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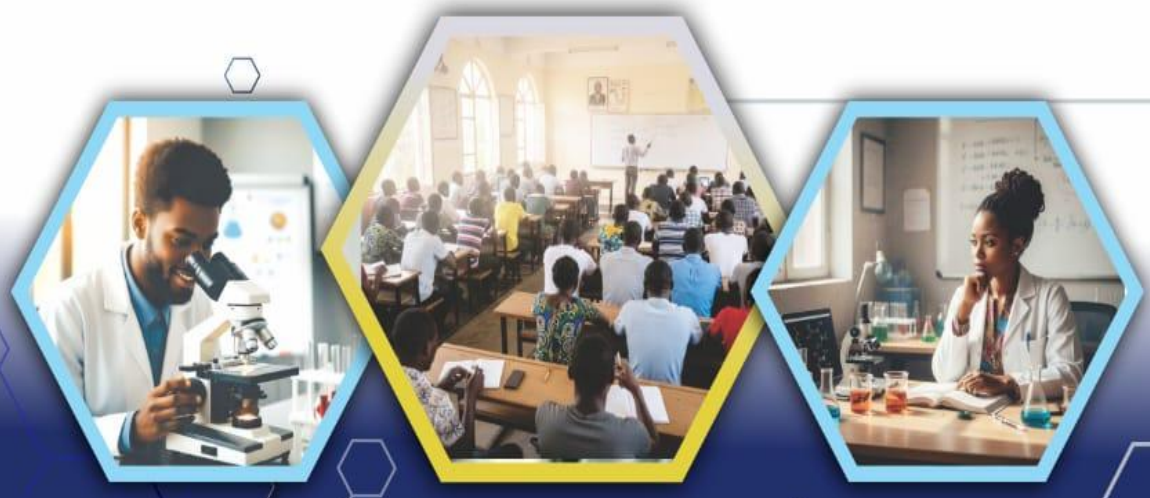

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EFFECTS OF JIGSAW-I AND JIGSAW-V INSTRUCTIONAL STRATEGIES ON STUDENTS' INTEREST AND ACHIEVEMENT IN GEOMETRY IN ABUJA MUNICIPAL AREA COUNCIL, NIGERIA

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Abstract

This study determined the effects of Jigsaw-I and Jigsaw-V Instructional Strategies on Students' Interest and Achievement in Geometry in Abuja Municipal Area Council, Nigeria. Three research questions and three corresponding null hypotheses were used to guide the study. The hypotheses were tested at 0.05 level of significance. The population of the study is 19,931 students from 61 public upper Basic schools in Abuja Municipal Area Council (AMAC) for 2024/2025 academic session. Sample for the study comprised 183 students (99 females and 84 males) in 3 government owned coeducational Basic schools in AMAC, Nigeria selected through simple random sampling technique. The same technique was equally used to sample Basic 9 intact classes used for the treatment and control groups respectively. Pretest posttest Quasi Experimental research design which involves two treatment groups and a control group was adopted for the study. The instruments, Geometry Interest Scale (GIS) and Geometry Achievement Test (GAT) which were validated by three experts, two from the Department of Science, Technology and Mathematics Education and one from Measurement and Evaluation unit of Educational Foundations all from Nasarawa state University Keffi was used for data collection with reliability coefficient of 0.75 using Cronbach Alpha. The descriptive statistic of Mean and Standard deviation was used to answer the research questions, ANCOVA for testing the hypotheses at 0.05 level of significance while Bonferroni analysis was used for pairwise comparison. The findings revealed significant difference on interest level of the learner's taught geometry with Jigsaw-I and Jigsaw-V instructional strategies respectively than those taught with conventional method. Gender was found not to have significant influence on interest and achievement of female and male students taught using Jigsaw-I and Jigsaw-V respectively. Based on the findings, it was recommended among others that Jigsaw-I and Jigsaw-V instructional strategies be integrated and adopted by Mathematics teachers in teaching geometry.

