Impact of Inductive and Problem-Solving Teaching Methods on Students' Performance in Geometrical Concepts of Mathematics among Junior Secondary School Students in Katsina State, Nigeria

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DOI: https://dx.doi.org/10.47772/IJRISS.2023.7757

Received: 07 June May 2023; Revised: 18 June 2023; Accepted: 26 June 2023; Published: 23 July 2023

ABSTRACT

The study investigates the impact of Inductive Teaching Method (ITM) and Problem-Solving Teaching Method (PSTM) on the performance of Junior Secondary School two (JSS II) students in Geometry Concepts. The study applied a pre-test post-test experimental design. There are 12 Zonal Education Quality Assurance (ZEQA) zones with a total of 251 Junior Secondary Schools and a population of 300,125 Junior Secondary School year two (JSS II) students in Katsina state. The population comprises of 166,270 male students and 133,855 female students. The strata of 12 ZEQA zones were used and one school was randomly selected from each zone. In each selected school, 60 students were randomly selected for the three classes i.e. 20 students per class which were randomly assigned for traditional (control), problem-solving and inductive (experimental groups) methods. Consequently a total 720 JSS II students were selected for the experimental and control groups. The instrument used for the data collection for both pre-test and post-test was the Geometry Performance Test (GPT) with reliability coefficient of r=0.84. The arithmetic means, standard deviations and t-test were applied using Statistical Package for Social Sciences (SPSS) version 23 to test the three hypotheses at the 0.05 level of significance. The analysis showed that the problem-solving and inductive methods of teaching were more effective than the traditional method in the teaching of geometry concepts. However the result also showed that there is no significant difference in the performance of students taught with the inductive method of teaching and those taught with the problem-solving method of teaching. Given these discoveries, it was suggested that the utilization of both problem-solving and inductive teaching methods should be encouraged in teaching geometry concept and the necessary facilities and equipment needed for their effective use should be provided by the government and school authorities.

Keywords: Inductive Teaching Method, Problem-Solving teaching method, Traditional Teaching method, Geometry Performance Test (GPT), Geometry concepts

INTRODUCTION

Many countries in the world like Nigeria are striving hard to develop technologically and scientifically, since the world is becoming more scientific, and our lives depend greatly on science and Mathematics. According to Jimoh et al (2020), Mathematics has been described as the key to unlock the hidden human talent and resources of nations that would lead to national growth and development. Nations, the world over, see mathematics as an instrument for effecting economic, social, political, scientific and technological change (Etsu & Manko, 2019). Geometry is part of the mathematics concepts that many of the students find difficult to understand. Despite the importance of mathematics among Nigerian students, performance at the Junior Secondary School Level which spills over to the Senior Secondary School Level has been poor (Suleiman et al, 2020). There are many methods used in teaching and solving Mathematics problems. In this study attempt was made to find out whether inductive and problem-solving methods can have significant effect in promoting the teaching and learning of geometrical concepts in JSS II Mathematics.

Inductive Method

This is a term that embodies a range of instructional methods that include inquiry learning, problem-based learning, discovery learning etc. This teaching method is student-centered in the sense that students are actively involved. It can either be statistical or experimental based. The advantages include giving room for students to participate in lessons, building curiosity and scientific mind set approach among learners and so on. Disadvantages may include time consumption and developing incorrect rules.

This method is also called scientific method since teachers proceed from known to unknown, from specific to general and from example to rule or formula. In a study conducted by Umesh (2016) it was discovered that inductive method of teaching had better achievement than the deductive method used in teaching geometry.

Another research conducted by Samuel, Rachel and Jason (2021) also showed that the most effective and preferred teaching method is the inductive teaching of method. In the research they found that there was a significant difference in the male student's mean performance between three groups that were taught using inductive, deductive and conventional methods of teaching. The study also discovered no significant difference in the female student's mean performance between the three groups while adjusting for the pre-test score. The research suggested the utilization of inductive teaching method for proper teaching delivery.

Problem-Solving Method

This is a teaching strategy that uses the scientific method in searching for information. Decisions are usually arrived at based on prior knowledge and reasoning. It has to do with providing students with real world problems and challenging them to apply their knowledge, skills, and creativity to arrive at solutions. It encourages collaboration and active learning and allows students to be in control of their learning.

In other words it is a process of identifying a problem, determining the root cause of the problem, deciding the best course of action in order to solve the problem and then implementing it to solve the problem. Problem solving is a process and it has techniques to go about it.

Instructional methodologies should be able to improve reasoning abilities in students. In this way, they become capable of finding out the solutions of different kinds of problems not only during the studies but in their daily routine. Every child has the curiosity to explore things and this psychology of the children can be utilized in a better way through problem solving method. It is the most important instructional methodology for mathematics (Collier and Lerch, 1969). In similar vein, some famous psychologists like Bruner, Oliver & Greenfield (1966) and Gagn*e* (1970), gave this method top priority when it comes to teaching.

Abdelhafid (2018) discovered that there was significant difference between the experimental and control groups in terms of the word problem solving progress measure, favoring the experimental group. This confirms that providing students with a computer-assisted system offered the opportunity to explore all stages of the problem-solving procedure as one possible way to enhance their problem-solving skills. Another research conducted by Reasat et al (2010) revealed that there was significant difference between the effectiveness of traditional teaching method and problem-solving method in teaching of mathematics. The study recommended the use of problem-solving method in the teaching of mathematics. In another study by Joseph and Neji (2018), it was discovered that the use of problem-solving approach had a higher mean score than the control group taught with traditional method in physics and chemistry. This may also be applicable in the case of geometrical concepts.

Findings from Juman (2022) revealed that students had greater difficulties in learning Geometry such as drawing diagrams for a given geometric problem. Furthermore, Students' disinterest in the Geometry component and their family background affects their Geometry learning. Additionally, results from the teaching experiment indicate that the student-based learning approaches are more effective than

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue VI June 2023

conventional methods for teaching Geometry.

