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Effectiveness of Interactive Jigsaw Method in Enhancing Students' Achievement and Retention in Mathematics Concept of Quadratic Equation in Nigeria

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ABSTRACT

The methods used in teaching Mathematics have remained one of the challenges facing students' achievement and retention in the subject. Studies on under-achievement of students in Mathematics have shown that students experience difficulties in some branches of Mathematics as a result of the method of instruction used by most teachers. Hence the study investigated on the effectiveness of interactive jigsaw method of instruction on students' achievement and retention in quadratic equation in Anambra State. Specifically, the study objectives are to: Determine the mean achievement and retention scores of the students taught quadratic equation using interactive jigsaw method and those taught with lecture methods, determine the mean achievement and retention scores of male and female students taught quadratic equation using interactive jigsaw method. The study utilized a quasi-experimental, study design guided by four research questions and four null hypotheses. The sample size for the study comprised 300 SSS1 students (130 males &170 females). Experimental and control groups were randomly assigned (experimental males 70, females 89) while (control males 60 and females 81). Fifteen item Quadratic Equation Achievement Test (QEAT) which consisted of multiple-choice objective tests were developed by the researcher. It was based on the relative weighting of the topics in quadratic equation as contained in the SSS1 scheme of work and syllabus. QEAT reliability was established using Kudar Richardson 20 (KR-20) with coefficient of 0.98. The data collected were statistically analyzed using mean and standard deviation which answered the research questions while the null hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA). The findings of the study showed that the statistical mean effect for method (F (1,299) = 7.322, P=.003) and statistical mean effect for method (F (1,299) = 7.322, P=.000) on achievement and retention respectively were less than 0.05 level of significant set as bench mark for taking decisions, hence the null hypotheses were rejected. Also, the results from the study showed that the significant difference in gender (F (1,158) = 2.034, P= .051), (F (1,158) = 3.185, P= .006) were greater than .05 level of significant, the null hypotheses were upheld indicating that there was no significant difference in the influence of gender on students' mean achievement and retention scores when taught quadratic equation using jigsaw method. Based on the findings, recommendations were made that the use of interactive jigsaw method should be incorporated into teaching quadratic equation and all other topics in Mathematics in order to enhance students' understanding in Mathematics learning. The findings of this study made several contributions to the existing body of knowledge by demonstrating the use of interactive jigsaw method of instruction to improve male and female students' achievement and retention in quadratic equation compared to lecture method.

Keywords: Interactive Jigsaw Method, Mathematics, Academic Achievement, Retention, Quadratic Equation.

INTRODUCTION

Education is a process by which knowledge, skills and values are acquired, developed and transmitted from one person to another or from one generation to the next. Among the goals of Nigerian education as stated in the National Policy on Education (FGN, 2014) are the development of the individual into a morally sound, patriotic and effective citizen as well as the total integration of the individual into the immediate community, the Nigeria society and the world. Education cuts across many branches like Arts education, Vocational education, Social Sciences education and Science education among others for the general purpose of preparing people to lead personally and responsible lives.

Science education meaning education in Science, Technology and Mathematics (STM) is a branch of education which helps students to develop the understandings and habits of mind wherein they become compassionate human beings, able to think for themselves and to face life. Mathematics education which is a branch of science education is the practice of teaching and learning Mathematics as well as the scholarly research in the practice. Okeke, Okigbo and Okeke (2017) stated that emphasis on the need for education in every nation is incomplete if Mathematics education is not considered because it is the basis of all knowledge whether art, science and technology as well as commerce and its everyday applications.

Lending credence to the above assertion, Mathematics equips pupils with uniquely powerful tools to understand and change the world. These tools according to British National Curriculum (BNC) (2014) include, logical reasoning, problem solving skills and the ability to think in abstract ways. Mathematics is also considered important in terms of the interrelatedness and interconnectivity of its branches. The major branches of Mathematics include: Number & Numeration, Trigonometry, Statistics, Calculus, Number theory, Geometry, Mensuration, Topology and Algebra (Salman, 2017).

Among these branches of Mathematics, Salman (2017) remarked that Algebra (Quadratic Equation inclusive) serves as an opportunity gateway to higher studies that involve Mathematics. Quadratic equation which is a topic in Algebra is an algebraic equation of the second degree in x. Quadratic equation has numerous applications in physics, engineering, astronomy etc. yet most students find it difficult to learn and understand because of its abstract nature (Ajogboge 2021). Record from National Bureau of Statistics (NBS) (2020) indicated that the poor performance of students in Mathematics can be seen from the WAEC results from 2013-2022. Furthermore, the statistics from Anambra State Ministry of Education (ANSMOE) Examination division revealed that the failure rates of students in the Senior Secondary Certificate Examination (SSCE) in quadratic equation in the State in years 2018-2023 were 48.3%, 47.84%, 47.35%, 47.35%, 48.47% and 49.12%. To further buttress this point, Iketaku (2019) reported that the statistics from the West African Examination Council (WAEC) results for the past 7 years (2015-2021) showed that the percentage of students who answered algebraic equation questions correctly are within the average of 34.37%. Iketaku (2019) further asserted that enough time is not given to quadratic equation in the Mathematics. The method of teaching Mathematics especially algebra need to be revisited by the Mathematics teachers by using an interactive method which improves the learning of Mathematics. Mathematics is better learnt by student's involvement in the learning process.

