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Effect of Cooperative Learning Strategy on Students' Achievement in Senior Secondary School Geometry

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Abstract: *This study investigated the Effects of Cooperative Learning Strategy on Senior Secondary School Students' Achievement in Geometry as a probable solution to the problem of poor achievement of students in mathematics all over the world. Three research questions guided the study. Three null hypotheses were formulated and tested at 0.05 α level of significance. The study adopted a quasi-experimental design with non-equivalent pretest- post test control group. A sample of two hundred and ninety-eight (298) SS II students participated in this study. They were selected from a population of 1845 students. One hundred and forty-four (144) of them are males and one hundred and fifty-four (154), females. Geometry Achievement Test (GAT) was the instrument used for data collection. It was developed after content validation and exposed to item analysis. The instrument was administered to155 students; seventy four (74) males and eighty-one (81) females, that formed the experimental group and also to another 143 students; seventy (70) males and seventy-three (73) females, that made up the control group. Cooperative learning strategy was used in teaching the experimental group while the conventional talk and chalk method was used on the students in the control group.*

The reliability of GAT was established using Kuder-Richardson Formula, K-R20. Mean and standard deviation were used to answer the research questions while the analysis of covariance (ANCOVA) was applied in testing the hypotheses. The findings revealed that there was a significant difference between students taught geometry with cooperative learning strategy and those taught with conventional method; there was no significant difference between the mean achievement scores of male and female SS 2 students taught geometry with cooperative learning strategy and there was no significant interaction effect between method and gender on students' academic achievement in geometry. The educational implication is that during teaching and learning of mathematics and geometry in particular, teachers should pattern their teachings to put into effect students-students interaction among other lively learning approaches. Recommendations were made which include among others: that teachers of mathematics at senior secondary school level should adopt the cooperative learning strategy in teaching mathematical/geometry concepts as it facilitates students' achievement in mathematics.

Key words: *Cooperative learning strategy, Achievement, Geometry, Quasi experimental design.*

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I. Introduction

Mathematics is a very important and one of the core subjects, taught at all levels of education, to build the students' mental capability, teach them logical reasoning and problem solving skills. Mathematicians and other scholars in diverse areas of study had given different definitions to mathematics as it applies to them. Kolawole, Oladosun, Ajetumobi (2013) described mathematics as a tool for enhancing the learning of other school subjects; an essential instrument for solving problem conditions in all fields. Andaya (2014: 83) expressed that "mathematics is not just computation but a tool for understanding structures, relationships and patterns to produce solutions for complex real life problems". So mathematics, as a subject and career is indispensable in our everyday activity and most importantly in the world of science, technology and engineering. Mathematics is considered as the mother of all learning in both arts and science. It is essential in almost every field: measurement, fashion, sports, technology and economics. Professionals in the sciences like the architects, eng ineers, physicists, land surveyors and their likes cannot do without mathematics, because they apply measurement in their every day dealings. Ochuenwike (2014) asserted that mathematics is a dynamic field of knowledge which has much to offer in the sciences, technology, arts, everyday living as well as entrepreneurship development. Emphasizing the great importance of mathematics, Atiku (2014), said that the failure of the Nigerian students in mathematics in the 2014 West African Examination Council result is a failure of the nation.

The branches of mathematics are: arithmetic, algebra, trigonometry, geometry, calculus, statistics and probability. Geometry, which is the area involved in this study is defined by Quirk (2009) as an aspect of

mathematics that is concerned with angles and shapes formed by the relationships of lines, surfaces, and solid objects in space. Geometry is so important that it is taught at all levels of education, from the Primary through the Basic Secondary School to the final year in Senior Secondary School in Nigeria and in most countries of the world because of its importance. Dangpe in Bot & Gopep (2015) stated that geometry serves as the key to understanding nature. It develops and promotes the power of thinking and reasoning and useful in studying different subjects.

Importance of mathematics in all spheres of life notwithstanding, students' achievement in mathematics is low (WAEC 2015 and 2016). Also studies by WAEC (2011 & 2015) showed that achievement of students in secondary school mathematics in Nigeria has been comparatively low over the years. WAEC Chief Examiners' reports (2011 and 2012) indicated the candidates' areas of poor performance in mathematics which consistently included geometry. The reports stated further that most students tactically avoided geometry questions or attempted them haphazardly. Geometry topics are among the topics being conceived as abstract and complex part of mathematics that students consider hard to study and several teachers find it burdensome to explain.

This fact is not only established in Nigeria, Schwatt in Melo & Martins (2015) observed that the average student seems to have less understanding of geometry than any other of the elementary mathematical disciplines. This according to him was because of the difficulty of the subject of geometry. Melo & Martins (2015), talking about teaching and learning topics of geometry that are part of high school courses said that internationally, the teaching of geometry has been the subject of several studies. In a case study they conducted, where 90 students were drawn in 2014 – 2015 academic year, and geometry topics taught in the degree of Educa-ão Básica from the University of Azores, research continues to reveal that geometry is disliked by most students, is misunderstood, and the notations is totally ignored. According to Melo & Martins, one of the reasons for the failure is that these issues are addressed superficially in the curriculum of training of teachers. Lewis (2014), said that many students do not understand geometry and conceptually difficult for them. He said that geometry is not interactive like language, arts, writing and even science. Geometry is boring and has to follow sets of rule prone to memorization; many of such rules do not have exceptions. He concluded by saying that that to guarantee success in geometry, either in teaching or in learning, its concepts must be explained and understood, never memorized by the use of formulae. He added that we cannot forget that we learn by doing.