In a Functional near-infrared spectroscopy (FNIRS) results obtained by Shi (2023) it was found that meaningful hands-on experience with concrete manipulates related to learning contents increased reactivation of the somatosensory association cortex during subsequent reasoning, this helped in improving the problem-solving performance. The Hands-on experience is also noted to have reduced students' cognitive load during the well-structured problem-solving process. Such ?ndings contribute in better understanding of the value of hands-on experience in geometry learning and their implications for mathematics classes.

Geometry Concepts

This is a branch of Mathematics that deals with shapes, angles, dimensions and sizes of a variety of things that people see in everyday life. It derived from the ancient Greek words- 'Geo' meaning earth and 'metron' which means 'measurement'. The three fundamental basic geometrical concepts are line, point and plane. Geometrical concepts are sometimes taught using the Geo board or using such methods of teaching like the deductive method.

In a study titled 'Geometry concepts perceived Difficult To Learned' by Fabiyi (2017) it was found that out of 23 concepts, eight were perceived difficult to learn by students which includes: construction, coordinate geometry, circle theorem and so on and the reasons given for perceiving geometry concepts difficult includes: lack of instructional materials, teachers' method of instruction and so on. He also showed that students' gender had a great influence on the learning of concepts in geometry at 0.05 level of significance in favor of female students.

Statement of the problem

Despite lots of commitment and much campaigns by different stakeholders at all levels to improve the teaching of science and mathematics, the problem still persists. Among the reasons given for poor scores in mathematics education are the methods of teaching (Badmus and Harbor-peters, 2002). To Ezengwu (2007) majority of our teachers still employ conventional methods in classroom teaching. This study is one more attempt to find out whether the inductive and problem-solving methods of teaching if used properly will help in boosting the teaching /learning of geometrical concepts of Mathematics as opposed to the use of traditional or conventional method that is widely applied when teaching the subject.

Objectives of the Study

This study investigates the effect of inductive and Problem-Solving teaching methods in geometrical concepts in Mathematics in some selected public junior secondary schools two (JSS II) in Katsina State, Nigeria.

The objectives are to:

- Examine the effectiveness of inductive and Problem-Solving teaching techniques on Student's performance in Geometrical concepts of Mathematics vis a vis the traditional method.
- Determine which of the two teaching methods is more effective in teaching and learning of geometrical Concepts in Mathematics.

Research Hypotheses:

Ho1: There is no significant difference between Inductive teaching method (ITM) on JSS II students' performance in geometrical concepts of Mathematics in Katsina State.

$H_1$1: There is significant difference between Inductive teaching method (ITM) on JSS II students' performance in geometrical concepts of Mathematics in Katsina State.

$H_0$2: There is no significant difference between Problem-Solving teaching methods (PSTM) on JSS II students' performance in geometrical concepts of Mathematics in Katsina State.

$H_1$2: There is significant difference between Problem-Solving teaching methods (PSTM) on JSS II students' performance in geometrical concepts of Mathematics in Katsina State.

$H_0$3: There is no significant difference between inductive and problem-solving teaching methods on JSS II students' performance in geometrical concepts of Mathematics.

$H_1$3: There is significant difference between inductive and problem-solving teaching methods on JSS II students' performance in geometrical concepts of Mathematics.

METHODOLOGY

Research Design

The pre-test post-test experimental design was used in the study. The pre-test is to ascertain the prior knowledge of geometry concept of all the students involved in the experiment before the treatment is applied. The post-test was used to determine the best method of teaching among traditional, inductive and Problem-Solving methods.

Twelve (12) schools were randomly selected within Katsina State of Nigeria based on the availability of qualified Mathematics teachers and some functional facilities for teaching students through inductive and Problem-Solving methods. The design was considered appropriate because it enabled the researchers to determine the level of detecting or notice rules, examples, patterns, and rules interaction among the junior secondary school two (JSS II) students. It also allowed obtaining an opinion of the sample population, analyzing the data collected using appropriate data analysis technique, and reaching a reasonable conclusion about the people from the study's findings.

Population, Sample Size and sampling technique

There are 12 Zonal Education Quality Assurance (ZEQA) zones with a total of 251 Junior Secondary Schools and a population of 300,125 Junior Secondary School year two (JSS II) students in Katsina state. The population comprises up of 166,270 male students and 133,855 female students (MOE, Katsina, 2020). The strata of 12 ZEQA zones were used and one school was randomly selected from each zone. In each selected school, 60 students were randomly selected for the three classes i.e. 20 students per class which were randomly assigned for traditional (control), problem-solving and inductive (experimental groups) methods of teaching. The 36 classes gave a total of 720 students for the experimental and control groups. The ZEQA zones and the selected schools from each zone are as shown in the table below:

Educational Zones and Schools Selected

	Educational zone	School selected	Inductive Pre-Test Codes	Inductive Post-Test Codes	Problem-Solving Pre-Test Codes	Problem-Solving Post-Test Codes	Traditional Pre-Test Codes	Traditional Post-Test Codes
1	Daura	Govt. Junior Secondary School, Ganga (Gga)	IndGgaPre	IndGgaPost	PsGgaPre	PsGgaPost	TdGgaPre	TdGgaPost