Keywords: Mathematics, Geometry, Jigsaw-I, Jigsaw-V, Interest, Gender

Introduction

Mathematics is a fundamental part of human thought and logic, and integral part to attempts at understanding the world and ourselves. It serves as a universal language that bridges cultures and disciplines, fostering critical

inquiry, analytical reasoning, and problem-solving skills necessary for daily life and scientific advancement. It deals with the logic of shape, quantity and arrangement. It is a subject that helps to provide an effective way of building mental discipline and encourages logical reasoning and mental rigor. For any country engaged in nation building to achieve success, it must first produce logical minds. In our world today, Mathematics gives us a way to understand patterns, to quantify relationships, and to predict the future. Ameen and Salman (2016) referred to Mathematics as the ultimate instrument of science, which uncovers hidden pattern that assist in understanding the world around us. Hence, education policy makers position Mathematics as a compulsory subject both for matters of employment and admission into tertiary institutions. It also becomes key in school curriculum because it is foundation of many other subjects.

Mathematics is so important that no one can live devoid of it as everyone's day starts with mathematics and ends also with mathematics. Without mathematics, there's nothing you can do. Everything around you is mathematics. Everything around you is numbers (Shakuntala in Jordan, 2024). Apart from mathematics being part of our daily existence from the moment we get up in the morning to when we sleep, it is also used for finance and money management, cooking and general household management, helping in achieving educational goals, improves logical thinking, aids in cognitive development, enhances problem-solving skills and many more. Without mathematics, modern inventions and scientific discoveries would not be possible. Even in nature, we see mathematical patterns from the symmetry of flowers to the spirals of seashells. Shut out mathematics from daily life and all civilization comes to standstill. Despite the importance of mathematics and the role it plays in our daily life activities even in management of financial crises as we know that there is always uncertainty surrounding the economic crises in Nigeria and the world in general; yet chunk numbers of students find it difficult to comprehend because it is believed that it is abstract in nature.

Mathematics has branches such as: Number and Theory, Algebra, Arithmetic, Trigonometry, Statistics and Probability, Calculus, Geometry, Analysis and Topology. All these branches are of advantage to humanity. Unfortunately, Bennet (2018) confirmed that most students lack interest in mathematics which Geometry is inclusive and of concern to the researcher. The WAEC chief examiner's report for the last five years (from 2020 to 2024) have consistently showed that students have weaknesses in answering questions on geometry. Also, the pass rate of students in BECE mathematics call for concern (Ref: table 1.1).

Geometry is defined as an important branch of mathematics that deals with study of points, lines, shapes, spaces, sizes, and position of 2 and 3 dimensional figures (Kurumeh, et al., 2016). Geometry plays a crucial role in nabling students to analyze and interpret the world around them, with applications in various fields, including the

study of the solar system (Fabiyi, 2017). Its knowledge is being applied in many vocations across the globe (Sam & Salman, 2016). It is used in architectural design, building and construction, aesthetics, computer application, modern mathematics problem solving, crystallography, art, sports, technical, robotics, astronomy, sculpture, machines, cars, engineering and much more is a nightmare to students probably because of the way it is being presented to them by the teacher of mathematics or lack of interest in the topic due to inability of the teacher or students to relate it usefulness to our daily activities or involve the students actively in the class which would have been a basic simple reason for students to show interest in learning the topic and for better achievement when taught.

Table 1 Performances of Students in Mathematics in BECE Examination in FCT Abuja

Year	2018	2019	2020	2021	2022	2023	2024	2025
No of students registered	44,218	46,062	47,113	48,167	48,088	46,825	49,190	45,574
No of students sat	44,218	46,062	47,113	48,167	48,086	46,825	49,188	45,573
No of pass	11,134	11,340	7,348	6,725	7,040	9,145	12,967	6,817
Percentage pass	25.18	24.62	15.60	13.96	14.64	19.53	26.36	14.96

Source: Education Resource Centre, FCT Abuja (2018-2025)

Table 1.1 shows the decline in students' performance in mathematics. The pass rate has been below the average of 50% all through. The results clearly indicated that there is need for improvement in teaching and learning of geometry as it is one of the major topics in mathematics which cut across all the classes in the basic school curriculum and by extension mathematics in general. The use of appropriate instructional strategies to arouse and maintain the interest of the students in learning the subject and improvement in the pass rate of BECE examinations is also necessary.

