International Journal of Academic Research
ISSN: 2360-9949, Volume 13, Issue 8, (June, 2023) pages 01 - 12
DOI:272614288731381
www.arcnjournals.org

Experimental Evaluation of the Effect of Cooperative Learning Strategy in Retention Ability on Geometry among Male and Female Students in Sokoto Metropolis

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Abstract: The study investigated the Experimental Evaluation of the Effect of Cooperative Learning Strategy in Retention Ability on Geometry among male and female students in Sokoto Metropolis. The purpose was to investigate whether or not cooperative learning enhances the retention ability of students on geometry construction of JSS III. The design of the study was quasi experimental design employing pretest, posttest and post posttest design. 4058 students formed the population of the study; purposive sampling technique was used to select 354 students from the study area. GCPT was administered before and after the treatment. One research questions was asked from which four null hypotheses were developed and tested at 0.05 level of confidence. Independent t-test was used to analyze hypothesis appropriately. CLS was used to guide experimental group on geometry construction of JSS III while CLM was used to teach control group the same topics. Male students guide with CLS performed better than the female students taught with CLS. Male students taught with CLS retained more than female students exposed to CLS. On the basis of these findings, the study concluded that CLS improved students' retention in geometry construction of JSS III. The study therefore, recommends that CLS should be adopted in the teaching and learning of mathematics in general and geometry construction in particular.

Introduction

This study attempted to explore the effects of cooperative learning strategy on performance and retention on Geometry among government own junior secondary schools students in Sokoto metropolis. The low performance of pupils in mathematics has become a concern in mathematics education (Kajuru and Kauru, 2010). Yet many students find it very difficult to solve mathematical problems. The reason for these difficulties may vary but this could sometimes be related to the teaching method being used to explain such topics (Chianson, Kurumeh and Obida, 2011). To corroborate the above findings, Peter (2001) asserted that 'the issue of poor performance in mathematics examination was due to the problem of teaching methods'.

In the United States (US) for instance, students' performance in mathematics (specifically in Geometry content area) was bottom third of all countries tested. Thirty eight (38) countries outperformed the US in geometry with Japan at the top with a score of five thousand seven hundred and five (5705) and international average of four hundred and seventy three (473) in geometry (Unal, 2005). In Nigeria, there is ample evidence of continued poor performance of students in both standardized and teacher made examinations (Benjamin & Agwagah, 2006). Reports from examination bodies such as West African Examinations Council (WAEC) and National Examinations Council (NECO) indicated students' low performance in mathematics as contained in the chief examiner's report (1995; 1996; 2000 and 2005). Considering these reports,

Fajemidagba (1998) and Atebe (2008) opined that, high performance in mathematics is a good indication of high performance in geometry in particular, the reverse may be true.

Many reasons have been advanced for this poor state of students' performance in mathematics and geometry in particular. Some researchers viewed strategy of teaching as one of the contributing factors to poor performance of students in geometry, some of whom include: Undeinya and Okabiah (1991), Peter (2001) and Chainson *et al* (2011). There has also been an increased awareness by those concerned with mathematics education that the traditional lecture method of teaching mathematics has not been very successful (Chainson et al, 2011). For effective teaching to take place, the skillful mathematics teacher needs to adapt many different strategies of teaching. A well formulated teaching method would yielded teaching and learning effective. This study therefore attempts to explore avenues through which teaching of Geometry in public secondary schools can be made more effective. This implies the use of cooperative learning which according to Slavin (1990); is one of the many teaching methods which result in positive effect and retention of information among students. Performance can be defined as the quality of results produced by students as reflected in the quality of their examination scores (Musa, 2000).

Retention on the other hand as defined by Kudu & Tutoo (2002) is a preservative factor of mind. The mind acquires the materials of knowledge through sensation and perception (Chianson et al, 2011). These acquired materials in mind need to be preserved in form of images for knowledge to develop. If a stimulating situation happens retained images are restored to make memorization possible. Hence geometry concepts need to be presented to the learners in a way or method that touches sub-conciousness which can trigger quick recalling of the concepts being taught or learnt (Chainson et al, 2011). According to the authors, using cooperative learning method yield promotive understanding, explanation and retention of geometric concept being learnt by the students.

Theoretical Frame Work

The theoretical basis of this study is cooperative learning as proposed by Vygotsky. Its roots therefore lie deep in learning theories. Cooperative learning is developed by social constructivists. The proponent of Social constructivist theory is Piaget (Nguuma, 2010). Social constructivist theory is a learning approach which argues that individuals can learn best when they actively construct knowledge and understanding through interaction with others (Cam, 1995; Santrock, 2004). Emphasis in cooperative learning is therefore, given to interactions rather than actions of individuals (Nguuma, 2010). Scholars define cooperative learning in different ways some of these scholars include: Yi-wen (1999) who defined cooperative learning as a kind of learning strategy in which students study together and complete common goals.