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2	Funtua	Govt. Junior Secondary School, (Day Wing) (Fta)	IndFtaPre	IndFtaPost	PsFtaPre	PsFtaPost	TdFtaPre	TdFtaPost
3	Dutsinma	Govt. Junior Secondary School, Darawa (Drw)	IndDrwPre	IndDrwPost	PsDrwPre	PsDrwPost	TdDrwPre	TdDrwPost
4	Katsina	Katsina College, Katsina (Kck)	IndKckPre	IndKckPost	PsKckPre	PsKckPost	TdKckPre	TdKckPost
5	Kankia	Govt. Junior Secondary School, Kankia (Kka)	IndKKaPre	IndKKaPost	PsKKaPre	PsKKaPost	TdKKaPre	TdKKaPost
6	Mani	Govt. Junior Secondary School, Muduru, Mani (Mdr)	IndMdrPre	IndMdrPost	PsMdrPre	PsMdrPost	TdMdrPre	TdMdrPost
7	Baure	Govt. Junior Secondary School, Karkarku (Kkk)	IndKkkPre	IndKkkPost	PsKkkPre	PsKkkPost	TdKkkPre	TdKkkPost
8	Musawa	Govt. Junior Secondary School, Musawa (Msw)	IndMswPre	IndMswPost	PsMswPre	PsMswPost	TdMswPre	TdMswPost
9	Faskari	Govt. Junior Secondary School, Mairuwa (Mrw)	IndMrwPre	IndMrwPost	PsMrwPre	PsMrwPost	TdMrwPre	TdMrwPost
10	Safana	Govt. Day, Junior Secondary School (Sfn)	IndSfnPre	IndSfnPost	PsSfnPre	PsSfnPost	TdSfnPre	TdSfnPost
11	Rimi	Govt. Secondary School, Abukur (Abr)	IndAbrPre	IndAbrPost	PsAbrPre	PsAbrPost	TdAbrPre	TdAbrPost
12	Malumfashi	Govt. Secondary School, Karfi (Krf)	IndKrfPre	IndKrfPost	PsKrfPre	PsKrfPost	TdKrfPre	TdKrfPost

Research Instrument

Geometry performance Test (GPT) was used to collect the appropriate data and the Geometry was taught as contained in the syllabus of Junior Secondary School II (Federal Ministry of Education, 2012). The 36 classes in the 12 schools were taught using the inductive and problem solving methods for the experimental groups while the control groups were taught using the traditional method of teaching. The two instruments used in the study were pre-test and post-test Geometry performance Test (GPT) questions. They each contained two sections A and B. Section A sought for the students Bio-data, while section B consisted of 20 item questions based on JSS two Mathematics curriculum on Geometrical concepts. The pre-test instrument was conducted to give information on the present level of the students before the treatment while the post-test instrument was conducted to give information on the performance levels of the students after treatment.The post-test was administered after treatment to all the groups to determine the performance of the students.

Reliability and Validity

To ensure validity, the instrument was given to two experienced teachers from Junior Secondary Schools and two Mathematics educators for content validation and face validity. After this, appropriate adjustments were made to ensure conformity with their suggestions. Purposively, Govt. Sec. Sec. School, K/Yandaka, Katsina which was not among the randomly selected schools was selected for the pilot study because the randomly selected schools cannot access what happened in the purposively selected school. Thus, three intact classes were used for the pilot study. A reliability test was performed on the objective question scores which has a multiple choice of A – D to test internal consistency of the questions using Cronbach alpha reliability test.

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Method of Data Analysis

The geometry performance Test (GPT) comprising up of 20 objective questions was used. The mean, standard deviation and t – test of the data were then obtained. The mean was to give the average of each group, standard deviation was to give the variations among the score while the t-test will help in making a decision since the data are independent. The test was carried out at 0.05 significant level and SPSS statistical package version 23 was used for the data analyses.

DATA ANALYSIS AND RESULTS

The results and data analysis for each of the twelve (12) schools were performed according to the three (3) hypotheses raised above. The pre-tests and post-tests were computed and analyzed using t-test and the hypotheses were tested at 0.05 significant levels.

Hypothesis one

There is no significant difference between Inductive Teaching Method (ITM) on JSS II students' performance in geometrical concepts of Mathematics in Katsina State.

This hypothesis was analyzed using t-test staistic at ?=0.05, as shown in the table 1 and 2 below.

Pre-test for traditional and inductive methods of teaching in all the 12 zones of Katsina State to ascertain the prior knowledge of geometry concept of all the students in the experiments.

Table 1: The t – test Analysis of Pre-test Data for the Traditional and Inductive Groups

Pair	Group	N		SD	df	t-cal	P value
Pair 1	TdDrwPre	20	3.95	.826			
					38	-.195	.847
	IndDrwPre	20	4.00	.918			
Pair 2	TdSfnPre	20	4.20	.834			
					38	.400	.694
	IndSfnPre	20	4.10	.912			
Pair 3	TdFtaPre	20	3.90	.788			
					38	.165	.861
	IndFtaPre	20	3.85	.745			
Pair 4	TdMrwPre	20	3.95	1.191			
					38	-.335	.741
	IndMrwPre	20	4.05	.887			
Pair 5	TdKkkPre	20	4.00	.858			
					38	.384	.705
	IndKkkPre	20	3.90	.852			
Pair 6	TdKrfPre	20	3.70	.865			
					38	.195	.847
	IndKrfPre	20	3.65	.813			
Pair 7	TdAbkPre	20	3.70	.681			
					38	-.547	.591
	IndAbkPre	20	3.65	.716			

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Pair 8	TdGgaPre	20	3.65	.745			
					38	-.400	.694
	IndGgaPre	20	3.75	.716			
Pair 9	TdMswPre	20	6.30	1.559			
					38	-.700	.492
	IndMswPre	20	6.75	2.023			
Pair 10	TdMdrPre	20	5.35	2.231			
					38	.395	.697
	IndMdrPre	20	5.15	1.309			
Pair 11	TdKkaPre	20	9.30	1.720			
					38	-.093	.927
	IndKkaPre	20	9.35	1.226			
Pair12	TdKckPre	20	5.00	1.076			
					38	-.335	.741
	IndKckPre	20	5.10	.912			

