goals of education. However, research reports continually indicates that the students do not learn well as much of them achieve poorly in public mathematics examination, Strigler and Hiebert (2004) and Barrow (2007). The search for ways of maximizing learners' performance in schools has been a major pre-occupation of personnel to maintain achievement in schools. This challenge is greatly intensified by the dire need for teaching methods. In order to enhance students' mathematics performance, teaching pedagogy cannot be put aside with a wave of hand. This gives us the assumption that teaching of mathematics is deficient since good teaching will always yield high and better performance. Mathematics educators therefore are continually making efforts on these issues of poor learning of mathematics and how to ameliorate the situation.

Adebayo, 2001 noted that the teaching of secondary school mathematics is beset with diverse problems such as inadequate teaching facilities that will bring out the best in Nigerian students. Similarly, Betiku, (2002), maintained that poor foundation in secondary school mathematics is as a result of incompetent mathematics teachers in the school system.

The current teaching approach in the secondary school level is reported to be unsuitable, ineffective and inappropriate for the teaching and learning of mathematics, Enayeju (2001). The traditional teaching approach has been found to be deficient as the students have consistently performed poorly in mathematics achievement tests. Enayeju found that, the approach is characterized by predominance of teacher's task with no involvement of student in the process. It is a teacher centered approach. Even lessons that require practical are taught through teacher demonstration. Student's participation is limited to listening, answering and asking questions and writing notes as the lesson progress. The method is one directional, hence it limits the freedom of students to apply, analyze and synthesize the knowledge they acquired. The method is also characterize by the teacher working the previous assignment, presentation of the day's lesson, class work from the text books, everyday homework and occasional test. This approach is described as didactic as the students simply ingest and absorb knowledge presented by the teacher and the recommended textbook (Greene, 1993). It has no room for learner to interact closely with their social environment which is necessary for retentive and permanent learning.

Collaborative learning is based on the social interdependence theories of Roger and David (1949). These theories and associated research explore the influence of the structure of the social interdependence on individual interaction within a given situation which, in turn affects the outcomes of that interaction Bricker (1987). Collaborative learning is a learning process which involves interaction between individuals with common goals. According to Felder and Michael (2007), there is need for the opportunities in the educational system for the individuals involved in instructional issues to interact. Mattive (1994) noted that collaborative work helps to eliminate misconceptions and lack of understanding thus, better understanding and higher achievement are enhanced. Also, kankia (2008) maintained that the interaction enable the mathematics teacher, the learners and educators share a common aspiration of ensuring that appropriate skills are inculcated in and acquired by the learner.

Therefore, the area that has continued to generate interest among researchers and students in mathematics is the problem of instructional approach. The instructional strategy and uninspiring teaching method that teachers apply can make the attainment of

instructional objectives illusive. Thus, according to Amoo (2002), mathematics educators around the globe are searching for the desirable teaching strategy that will engage the student with task that will influence them to learn mathematics successfully. It is against this background that this study is carried out to investigate how collaborative approach will improve the teaching and learning of mathematics in Mubi North Local Government Area.

'Gender' refers to the social roles that are believed to belong to boys and girls within a particular social grouping. These have been a series of debate on the issues of gender difference and practice in the mathematics classrooms. This debate currently focuses on why variation exists between male and female performance in the classroom especially in Science, Mathematics and Technology (Okeke, 2007, Adeleke, 2007, Adeleke and Amoo, 2007, Amoo and Onasanya, (2010). The main issue is that girls seldom study mathematics, science and Technology at every level of education from elementary school to graduate school (Byrne, 1978, Adeleke, 2007).

In mathematics and science related subjects enrolment have always recorded more boys than girls. In Nigeria, many researchers are still finding differences in performance as well as general interest in areas related to mathematics and science (Halpern and Saw, 2000, Adeleke, 2007, Adeleke and Amoo, 2007). Based on these issues, the following research questions and hypotheses were included.

