IMPACTS OF JIGSAW II CO-OPERATIVE LEARNING STRATEGY ON ACADEMIC PERFORMANCE IN MENSURATION AMONG SECONDARY SCHOOL STUDENTS IN KANO STATE, NIGERIA.

By

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Abstract

This study investigated the impact of Jigsaw II cooperative learning strategy on students' academic performance in mensuration concepts among senior secondary school students in Kano state, Nigeria. The study adopted the Quasi-experimental non-randomized pre-test-post-test control group design. The target population of the study was all SSI students of public secondary schools in Kano state, totaling 69,736 from which four (4) intact classes from four schools were selected using random sampling technique. Two intact classes with 82 students were randomly assigned to experimental group and the other two with 77 students assigned to control group. Thus, the sample size was 159 SS1 mathematics students. In this study, two (2) research questions were raised and answered. Also, two (2) hypotheses were formulated and tested at 0.05 level of significance.. The instrument used for the study was Geometry Achievement Test (GAT). GAT was constructed by the researcher and contained 30 multiple choice items. Using split-half method, the reliability coefficient of GAT was 0.74. GAT was used as pretest and as posttest, after reshuffling some of the items. Both experimental and control groups took GAT as a pre-test before the experiment started. Experimental group was then taught mensuration concepts for six (6) weeks by using jigsaw II co-operative learning strategy while the control group was taught the same topic for the same period using conventional lecture method, after which GAT was taken by both groups. Data collected was analyzed using mean, standard deviation and t-test statistic. Findings showed that the mean performance score of the experimental group was significantly higher than that of the control group. In terms of gender, findings revealed that there was no significant difference between the mean performance score of male and female students when taught using jigsaw II co-operative learning strategy. Therefore, the strategy is gender- friendly It is recommended that Mathematics teachers should endeavor to employ JigsawII co-operative learning strategies in mathematics classrooms.

Keywords: Jigsaw II Co-operative Learning Strategy, Mensuration, Performance.

Introduction

Mathematics is primarily concerned with ideas, processes and reasoning leading to the solutions of problems. It is widely recognized as a necessary tool for achieving the development goals of any society. This is because the development of any nation depends on her scientific and technological advancements. However, there can be no science and technology without mathematics (Musa, 2006). The application of mathematics cuts across all areas of science, technology, commerce, agriculture, health, etc. It is in recognition of this importance that mathematics is made one of the core subjects that students must study at both basic and post-basic levels of education. Mathematics education, therefore, is indispensable to both individual and national development.

Mensuration is an area in geometry which deals with measurement of an object for the purpose of comparing its size with some standard units (Odili,2006). Further, Musa and Bolaji (2015) defined mensuration as a science of numerical representation of geometrical magnitudes. These measurements can be linear mensuration such as lengths, area

mensuration or volume mensuration .Mensuration is very important because most of the objects human being deals with, have some shapes that possess either area or volume. Odili (2006) emphasized that we live in 3-Dimensional space that has volume. Thus, mensuration can be regarded as the backbone of the study of geometry.

However, despite the importance of Mathematics to the individual and the society, literature review constantly reveals persistent low students' performance at all levels. For instance, Eniayeju and Azuka (2010) lamented that statistics from West African Examinations Council (WAEC) indicated that from 2000 – 2009, less than 40% of Nigerian students obtained credit passes in mathematics in each of the 10 years in SSCE.

Poor performance in mathematics is also evident among Kano state senior secondary school students. Data collected from Kano Educational Resource Department (KERD) revealed that unprecedented number of Kano state students persistently performed poorly in SSCE in mathematics. (see Appendix A).

The implication of the information contained in Appendix A is that from 2005 – 2013, the highest percentage of Kano state students that qualified for admission into science and technical courses in Nigerian universities is approximately 30% with some years having less than 5%. This is because of lack of credit pass in mathematics. This is quite alarming.

Specifically, researchers reported poor academic performance in mensuration aspect of geometry due to students' and even teachers' perceived difficulty in teaching and learning the area (WAEC, 2005; Idehen, 2012; Musa and Bolaji, 2015;). Musa and Bolaji (2015) cited WAEC Chief Examiners' Report (2003 -2012) which consistently indicated candidates' lack of skill in answering questions in geometry of 3-dimensional shapes. As for teachers, Idehen (2012) showed that teachers had misconception about the differences between a cube and a cuboid and seemed not to understand the best description of a cube. It is this misconception that teachers pass to students in a geometry class that leads to wrong solution of geometry problems.
This clearly showed that mensuration aspect of geometry remains a difficult area among senior secondary school students.