There is no significant difference at α = 0.05 of all 12 pair groups compared

In table 1 on Darawa above, it showed that the t -calculated of -.195 was greater than the t – critical of -1.96 i.e. t – calculated = -.195 > t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Safana above, it showed that the t -calculated of .400 was however less than the t – critical of 1.96 i.e. t – calculated = .400 < t – critical = 1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Funtua above, it showed that the t -calculated of .165was however less than the t – critical of -1.96 i.e. t – calculated = .165> t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Mairuwa above, it showed that the t -calculated of -.335 was however greater than the t – critical of -1.96 i.e. t – calculated = -.335 > t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Karkarku above, it showed that the t -calculated of .384 was however less than the t – critical of 1.96 i.e. t – calculated = .384 < t – critical = 1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Karfi above, it showed that the t -calculated of .195 was however greater than the t – critical of 1.96 i.e. t – calculated = .195 > t – critical = 1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Abukur above, it showed that the t -calculated of -.547 was however greater than the t – critical of -1.96 i.e. t – calculated = -.547 > t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Ganga above, it showed that the t -calculated of -.400 was however greater than the t – critical of -1.96 i.e. t – calculated = -.400 > t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

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In table 1 on Musawa above, it showed that the t -calculated of -.700 was however greater than the t – critical of -1.96 i.e. t – calculated = -.700 > t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Muduru above, it showed that the t -calculated of .395 was however less than the t – critical of 1.96 i.e. t – calculated = .395 < t – critical = 1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Kankara above, it showed that the t -calculated of -.093 was however greater than the t – critical of -1.96 i.e. t – calculated = -.093 > t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

In table 1 on Katsina above, it showed that the t -calculated of -.335 was however greater than the t – critical of -1.96 i.e. t – calculated = -.335 > t – critical = -1.96. This shows that there is no significant difference between the pre- test scores of the experimental group and that of the control group.

Consequently, this means that the prior knowledge of geometry concept of all the students in both inductive and traditional groups can be assumed to be the same.

Post-test for traditional and inductive methods of teaching in all the 12 zones of Katsina State to ascertain the method that improves the knowledge of geometry concept of the students.

Table 2: The t – test Analysis of Post-test Data for the Traditional and Inductive Groups

Pair	Group	N		SD	df	t-cal	P-value
Pair 1	TdDrwPost	20	11.85	1.663			
					38	-12.337	.000
	IndDrwPost	20	17.25	1.251			
Pair 2	TdSfnPost	20	11.70	1.380			
					38	-17.168	.000
	IndSfnPost	20	17.20	1.196			
Pair 3	TdFtaPost	20	11.00	1.170			
					38	-20.459	.000
	IndFtaPost	20	17.55	.945			
Pair 4	TdMrwPost	20	8.55	1.504			
					38	-23.119	.000
	IndMrwPost	20	17.50	1.051			
Pair 5	TdKkkPost	20	11.65	1.309			
					38	-17.212	.000
	IndKkkPost	20	17.70	1.218			
Pair 6	TdKrfPost	20	11.75	1.517			
					38	-16.212	.000
	IndKrfPost	20	17.85	.988			
Pair 7	TdAbkPost	20	11.45	1.146			
					38	-21.697	.000
	IndAbkPost	20	17.80	.951			

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Pair 8	TdGgaPost	20	11.70	1.174			
					38	-17.698	.000
	IndGgaPost	20	17.65	.933			
Pair 9	TdMswPost	20	10.80	1.322			
					38	-12.014	.000
	IndGgaPost	20	17.00	1.622			
Pair 10	TdMdrPost	20	10.20	1.436			
					38	-17.062	.000
	IndMdrPost	20	17.30	1.174			
Pair 11	TdKkaPost	20	12.60	2.137			
					38	-7.024	.000
	IndKkaPost	20	17.25	1.650			
Pair12	TdKkaPost	20	12.60	2.137			
					38	-13.934	.000
	IndKckPost	20	17.25	1.650			

There is significant difference at α = 0.05 of all 12 pair groups compared

In table 2 above, the data on Darawa showed that the t -calculated of -12.337 was less than the t – critical of -1.96 i.e. t – calculated = -12.337 < t – critical = -1.96. This shows that the achievement scores of the JSS two students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Safana showed that the t -calculated of -17.168 was less than the t – critical of -1.96 i.e. t – calculated = -17.168 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Funtua showed that the t -calculated of -20.459 was less than the t – critical of -1.96 i.e. t – calculated = -20.459 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Mairuwa showed that the t -calculated of -23.119 was less than the t – critical of -1.96 i.e. t – calculated = -23.119 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Karkarku showed that the t -calculated of -17.212 was less than the t – critical of -1.96 i.e. t – calculated = -17.212 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Karfi showed that the t -calculated of -16.212 was less than the t – critical of -1.96 i.e. t – calculated = -16.212 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Abukur showed that the t -calculated of -21.697 was less than the t – critical of -1.96 i.e. t – calculated = -21.697 < t – critical = -1.96. This shows that the achievement scores of the JSS

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue VI June 2023

students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Ganga showed that the t -calculated of -17.698 was less than the t – critical of -1.96 i.e. t – calculated = -17.698 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Musawa showed that the t -calculated of -12.014 was less than the t – critical of -1.96 i.e. t – calculated = -12.014 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Muduru showed that the t -calculated of -17.062 was less than the t – critical of -1.96 i.e. t – calculated = -17.062 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Kankia showed that the t -calculated of -7.024 was less than the t – critical of -1.96 i.e. t – calculated = -7.024 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

In table 2 above, the data on Katsina showed that the t -calculated of -13.934 was however less than the t – critical of -1.96 i.e. t – calculated = -13.934 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is better than the students taught using the traditional method.

Conclusively the data in table 2 shows that there is significant difference between all the post- test scores of the experimental group and those of the control group. This shows that the achievement scores of all the JSS students taught geometry concept using inductive method is better than the achievement scores of all the students taught using the traditional method.

