EFFECT OF JIGSAW COOPERATIVE LEARNING STRATEGIES ON STUDENTS' INTEREST AND PERFORMANCE IN MATHEMATICS AMONG JUNIOR SECONDARY SCHOOL STUDENTS IN KATSINA STATE – NIGERIA

IBRAHIM MUSA AHMAD
Department of Mathematics and Statistics
College of Science and Technology
Hassan Usman Katsina Polytechnic, Katsina
ibrahim.musaahmad88@gmail.com

Abstract
This study aimed at finding the effects of Jigsaw cooperative learning strategies on students' interest and performance in Mathematics. The study was Quasiexperimental Design. The target population for this study consisted of all the 4,276 J.S.S II students in Baure Zonal Education Quality Assurance of Katsina State. Purposive sampling technique was used to obtain a sample of two schools. The sample for the study was 100 J.S.S II students from the selected. The instrument used for data collection was "Mathematics Interest and Performance Test". The instrument was pilot tested and the reliability coefficient was 0.78. Data was analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance used to test the null hypotheses at 0.05 significant level. The result of the study show that there is significant difference in the mean performance scores of students in Mathematics taught using Jigsaw cooperative learning and conventional Strategies and there is significant difference in the students' mean interest scores in Mathematics taught using Jigsaw cooperative learning and conventional Strategies. The researcher concluded that JCLS is an effective teaching method, which Mathematics should be encouraged to use and should be implemented in all teacher education programmes in Nigeria.

Keywords: Jigsaw Strategy, Cooperative learning, Mathematics, Interest and Performance

Introduction

Jigsaw cooperative learning is a concept that grew out of the field of social psychology. Because of its unique characteristics and effectiveness, it is commonly adopted as a teaching strategy in special education whereby students engage in collaboratively designed activities to achieve a common goal or task. Various theories have been associated with cooperative learning; and they have framed the context in which cooperative learning serves as an intragroup learning method that is outcome oriented. For instance, social interdependence theory has contributed to the development of cooperative learning theory. Kurt Levin – in the mid-1930s – was one of the first to introduce the concept of group dynamics and to show how each individual in the group contributes to a common goal, thus becoming a dynamic whole. This theory was fully conceptualized by Morton Duetsch, in 1949. He is recognized as the theorist who fully conceptualized social interdependence theory and provided the fundamental concepts for cooperative learning. The primary principle supporting the theory is the notion that humans are primarily concerned with developing organized and meaningful views of their world by perceiving events as integrated wholes rather than a summation of parts or properties. As a result, individuals within a group rely upon each other

to achieve common goals. Deutsch penned two types of social interdependence: positive interdependence and negative interdependence. He referred to positive interdependence as the phenomena when individuals believe they can only achieve goals when there is an interactive group working toward a common goal. Negative interdependence exists when individuals believe they can accomplish goals only when their competitors fail to obtain their goals.

The cooperative learning strategy as used in education, generally – and, specifically, in special education – relies heavily upon the concept of positive interdependence. When operationalized, the social interdependence theory translates into a viable instructional method that requires the participation of several group members. The social identification theory is another theory that informs the cooperative learning-teaching strategy. This theory suggests that members of the group experience a collaborative awareness.

Interest is conceived by Beier & Rittmayer (2008) as a determinant of the valence components of expectancy-value models. It is a motivational variable that is linked with educational attainment in that students are more likely to engage in an academic activity, pay more attention, and generate higher performances if they are interested in the topic (Schunk, Pintrich & Meece, 2008). Moreover, it can be described as an important variable in learning Mathematics because when one becomes interested in an activity, one is likely to be more deeply involved in that activity (Okigbo & Okeke, 2011). Nevertheless, lack of interest in Mathematics has direct implications for student motivation to learn skills needed for accomplishing everyday tasks and for student involvement in science, technology, engineering, and Mathematics (STEM) disciplines, particularly for females (Amelink, 2012). Lower interest is closely related to lower performance on Mathematics-related achievement tests and lower grades in Mathematics. Less interest in taking challenging Mathematics curricula prior to enrolling in college and less interest in pursuing a career in science disciplines (Usher, 2009), with females at a higher risk (Usher, 2009). The low interest in Mathematics could also emanate from Mathematics anxiety and fear (Okigbo & Okeke, 2011).