Cooperative learning strategy (CLS) could therefore be understood as a small group of learners working together to achieve common educational objectives. Each student contributes his/her own efforts in small groups to promote one another's performance. Mckeachie (1999) explains that in a cooperative learning class, students often elaborate on the concept being taught to achieve what is expected.

Elaboration provided from one student to another is a win/ win situation (Chianson et al, 2011). According to the authors elaboration not only enhances the learning of student who receives the explanation but also deepens the understanding of student providing the explanation. Hence, consistent and continues elaboration or explanation of a topic brings complete retention of a topic being learnt for a longer period of time.

Therefore, if this method (**CLS)** is to be adopted to guide students in geometry construction of JSS III there might be good performance and complete retention ability of the concept been taught. Construction means practical formation of a figure or object by putting together the combinations of lines and arcs. For a construction of a figure to be effective, the students must to put the following instruments in his position such as: a sharp pencil, a straight ruler, a fresh eraser and a pair of compasses. In every construction of a figure there must to be a starting point or a line AB often which a construction may be developed. There is no complex construction in JSS construction contents. The contents of JSS III construction include: construction of line, construction of parallel line, construction of perpendicular line, construction of angle 60^0, bisection of angle 30^0, construction of angle 90^0 and bisection of angle 45^0.

In view of this therefore, Cooperative learning was reported as effective in the teaching and learning of mathematics at various part of the world. For instance, a Meta analysis of cooperative learning methods indicated that in the world, one thousand (1000) studies have been conducted in cooperative learning (Iqbal, 2004). Out of these studies only few have been conducted in Nigeria. Specifically, in Sokoto, no single study has attempted to investigate the impact of cooperative learning strategy in geometry construction of JSS III among junior secondary schools. Therefore, this study is designed to justify the application of cooperative learning strategy in Geometry construction, to see if it can facilitate and improve the performance and aids students in retaining the concept of geometry construction.

Statement of the Problem

Despite the relative importance of mathematics in science and information based courses as well as in medicine and social sciences, students' performance in the subject in both internal and external examinations has remained consistently poor (Adolphus, 2011). According to him mathematics educators are trying to identify the major problems associated with the teaching and learning of mathematics in the nation's schools. Despite all these noble efforts, the problem of poor performance in mathematics has continued to surface in nation's public examinations. Even though scholars viewed geometry as the most difficult aspect of mathematics such as (Nguuma, 2010; Adolphus, 2011). Researchers also conducted studies in geometry, some of them include Chainson, Krumeh and Obida (2011) who worked in circle geometry at Benue State with cooperative learning as the strategy of teaching and found the strategy very effective.

Yet retention of students in geometry in Nigeria schools is generally poor. Many students especially in the study area have fear and lack of interest for mathematics; they shun away from mathematics classes, paid little or no attention to lessons and as a result, continue to experience difficulties in answering questions, particularly in geometry and Mathematics in general. Therefore, they have very poor performances and retention in terminal and promotional examinations. To corroborate the above statement West African Examination Council (WAEC) Zonal coordinator reported that 80% of candidates that sat for the WAEC examination in the year

2012/2013 failed mathematics. This agrees with the report of registrar and chief executive of National Examination Council (NECO) who said that 71.92% of candidates who registered for further (additional) mathematics in the examination failed the subject. The following table concretized all the above reports about poor performance of students in mathematics.

Table 1.1 Performance of Students in Mathematics in WAEC from 2002-2011

Years	Total	Percentage with credit and above (%), (A1-C6)	Percentage with pass and bellow (%) (D7-F9)
2002	9082235	34.06	65.93
2003	1024451	36.83	58.84
2004	1019524	33.97	62.63
2005	1054853	38.20	59.77
2006	1149277	41.12	56.04
2007	1249028	46.75	50.96
2008	1268213	57.27	41.06
2009	1348528	47.04	48.97
2010	1306535	41.95	55.05
2011	1508965	40.35	59.39

Source: WAEC (2014).

The Table above showed poor performance of students in mathematics through all the years. Indeed, the observed poor performance in mathematics in general and geometry in particular required an effective strategy of teaching (Chainson, Krumeh and Obida, 2011). This without any argument cooperative learning was reported as effective strategy of teaching mathematics at various places (Johnson & Smith, 1998). Hence, in an attempt to possibly promote the performance and retention and equally solve the problem of poor performance of students in geometry at JSS III in Sokoto metropolis, impact of cooperative learning strategy on performance and retention in geometry among junior secondary school students in Sokoto metropolis is proposed in our own setting to see if it could address this problem.