Hypothesis two

There is no significant difference between Problem-Solving Teaching Methods (PSTM) on JSS II students' performance in geometrical concepts of Mathematics in Katsina State.

This hypothesis was analyzed using t-test statistic at ?=0.05, as shown in the tables 3 and 4 below.

Pre-test for traditional and problem-solving methods of teaching in all the 12 zones of Katsina State to ascertain the prior knowledge of geometry concept of all the students in the experiments.

Table 3: The t – test Analysis of Pre-test Data for the Traditional and Problem-solving Groups

Pair	Group	N		SD	df	t-cal	P-value
Pair 1	TdDrwPre	20	3.95	.826			
					38	-.175	.863
	PsDrwPre	20	4.00	.918			
Pair 2	TdSfnPre	20	4.20	.834			
					38	.282	.781
	PsSfnPre	20	4.10	.912			

Pair 3	TdFtaPre	20	3.90	.788			
					38	-.567	.698
	PsFtaPre	20	4.05	.826			
Pair 4	TdMrwPre	20	3.95	1.191			
					38	-.149	.883
	PsMrwPre	20	4.00	.918			
Pair 5	TdKkkPre	20	4.00	.858			
					38	.145	,886
	PsKkkPre	20	3.95	1.099			
Pair 6	TdKrfPre	20	3.70	.865			
					38	-.748	.464
	PsKrfPre	20	3.90	.852			
Pair 7	TdAbkPre	20	3.60	.681			
					38	-.418	.681
	PsAbkPre	20	3.70	.865			
Pair 8	TdGgaPre	20	3.65	.745			
					38	-.590	.562
	PsGgaPre	20	3.80	.696			
Pair 9	TdMswPre	20	6.30	1.559			
					38	-.108	.915
	PsMswPre	20	6.35	1.872			
Pair 10	TdMdrPre	20	5.35	2.231			
					38	.443	.663
	PsMdrPre	20	5.05	2.114			
Pair 11	TdKkaPre	20	9.30	1.720			
					38	-.388	.703
	PsKkaPre	20	9.50	1.573			
Pair12	TdKckPre	20	5.00	1.076			
					38	.288	.776
	PsKckPre	20	4.90	1.071			

There is no significant difference at $\alpha = 0.05$ of all 12 pair groups compared

The table 3 above for Darawa showed that the t -calculated of -.175 was greater than the t – critical of -1.96 i.e. t – calculated = -.175 > t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Safana showed that the t -calculated of .282 was less than the t – critical of 1.96 i.e. t – calculated = .282 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Funtua showed that the t -calculated of -.567 was greater than the t – critical of -1.96 i.e. t – calculated = -.567 > t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

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The table 3 above for Mairuwa showed that the t -calculated of -.149 was greater than the t – critical of -1.96 i.e. t – calculated = -.149 > t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Karkarku showed that the t -calculated of .145 was less than the t – critical of 1.96 i.e. t – calculated = .145 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Karfi showed that the t -calculated of -.748 was greater than the t – critical of -1.96 i.e. t – calculated = -.748 > t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Abukur showed that the t -calculated of -.418 was greater than the t – critical of -1.96 i.e. t – calculated = -.418 > t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Ganga showed that the t -calculated of -.590 was greater than the t – critical of -1.96 i.e. t – calculated = -.590 > t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Musawa showed that the t -calculated of -.108 was greater than the t – critical of -1.96 i.e. t – calculated = -.108 > t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Muduru showed that the t -calculated of .443 was less than the t – critical of 1.96 i.e. t – calculated = .443 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Kankia showed that the t -calculated of -.388 was greater than the t – critical of -1.96 i.e. t – calculated -.388 > t – critical = -1.96This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 3 above for Katsina showed that the t -calculated of .288was less than the t – critical of 1.96 i.e. t – calculated = .288 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

Consequently, there is no significant difference between the pre- test scores of the experimental group (problem solving group) and that of the control group (traditional group). This means that the prior knowledge of geometrical concept of all the students in both groups can be assumed to be the same.

Post-test for traditional and inductive methods of teaching in all the 12 zones of Katsina State to ascertain the method that improves the knowledge of geometry concept of the students.

Table 4: The t – test Analysis of Post-test Data for the traditional and problem solving Groups

Pair	Group	N		SD	Df	t-cal	P-value
Pair 1	TdDrwPost	20	11.85	1.663			
					38	-14.655	.000
	PsDrwPost	20	17.70	1.302			
Pair 2	TdSfnPost	20	11.70	. 1.380			
					38	-14.453	.000
	PsSfnPost	20	17.50	1.318			

Pair 3	TdFtaPost	20	11.00	1.170			
					38	-18.812	.000
	PsFtaPost	20	17.70	1.302			
Pair 4	TdMrwPost	20	8.55	1.504			
					38	-23.309	.000
	PsMrwPost	20	17.75	1.070			
Pair 5	TdKkkPost	20	11.65	1.309			
					38	-11.222	.000
	PsKkkPost	20	17.20	1.281			
Pair 6	TdKrfPost	20	11.75	1.517			
					38	-14.696	.000
	PsKrfPost	20	17.90	.968			
Pair 7	TdAbkPost	20	11.45	1.146			
					38	-15.762	.000
	PsAbkPost	20	17.70	1.031			
Pair 8	TdGgaPost	20	11.70	1.174			
					38	-22.718	.000
	PsGgaPost	20	17.75	.910			
Pair 9	TdMswPost	20	10.80	1.322			
					38	-9.747	.000
	PsMswPost	20	16.80	2.167			
Pair 10	TdMdrPost	20	10.20	1.436			
					38	-16.821	.000
	PsMdrPost	20	17.55	1.146			
Pair 11	TdKkaPost	20	12.60	2.137			
					38	-6.380	.000
	PsKkaPost	20	17.30	2.029			
Pair12	TdKckPost	20	10.85	1.725			
					38	-11.699	.000
	PsKckPost	20	17.15	1.348			