One of such strategies is the Jigsaw. It is a cooperative learning technique in which students work in small groups of four to six (Aronson, 2008). Jigsaw strategy, according to Gregory (2013) can be used for students by giving them different materials and content to match different levels of readiness. Products, projects, or other authentic tasks and assessment that are expected from the group, based on their preferences and multiple intelligences, offer another way to differentiate. Empirically, Mbacho (2013) identified several factors attributed to the students' dismal performance and lack of interest in the subject to include: inadequacy of facilities in the schools like the text books, qualified teachers, poor attitude towards the subject by the students, teachers, gender stereotypes, lack of role models, and the instructional methods used by teachers. Alcock, et, Al., (2014) investigated two factors that predict students' achievement and behaviour in undergraduate Mathematics: gender and personality. They found that gender predicted students' achievement and behaviour when considered in isolation, but ceased to be predictive when personality profiles were taken into account. It was therefore submitted that personality provides the more productive lens through which to understand the behaviour of undergraduate Mathematics students. The findings relate to research emphasizing gender differences in Mathematics education, and suggest that researchers wishing to promote equity in participation at and beyond the undergraduate level should consider shifting their focus to individual differences in personality. In lieu of this, the authors feel that variance in students' interest at secondary school level can be revealed when Jigsaw-strategy is investigated. Besides, it is believed that Jigsaw instructional strategy is capable of enhancing student's interest at this level.

Timayi (2016) examined the Effects of Jigsaw Cooperative Learning Strategy (J4CLS) on Interest and Academic performance of Secondary School II Students in Geometry in Kaduna State, Nigeria. The study focused on solving the persistent low interest and poor performance of students in geometry at the senior secondary school level. The results obtained showed a significant difference in performance in favour of students exposed to the Jigsaw. Therefore this study is going to investigate the Effect of Jigsaw Cooperative Learning Strategies on Students' Interest and Performance in Mathematics among Junior Secondary School Students in Katsina State – Nigeria. According to Ali, Hukamdad, Akhter & Khan (2010), the conventional method of teaching Mathematics is based upon lessons employing lecture/questioning method to teach concepts of selected topics and depends on the teacher's explanations, discussions and textbooks. This view is supported by Ihedioha (2012) who asserted that the conventional teaching is concerned with the teacher being the controller of the learning environment. He postulated that power and responsibility are held by the teacher who doubles as instructor and decision maker. The teacher sees the students as having knowledge holes' that needed to be filled with information and believes he/she causes learning to occur, and classroom discipline is based upon fear.

Statement of the Problem

The issue of lack of interest and poor performance among students in Mathematics in secondary schools has continue to affect the academic performance of students in Mathematics despite the importance of the subject to nation building and development. Studies such as Iji et al (2014) and Charles-Ogan (2014) asserted that secondary school students' performance is less than 50 percent in Mathematics for the past decades. Also, the Chief Examiners report for WAEC (2009 - 2014) and NECO (2014) expressed worries over the low achievement of students in Mathematics.

The low performance and lack of interest among students in Mathematics is also observed by Kurumeh, Onah & Mohammed (2012) who asserted that it is a function of the instructional method adopted by the teacher. The instructional method employed by the teacher plays an important role in the acquisition of instructional content for meaningful learning and development of necessary skills. Nigerian secondary school classrooms are predominantly dominated by the conventional method of instruction, which does not encourage students-student's interaction. It is teacher-centered instructional methods that make students passive with less interaction. The lack of active participation of students in their learning was also indicted for students' poor performances in Mathematics (Gambari & Olumori, 2013).

Research in many areas of education has shown that the methods of teaching utilized by the teacher is an important factor in students' learning and subsequent performance in examinations (Obeka, 2014). Hence there is the need to try out other method to salvage the situation. Based on the above, this study investigated the effects of Jigsaw IV cooperative learning strategy on interest and academic performance of secondary school students in geometry in Kaduna State, Nigeria.

Objectives of the Study

The main aim of this study is to investigate the effects of Jigsaw cooperative learning strategy on students' interest ad performance in Mathematics. Specifically, the study is designed to achieve the following objectives;

1. To examine if there exist significant difference between the mean scores of students taught using Jigsaw cooperative learning and those taught using conventional strategies on interest in Mathematics.
2. To examine if there exist significant difference between the mean scores of students taught using Jigsaw cooperative learning and those taught using conventional strategies on performance in Mathematics.

Research Questions

The study is guided with the following research questions;

1) What is the difference between the mean scores of students taught using Jigsaw cooperative learning and those taught using conventional strategies on interest in Mathematics?

2) What is the difference between the mean scores of students taught using Jigsaw cooperative learning and those taught using conventional strategies on performance in Mathematics?

Hypotheses

The following null hypotheses were formulated to guide the study;

(1) There is no significant difference in the mean interest scores of students in Mathematics taught using Jigsaw cooperative learning and those taught using conventional strategies.

(2) There is no significant difference in the students' mean performance scores in Mathematics taught using Jigsaw cooperative learning and those taught using conventional Strategies.