Interactive exchanges are very important in classroom situation between teachers and students as well as students and students. Classroom interaction is the activity and process of expressing ideas or of giving people information. Interaction during the teaching-learning process could be verbal or non-verbal behaviors. It is a predictive teaching technique in Mathematics which refers to the whole range of activities and experiences through which the teacher, curriculum materials and the learners interact (Abe and Bello, 2019). Classroom interaction among students and teachers promotes involvement, enhances learning and motivates the students. It promotes a shift from teacher centered to student centered method. Awal (2020) indicated that teacher-student interaction through classroom discussion and other forms of interactive participation is fundamental to developing understanding and is related to students' interest, retention and achievement. In interactive method of instruction, learners are involved in the retrieval of information, understanding the information by integrating it with the existing knowledge and arrangement of the knowledge in order to produce a new or a desired learning.

Jigsaw is an interactive method which teachers can use to improve the interaction in the classroom. Interactive jigsaw method of instruction is a co-operative learning method that brings about both individual accountability and achievement of the team goals. Interactive jigsaw method involves group work, and each group has an assignment of putting parts of an assignment together to form a whole picture of the assignment. Interactive jigsaw method equips learners with skills, understandings, attitudes, habits and appreciations that will help increase their engagement through group work that facilitates learning. According to Nduji; Nwadikor; Keziah and Elejere (2022) jigsaw method is not a common teaching method in Nigerian secondary schools because it consumes more time than the conventional lecture method where teachers are more concerned with content coverage. Several studies as Khan; Khan and Ahmed (2019), Alori; Oghuvbu and Ozoro (2019) found that jigsaw interactive activities enhanced students' achievement and retention in quadratic equations than traditional mode of instruction. These were done with Mathematics in general and also not in Anambra state. The study wishes to determine the extent jigsaw can improve performance of students in algebra in WAEC in Anambra state.

Lecture method is the oldest method of instruction given by philosophy of idealism. It lays emphasis on the presentation of the content rather than methodology (Awal, 2020). In most cases, there are no rooms for asking and answering questions, hence the method is referred to as "chalk-and-talk" method of instruction (Ikwumelu,2019). FGN (2014) noted that the lecture method, though viewed as outdated, is one of the methods widely used in secondary schools. Omoike., Oviawe and Ibhafidon (2018) confirmed the popularity of lecture method among secondary school teachers on the basis that the method allows quick coverage of syllabus, consumes less time and can be used to teach large class. Owing to continuous use of lecture method, students stay in the classroom bored and inactive. In-depth knowledge of the Mathematics concepts is not understood by them. This is one of the reasons why they perform poorly in Mathematics because learning of Mathematics involve interaction with fellow students and teacher.

Achievement could be referred to as something very good or difficult which was carried out successfully. Achievement refers to the degree of success reached or attained by an individual in some general or specific academic area which is measurable (Eneze, 2018). Academic achievement is a measure of students' cognitive abilities. Evidence from past and present research in Mathematics has long established that academic achievement of all categories of students have been a point of concern to many Mathematics educators. This is because of the poor performance of students in the subject. Poor academic achievement of students in quadratic equation as described by Ajogbeje (2021) was as a result of non-comprehension of simple algebraic concepts like variables, expressions and its equivalence, poor mathematical background in earlier classes, poor and ineffective instructional skills, lack of meaningful interaction in classroom between teachers and students, among students themselves and more importantly lack of critical thinking. Eneze (2018) however posited that once teachers desist from using lecture method in teaching Mathematics, interest which is the mother of attention will be enhanced, and once attention is guaranteed, retention will be assured. Interactive jigsaw method of instruction which equips learners with skills, understandings, attitudes, habits and appreciations that helps increase their engagement through group work is advocated for in teaching and learning process in order to facilitate learning and ensure retention.

Retention is the ability to remember things more effectively when experiences are passed across to the learner through an appropriate instructional strategy which is capable of arousing students' interest. Retentive ability is a vital component in the educational process as it tells the worth of a student in a subject area in terms of skills and knowledge acquired overtime. This implies that if there are no proper storage structures developed in the learners during teaching, information recalling may be marred and consequently resulting to poor achievement. Adequate teaching method helps students to code information especially when the teaching method engages students in interactive activities. Retention is facilitated by motivation as well as by giving students opportunity to participate in the learning process and to draw conclusions by themselves. Jigsaw is an interactive instructional strategy that involves students' participation in class activities and enhance coding. Improvement of male and female students' coding of information in Mathematics is one of the problems of this study.