* There is significant difference at $\alpha = 0.05$ for all the 12 zones

The table above for Darawa showed that the t -calculated of -14.655 was less than the t – critical of -1.96 i.e. t – calculated = -14.655 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Safana showed that the t -calculated of -14. 453 was less than the t – critical of -1.96 i.e. t – calculated = -14. 453 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Funtua showed that the t -calculated of -18.812 was less than the t – critical of -1.96 i.e. t – calculated = -18.812 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Mairuwa showed that the t -calculated of -23.309 was less than the t – critical of -1.96 i.e. t – calculated = -23.309 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Karkarku showed that the t -calculated of -11.222 was less than the t – critical of -1.96 i.e. t – calculated = -11.222 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Karfi showed that the t -calculated of -14.696 was less than the t – critical of -1.96 i.e. t – calculated = -14.696 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Abukur showed that the t -calculated of -14.655 was less than the t – critical of -1.96 i.e. t – calculated = -14.655 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Ganga showed that the t -calculated of -22.7 18was less than the t – critical of -1.96 i.e. t – calculated = -22.718 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Musawa showed that the t -calculated of -9.747 was less than the t – critical of -1.96 i.e. t – calculated = -9.747 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Muduru showed that the t -calculated of -16.821 was less than the t – critical of -1.96 i.e. t – calculated = -16.821 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Kankia showed that the t -calculated of -6.380 was less than the t – critical of -1.96 i.e. t – calculated = -6.380 < t – critical = -1.96. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

The table above for Katsina showed that the t -calculated of -11.699 was less than the t – critical of -1.96 i.e. t – calculated = -11.699 < t – critical = -1.96 This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

Conclusively, there is significant difference between all the post- test scores of the experimental group and that of the control group. This means that the achievement scores of the JSS students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue VI June 2023

Hypothesis Three

There is no significant difference between inductive and problem-solving teaching methods on JSS II students' performance in geometrical concepts of Mathematics.

This hypothesis was analyzed using t-test analysis at ?=0.05, as shown in the tables below.

Pre-test for problem-solving and inductive methods of teaching in all the 12 zones of Katsina State to ascertain the prior knowledge of geometry concept of all the students in the experiments.

Table 5: The t – test Analysis of Pre-test Data for the two Experimental Groups (problem-solving and inductive methods)

Pair	Group	N		SD	Df	t-cal	P-value
Pair 1	PsDrwPre	20	4.00	.918			
					38	.000	1.000
	IndDrwPre	20	4.00	.795			
Pair 2	PsSfnPre	20	4.10	.912			
					38	.000	1.000
	IndSfnPre	20	4.10	.912			
Pair 3	PsFtaPre	20	4.05	.826			
					38	.657	.289
	IndFtaPre	20	3.85	.745			
Pair 4	PsMrwPre	20	4.00	.918			
					38	-.175	.863
	IndMrwPre	20	4.05	.887			
Pair 5	PsKkkPre	20	3.95	1.099			
					38	.156	.878
	IndKkkPre	20	3.90	.852			
Pair 6	PsKrfPre	20	3.90	.852			
					38	1.422	.171
	IndKrfPre	20	3.65	.813			
Pair 7	PsAbkPre	20	3.70	.865			
					38	-.195	.847
	IndAbkPre	20	3.75	.716			
Pair 8	PsGgaPre	20	3.80	.696			
					38	.195	.847
	IndGgaPre	20	3.75	.716			
Pair 9	PsMswPre	20	6.35	1.872			
					38	-.748	.464
	IndMswPre	20	6.75	2.023			
Pair 10	PsMdrPre	20	5.05	2.114			
					38	-.203	.841
	IndMdrPre	20	5.15	1.309			
Pair 11	PsKkaPre	20	9.50	1.573			
					38	.353	.728

	IndKkaPre	20	9.35	1.226			
Pair12	PsKckPre	20	4.90	1.071			
					38	-.593	.560
	IndKckPre	20	5.10	.912			

No significant difference at α = 0.05 for all the 12 zones

The table 5 above for Darawa showed that the t -calculated of .000 was however less than the t – critical of 1.96 i.e. t – calculated = .000 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Safana showed that the t -calculated of .000 was however less than the t – critical of 1.96 i.e. t – calculated = .000 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Funtua showed that the t -calculated of .657 was however less than the t – critical of 1.96 i.e. t – calculated = .657 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Mairuwa showed that the t -calculated of -.175 was however greater than the t – critical of -1.96 i.e. t – calculated = -.175 < t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Karkarku showed that the t -calculated of .156 was less than the t – critical of 1.96 i.e. t – calculated = .156 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Karfi showed that the t -calculated of 1.422 was less than the t – critical of 1.96 i.e. t – calculated = 1.422 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Abukur showed that the t -calculated of -.195 was less than the t – critical of -1.96 i.e. t – calculated = -.195 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Ganga showed that the t -calculated of .195 was less than the t – critical of 1.96 i.e. t – calculated = .195 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Musawa showed that the t -calculated of -.748 was less than the t – critical of 1.96 i.e. t – calculated = -.748 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Muduru showed that the t -calculated of -.203 was greater than the t – critical of -1.96 i.e. t – calculated = -.203 < t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

The table 5 above for Kankia showed that the t -calculated of .353 was less than the t – critical of 1.96 i.e. t – calculated = .353 < t – critical = 1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue VI June 2023

The table 5 above for Katsina showed that the t -calculated of -.593 was however greater than the t – critical of -1.96 i.e. t – calculated = -.593 < t – critical = -1.96. This means that the prior knowledge of geometry concept of the students in both groups could be assumed to be the same.