Methodology

The study adopted the non-equivalent pre-test, post-test, control group design to verify the relative effectiveness of Jigsaw Cooperative Learning Strategy (JCLS) on students' interest and performance in Mathematics. According to Emaikwu, (2010) the non-equivalent pre-test, post-test, control group design is a type of quasi-experimental design. The choice of the design is because the researcher does not intend to distort the normal academic plan of the sampled schools. The target population for this study consisted of all the 4,276 J.S.S II students in Baure Zonal Education Quality Assurance of Katsina State during the 2021/2022 academic session in Katsina State (Source: Katsina State Ministry of Education, 2022). J.S.S II students are deemed best for the study because they are more stable than J.S.S I students who are newly admitted and J.S.S III students who are busy with preparation for Basic Education Certificate Examination (BECE). Thus, such involvement may be a distraction to their schedules. The sample consisted of 100 students in two intact classes in two selected secondary schools in Baure zonal education quality assurance of Katsina State using purposive sampling technique. The instrument used for data collection was a Mathematics Interest and Performance Test (MAIPT), which consisted of twenty structured multiple choice questions. The instrument was given to two experts in Mathematics Education in the Department of Science Education, Federal University Dutsinma, and Mathematics teachers to establish the face validity of the instruments. Their corrections were followed in selecting the items included in the instrument. Field testing was carried out by administering the instruments on some students from an intact class of a co-educational secondary school different from the selected schools used for the study. Test retest method was used to determine the reliability of the instrument. The reliability coefficient of the instrument was found to be 0.78. The researcher visited the chosen schools to seek for permission in using the students as well as some facilities in the schools. This was followed by the administration of the MAIPT as a pre-test, the experimental groups and control groups. Treatments were introduced to the experimental groups. Students in experimental groups were taught using the JCLS, while the control group were taught using the conventional strategies. Two topics (Cylinders and Cones) were taught concurrently in all the four schools using the appropriate treatment in each school for a period of two weeks. The research questions were answered using mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. This method helps to remove the initial differences among research respondents and to control the extraneous variables.

Results and Findings

Data were presented, analyzed and interpreted based on the research questions and hypotheses. In all cases, the decision rule is that null hypotheses are not accepted if the p-value is less than 0.05. On the other hand, hypotheses are accepted if the p-value is greater than 0.05.

Research Question 1

What is the difference between the mean scores of students taught using Jigsaw cooperative learning and those taught using conventional strategies on interest in Mathematics?

Table 1: Mean and standard deviation of students' mean interest scores in Mathematics taught using Jigsaw learning and those taught using conventional strategies.

Groups		Pretest	Posttest	Mean Gain
Jigsaw cooperative strategy	Mean	64.16	73.04	8.88
	N	25	25	
Conventional strategy	Mean	63.81	63.43	0.38
	N	25	25	
	Standard deviation	7.91286	5.78421	

Table 1 shows that the mean performance using JCLS and conventional strategies are 64.16 and 63.81 with the corresponding standard deviation of 7.91 during pretest. While during the posttest the mean performance for JCLS and conventional strategies are 73.04 and 63.43 with the corresponding standard deviation of 5.78. The Table further reveals the mean gain of JCL as 8.88, and conventional strategies 0.38. Thus, the experimental group achieved higher than the control group, meaning the use of jigsaw cooperative learning strategies enhance maximum interest than the conventional strategy.

Research Question 2

What is the difference between the mean scores of students taught using Jigsaw cooperative learning and those taught using conventional strategies on performance in Mathematics?

Table 2: Mean and standard deviation of students' mean performance scores in Mathematics taught using Jigsaw learning and those taught using conventional strategies.

Groups		Pretest	Posttest	Mean Gain
Jigsaw cooperative strategy	Mean	64.16	72.64	8.48
	N	25	25	
Conventional strategy	Mean	56.81	60.33	3.52
	N	25	25	
	Standard deviation	5.91	6.97	

Table 2 shows that the mean and standard deviation performance using JCLS and conventional strategies 64.16 and 56.81 with the corresponding standard deviation of 5.91 during pretest. While during the posttest the mean performance for JCLS and conventional strategies is 72.64 and 60.33 with the corresponding standard deviation of 6.97. The Table further reveals the mean gain of JCLS 8.48 and conventional strategy 3.52. Thus, the experimental group retains higher than the control group, meaning the use of jigsaw cooperative learning strategies enhance higher performance conventional strategy.

Hypothesis 1

There is no significant difference in the mean interest scores of students in Mathematics taught using Jigsaw cooperative learning and those taught using conventional strategies.