Gender is a social construct that refers to the cultural, social, and psychological characteristics associated with being male or female. It is a cultural construct that distinguishes the roles, behavior,

mental and emotional characteristics between male and female as developed by the society. It ranges from biological characteristics, physical characteristics as well as biological characteristics distinguishing males and females particularly in the masculine and feminine attributes assigned to them. Gender is regarded as a determining factor which affect students' retention and achievement in teaching and learning of Mathematics (Ude, 2019). Gender difference in Mathematics achievement has been investigated in many studies with conflicting findings. While Bashir and Bashir (2019) showed that male students achieve significantly higher than their female counterparts in Mathematics, Ajai and Imoko (2019) reported that there was no significant differece between male and female students in Mathematics achievement. Salau (2020) reported that there is no innate biological and psychological attributes that prevents girls from performing academically as well in Mathematics. Gender and achievement, interest and retention may be a problem of how the topics are taught. In view of the above, this study wish to determine the extent male and female students' achievement and retention in Mathematics can be achieved by using jigsaw method in teaching Mathematics.

Statement of the Problem

Mathematics is an integral part of everyone's life. It affects virtually every field of human endeavor in the home, office, business, industries, agriculture, decision making and even in governance. In Mathematics, there are three major areas namely algebra geometry and arithmetic. In algebra, there is quadratic equation. The relevance of quadratic equation to technology cannot be overemphasized. The most effective and unparalleled accomplishments of human beings such as electricity, mobile telephone, radio, television, military arsenals, medical equipment, voyages to the moon, sea and space are achievable by man's effort to utilize mathematical reasoning in area of quadratic equation. Quadratic equation is very relevant to technology and covers a large area in the Mathematics curriculum. The areas it covers are factorization of quadratic equation, graphical solution of quadratic equation, completing the square method of solving quadratic equation and the use of general formula for finding roots of quadratic equation. Failure of students in quadratic equation pulled down their score in WAEC Mathematics resulting to poor performance.

Due to the way the quadratic equation is taught using chalk and board, the coding of the topic to facilitate students' retention of what was taught becomes a problem. In this study the two major problems; achievement and retention constitute major problem in students' excellence in Mathematics. These problems can be addressed if all inclusive, interactive teaching strategy is used. The problems persisted from year to year because many Mathematics teachers use strategies which are teacher-centered with minimal students' participation in the teaching and learning process. This not only make the topics abstract but the students got bored and uninterested because the students are passive and the processing and coding of the information for retention became difficult. All these at the end result to poor achievement.

This study is advocating for a more innovative, interactive strategy where students are involved in building of their knowledge. A situation of this nature will help to enhance coding and retention and thus improve achievement in Mathematics. One of such strategy is jigsaw method of teaching. Jigsaw is an interactive method of instruction, a co-operative learning method that brings both individual accountability and achievement of team goals. It is a method of organizing classroom activities that makes students depend on each other to succeed. It is a student-centered instructional strategy. This study aimed at determining the extent jigsaw strategy of instruction can improve students' retention in Mathematics so as to improve achievement in Mathematics among the SSS1 male and female students in Anambra state, Nigeria.

Purpose of the Study

The purpose of this study is to determine the effect of interactive jigsaw method on secondary school students' achievement and retention in quadratic equation in Anambra state.

Specifically, the study will determine the:

1 Mean achievement score of the students taught quadratic equation using interactive jigsaw method and those taught using lecture methods.
2 Mean retention score of the students taught quadratic equation using interactive jigsaw method and those taught using lecture methods.
3 Mean achievement score of male and female students taught quadratic equation using interactive jigsaw method.

4 Mean retention score of male and female students taught quadratic equation using interactive jigsaw method.

Significance of the Study

The benefits that will accrue from this study will be of both theoretical and practical significance. Theoretically, the findings of the study will validate and also add a body of knowledge to Lev Vygotsky's social constructivism theory of cognitive development. This is because the kind of interaction that occurs in this theory is a typical form of concretization of learning in general, and pedagogy of secondary school Mathematics in particular. The findings will also present Mathematics as an observable, conceptual activity where students will be made to learn and internalize mathematical knowledge in an interesting manner.

Practically, the findings of the study when published and presented in conferences would be beneficial to the stakeholders in education namely: Students, Mathematics Teachers, Curriculum Planners, and future Researchers.

The following research questions guided the study:

1. What is the mean achievement score of students taught quadratic equation using interactive jigsaw method and those taught using lecture method.
2. What is the mean retention scores of students taught quadratic equation using interactive jigsaw method and those taught using lecture method.
3. What is the mean achievement scores of male and female students taught quadratic equation using interactive jigsaw method and those taught using lecture method.
4. What is the mean retention scores of male and female students taught quadratic equation using interactive jigsaw method and those taught using lecture method?