In conclusion from the above table 5 analyses for the 12 zones, the prior knowledge of geometry concept of the students in all the groups is assumed to be the same.

Post-test for problem-solving and inductive methods of teaching in all the 12 zones of Katsina State to ascertain the method that improves the knowledge of geometry concept of the students.

Table 6: The t – test Analysis of Post-test Data for the two experimental groups (problem-solving and inductive)

Pair	Group	N		SD	Df	t-cal	P-value
Pair 1	PsDrwPost	20	17.70	1.302			
					38	.963	.348
	IndDrwPost	20	17.25	1.251			
Pair 2	PsSfnPost	20	17.50	. 1.318			
					38	.670	.511
	IndSfnPost	20	17.20	1.196			
Pair 3	PsFtaPost	20	17.70	1.302			
					38	.382	.232
	IndFtaPost	20	17.55	.945			
Pair 4	PsMrwPost	20	17.75	1.070			
					38	.773	.449
	IndMrwPost	20	17.50	1.051			
Pair 5	PsKkkPost	20	17.20	1.281			
					38	-1.157	.262
	IndKkkPost	20	17.70	1.218			
Pair 6	PsKrfPost	20	17.90	.968			
					38	.149	.883
	IndKrfPost	20	17.85	.988			
Pair 7	PsAbkPost	20	17.70	1.031			
					38	-.276	.785
	IndAbkPost	20	17.80	.951			
Pair 8	PsGgaPost	20	17.75	.910			
					38	.302	.766
	IndGgaPost	20	17.65	.933			
Pair 9	PsMswPost	20	16.80	2.167			
					38	-.276	.785
	IndMswPost	20	17.00	1.622			
Pair 10	PsMdrPost	20	17.55	1.146			
					38	.665	.514
	IndMdrPost	20	17.30	1.174			

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Pair 11	PsKkaPost	20	17.30	2.029			
					38	.085	.934
	IndKkaPost	20	17.25	1.650			
Pair12	PsKckPost	20	17.30	2.029			
					38	-.725	.477
	IndKckPost	20	17.25	1.650			

No significant difference at α = 0.05 for all the 12 zones

The table 6 above for Darawa showed that the t -calculated of .963 was less than the t – critical of 1.96 i.e. t – calculated = .963 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Safana showed that the t -calculated of .670 was less than the t – critical of 1.96 i.e. t – calculated = .670 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Funtua showed that the t -calculated of .382 was less than the t – critical of 1.96 i.e. t – calculated = .382 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Mairuwa showed that the t -calculated of .773 was less than the t – critical of 1.96 i.e. t – calculated = .773 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Karkarku showed that the t -calculated of -1.157 was greater than the t – critical of -1.96 i.e. t – calculated = -1.157 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Karfi showed that the t -calculated of .149 was less than the t – critical of 1.96 i.e. t – calculated = .149 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Abukur showed that the t -calculated of -.276was less than the t – critical of -1.96 i.e. t – calculated = -.276 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Ganga showed that the t -calculated of .302 was less than the t – critical of 1.96 i.e. t – calculated = .302 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Musawa showed that the t – calculated of -.276 was greater than the t – critical of -1.96 i.e. t – calculated = -.276 > t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Muduru showed that the t -calculated of .665 was less than the t – critical of 1.96 i.e. t – calculated = .665 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Kankia showed that the t -calculated of .085 was less than the t – critical of 1.96 i.e. t – calculated = .085 < t – critical = 1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

The table 6 above for Katsina showed that the t -calculated of -.725 was greater than the t – critical of -1.96 i.e. t – calculated = -.725 < t – critical = -1.96. This shows that the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

In conclusion from the table 6 above analyses for the 12 zones, the achievement scores of the JSS students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

DISCUSSION OF RESULTS

From Table 1 above for the pre-test scores, it was found that prior knowledge of geometry concept of all the students in both inductive and traditional groups can be assumed to be the same.

From table 2 we have seen that there is significant difference between all the post- test scores of the experimental group and those of the control group. This has gone a long way to show that the achievement scores of all the JSS II students taught geometry concept using inductive method is better than the achievement scores of all the students taught using the traditional method. This is corroborated by the findings of Umesh (2016) in a research where he found that the inductive method of teaching is more effective than the deductive method. He also found it to be more helpful and enjoyable as a method of teaching by students.

We have also similarly seen that there is significant difference between all the post- test scores of the experimental group and that of the control group. This means that the achievement scores of the JSS II students taught geometry concepts using problem solving method is better than the students taught using the traditional method.

Conclusively we can see from the table 6 above in the analyses for the 12 zones, the achievement scores of the JSS II students taught geometry concept using inductive method is not better than the students taught using the problem solving method.

SUMMARY OF THE FINDINGS:

From the findings of the study we have discovered that:

1. Students taught geometrical concepts using the inductive method of teaching have a better performance than the students taught using the traditional method of teaching.
2. Students taught geometrical concepts using the problem-solving method of teaching have a better performance than the students taught using the traditional method of teaching.
3. There is no significant difference in the performance between students taught using the inductive method of teaching and those taught using the problem-solving method.

CONCLUSION

In this study, the effect of inductive and problem-solving teaching methods on junior secondary students' performance in geometrical concepts among junior secondary school students in Katsina State, Nigeria, was investigated. A sample size of seven hundred and twenty *(720)* students were involved in the study. The data for the study was collected through geometry Performance Test (GPT). The preliminary test result revealed that; the data collected is assumed to be normally distributed.

According to the results obtained from this study, the students taught geometrical concepts through inductive teaching method had no significant difference in mean achievement than those taught geometrical concepts through Problem-Solving method. On the other those taught using the traditional methods had a lower mean achievement which implies that inductive and problem solving methods are more effective in teaching geometrical concepts.