Hence the need for the researcher to, determine the effects of Jigsaw-I and Jigsaw-V instructional strategies on the interest and achievement of students' in geometry in AMAC Nigeria. Jigsaw-I instructional strategy is a cooperative learning strategy the promotes active learning, encourages effective collaboration among students, increases interest in subject/topic learnt and enhances cooperative learning by making students responsible for teaching some of the materials to the group. The method entails breaking down a large topic into sub-topics, followed by creation of expert sheet prepared by the teacher, the student collaborate in a heterogeneous jigsaw group; they assigned to read the expert sheet and those who have the same sheet are moved from the jigsaw group to a separate expert group to discuss their topic in depth, when the discussion is over, they return to their jigsaw group and teach all of the members in the jigsaw group about the topic in which they are now expert on (Poonam & Gunjan, 2019). Jigsaw-I learning strategy allows students to exercise a sense of control on task.

Jigsaw-V also known as the reverse jigsaw teaching strategy is a cooperative learning

technique that has gained popularity in recent years. It is a variation of the jigsaw technique, which is a well-established method of promoting collaboration and engagement among students (Aronson, 2011).

In jigsaw-V technique, students' become experts in a particular area and teach it to the rest of the class, taking the approach of the jigsaw technique one step further (Maitra & Staisloff, 2017). According to Hedeen (2003) students move from their respective 'home group' after studying the piece assigned to them to 'expert group' to discuss the activity assigned to them to gain and share more knowledge on the activity from which they will not return to their home group after the assigned task is completed but rather remain in that group and teach the whole class what they have learnt.

Interest is considered to be feeling of an individual towards a particular object or activity. Interest in learning is crucial, positive, driver of academic achievement and engagement, comprising both situational (immediate) and individual (long-term) motivation. It enhances cognitive processing and persistence, directly correlating to better achievement often fostered by relevant content, teacher enthusiasm, and connecting new information to prior experiences. Interest in learning influences learning motivation, it is a major factor determining learners' learning activities (Triarisanti, 2019). When students are interested in learning a particular concept, they display improved focus, persistence, and self-regulation, which directly translate into higher grades and a better understanding of course content. Interest is a powerful motivational process that energizes learning and guides academic and career trajectories (Renninger & Hidi, 2016).

Gender is an expression of traits or attributes associated with certain groups of people with respect to having male or female characteristics. It refers to characteristics of women, men, girls and boys that are socially constructed. Gender is a state of being a male or a female (Igbojinwaekwu, 2016). The issue of gender and students' learning interest in geometry has remained a controversial issue. While some researchers propose that males show more interest better than females, others stated otherwise.

The study of Areelu and Ladele, (2018) on adopting jigsaw instructional strategy for improving students' interest in mathematics using SSII students drawn from Epe, Ibeju and Ikorodu in Lagos state Nigeria, revealed that Jigsaw strategy is the most effective among the strategies used in improving students' interest in mathematics.

Nduji et al. (2020) determined the effects of jigsaw-based cooperative learning strategy (JBCLS) on senior secondary school students' interest and achievement in physics in Agbani Education Zone in Nkanu-west LGA of Enugu State. The finding revealed that students who were taught using JBCLS had higher mean interest ratings than those taught with lecture method. Further analysis indicated that there

was significant difference in the mean rating of senior secondary school physics students' academic interest when taught using JBCLS and those taught using lecture method.