Research Hypotheses

The following null hypotheses guided the study. All the hypotheses were tested at 0.05 level of significance

1. There is no significant difference in the mean achievement scores of students taught quadratic equation using interactive jigsaw method and those taught using lecture method.
2. There is no significant difference in the retention scores of students taught quadratic equation using interactive jigsaw method and those taught using lecture method.
3. There is no significant difference in the mean achievement scores of male and female students taught quadratic equation using interactive jigsaw method and those taught using lecture methods.
4. There is no significant difference in the mean achievement scores of male and female students taught quadratic equation using interactive jigsaw method and those taught with lecture method.

REVIEW OF RELATED LITERATURE

Schematic Representation of Conceptual Framework

The conceptual framework showing the relationship between the variables of interest in the study on effectiveness of Interactive Jigsaw method in enhancing Students' Achievement and Retention in Mathematics concept of Quadratic Equation is represented in figure 1.

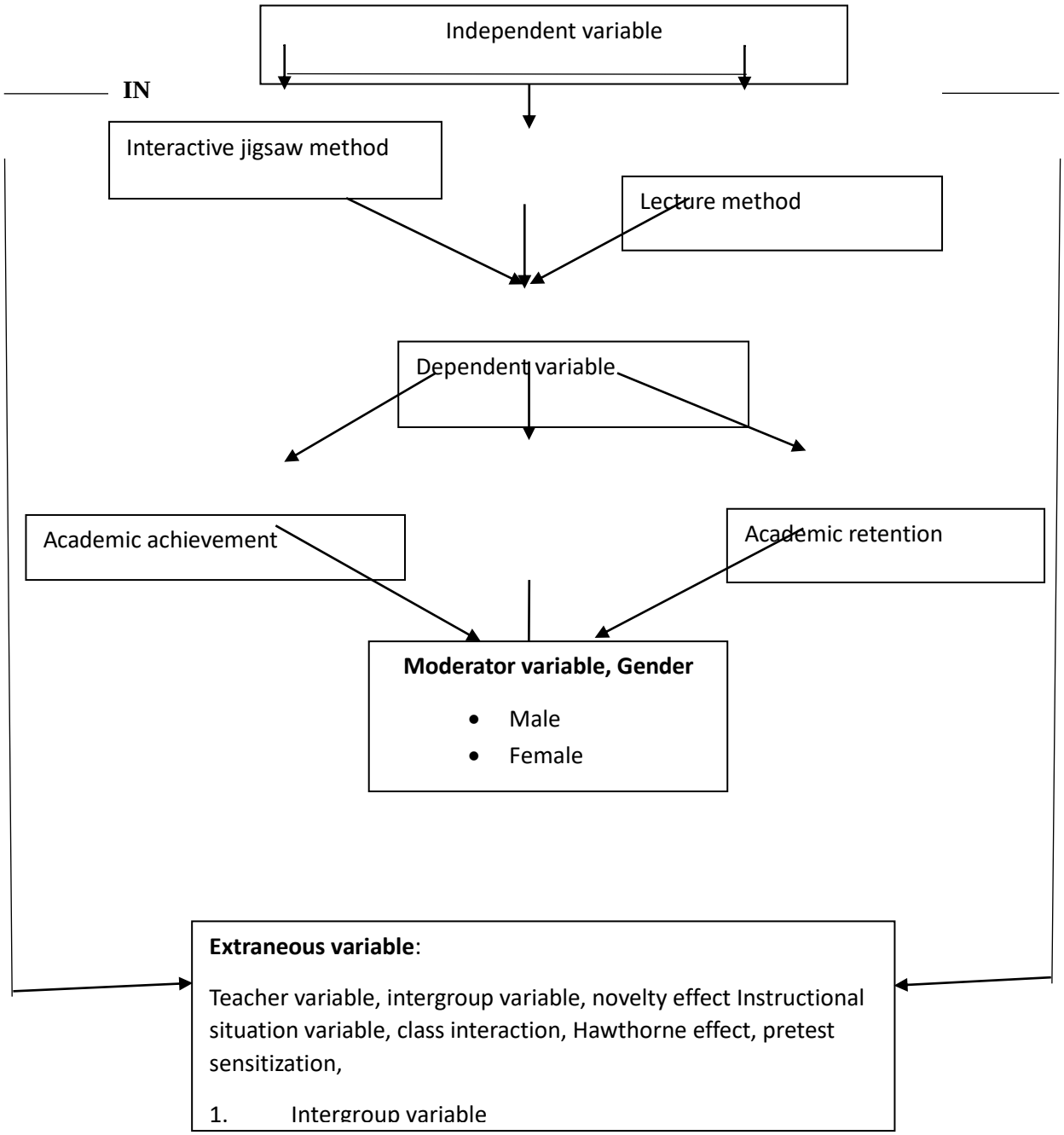

Figure 1: Diagrammatic representation of the study concepts.