Objectives of the Study

The objectives of the study are to:

1) Assess whether or not cooperative learning improve retention ability of male and female students in geometry construction of JSS;

Research Question

The following research questions guided the conduct of this study:

1. What is the effect of CLS on mean retention scores of male and female students taught geometry construction using cooperative learning strategy and those taught with lecture method?

Hypothesis

To achieve the objectives of this study the following null hypotheses were formulated and tested at 0.05 level of significance:

H_{01}: There is no significant difference in the mean retention scores of male and female students taught geometry using cooperative learning and those taught using the lecture method.

Significance of the Study

The significance of this study lies in its potentiality of addressing key issues to the teaching and learning of mathematics as a compulsory discipline as well as being it prerequisite for further education. This study is significant for the following reason:

This study will be of tremendous assistance to all involved in the teaching and learning process. Specifically, it is hoped that this study would be of help to the mathematics teachers. It is hoped to provide a more efficient method of teaching mathematics considering the worldwide reports about the capability of cooperative learning strategy. It is hope to promote students personal relationship as they relate with one another during lessons' periods and equally enable the slow learners to learn from the past learners in the group. Others that may find this study significant include: National mathematical Centre who train and retrain mathematics teachers to refresh and update their mathematics teaching and learning skills. In another way, It is hoped that this study would assist the stakeholders in curriculum development and decision making in the area of mathematics curriculum development, in particular, the Nigerian Educational Research and Development Council (NERDC), who are in charge of curriculum development in Nigeria.

The result of this study may also provide curriculum planners necessary information that may be importance when curriculum review is needed. The curriculum planners may use the result to measure students' performance in achieving the set objectives of JSS III mathematics curriculum. On the other hand, professional bodies and associations such as: Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigeria (STAN) and National Mathematical Society of Nigeria (NMS), would also be beneficiaries of this study as their members meet annually to review and update their members' knowledge in current researches in the field of mathematics education.

Fellow researchers might also find the study valuable from the design, method and the research gap been identified for their further study in the field. Text book publishers may also find the study valuable as they consider good methods of teaching when writing text book.

The problem areas of the students identified from this study would serve as a vehicle for further research work, the result of this study may further show how to overcome the difficulties.

Scope of the Study

In this study, the researcher investigated the impact of cooperative learning strategy on performance and retention among junior secondary school students in Sokoto metropolis only. Strictly, public junior coeducational secondary schools (JSS) III in Sokoto metropolis were considered during the research. The choice of JSS III was because; they are the students preparing for Junior Leaving Certificate (JLC) examination. Federal government and private junior secondary schools in Sokoto metropolis were also excluded in this study, because they are not under the same regulatory body. Construction contents of JSS III were precisely considered only, these include: construction of line, construction of perpendicular line, construction of angle 60^0, bisection of angle 30^0, construction of angle 90^0, bisection of angle 45^0. The reason for choosing geometry construction was because it was identified as one among many difficult areas in mathematics as a result of these difficulties; students are consistently failing mathematics in general. Johnson and Johnson model of CLS was adopted in this study.

Literature Review

Chiason, et al (2011) investigated the effects of cooperative learning strategy on student's retention in circle geometry in secondary school in Benue State Nigeria. They found that cooperative learning was found to be more effective in the learning of circle geometry in terms of retention; this implies that the student in the cooperative learning group maximized the rules binding on the successful implementation of cooperative learning. Feglengve and Grabosk, (2006) investigated the effect of cooperative learning in game playing for mathematics, cooperative or not? Their finding has showed that mathematics game playing context using cooperative learning strategy promote understanding and retention in the learner. Toumasis (2004), Investigated the effects of cooperative learning, in study teams in mathematics. He was however, convinced that cooperative learning helped effectively. Artut (2010) investigated the effect of cooperative learning in a parameter evaluation of the effects of cooperative learning on kindergarten children mathematics ability. His findings showed that cooperative learning methods can be applied to any academic level in mathematics concept from kindergarten to colleges and it promotes positive effect in the learner.