Nwafor, (2023) on effect of collaborative learning strategy on students' interest in geometry among senior secondary schools in Zaria metropolis, Kaduna state, Nigeria. The findings of the study showed that, there was significant difference between the mean interest rating of students exposed to collaborative learning strategy (CLS) and those exposed to the conventional method (CM). The treatment group exhibited higher level of interest in geometry than students in control group.

Etok, et al, (2024) conducted a study on the effects of competitive and jigsaw collaboration learning strategies on students' interest in geometry among senior secondary school students in FCT, Abuja, Nigeria. The findings indicated that competitive learning strategy is more effective than jigsaw collaboration learning strategy in promoting students' interest in geometry. Also, the result revealed that, gender has no effect on students' interest rating taught geometry using competitive learning strategy but students taught geometry using jigsaw collaboration learning strategy has significant difference in the mean interest rating scores in favour of female students

Oluyemo et al, (2020) determined gender differences in mathematics interest and achievement in junior secondary school students, Niger state, Nigeria. The findings showed there was a significant relationship between mean achievement of male and female students in mathematics test by gender, male excel in mathematics more than their female counterparts

Objectives of the study

The main objective of this study was to determine the effects of Jigsaw-I and Jigsaw-V on interest of students in Geometry on Basic Education Students in Abuja Municipal Area Council, Nigeria. Specifically, the researcher sought to:

1. Determine the effects of Jigsaw-I and Jigsaw-V instructional strategies on students' interest in geometry.
2. Investigate the influence of gender on students' interest when taught geometry using Jigsaw-I instructional strategy.
3. Investigate the influence of gender on students' interest when taught geometry using Jigsaw-V instructional strategy.

Research Questions

This study aimed at addressing the following questions:

1. What are the mean interest ratings of students' who were taught geometry using Jigsaw-I and Jigsaw-V instructional strategies and those taught using conventional method?
2. What are the mean interest ratings of male and female students who were taught geometry using Jigsaw-I instructional strategy?

3. What are the mean interest ratings of male and female students who are taught geometry using Jigsaw-V instructional?

Statement of Hypotheses

Based on the objectives of the study, the following null hypotheses were formulated and were tested at 0.05 level of significance.

Ho_1 There is no significant difference in the mean interest ratings of students taught geometry using jigsaw-I and Jigsaw-V instructional strategies and those taught geometry using the conventional method.

Ho_2 There is no significant difference in the mean interest ratings of male and female students taught geometry using jigsaw-I instructional strategy.

Ho_3 There is no significant difference in the mean interest ratings of male and female students taught geometry using jigsaw-V instructional strategy.

Methodology

The research adopted pre-test post-test quasi-experimental design which involves three groups: Two treatment groups (Jigsaw-I and Jigsaw-V group) and the control group. Three co-educational schools out of 61 Basic schools with sample size of 183 basic 9 students (99 females and 84 males) from three intact classes out of 19,931 students for 2024/2025 academic session in Abuja Municipal Area Council were selected using a simple random sampling technique for the study. The sample consisting of 183 students were assigned to the three groups (63 to Jigsaw-I, 64 to Jigsaw-V and 56 to Conventional method group). The instruments (GIS) was used to collect data for the study. The GIS consists of 20 items validated by three experts from Nasarawa state university, Keffi with 4 points rating scales covering items, assessing willingness to learn / engage with tasks in geometry, perceived importance and whether they enjoy geometry. A trial testing was carried out in a school different from the ones chosen for the study using the validated instruments and the Reliability coefficient of 0.75 computed using Cronbach Alpha was obtained.

A lesson of five weeks was delivered to the students using jigsaw-I instructional strategy for EG1 and jigsaw-V for EG2 (the treatment groups) while on control group, the conventional method. The lesson was delivered by the trained research assistant in the various schools using the researcher's prepared lesson notes. After which the GIS was administered as posttest.