As shown in figure 1 above, effectiveness of interactive jigsaw teaching method in enhancing secondary school student's achievement and retention in quadratic equation in Anambra state was investigated. The independent variables are interactive jigsaw method and lecture method which forms the experimental and control groups respectively. The dependent variables are academic achievement and retention. Gender (male and female) served as moderator variable. The extraneous variables are: teaching variability, intergroup variable, instructional situation variable, Hawthorne effect, class interaction, novelty effect and pre-test sensitization. All these four (4) variables (independent, dependent, moderator and extraneous) were individually and interactively investigated with reference to students' academic achievement and retention towards quadratic equations.

METHOD

The study adopted a pretest-posttest control quasi-experimental research design. The population for this study was made up of 3,950 senior secondary school class one (SS 1) Mathematics students in all the 74 co-education secondary schools in Awka and Otuocha Education Zones of Anambra state. While Awka zone has 3,280 SS1 students (1353 males and 1927 females), Otuocha zone has 670 SS1 students (319 males and 351 females). The researcher sampled Awka and Otuocha Education Zones using balloting method. In the zones, there are 74 co-education senior secondary schools. The researcher sampled three secondary schools each from the two zones whose characteristics in terms of class size were related. The instrument for data collection was Quadratic Equation Achievement Test (QEAT) which was developed by the researcher. QEAT contained 15 multiple choice items intended to measure the students' achievement in mathematics. The face and content validation of the instrument was established by presenting copies of the initial draft of QAET to four experts in the areas of Measurement and Evaluation as well as Science Education. The internal consistency of QEAT was determined using Kuder-Richardson 20 Formula and an internal consistency reliability coefficient of 0.98 was obtained.

Prior to the beginning of the treatment a pretest of the QEAT was administered to the sampled students to serve as the baseline data. Afterwards the experimental classes were taught quadratic equation applying interactive jigsaw method while the control group classes were taught using lecture method solely by the regular classroom teachers. At the pretest, the research assistants began the administration of the treatment as it was in the lesson plan for each group. The teaching took place during the class period for each group. The entire exercise which lasted for 4 weeks in the two zones. At the end of the fourth week, the researcher rearranged the QEAT which were administered as posttest to the participants. After a period of two weeks, the researcher rearranged the items of the posttest to ascertain the retention of the students.

Treatment procedure for experimental group using jigsaw method:

Jigsaw method is an interactive method which teachers can use to improve the interaction in the classroom. Jigsaw method of instruction is a co-operative learning method that brings about both individual accountability and achievement of the team goals. In this method, a topic is divided into sub-topics equal to the number of students in each group. Each student in a group is assigned a sub-topic and is given a learning material relevant to his/her assigned portion of the topic to study for some moment. Members of different groups who have studied the same material meet together, to share information and solve the task. Their expert knowledge is shared with other members in the original main group. The group that excels in terms of improved performance is awarded a group reward. Therefore, jigsaw emphasizes the use of group work and reward for co-operation to achieve group goal.

The process was carried out in two phases:

Phase 1: Training program for research assistants. Six research assistants were used for the study. These were Mathematics teachers teaching in the sampled respective schools in the two zones. The training focused on the purpose of the study and how to use interactive jigsaw method to teach quadratic equation. This training lasted for two days.

At the pretest, the research assistants began the administration of the treatment as it was in the lesson plan for each group. The teaching took place during the class period for each group. During the four weeks of the study, four subtopics in quadratic equation were taught to both experimental and control groups using two sets of lesson plans which were prepared by the researcher.

Towards the end of the four weeks of the treatment, the researcher rearranged the items in the pretest of QEAT. This made the items look different at first glance. A day before the end of the treatment, the researcher visited the sampled schools and gave the research assistants the posttest of QEAT. The day the treatment ended, the research assistants administered the QEAT as posttest. After a period of two weeks, the posttest was rearranged and was given to the students as retention test. The research assistants sorted the instruments according to gender. At the end of the experiment, the question papers, the answer scripts of the QEAT were returned to the researcher.

Thus, the scores generated from pretest, posttest and retention test were used for data analysis. The data collected were analyzed using mean and standard deviation to answer the research questions while analysis of covariance (ANCOVA) was used to test the null hypothesis at .05 level of

significant. In taking decision, a mean score of 50 and above indicated that the treatment is effective for achievement which is in line with the pass mark in secondary schools while a mean retention score of 55 was considered effective. If the probability value (P-Value) is less than the significant value of .05 (P<.05), the null hypothesis was rejected. On the other hand, if the probability value (P-Value) is greater than or equal to significant value if .05, null hypothesis was not rejected.