METHODOLOGY

Introduction

This study attempted to examine the impact of Cooperative Learning strategy on Performance and Retention in Geometry among Public Senior Secondary School Students in Sokoto Metropolis. The focus of this chapter however, was discussed in the following sub-headings:

Research Design

The design for this study was qausi-experimental-control group design adopting Pretest, post-test, and post posttest. According to Tuckman (1975) Quasi experimental design is partly but not fully true- experimental design it controls some but not all of the sources of internal validity. Quasi experimental design involves selecting groups, upon which a variable is tested i.e.

intact class (Shuttleworth, 2008). It is possible that school system may not accept new programs for testing on an experimental basis, may not allow intact classes to be disrupted or divided to provide for random or equivalent samples, may not allow for a treatment to be given to some and withheld from others. Pretest-posttest and post posttest were given to both experimental and control groups only that it was the experimental group that was exposed to cooperative learning strategy while control group was taught with lecture method. The same instrument Geometry Construction Performance Test (GCPT) was used for pretest, posttest and post-posttest. This was diagrammatically illustrated as follows:

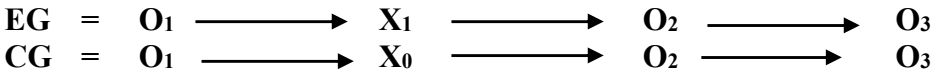

Figure 3.1: Research Design illustration

Population

The study area consisted 10 public coeducational junior secondary schools in Sokoto metropolis which together sums up to a total of four thousand and fifty eight (4058) JSS III students. The average age of the population was 15 years. Two thousand four hundred and three (2403) male and one thousand six hundred and fifty five (1655) were female which all together sums up to four thousand and fifty eight (4058) JSS III students. Sokoto metropolis cut across five local government areas of Sokoto state namely: Sokoto South, Sokoto North, Kware, Dange Shuni, and Wammako local governments. The reason for using coeducational schools was because the researcher was looking for the significant difference between male and female students in geometry construction. Table 3.1 shows the details of population in their representative schools.

Sample and Sampling Technique

Out of 10 schools in the population, two schools were purposively selected. Purposive sampling technique was proposed here to enable the researcher to reach the targeted sample quickly. The sample schools include: GDSS Mabera with 402 students and GDSS Arkilla with 240. Allocation of schools in to experimental and control groups were done by the flip of a coin (Abakpa & Igwue, 2013). All the students that chose head became experimental group while students that chose tail remained control group; this was merely for the convenience of the researcher. Hat and draw sampling technique was used to draw one class from each school, to serve as Experimental and Control groups which all together sums of to three hundred and fifty four (354) students, 207 males and 147 females students out of 4058 students from the population which correspond to (Krejecie & Mogan, 1970). The following Table 3.2 shows the presentation of sampled students in their respective schools.

Instrument

The instrument used in this study was Geometry Construction performance Test (GCPT). Adopted from Aminu Isah (2014). It is 30 multiple choice objective test.

Data Collection procedure

The data was collected through pretest, posttest and post-posttest. pretest was conducted before the treatment to establish the homogeneity among the students under investigation, posttest was administered after the treatment of 5 weeks period to see the impact of the treatment among the students under investigation while post-posttest was administered after two weeks of posttest to see the retention ability of students under investigation.

DATA ANALYSES, RESULTS AND DISCUSSIONS

Introduction

The aim of this study was to investigate the experimental evaluation of cooperative learning strategy on retention ability between male and in geometry construction among junior secondary schools students in Sokoto metropolis. In this chapter, data collected were analyzed as follows: The pre-test was employed to establish the homogeneity among the students before the treatment. Descriptive statistics inform of mean and standard deviation was used to analyze the data and inferential statistics employing independent t-test was used to answer the research hypotheses.

Research Questions Analysis

The data collected using geometry construction performance test (CGPT), in this study was analyzed. Descriptive statistics employing Mean and standard deviation were used to answered the research questions, while at 0.05 level of confidence, inferential statistics adopting independent t-test statistics was used to test the research hypotheses of the study.

Research Question

Table 2: Shows Mean and Standard Deviation Retention Scores of Male and Female Students in Experimental Group in Post-Posttest.

Gender for Exp.	N	$\overline{X}$	S	Mean Diff.
Male	67	24.21	9.16	2.24
Female	66	21.97	5.91	

Table 2, Shows the mean and standard deviation retention scores of male and female students in post posttest as 24.21 and 9.16 for male and 21.97 and 5.91for female in experimental group. This shows that, male students who were guided with cooperative learning strategy retained higher than their counter part females students taught with the same method. This shows that male students were guided with cooperative learning strategy retained higher than their counterpart female.