Table 3: ANCOVA test of students' mean interest scores in Mathematics taught using jigsaw cooperative learning and those taught using conventional strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Significance
Corrected Model	2171.655[a]	3	723.885	21.642	.000
Intercept	1509.910	1	1509.910	45.142	.000
Achievement pretest	966.493	1	966.493	28.895	.000
Groups	**418.671**	**2**	**209.335**	**6.259**	**.003**
Error	2307.906	69	33.448		
Total	359664.000	73			
Corrected Total	4479.562	72			

a. R Squared = .483 (Adjusted R Squared = 462)

Table 3 shows that F = 6.269 df 2; p=003. Since P-value of 0.003 is less than 0.05 the null hypothesis is accepted. This means there is significant difference in the mean interest scores of students in Mathematics taught using jigsaw cooperative learning and conventional Strategies.

Hypothesis 2

There is no significant difference in the students' mean performance scores in Mathematics taught using Jigsaw cooperative learning and those taught using conventional Strategies.

Table 4: ANCOVA test of students' mean performance scores in Mathematics taught using jigsaw cooperative learning and those taught using conventional strategies.

Source	Type III Sum of Squares	df	Mean Square	F	Significance
Corrected Model	2739.322[a]	3	913.107	25.321	.000
Intercept	2214.804	1	2214.804	61.419	.000
Achievement pretest	482.760	1	482.760	13.387	.000
Groups	**1313.650**	**2**	**656.825**	**18.214**	**.000**
Error	2488.185	69	36.061		
Total	353609.000	73			
Corrected Total	5227.507	72			

a. R Squared = .524 (Adjusted R Squared = .503)

Table 4 shows that F=8.21; df=2; p=.000. Since P-value (.000), is less than 0.05 the null hypothesis is accepted. This means that there is significant difference in the students' mean performance scores in Mathematics taught using jigsaw cooperative learning and conventional Strategies.

Discussion

The findings of the study revealed that there was no significant difference in the mean interest of Mathematics students before they were taught Mathematics using JCLS and the conventional strategies. This suggests that the two groups were quite homogenous at the start of the study. It implies that students used for the study have relatively equal background knowledge of Mathematics. The result of hypothesis

one which states that there is no significant difference in the effect of JCLS and the conventional strategies of teaching on students' academic interest in Mathematics showed that the two teaching strategy used have effect on the academic interest of the students in their groups as the post-test mean scores in each group are higher than the respective pre-test mean scores. This is an indication that the treatments given improved the interest of the students. The result also showed that the students in the JCLS group performed better than those in the CLS group and then the control group. This is in agreement with Olubodun (2016) who opined that JCLS improved the performance of Mathematics students, and Oluwatosin & Bello (2015) that JCLS is an effective tool for improving the performance of student in Physics.

Furthermore, the result of hypothesis two shows that student that were taught using jigsaw cooperative learning strategies perform more than those in the conventional class. This finding agrees with Olubodun (2016) who discovered that teaching with jigsaw cooperative learning strategies enhanced students to perform more. Also, Adodo. (2013) found out that jigsaw cooperative learning strategy is a potent strategy which increases students' performance, knowledge. This is because the method gives room for learners to participate, which enables them to understand and retain higher when situation demands. This method is in line with the Chinese adage which says when hear, I forget, when I see I remember but when I do I understand.

Conclusion

The study had been able to show that JCLS is more effective in improving the academic interest of students in Mathematics when compared to conventional teaching strategies, though the difference is not something worry about. This implies that JCLS has the capacity to help students associate ideas, think creatively, and make connections that might not be achievable in the conventional note taking strategy. Again, the approaches used in this study do not differ in the ways they enhance the performance ability of Mathematics concepts by learners. This implies that this could improve on the learners' performance ability in the same proportion. It therefore entails that JCLS would be one of the most effective learning strategies that could be employed by teachers to overcome many of the problems encountered in teaching and learning of Mathematics. In similar manner, JCLS could also be used to effectively teach and learn Mathematics but where the facilities needed for JCLS are available; it should be utilized to be able to obtain maximum output by learners.

Recommendations

Based on the findings of this study and the conclusion reached, the following recommendations are made:

1. Following the findings of this study that JCLS significantly improves learning, it is recommended that Mathematics teachers should adopt the strategy and other participatory strategies during instruction so that learners could be guided to learn meaningfully.
2. Mathematics teachers and researchers should gear their efforts towards understanding the characteristic, strength and weaknesses of the individual learners so as to help in designing the appropriate instructional programmes to meet their needs.
3. Seminars, workshops and conferences should be organized by the ministry of education for Mathematics teachers to educate them on how to implement jigsaw cooperative learning strategies in school.

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