RESULTS

Table 1: Mean Achievement Scores of Students Taught Quadratic Equation Using Jigsaw Method and those Taught Using Lecture Methods

		Pretest		Posttest		
Groups	N	Mean	SD	Mean	SD	Mean Gain
JS	159	18.43	10.14	46.09	8.95	27.66
LM	141	17.06	7.58	18.60	7.57	1.54

Table 1 showed that students exposed to jigsaw method had mean achievement score of (M= 18.43, SD=10.14) at the pretest and (M=46.09, SD= 8.951) at the posttest while the mean achievement scores of students exposed to lecture methods were (M= 17.06, SD=7.58) at pretest and (M= 18.60, SD= 7.57) at the posttest. This gave mean gain scores of 27.66 and 1.54 for both groups indicating that students exposed to jigsaw method had higher posttest mean achievement score than their control group counterparts.

Table 2: Mean Retention Scores of Students Taught Quadratic Equation Using Interactive Jigsaw Method and those Taught Using Lecture Methods

		Posttest		Delayed Posttest		
Groups	N	Mean	SD	Mean	SD	Mean Gain
JS	159	49. 09	8.95	60.18	8.70	11.09
LM	141	18.07	7.57	20.28	7.68	2.21

Table 2 showed that students exposed to jigsaw method had mean retention score of (M= 49.09, SD=8.95) at the pretest and (M=60.18, SD= 8.70) at the posttest while the mean achievement scores of students exposed to lecture methods were (M= 18.76, SD=7.52) at pretest and
(M= 20.28, SD= 7.68) at the posttest. This gave mean gain scores of 11.09 and 2.21 for both groups indicating that students exposed to jigsaw method had higher posttest mean achievement score than their control group counterparts.

Table 3: Mean and Standard Deviation Mathematics Achievement Scores of Male and Female Secondary School Students Taught Quadratic Equation with Interactive Jigsaw Method

			Pretest		**Posttest**		
Groups	**Gender**	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean Gain**
JS	**Male**	**70**	**22.46**	**14.10**	**46.40**	**10.41**	**23.94**
	Female	**89**	**15.26**	**2.3**	**45.86**	**7.63**	**30.60**

Table 3 revealed that male students exposed to jigsaw method had mean achievement score of (M= 22.46, SD= 14.10) at the pretest and (M=46.40, SD= 10.41) at the posttest while the mean achievement scores of female students exposed to interactive jigsaw method were (M= 15.26, SD=2.30) at pretest and (M= 45.86, SD= 7.63) at the posttest. This gave mean gain scores of 23.94 and 30.60 for both groups. The standard deviation scores for the pretest for the male and female students were higher than that of posttest. Since posttest mean achievement score for male students was higher than that of their female counterpart, the male students achieved higher in quadratic equation with mean gain difference of 6.66 in their favor.

Table 4: Mean and Standard Deviation Mathematics Retention Scores of Male and Female Secondary School Students Taught Quadratic Equation with Interactive Jigsaw Method

			Post-test		Delayed Post-test		
Groups	Gender	N	Mean	SD	Mean	SD	Mean Gain
JS	Male	70	46.40	10.41	56.79	10.11	10.39
	Female	89	45.86	7.63	62.85	6.27	16.99

Table 4 showed that male students exposed to jigsaw method had mean retention score of (M= 46.40, SD= 10.41) at the posttest and (M=56.79, SD= 10.11) at the delayed posttest while the mean retention scores of female students exposed to interactive jigsaw method were (M= 45.86, SD=7.63) at posttest and (M= 62.85, SD= 6.27) at delayed posttest. This gave mean gain scores of 10.39 and 16.99 for both groups. The standard deviation scores for the post-test of male and female students were higher than their standard deviation in retention score. This suggested more variability in post-test scores of the female students than their retention score but not so among their male counterpart. However, the mean gain difference between male and female students was 0.46 in favor of female students. This implied that in use of interactive jigsaw method, female students retained better in quadratic equation than their male counterpart.

Table 5: Analysis of Covariance (ANCOVA) of Students' Mean Achievement Score Between Groups in Quadratic Equation

Source	Type III Sum of Squares	d f	Mean Square	F	Sig	Decision
Corrected Model	9522.470[a]	2	4761.235	39.290	.000	
Intercept	7130.747	1	7130.747	58.844	.000	
Achievement	938.231	1	938.231	7.742	.000	
Groups	5265.815	1	5265.815	43.454	.003	S
Error	21812.514	297	121.181			
Total	214337.000	300				
Corrected Total	31334.984	299				

The result in table 5 showed that there was a significant difference in the mean achievement score of students taught quadratic equation using interactive jigsaw method and those taught using lecture method, F (1, 299) =7.322, p=.003, since the obtained p-value was less than the stipulated .05 level of significance, the null hypothesis was rejected. This implied that the mean achievement score of students taught quadratic equation using interactive jigsaw method was higher than the mean score of those taught with lecture method indicating that the significant difference was in favor of those taught quadratic equation with interactive jigsaw method of teaching.