Hypotheses Testing

At 0.05 level of confidence, four null hypotheses were tested in this study, one tested the significant difference of the mean performance scores of students taught geometry construction using cooperative learning and students taught with the lecture method. Two tested the significant difference of the mean retention scores of students taught geometry construction using cooperative learning and those taught with the lecture method. Three tested the significant difference of the mean performance of male and female students taught geometry construction using cooperative learning and those taught using the lecture method. Four tested the significant difference of the mean retention scores of male and female students taught geometry construction using cooperative learning and those taught with the lecture method. Inferential statistics employing Independent t-test statistics was adopted and analyzed the data as shown in the following Tables.

Ho_1: There is no significant difference between the mean retention scores of male and female students taught geometry using cooperative learning strategy and those taught using lecture method.

Table 3: t- test analysis of Mean Retention Scores of Male and Female Exposed to CLS.

Post-post test	N	$\bar{x}$	S	Df	t_{cal}	t_{crict}	P	Remark
Male	67	24.21	9.16	131	1.67	1.64	0.01	**Significant**
Female	66	21.97	5.91					

- Significant at $P \leq 0.05$

Results of Table 2, shows that, at $\alpha = 0.05$ level of significance, $t_{cal.} = 1.67 > t_{crict.} = 1.64$, at df = 133, this shows that there is significant difference in the mean retention ability scores of male students guided geometry construction using CLS over their counterpart female guided with the same CLS. The null hypothesis of no significant difference in the mean retention ability scores of male student guided geometry using CLS and their counterpart female guide with the same CLS, is therefore rejected. Therefore, the use of CLS enhanced the retention ability of male students in geometry construction of JSS III over their counterpart guided with the same CLS at JSS III geometry construction.

Findings of the Study

It has found in this study that male students guided with CLS retained more than female students guided with CLS.

Discussion

A t-test analysis was conducted to assess the experimental evaluation of cooperative learning strategy in retention ability in geometry construction among male and female JSS III

students in Sokoto metropolis. the scores on geometry construction performance test (GCPT), which were administered before and after the completion of treatment as well as after two weeks, scores from pre -GCPT was used to establish homogeneity among the students. The findings of Table 2, shows that the two groups of students were equivalent before the treatment. But the findings of Table **3** shows that, male students had a higher post- posttest mean retention scores in geometry construction of JSS III than the female students guided with CLS , this shows that male students in guided with CLS retained better than the female students guided with CLS.

The findings of this study buttressed the earlier findings of : Toumasis (2004), Feglengve and Grabosk, (2006), Artut (2010) and Chiason, et al (2011). These all showed that male students guided with CLS have greater retention ability than their counterpart female guided with CLS.

Recommendations

This study shown that cooperative learning strategy, found effective and has a positive impact on male students over their female students guided with the CLS in academic performance in geometry construction, therefore, the following points are recommended:

1. Cooperative learning strategy should be adapted by mathematics teachers, to teach concepts in mathematics and ensure that the best requirement of cooperative learning is utilized towards the teaching of mathematics.

Conclusions

The findings of this study supported the earlier findings on CLS. As a result of student team, they were able to create a new learning experience for themselves. Through the study, the researcher was able to notice that for a successful cooperative learning strategy, the following points are of paramount importance:

1. Adequate class rooms for conducive learning
2. Enough time for wider discussion of topics
3. Shared equal delegation of power

Based on the empirical evidences presented, male students in the cooperative learning strategy has performed more than the male students in the lecture method. Despite the treatment given, many problems were noticed and further recommendations were suggested. In summary therefore, this study has shown that, cooperative learning strategy has a very formidable role to play in learning of mathematics in general and geometry in particular. My future researchers would surely benefit from this study carrying out more investigations that would improve the teaching and the learning of geometry construction.

Contribution to the Knowledge

The contributions of this study to the exiting knowledge are:

1. Use of CLS enhances the teaching of geometry construction at JSS level.

2. It has been established by the researcher that CLS can be used to promote performance of male students over their counterpart male taught by CLM.

Conclusion

The findings of this study support much of the existing knowledge on cooperative learning strategy. However, any cooperative learning program customized to suit the curriculum, teachers and students. It has been found in this study also, as a result of student interaction in the group, students were able to create a new learning experience for themselves. Through the study, the researcher was able to notice that for a successful cooperative learning strategy, the following points are of paramount importance:

4. Adequate class rooms for conducive learning
5. Enough time for wider discussion of topics
6. Shared equal delegation of power

Based on the empirical evidences presented, cooperative learning strategy has gained more than the lecture method and enhances the performance and retention of students in mathematics. Despite the treatment given, many problems were noticed and further recommendations were suggested. In summary therefore, this study has shown that, cooperative learning strategy has a very formidable role to play in learning of mathematics in general and geometry in particular. My future researchers would surely benefit from this study carrying out more investigations that would improve the teaching and the learning of mathematics.

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