### Significant of this paper
The outcome of this research will be of importance to Mathematics teachers as it will help them to improve teaching quality, effectiveness and accountability to students. It will help teachers to either move away or not from the traditional (lecture) teaching method to new teaching and learning strategies that would make learning very interesting to the students. The study will also be of importance to teachers as it will provide them an innovative teaching learning strategy (collaborative learning approach) for better understanding of the concepts and cognitive development.

### Statement of the Problem
It has been found that students in secondary school perform poorly in mathematics, despite the fact that teachers use variety of teaching approaches, such as Demonstration, Discussion, Lecture Method and so on, yet students perform poorly in mathematics. In view of this the researcher intends to find out the effect of collaborative approach in teaching and learning of mathematics in secondary schools Mubi North Local Government Area.

### Objective of the Study
1. To find out the significant effect between teachers collaborative approach and students' performance in mathematics.
2. To establish if there is significant difference between boys and girls when exposed to collaborative approach of teaching mathematics.
3. To help teacher/learners understand the concept 'collaborative approach'.

### Research Question
1. What is the difference between teachers' use of collaborative approach and students' academic performance in mathematics?
2. Is there any significant difference between the academic performance of boys and girls when exposed to collaborative approach in teaching mathematics?

### Research Hypotheses
1. There is no significant difference in the performance scores between students taught Mathematics using the Collaborative Learning Appraoch (CLA) and those taught using traditional Lecture Method (LM) in senior secondary schools in Mubi north local government area, Adamawa State-Nigeria.
2. There is no significant difference between academic performance of boys and girls when exposed to collaborative learning approach in teaching mathematics.

### Research Design

The study adopted the non-equivalent pre-test post-test quasi-experimental control group research design. The representation of the study design summarized as follows:

$$O_1 \quad X_1 \quad O_2$$
$$O_3 \quad X_2 \quad O_4$$

Where $O_1$ and $O_3$ are the pre-test scores on $X_1$ and $X_2$ respectively, $O_2$ and $O_4$ are the post-test scores to $X_1$ and $X_2$ treatments. $X_1$ and $X_2$ represent the experimental and control group treatments respectively.

### Population
The population of the study targeted all SSII students in Mubi North Local Government Area, Adamawa State.

### Sample and Sampling Technique
The sample comprised all public Senior Secondary School students extracted from the population. Using the simple random sampling technique, four schools were pooled out from population out of 14 senior secondary schools in the area. Intact class streams were used for instruction and assessment. Schools in the study were selected in such a way that subjects in the experimental and control groups could not easily get in touch in order to reduce contamination. The subjects in a given senior

secondary school were assigned to the same instructional condition (Experimental and Control). Two of the schools were assigned to the Experimental treatment group while the other two formed the control group. Each selection was randomly done by balloting.

**Instrumentation/Data collection**
An Achievement Test in Mathematics (ATM) consists of a 20-item objective test carefully drawn from the senior secondary school curriculum by the researcher was used for collecting the data after treatment. ATM consisted of two sections, A and B. In section A, students were asked to supply their basic demographic data such as sex, class, age and name of school, while Section B Contained 20 multiple choice items with five options (a-e) each. Here students were asked to choose the correct answer after solving the problem in this section; all items were awarded 1 mark each for the correct answer. The total marks earned were converted to percentage for the testee.

**Validation of the instrument**
The instrument, Achievement Test in Mathematics (ATM) that was used for the study was subjected to face and content validation by some experts in the Department of Science Education Faculty of Education, Adamawa State University, Mubi and an expert in the Department of Mathematics, Faculty of Science in the same University .The experts reviewed the content and the items and then offered suggestions to the researcher.

**Method of Data Analysis**
Data collected from the various pre-tests and post-tests were subjected to appropriate statistical analyses. The data were analyzed to answer the research questions using descriptive statistics of mean and standard deviation, while t-test statistics analysis was used to test the stated research hypotheses. The determination of significant difference was based on .05 level of significant, $p < .05$.

**Results and Discussion**
This section presents the relevant data for answering the research questions and for testing the research hypotheses raised. In the study, two research questions and two hypotheses were raised. Hence, independent samples t-test statistic was used for inferential analysis based on the hypotheses tested for the study at 0.05 level of significant.