Table 6: Analysis of Covariance (ANCOVA) of Students' Mean Retention Score Between Groups in Quadratic Equation

Source	Type III Sum of Squares	d f	Mean Square	F	Sig	Decision
Corrected Model	12059.942[a]	2	6029.971	19.865	.000	
Intercept	62286.327	1	62286.327	205.197	.000	
Retention	3580.719	1	3580.719	11.796	.000	S
Groups	2222.401	1	2222.401	7.322	.007	
Error	54637.807	297	121.181			
Total	933688.000	300				
Corrected Total	66697.749	299				

The result in table 6 revealed that there was a significant difference in the mean retention scores of students taught quadratic equation using interactive jigsaw method and those taught using lecture method, F (1, 299) = 7.322, p = .000. Since the obtained p-value was less than the stipulated .05 level of significance, the null hypothesis which stated that there is no significant difference in the mean retention scores of students taught quadratic equation using interactive jigsaw method and those taught using lecture method was rejected. This implied that the mean retention score of students taught quadratic equation with interactive jigsaw method was higher than the mean score of those taught using lecture method. This implied that the significant difference was in favor of those taught quadratic equation with interactive jigsaw method of teaching.

Table 7: Analysis of Covariance (ANCOVA) on Mean Achievement Score of Male and Female Students Taught Quadratic Equation Using Interactive Jigsaw Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Decision
Corrected Model	1189.351[a]	2	594.676	1.721	.184	
Intercept	32724.251	1	32724.251	94.708	.000	
Achievement	424.693	1	424.693	1.229	.270	
Groups	702.892	1	702.892	2.034	.051	NS
Error	34207.355	157	345.529			
Total	362024.000	159				
Corrected Total	35396.706	158				

The result in table 7 showed that there was no significant difference in the mean achievement scores of male and female students taught quadratic equation using interactive jigsaw method. F (1, 158) = 2.034, p = .051. Since the obtained p-value was higher than the stipulated .05 level of significance, the null hypothesis which stated that there is no significant difference in the mean achievement scores of male and female students taught quadratic equation using interactive jigsaw method was upheld. This implied that the mean achievement scores of male and female students taught Mathematical concept of quadratic equation with interactive jigsaw method was the same.

Table 8: Analysis of Covariance (ANCOVA) on Mean Retention Scores of Male and Female Students Taught Quadratic Equation Using Interactive Jigsaw Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Decision
Corrected Model	10021.153[a]	2	5010.576	18.983	.000	
Intercept	11489.348	1	11489.348	43.528	.000	
Retention	8134.562	1	8134.562	30.818	.000	
Gender	840.580	1	840.580	3.185	.006	S
Error	25867.481	156	263.954			
Total	434116.000	159				
Corrected Total	35888.634	158				

The result in table 8 showed that there was a significant difference in the mean retention scores of male and female students taught quadratic equation using interactive jigsaw method, (F (1, 158) = 3.185, p = .000.) Since the obtained p-value was less than the stipulated .05 level of significance, the null hypothesis which stated that there is no significant difference in the mean retention scores of male and female students taught quadratic equation using interactive jigsaw method was rejected. There existed more variability in post-test scores of the female students than their retention score but not so among their male counterpart indicating that in use of interactive jigsaw method, female

students retained better in quadratic equation than their male counterpart. This implied that there was a significant difference in the mean retention scores of male and female students taught quadratic equation with interactive jigsaw method in favor of female students.

DISCUSSION

The findings of the study revealed that at the posttest, the students exposed to interactive jigsaw method had a mean achievement score of (M=46.09, SD= 8.95) while the mean achievement scores of students exposed to lecture methods were (M= 18.60, SD= 7.57). Furthermore, the mean gain scores of 27.66 and 1.54 for the experimental and control groups respectively indicate that students taught with interactive jigsaw method achieved higher than their counterparts in quadratic equation test because of the interactive nature of jigsaw method. It fostered cooperation and assistance among the groups in the process of learning quadratic equation. The result of the finding was in line with the studies carried out by Yemi et. al (2018), Ndukwe et.al (2018) and Olanrewaju (2020) who stated that jigsaw method yielded higher academic achievement in Mathematics than lecture method and other traditional methods. Thus the teachers' ability to employ innovative teaching method like the interactive jigsaw method will enhance students' academic achievement in quadratic equation.