Based on the findings from this study, the following conclusions were drawn:

1. Inductive teaching method enhances qualitative teaching and understanding of geometrical concepts.
2. Problem-Solving teaching method enhances qualitative teaching and understanding of geometrical concepts.
3. The traditional method of teaching appears to produce lower scores than the other two methods studied above.

RECOMMENDATIONS

Based on this study's findings, the following recommendations were made;

– teachers' of geometry aspect of Mathematics at the JSS level should consider applying more inductive and problem-solving teaching techniques while teaching geometric concepts.

-relevant facilities and equipment needed for proper use of inductive teaching and problem-solving methods should be provided in all schools by concerned authorities.

-Mathematics teachers should endeavor to learn different methods of teaching so as to provide their students with better learning experiences in order to enhance learning of the subject.

ACKNOWLEDGEMENT

The researchers hereby appreciates and thanks the Tertiary Education Trust Fund (TETFUND) for sponsoring this research through the Institution Based Research (IBR). The Federal College of Education, Katsina, the reviewers as well as the publishers are also appreciated

REFERENCES

1. Abdelhafid, C., Erwan, T., Youcef, D., Fatima, B., and Karima, B. (2018). An empirical investigation into student's mathematical word-based problem-solving process: A computerized approach https://doi.org/10.1111/jcal.12301
2. Badmus, G. A. (2002). Changes in contents and Teaching of School Mathematics in Nigeria. A paper presented at the National Mathematics Education Summit. Abuja, September, 15th– 17th.
3. Bovey, A.D. & Hull, N.A. (2014). Impact of the use of dynamic geometric software on students 'achievement and attitude towards mathematics. Retrieved from: citex psu.edu/view

4. Bruner, J. S., Oliver, R. R., & Greenfield, P. M., et al. (1966). Studies in cognitive growth. New York: John Wiley and Sons Inc.
5. Collier, C. C., & Lerch, H. H. (1969). Teaching mathematics in the modern elementary school. London: Collier – Macmillan Ltd.
6. Denama, F., & Waits. K. (2010). Computer for all students. The Mathematics Teacher 9(1).
7. Ekwueme, C. O. (2006). Process Errors and Teachers' Characteristics as Determinants of Secondary School Students' Academic Achievements in Senior Secondary Certificate Examination in Mathematics in Nigeria (Unpublished doctoral dissertation, University of Nigeria, Nsukka).
8. Ekwueme, C. O., & Meremukwu, A. (2010). Evaluation of the Millennium Development Goals Project (NDG) for Primary Schools Teachers in Nigeria: Teacher‘s Perspective. International Journal of Research in Education, 2(6), 84-88.
9. Etsu, S.M. & Manko, A. U. (2019). Effects of Mathematics Peer-Tutoring Strategy on Geometry Achievement among Junior Secondary School in Niger St ate. Abacus, the Journal of the Mathematics Association of Nigeria 1(44), 541-550.
10. Ezengwu, E. N. (2007). Effects of self-regulated and lecture Models on students Achievement in Biology. Nigeria Journal of Functional Education. 5(1), 82-91.
11. Eze, S.A. (2014). Improving Teacher performance in secondary school in Agbani Education Zone. Association for Promotion of Creative Education Journal, 3(1). 62-70.
12. Fabiyi, T.R. (2017). Geometry Concepts in Mathematics Perceived Difficult To Learn By Senior Secondary School Students in Ekiti State, Nigeria. IOSR Journal of Research & Method in Education (IOSR-JRME). 7(1), 83-90.
13. Gagné, R. M. (1970). The conditions of learning (2nd ed.). New York: Holt Rine Hart & Winston.
14. Jimoh, A. E. et al (2020). Effects of Constructivists Strategies Using Instructional Technology on Attitude and Academic Performance in Algebra Among Junior Secondary School Students in Zaria Metropolis, Kaduna State, Nigeria, Proceedings of September 2020 57th Annual National Conference (Mathematics Science) N (3) PP. 167-176.
15. Joseph E.and Nneji H. A, (2018). Effect of Problem Solving Method of Teaching on Students' Academic Performance in Physics and Chemistry in Calabar Municipality, Cross River State, Nigeria.
16. Juman, Zeinul Abdeen M. Silmi, et al (2022). Difficulties in Learning Geometry Component in Mathematics and Active-Based Learning Methods to Overcome the Difficulties. Shanlax International Journal of Education. 10 (2), 41–58.
17. Katsina State Ministry of Education (2020). Annual School census report. https: Subeb Katsina.com.
18. Resat A, Hukam D, Akhter A, Khan A. (2010). Effect of Using Problem Solving Method in Teaching Mathematics on the Achievement of Mathematics Students. Asian Social Science 6(2).
19. Samuel O. A., Rachel U. O., & Jason U. I. (2021). Effect of Inductive and Deductive Teaching Methods on Students' Performance in Basic Science Among Junior Secondary Schools Students: A Gender Study. American Journal of Education and Information Technology. 5(1), 27-36. doi: 10.11648/j.ajeit.20210501.15
20. Shi L, Dong L, Zhao W and Tan D (2023). Improving middle school students' geometry problem solving ability through hands-on experience: An fNIRS study. Front. Psychol. 14:1126047. doi: 10.3389/fpsyg.2023.1126047
21. Suleiman, B., Isma'il, A., & Bello, A. (2020). Investigation into Secondary School Students' Attitude towards Learning of Geometry in Zamfara State, Nigeria. IRA International Journal of Education and Multidisciplinary Studies 16(4) 236-242. DOI: http://dx.doi.org/10.21013/jems.v16.n4.p4
22. Umesh P. A. (2016). Effectiveness of Inductive Method in Teaching geometry At Secondary Level. Nigeria (Unpublished Masters dissertation, Tribhuvan University, Kirtipur, Kathmandu).