The pre-test scores of students in the experimental and control groups were analyzed to ascertain the entry behavior of students in the experimental and control groups before the treatment is administered. The students' pre-test scores in the experimental (collaborative Learning Strategy) and control group (traditional learning method) were analyzed using independent samples t-test. The descriptive statistics and t-test results are presented in Tables 1.

**Table 1: Descriptive Statistics of Pre-Tests Scores of the Treatment Groups**

| Group Type | N | Mean Score | 95% CI | | SE | SD | Min | Max |
|---|---|---|---|---|---|---|---|---|
| Experimental Group | 82 | 47.77 | 36.0 | to 38.3 | 0.58 | 9.55 | 12 | 64 |
| Control Group | 86 | 46.32 | 35.2 | to 37.5 | 0.59 | 9.68 | 13 | 68 |

Results in Table 1 show a descriptive analysis of students' pre-test scores in the experimental and control groups at the beginning of the study. The descriptive analysis shows that the mean scores of students in the two groups were relatively close indicating that students in the experimental and control groups were of equal performance at the pre-test stage. The scores shows that the experimental group (collaborative learning approach) (Mean = **47.77**) and control group (traditional learning approach) (Mean = 46.32).

**Table 2: Summary of t-Test Analysis of Students' Pre-test Scores in the Experimental and Control groups**

| Methods | N | Mean | Mean Difference | SD | Df | T | Sig. (2-tailed) | (2- |
|---|---|---|---|---|---|---|---|---|
| Collaborative Learning Approach | 82 | 47.77 | | 3.96 | | | | |
| | | | 2.45 | | 166 | 1.41 | .123 | |
| Traditional Learning Method | 86 | 46.32 | | 3.76 | | | | |

**Not Significant**; $p > 0.05$.

To determine and compare whether the mean achievement scores of students in the two groups are significant, the data were subjected to independent samples t-test. The results are also presented in Table 2 and it shows that there is no statistically significant difference in the academic performance of students in mathematics test at the pre-test level ($t_{(166)} = 1.41$, $p > 0.05$). This implies that both the students in the experimental and control groups have equivalent entry behavior prior to treatment.

**Research Question One**

What is the difference between teachers' use of collaborative approach and students' academic performance in mathematics?

**Table 3: Mean Performance and standard deviation scores of Mathematics Students, taught with the Collaborative Learning Approach (CLA) and those taught using Traditional Lecture Method (TLM).**

| GROUP | | | MEAN | SD | N=168 |
|---|---|---|---|---|---|
| **Collaborative Learning Approach** | | Pre-test | 47.77 | 5.69 | |
| | | Post-test | 66.08 | 9.95 | 82 |
| | | **Gain Score** | **18.31** | | |
| **Traditional Learning Method** | | Pre-test | 46.32 | 2.76 | |
| | | Post-test | 57.86 | 7.44 | 86 |
| | | **Gain Score** | **11.54** | | |

Table 3 present the profile of the mean scores of students taught using collaborative learning approach and traditional learning method with control group of 86 and experimental group of 82 students. The table showed a remarkable mean gain between the pre-test and post-test for both groups. Students in the experimental groups (collaborative learning approach) had total mean score of 66.08 which was higher than the control group (traditional learning method) with 57.86. This suggests that instruction using collaborative learning approach enhances learning better than traditional lecture method.

**Table 4: Descriptive Results of male and female students taught with Collaborative Learning approach (CLA).**

| Variable | Treatment | Mean | Std. Error | 95% confidence interval |
|---|---|---|---|---|
| Male | Collaborative learning approach | 59.32 | 2.462 | 41.411 |
| Female | Collaborative learning approach | 43.05 | 2.279 | 51.595 |

Table 4 buttressed the difference in mean scores of male and female students in post-test Mathematics performance for the collaborative learning group. The results indicate that the Male students' mean performance score was 59.32, while that of the female counterpart was 43.05. This shows that the female students achieved higher than the male students in the post-test. However, the standard deviations obtained for the male and female students are 2.462 and 2.279 respectively, indicating that the individual scores of both male and female students are relatively clustered around the mean almost equal.