Results

Research Question 1. What are the mean interest ratings of students' who were taught geometry using Jigsaw-I and Jigsaw-V instructional strategies and those taught using conventional method?

Table 2: Mean Interest Ratings and Standard Deviation of Students who were Taught Geometry Using Jigsaw-I and Jigsaw-V instructional Strategies and Conventional Method.

Group	Statistics	PreInterest	PostInterest
Jigsaw-I	Mean	44.97	52.67
	N	63	63
	Std. Deviation	7.729	8.525
Jigsaw-V	Mean	45.47	58.86
	N	64	64
	Std. Deviation	7.732	9.600
Conventional	Mean	45.73	51.36
	N	56	56
	Std. Deviation	7.202	8.482

Table 4.2 shows the mean interest ratings and standard deviations of students' in Jigsaw-I and Jigsaw-V groups 1 and Conventional method Group. Table 4.1 indicates that students 'taught using Jigsaw-I instructional strategy has pre-interest mean rating of 44.97 and postinterest mean rating of 52.67 with standard deviation of 7.729 and 8.525 respectively. Those taught using Jigsaw-V instructional strategy has preinterest mean rating of 45.47 and postinterest mean rating of 58.86 with standard deviation of 7.732 and 9.600 respectively while those taught using conventional method has 45.73 and 51.36 as preinterest and postinterest mean ratings respectively with standard deviation of 7.202 and 8.482 respectively.

Research Hypotheses 1. There is no significant difference in the mean interest ratings of students taught geometry using Jigsaw-I and Jigsaw-V instructional strategies and those taught geometry using the conventional method.

Table 3: ANCOVA Results of Students' Mean Interest Ratings on those Taught Using Jigsaw-I and Jigsaw-V Instructional Strategies and those Taught Using the Conventional Method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Squared
Corrected Model	5525.971[a]	3	1841.990	30.749	0.000	0.340
Intercept	3739.804	1	3739.804	62.429	0.000	0.259
PreInterest	3545.666	1	3545.666	59.189	0.000	0.248
Group	**1974.453**	**2**	**987.227**	**16.480**	**0.000**	**0.156**
Error	10722.925	179	59.905			
Total	558443.000	183				
Corrected Total	16248.896	182				

a. R Squared = .340 (Adjusted R Squared = .329)

Table 3 shows that $F_{(2,179)} = 16.480$; $P = 0.000 < \alpha = 0.05$, where P is the associated exact probability value. This indicates that the null hypotheses is rejected. Therefore, there is effect in the mean interest ratings of students taught geometry using Jigsaw-I and Jigsaw-V instructional strategies and the conventional method. Based, on the established difference there is need for pairwise comparison to determine the direction of the difference as shown below using Bonferroni

Table 4: Pairwise Comparisons

Multiple Comparisons (Bonferroni Test)

Dependent Variable: PostInterest

(I) Group	(J) Group	Mean Difference (I–J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference
					Lower Bound – Upper Bound
Jigsaw-I	Jigsaw-V	-5.899*	1.374	0.000	-9.220 – -2.578
	Conventional	1.757	1.423	0.655	-1.681 – 5.195
Jigsaw-V	Jigsaw-I	5.899*	1.374	0.000	2.578 – 9.220
	Conventional	7.657*	1.416	0.000	4.234 – 11.080
Conventional	Jigsaw-I	-1.757	1.423	0.655	-5.195 – 1.681
	Jigsaw-V	-7.657*	1.416	0.000	-11.080 – -4.230

Based on estimated marginal means

* The mean difference is significant at the 0.05 level.

[b] Adjustment for multiple comparisons: Bonferroni.