Various factors responsible for students' poor performance and retention in geometry and mathematics generally have been identified by researchers in mathematics education. These include lack of enough and qualified teachers, inadequate instructional materials, large class size and poor students' background. However, other findings have revealed that the most important factor is the use of poor teaching strategy in teaching mathematics (Obioma, 2011; James & Taiwo, 2011).

Empirical evidences (Bolaji, 1999; Azuka, 2009; Adewunmi, 2012) have indicated that traditional lecture method still remains popular among secondary school mathematics teachers.
In the traditional method, the teacher dominates the class with little opportunity for students to participate. Teaching mensuration aspect of geometry is not an exception in this regard. This shows that much is needed in the area of teaching and learning of mensuration aspect of geometry in order to actualize the desired goals by applying and exploring other innovative methods. One of these innovative strategies is the co-operative learning. There are various versions of co-operative learning; one of them is known as jigsaw II co-operative learning strategy.
Jigsaw II co-operative learning strategy is an instructional strategy in which small groups, each with students of different ability levels, use variety of learning activities to improve their understanding of a lesson. The Jigsaw II cooperative learning strategy is an efficient way for

students to learn classroom material. The process encourages students to listen and be engaged in a group setting. Just like a jigsaw puzzle, each member of the group plays an essential role in their group. What makes this strategy so effective is that group members work together as a team to achieve a common goal. Students are not able to succeed unless everyone works together (Chan, 2004). In this strategy, each student is a member of two groups (jigsaw or home group and an expert group). In the jigsaw or home group, students are assigned separate portions of the material to be learnt. Each member in the home group is asked to focus on reading one portion of the material. Upon finishing the reading, students who read the same portion of the material come together to form an expert group to discuss their assigned portion. After the discussion, group members go back to their home group to teach what they have learnt in their expert group to other members. After mastering all the sub-topics taught by each expert, individual group members take a short quiz. Individual score is compared with the base score to calculate the individual improvement score, based on which a group's average improvement score is worked out. The group having the highest average group improvement score is given group recognition by getting a group reward. Alternatively, a group which has its average group improvement score reaching a pre-determined level can receive a group reward. Thus, each member learns and helps his mates to learn since the success of a group member is the success of all members.

Moreover, scholars have observed and reported the problem of gender disparity in the students' performance in geometry and participation in mathematics (Amali, Ojogbane and Akume, 2004; Ebisine,2010; Haruna, 2012). Researchers in mathematics education have attributed gender performance differences in mathematics to the instructional strategies employed by teachers   (Amali, Ojogbane & Akume, 2004; Kurumeh, 2006).
Researches on jigsaw II co-operative learning have been conducted in various subject areas (Chan, 2004; Zakaria, Solfitri, Daud and Abidin, 2013; Gambari, Shittu and Taiwo, 2013; Gambari, Olumorin and Yusuf, 2013). But none of these studies was focused on mensuration and none was conducted in Kano state, despite the fact that performance in Mathematics in the area has been consistently low.

Therefore, the present study was designed to investigate the impacts of jigsaw II co-operative learning strategy, for possible improvement in academic performance and gender performance in mensuration aspect of geometry in Kano state.

Statement of the Problem

The researchers observed that students' performance in mathematics qualifying examination (Mock SSCE) conducted by KERD and even SSCE conducted by WAEC and NECO has been consistently very poor in Kano State (refer to Appendix A for evidence). As one of the examiners in qualifying examination and SSCE, the researcher observed that students rarely answer or totally avoid attempting questions on mensuration aspect of geometry. Where they even make attempt, they fail or score very low.

Based on the identified students' difficulties in mensuration aspect of geometry, the researchers are of the view that most teachers failed to deliver the geometry content they want to teach because of the use of inappropriate and irrelevant instructional strategy. This, among other factors, immensely contributes to students' poor performance in geometry and Mathematics generally. This calls for the urgent need to explore and apply other effective instructional strategies that have been found to improve performance in some other environments.

Therefore, this study investigated the impacts of Jigsaw II co-operative learning strategy in order to determine its effects on students' performance and gender performance difference in mensuration at senior secondary school level in Kano State, Nigeria.

Objectives of the Study
The objectives of the study are to:
1. investigate the impact of jigsaw II co-operative learning strategy on performance in mensuration aspect of geometry among senior secondary school (SSS) students in Kano state.
2. determine the effect of jigsaw II co-operative learning strategy on gender performance in mensuration aspect of geometry among SSS students in Kano state.

Research Questions
In order to achieve the objectives of the study, the following research questions were formulated:
1. What is the difference between the mean performance scores of students taught mensuration concepts using jigsaw II co-operative learning strategy and those taught using the conventional lecture method?
2. What is the difference between the mean performance scores of male and female students when taught mensuration concepts using jigsaw II co-operative learning strategy?