**Hypotheses Testing**

**Ho₁:** There is no significant difference in the performance scores between students taught Mathematics using the Collaborative Learning Approach (CLA) and those taught using traditional Lecture Method (LM) in senior secondary schools in Mubi North Local Government Area.

The hypothesis sought to determine if there is a significant difference in the mean scores of students taught Mathematics using the Cooperative Learning Approach (CLA) and those taught using traditional Lecture Method (LM). Students' scores in the post-test were generated and the Independent Samples t-Test statistic was used to analyze the data. The result is presented in Table 5.

**Table 5: Summary of t-Test Analysis of Students' Post-Test Scores in Mathematics Based on groups.**

| Source | N | Mean | Mean Difference | SD | Df | T | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|
| **Exptal Group** | 82 | 62.31 | | 14.50 | | | |
| | | | 10.47 | | 166 | 11.02 | .000 |
| **Control Group** | 86 | 51.84 | | 10.40 | | | |

Significant; p < 0.05.

Table 5 shows that there is significant difference in the mean scores of students taught mathematics based on the learning methods (t = 11.02, df = 166, p < 0.05). The result indicates that the alternative hypothesis is supported, which means that there is significant difference in the performance scores between students taught Mathematics using the Collaborative Learning Approach (CLA) and those taught using traditional Lecture Method (LM) in senior secondary schools in Mubi North Local Government Area.

**Ho₂:** There is no significant difference between academic performance of boys and girls when exposed to collaborative learning approach in teaching mathematics.

This hypothesis analyses the difference in the performance of gender (boys and girls) of students taught Mathematics using the Collaborative Learning Approach (CLA).

**Table 6: Summary of t-Test Analysis of Students' Performance Test Scores in Mathematics Based on Gender.**

| Source | N | Mean | Mean Difference | SD | Df | t | Sig. (2-tailed)s |
|--------|---|------|-----------------|-----|-----|------|----------------------|
| **Male** | | | | | | | |
| | 46 | 60.32 | | 13.02 | | | |
| | | | 9.45 | | 80 | 9.20 | .002 |
| **Female** | 36 | 50.87 | | 12.13 | | | |

Significant; $p < 0.05$.

Table 6 exhibits that there is significant difference in the performance test scores between boys and girls taught Mathematics using the Collaborative Learning Approach (CLA) in senior secondary schools in Mubi North Local Government Area ($t = 9.20$, $df = 80$, $p < 0.05$). Therefore, the study hypothesis which states that, there is no significant difference between academic performance of boys and girls when exposed to collaborative learning approach in teaching mathematics is hereby rejected.

### Discussion

From the analysis of data collected, it was found that the use of collaborative approach had significant effect on the student's performance in mathematics. The study revealed that students who were exposed to collaborative approach in teaching mathematics performed significantly better than those exposed to lecture method of teaching. This correspond with the findings of David and Johnson in Bot (2004) who reported that an experimental group of students who were instructed through collaborative approach showed significantly higher scores in a mathematics performance than control group that was instructed through the traditional method. Abdul (2009) maintained that the introduction of collaborative approach in teaching and learning process stimulate the teacher and student's interest which correspond with this study. This study enhances the sense of cooperative learning and understanding of one another. That was why Nicholas (2004) states that collaborative approach provides the ability in sharing of expertise and help knowledge to reach students simultaneously. In addition, the use of collaborative approach in teaching and learning process integrates brains with hands in a well-rounded education allowing the most suitable approach to carry the message challenging our sense of creativity.

### Conclusion

The analysis has shown that Collaborative approach by this study is identified as an essential instructional strategy that can enhance teaching and learning mathematics. It was found to be useful, making teaching and learning pleasurable, meaningful and yet more effective.

Gender disparity in performance was also revealed in the results of this study. However, the treatment actually impacted positively more on the performance of boys.

### Recommendation

In line with the findings, it is recommended that there should be government intervention and professional associations whose primary responsibility is to design and revise the curriculum for inclusion of collaborative learning approach in the teaching of senior secondary schools mathematics.

Publishers should consider writing mathematics textbooks in such a way that they are amenable to collaborative learning.

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