Table 4 shows Bonferroni pairwise comparisons of postinterest mean ratings of students taught geometry using Jigsaw-I and Jigsaw-V instructional strategies and the conventional method. The Table 4.3 indicates that for Jigsaw-I versus Jigsaw-V, the associated exact probability value of $P = 0.000 < \alpha = 0.05$, hence the null hypotheses is rejected in favour of Jigsaw-V. For Jigsaw-I versus conventional method, $P = 0.655 > \alpha = 0.05$, this indicates that the null hypotheses is not rejected since the associated probability value is greater than the significant level at $\alpha = 0.05$ while for Jigsaw-V versus conventional method, $P = 0.000 < \alpha = 0.05$ which signifies that the null hypotheses is rejected. Therefore, the postinterest mean ratings of students taught geometry using Jigsaw-V instructional strategies improves better compared to their counterparts taught geometry using Jigsaw-I and conventional method respectively.

Research Question 2. What are the mean interest ratings of male and female students who were taught geometry using Jigsaw-I instructional strategy?

Table 6: Mean Interest Ratings of Male and Female Students who were Taught Geometry Using Jigsaw-I Instructional Strategy

Gender (JI)	Statistics	PreInterest	PostInterest
Male	Mean	45.63	54.57
	N	30	30
	Std. Deviation	8.931	8.468
Female	Mean	44.36	50.94
	N	33	33
	Std. Deviation	6.533	8.329

Table 4.4 above shows the mean interest ratings and standard deviations of male and female students in Jigsaw-I group. The results reveal that male preinterest mean ratings is 45.63 and 54.57 for postinterest rating with standard deviation 8.931 and 8.468 respectively. The female students has preinterest mean of 44.36 and postinterest mean of 50.94 with standard deviations of 6.533 and 8.329 respectively.

Research Hypotheses 2. There is no significant difference in the mean interest ratings of male and female students taught geometry using jigsaw-I instructional strategy.

Table 6: Results on Male and Female Students' Mean Interest Ratings who were Taught Geometry Using Jigsaw-I instructional Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Corrected Model	1220.348[a]	2	610.174	11.143	0.000	0.271
Intercept	1498.548	1	1498.548	27.365	0.000	0.313
PreInterest	1013.594	1	1013.594	18.509	0.000	0.236
Gender JI	136.813	1	136.813	2.498	0.119	0.040
Error	3285.652	60	54.761			
Total	179254.000	63				
Corrected Total	4506.000	62				

[a] R Squared = .271 (Adjusted R Squared = .247)

Table 6 shows that there is no significant difference in the mean interest ratings of male and female students taught geometry using Jigsaw-I instructional strategy, since $F_{(1,60)}$= 2.498 and the exact associated probability value of P = 0. 119 > α = 0.05. The null hypotheses is therefore not rejected. It indicates that both genders showed the same level of interest when taught geometry using Jigsaw-I instructional strategy.

Research Question 3. What are the mean interest ratings of male and female students who are taught geometry using Jigsaw-V instructional strategy?

Table 7: Mean Interest Ratings of Male and Female Students who were Taught Geometry

Gender (JV)	Statistics	PreInterest	PostInterest
Male	Mean	46.29	59.39
	N	28	28
	Std. Deviation	7.985	8.770
Female	Mean	44.83	58.44
	N	36	36
	Std. Deviation	7.580	10.302

Table 7 shows the mean interest ratings and standard deviations of male and female students in Jigsaw-V group. The results indicate that male preinterest mean ratings is 46.29 and 59.39 for postinterest mean rating with standard deviation of 7.985 and 8.770 respectively. The female students has preinterest mean of 44.83 and postinterest mean of 58.44 with standard deviations of 7.580 and 10.302 respectively.

Research Hypotheses 3. There is no significant difference in the mean interest ratings of male and female students taught geometry using jigsaw-V instructional strategy.