Null Hypotheses
The following null hypotheses were tested at 0.05 level of significance to guide the study:
HO$_1$: There is no significant difference between the mean performance scores of students taught mensuration concepts using jigsaw II co-operative learning strategy and those taught using conventional lecture method.
HO$_2$: There is no significant difference in the mean performance scores of male and female students taught mensuration by jigsaw II co-operative learning strategy.

Methodology
The target population of the study was all SSI students of public secondary schools in Kano state, totaling 69,736 from which four (4) intact classes from four schools were selected using simple random sampling technique. Two intact classes with 82 students were randomly assigned to experimental group and the other two classes with 77 students assigned to control group. Thus, the sample size was 159 SS1 students. This sample is considered viable for the study because of the fact that central limit theorem recommended 30 subjects as the minimum and sufficient sample size for experimental studies (Sambo, 2008). The study adopted the quasi-experimental non-randomized pre-test-post-test control group design. The instrument used for the study was Geometry Achievement Test (GAT). GAT was constructed by the researchers and contained 30 multiple choice items. Using split-half method, the reliability coefficient of GAT was 0.74. GAT was used as pretest and as posttest, after reshuffling some of the items. Both experimental and control groups took GAT as a pre-test before the experiment started. Experimental group was then taught mensuration concepts (Surface area and volume of 3-D shapes) for six (6) weeks by using jigsaw II cooperative learning strategy while the control group was taught the same topic for the same period using conventional lecture method, after which GAT was taken by both groups. Lesson plan was developed and used to teach the control group. On the other hand, jigsaw II co-operative

teaching strategy guide as well as expert sheets for expert group discussion were designed by the researchers and used to teach the experimental group. Data collected was analyzed using mean, standard deviation and t-test statistic.

Results

Research Question 1: What is the difference between the mean performance scores of students taught mensuration concepts using jigsaw II co-operative learning strategy and those taught using the conventional lecture method?

In order to answer the research question 1, descriptive statistics of mean and standard deviation were used.

Data on the performance scores (GAT scores) of experimental group and control group in mensuration concepts is presented in Table 1:

Table 1: Mean and Standard Deviation of Posttest Scores of Experimental and Control Groups

Group	N	$\overline{X}$	SD	Mean Difference
Experimental (Jigsaw II)	82	28.54	5.72	
				9.04
Control (Lecture)	77	19.50	4.32	

The results on Table 1 showed that the experimental group exposed to jigsaw II co-operative learning had a mean of 28.54 with standard deviation of 5.72 while the control group taught using lecture method had a mean of 19.50 with standard deviation of 4.32 in the GAT. Therefore, the difference between the mean performance score of the experimental group exposed to jigsaw II co-operative learning and control group taught using conventional lecture method is 9.04 in favor of the experimental group.

Research Question 2: What is the difference between the mean performance scores of males and females when taught mensuration concepts using jigsaw II co-operative learning strategy?

Data on the performance scores (GAT scores) of males and females students taught mensuration concepts using jigsaw II co-operative learning strategy is presented in Table 2:

Table 2: Mean and Standard Deviation of Posttest Scores of Males and Females in experimental group

Gender	N	$\overline{X}$	SD	Mean Difference
Male	40	27.55	6.07	
				2.02
Female	42	29.57	5.14	

From Table 2, it can be seen that male students taught mensuration concepts using jigsaw II cooperative learning strategy had mean performance score of 27.55 with standard deviation of 6.07 while female students taught by jigsaw II co-operative learning had mean performance score of 29.57 and standard deviation of 5.14. Therefore, the difference between

the mean performance scores of males and females taught mensuration concepts using jigsaw II co-operative learning strategy is 2.02 in favor of the female students.

In order to ascertain whether the observed mean differences were significant, the formulated null hypotheses were tested at 0.05 level of significance using t- test statistic as follows:

HO$_1$: There is no significant difference between the mean performance scores of students taught mensuration concepts using jigsaw II co-operative learning strategy and those taught using conventional lecture method.

The summary of t – test analysis of the mean scores of experimental and control groups in posttest (GAT) is presented in Table 3:

Table 3: Summary of t-test Analysis of the Mean Performance Scores of Experimental and Control Groups in Posttest (GAT)

Group	N	X̄	SD	df	t – cal	P	Decision
Experimental	82	28.54	5.72				
				157	11.28	0.001	Significant
Control	77	19.50	4.32				

Table 3 revealed that calculated value of t is 11.28 and the P-value 0.001. Therefore, P – value of 0.001 is less than alpha value of 0.05. Based on this evidence, the null hypothesis was rejected. This implies that there was significant difference between the mean performance scores of students taught mensuration concepts using jigsaw II co-operative learning and those taught using conventional lecture method in favour of the Jigsaw II co-operative learning group.