Again the findings of the study revealed that students exposed to interactive jigsaw method had mean quadratic retention score of (M=60.18, SD= 8.70) at the delayed posttest while the mean retention scores of students exposed to lecture methods were (M= 20.28, SD= 7.68) at the delayed posttest. This gave mean gain scores of 11.09 and 2.21 for both groups respectively indicating that students taught with interactive jigsaw method retained better than their counterparts in quadratic equation because they were directly engaged with teaching materials which fostered depth understanding of quadratic equation. It helped students to gain practice in self-teaching thus helping them in their retention of quadratic equation concepts. This was against the lecture method class which was popular to teachers on the basis that it allowed quick coverage of syllabus and consumed less time. The result of the finding was in line with the studies carried out by Albert (2020), Samuel (2018a) and Olanrewaju (2022) who stated that students taught Mathematics with jigsaw method retained better than their counterparts taught using lecture method.

One possible reason for students' higher retention is that jigsaw method of instruction promoted active learning, engaged students and promoted deeper understanding and this helped to promote retention. So teachers are encouraged to use this method of instruction as against lecture method which gives room to limited retention due to lack of interaction in the classroom. The result in Table 7 shows that there was no significant difference in the mean achievement scores of male and female students taught quadratic equation using interactive jigsaw method. $F(1, 158) = 2.034$, $p = .051$. Since the obtained p-value was higher than the stipulated .05 level of significance, the null hypothesis which stated that there is no significant difference in the mean achievement scores of male and female students taught quadratic equation using is upheld. The study revealed that male students taught with interactive jigsaw achieved higher in quadratic equation than their female counterparts. There was statistically no significance difference in mean achievement score of male and female students taught quadratic equation using interactive jigsaw method. The non-significant difference in achievement between male and female students taught quadratic equation using interactive jigsaw method means that jigsaw provided conducive environment for both boys and girls. The result of the finding was in line with the study carried out by Arhin and Offoe (2018) who stated that there was no statistically significant difference between male and female students taught Mathematics. However, the findings were not in line with the study carried out by Agbasi et.al (2020) and Musa et.al (2019) who observed that male students taught with interactive jigsaw achieved higher in quadratic equation than their female counterparts.

Female students retained better in quadratic equation when taught with interactive jigsaw method than their male counterparts. There was statistically significance difference in retention in favor of female students, $F(1, 158) = 3.185$, $p = .000$.

The result in Table 8 showed that there was a significant difference in the mean retention scores of male and female students taught quadratic equation using interactive jigsaw method, $F(1, 158) = 3.185$, $p = .000$. Since the obtained p-value was less than the stipulated .05 level of significance, the null hypothesis which stated that there is no significant difference in the mean retention scores of

male and female students taught quadratic equation using interactive jigsaw method was rejected. Female students retained better in quadratic equation when taught with interactive jigsaw than their male counterpart. There was statistically significant difference in the retention of male and female students taught quadratic equation with interactive jigsaw method in favor of female students. The female students taught with interactive jigsaw method retained better than their female counterpart in quadratic equation because interactive jigsaw method of instruction engages both male and female students actively at the same time. The result of the finding was not in line with the study carried out by Ezeugwu et.al. (2017), Samuel (2018a) and Olanrewaju (2022) who observed that the use of jigsaw game-based instructional technique had equal effect on male and female students' retention in Mathematics. Hence, this study focused on improving students' retention in quadratic equation through jigsaw strategies which fosters collaboration, improves communication skills and increases empathy irrespective of gender.

CONCLUSION/ RECOMMENDATION

In a nut shell, the findings of the present study showed that the use of interactive jigsaw method of instruction was superior in enhancing academic achievement and retention of students in quadratic equation than with lecture method because of its interactive nature. It recommended that this method of instruction should be incorporated in the teaching and learning process because the group task that follows individual peer teaching in jigsaw class promotes discussion, problem- solving and learning among students.

Educational Implications of the Study

Ineffective use of teaching methods by teachers in teaching Mathematics concepts has made the subject extremely difficult on improving the students' achievement and retention. No doubt we still witness students' poor achievement and retention in our education system since most school Mathematics teachers are not acquainted with teaching methods that are innovative. However, innovative education which engages students on critical thinking enhances their achievement and retention. Interestingly the study found out that students taught using jigsaw method have higher mean achievement and retention rating more than those taught with lecture method. The implication of the finding is that a country that wants to develop her citizen to compete globally in science and technology, should adopt and train her science teachers (specifically Mathematics) on the use of jigsaw method of instruction. This will harness the learners' achievement and retention because jigsaw method of instruction is a method of organizing classroom activity that makes students depend on each other for meaningful learning. It encourages cooperation among students and helps build comprehension among both male and female students.

Contributions to Knowledge

The study has made the following contribution to knowledge:

1. The study has empirically proven and established that the use of interactive jigsaw method of instruction improves academic achievement and retention in quadratic equation in secondary school.
2. The study also revealed empirically that interactive jigsaw method of instruction will enhance male and female secondary school students' academic achievement and retention in quadratic equation.

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