Table 8: ANCOVA Results of Male and Female Students Mean Interest Ratings who were Taught Geometry Using Jigsaw-V Instructional Strategy

Source	Type II Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Corrected Model	614.155[a]	2	307.077	3.608	0.033	0.106
Intercept	2889.521	1	2889.521	33.951	0.000	0.358
PreInterest	599.988	1	599.988	7.050	0.010	0.104
Gender JV	2.093	1	2.093	0.025	0.876	0.000
Error	5191.580	61	85.108			
Total	227529.000	64				
Corrected Total	5805.734	63				

[a] R Squared = .106 (Adjusted R Squared = .076)

Table 8 shows that, there is no significant difference in the mean interest ratings of male and female students taught geometry using Jigsaw-I instructional strategy, since $F_{(1,61)}$= 0.025; and associated exact probability value of P = 0.876 > α = 0.05. Therefore, the null hypotheses is not therefore not rejected. This implies that both genders show the same level of

interest when taught geometry using Jigsaw-I and Jigsaw-V instructional strategies.

Discussion

The results were based on the data collected and analysed. The finding reveals significant difference in the mean interest of students taught geometry using Jigsaw-V instructional strategy but not on the students taught using Jigsaw-I instructional strategy while those taught geometry using conventional method exhibited similar level of interest with those taught using Jigsaw-I instructional strategy. The findings were in line with the previous findings of researchers like Nwafor et al, (2023); Nduji et al, (2020) and Areelu & Ladele, (2018). Nwafor, (2023) study showed that collaborative learning has influence on students' interest in geometry Etok et al, (2024) finding was contrary. It reveals that jigsaw strategy is less effective in promoting students' interest in geometry than competitive learning strategy.

Gender was found not having influence on students' interest levels. Both males and females taught geometry using Jigsaw-I and Jigsaw-V showed similar level of interest in the topic. This finding aligns with the finding of Nwafor et al, (2023) who determined the effect of collaborative learning strategy on students' interest in geometry and Kirabo et al, (2023) study, which determined the interest levels and differences in mathematics among Olevel students but contradicts the findings of Oluyemo et al, (2020) and Areelu and Ladele, (2018) that showed that male students demonstrated higher than their counterpart taught using conventional method. The students taught using collaborative learning exhibit higher interest than those taught using conventional method. Nduji, (2020) finding also indicated that student taught physics using jigsaw based Cooperative Learning Strategy exhibits higher interest in the subject than those taught using lecture method. Furthermore, the study of Areelu and Ladele, (2018) also indicated that jigsaw instructional strategy was more effective in improving students' interest in mathematics than those taught using conventional method and individual personalization instructional strategy. However, the study of

levels of interest than female students in mathematics respectively.

Conclusion

Based on the findings of the study, it is established that both Jigsaw-I and Jigsaw-V instructional strategies improves the interest level of students' taught geometry better than those taught using the conventional method. However, gender did not significantly influence interest levels of both male and female students who were exposed to Jigsaw-I and Jigsaw-V instructional strategies respectively. Furthermore, those taught using jigsaw-I instructional strategy and those taught using Jigsaw-V instructional strategy showed similar levels of interest and understanding when taught geometry.

Recommendations

Following the conclusion of this study, the following recommendations were made.

1. The use of Jigsaw-I and Jigsaw-V instructional strategies should be integrated and adopted by mathematics teachers in teaching geometry and other mathematics concepts in both Basic and senior classes in the school.
2. Curriculum planners and the Department of Quality Assurance in education system should integrate both strategies into classroom instruction to enhance students' interest, academic performance and outcomes.
3. The use of conventional teaching method should either be approached with caution, as evidence suggests it may be less effective; mathematics teachers, therefore, needs to exercise expertise in supplementing the conventional method with innovative strategies such as Jigsaw-I and Jigsaw-V to avoid situation whereby underachievement is inadvertently promoted.
4. Government should organize regular capacity building programme for mathematics teachers such as workshop, conference, seminar, symposium, exhibition and many more where the teacher can be taught on the use of Jigsaw-I and Jigsaw-V instructional strategies in other to equip them on the proper use of the strategies in the classrooms.
5. Mathematics educators should work towards the production of mathematics textbooks and teacher guides based on Jigsaw-I and Jigsaw-V instructional strategies.

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