HO$_2$: There is no significant difference in the mean performance scores of male and female students taught mensuration by jigsaw II co-operative learning strategy.

In testing HO$_2$, the mean performance scores of males and females in experimental group were analyzed using t-test at $P \leq 0.05$. Table 4 shows the summary of the t-test of the mean performance scores of the males and females in experimental group only.

Table 4: Summary of t-test Analysis of the Mean Performance Scores of Males and Females in Experimental Group in Posttest (GAT)

Gender	N	X	SD	df	t – cal	P	Decision
Males	40	27.55	6.07				
				80	-1.69	0.093	Not Significant
Females	42	29.57	5.14				

Table 4 revealed that the value of calculated t is -1.69 and the P – value is 0.093. This indicates that P-value of 0.093 is greater than 0.05 alpha - value. Based on this evidence, the null hypothesis was retained. This implies that there was no significant difference in the mean performance scores of males and females students in mensuration concepts when exposed to jigsaw II co-operative learning strategy.

Summary of the Major Findings

Based on the data analyzed in this study, the following were the major findings:

1. It was found that there was significant difference between the mean performance scores of the students taught mensuration concepts using jigsaw II co-operative learning strategy

and those taught using conventional lecture method. Students exposed to jigsaw II co-operative learning strategy performed significantly better than those exposed to conventional lecture method.

2. Although the mean performance score of females in the experimental group was higher than that of the males in the experimental group, yet, the findings revealed that the difference was not statistically significant.

Discussions of Findings

The study indicated the existence of significant difference between the performance of students taught using jigsaw II co-operative learning strategy and those taught using conventional lecture method in favour of those exposed to jigsaw II co-operative learning, as shown in Table 3. This implies that jigsaw II co-operative learning was more effective than conventional lecture method in teaching and learning mensuration aspect of geometry. This result further suggests that jigsaw II co-operative learning strategy could help to enhance students' understanding of mensuration concepts in mathematics more than the conventional lecture method. This finding agreed with the results of Gambari, Shittu and Taiwo (2013) as well as Zakaria, Solfitri, Daud and Abidin (2013) that jigsaw II co-operative learning improved students' performance in mathematics concepts. The superiority of jigsaw II co-operative learning over the conventional lecture method can be due to the fact that it is a strategy that helps each student to learn and helps his group members to learn by providing opportunity for dialogue and free debate on a task, which is not obtained in the conventional lecture method. Also, the difference could be attributed to the group reward feature in-built in the jigsaw II strategy which serves as motivation to perform better in subsequent lessons by earning higher improvement scores.

The results of this study (Table 4) also revealed that there was no significant difference in the performance of males and females exposed to jigsaw II co-operative learning, although the mean performance score of females was higher than that of the males. The findings showed that both males and females taught by jigsaw II co-operative learning performed equally as no significant difference was found in their mean performance score. This result is in line with those of Chianson, Okwu and Kurumeh (2010), Keramati, Tahmasbi, Rafat and Khashab (2011) as well as Gambari, Shittu and Taiwo (2013) who showed that gender had no effect on academic performance of students in co-operative learning. The finding also supports the view point of Hassan (2010) that gender differences in geometry performance were neither as marked nor always in favor of male students. The finding, however, debunked the results of Olson (2002) who found that females out-performed males when taught by co-operative learning and that of Khairulanuar, Nazre, Sairabanu and Norasikin (2010) who found gender difference in favour of male students when exposed to co-operative learning. This result indicates that jigsaw II cooperative learning favored both males and females in mensuration .aspect of geometry and the strategy is more effective in enhancing both male and female students' performance in Mathematics. This suggests that when teachers use the right strategies and activities, female students would learn equally as their male counterparts. It can also be deduced that jigsaw II co-operative learning strategy bridges the gap in Mathematics performance between male and female Mathematics students. It also indicated that female are wonderful in Mathematics when they are allowed to share ideas and interact freely among themselves.

Conclusion

The following conclusions were drawn from the findings of this study:

1. Jigsaw II co-operative learning strategy could effectively enhance and improve students' academic performance in mensuration aspect of geometry more than the conventional lecture method.
2. Gender was not a factor in learning mensuration concepts when jigsaw II co-operative learning strategy is employed. Therefore, the strategy is gender- friendly and could be used to bridge the gap in mathematics performance between boys and girls.

Recommendations

The following recommendations were made:

1. Mathematics teachers should endeavor to employ teaching strategies that are learner – centered like jigsaw II co-operative learning strategy in their classrooms.
2. Mathematics educators, professional associations in mathematics as well as mathematics textbook developers should incorporate jigsaw II co-operative learning procedures in their future publications for enhanced students' academic performance in mathematics concepts.

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