The students' inability to answer geometry questions in mathematics examinations may have contributed to the low achievement in mathematics. Based on this reality, this study pinpointed geometry to be a fundamental hard domain for which students' achievement has been poor and needs to be addressed. It looked at the effect of cooperative learning as a strategy in enhancing students' achievement in geometry. It examined how effective the use of cooperative learning strategy in teaching and learning will enhance students' achievement in geometry. Johnson and Johnson (2009: 69) explained cooperative learning as a "set of methods in which students work together in small groups and help one another to achieve learning objectives." In cooperative learning strategy, peers assist each other's learning and effectively communicate among themselves. Working together enables weak students to learn from the intelligent students. When this is done, concepts make deep meaning to them. As asserted by Anugwo (2015), when these concepts make deep meaning to the students, learning takes place, its application to real life problems are possible and achievement enhanced as well.

The purpose of the study therefore specifically examined*:*

1. Effect of cooperative learning strategy on the mean achievement scores of Senior Secondary Two (SSII) students in geometry.
2. Effect of cooperative learning strategy on the mean achievement scores of male and female Senior Secondary Two (SSII) students in geometry.
3. Interaction effect of method and gender on the mean achievement scores of SSII students in geometry.

The following research questions guided the study:

1. What is the effect of cooperative learning strategy on the mean achievement scores of SSII students in geometry when compared with the conventional method?

2. What is the effect of cooperative learning strategy on the mean achievement scores of male and female SSII students in geometry when compared with the conventional method?

3. What is the interaction effect of method and gender on students' mean achievement in geometry when compared with the conventional method?

Based on the research questions, the following null hypotheses were generated and tested at 5% alpha level (i.e. $\alpha = 0.05$):

$H0_1$: There exists no statistically significant effect on the mean achievement scores of SSII students taught geometry with cooperative learning strategy and those that are exposed to the conventional method.

$H0_2$: There exists no statistically significant effect of cooperative learning strategy on the mean achievement scores of male and female SSII students in geometry.
$H0_3$: There is no significant interaction effect between method and gender on students' mean achievement in geometry**.**

II. Methods

Quasi-experimental design was applied in the research. Explicitly, pretest-post test unequal control group design was adopted. This research was conducted within Aguata Education Zone, Anambra State Nigeria. Aguata Education Zone covers three (3) Local government areas (LGAs): Aguata, Orumba North and Orumba South. School population for the study consisted of all the 1,845 Senior Secondary Two (SSII) students within the 47 (forty-seven) public secondary schools in Aguata Education Zone in the year 2015/2016 academic session. This comprised of eight hundred and seventy-seven (877) male students and nine hundred and sixty-eight (968) female students (Source: Statistics Department of Post Primary School Commission (PPSC) Aguata Zone, 2015/2016 Session). A sample of two hundred and ninety-eight (298) students participated in the study; one hundred and forty-four (144) male and one hundred and fifty-four (154) females. The experimental group was made up of seventy-four (74) males and eighty-one (81) females, totaling one hundred and fifty-five (155) students while the control group was made up of seventy (70) males and seventy-three (73) females, making a total of one hundred and forty-three (143) students.

Stratified random sampling technique was applied to draw the sample from each of the LGAs representing a stratum. Six (6) coeducational schools were sampled from the target school population which involved 2 schools from each LGA in the zone. Through a simple toss of a coin, three schools (one from each LGA) were selected as the treatment (cooperative learning strategy) group and the other three schools, one from each LGA formed the control group.. The instrument applied in collecting data for the present research was Geometry Achievement Test (GAT). GAT is an achievement test developed by the researchers using the test blue print. It was face validated with each of the items exposed statistically to the difficulty and discrimination indices aspects of item analysis. Data was collected after administering the pretests to both the control and experimental groups. Different packages for the control and experimental groups were duly developed by the researchers and used in training the mathematics teachers of the students involved in the groups as intact classes were used. The study tried as much as possible to control the extraneous variables like teacher, instructional situation, inter group and subject interaction variables. The reliability of GAT was established using Kuder-Richardson Formula, K-R20. The experimental group was taught with a package that involved the use of cooperative learning strategy. The control group was taught with the conventional Talk and Chalk method. At the end of 6 weeks of teaching, the instrument was again administered to both groups. The scripts were collected after the test administration, marked and scores of students collated. The research questions were descriptively answered using mean and standard deviation while Analysis of Covariance (ANCOVA) was applied in testing the hypotheses. All hypotheses formulated were tested at $\alpha = 0.05$ level of significance.

III. Results

Research Question one

What is the effect of cooperative learning strategy on the mean achievement scores of SSII students in geometry?

Table 1: Mean and Standard Deviation of Achievement Scores of Experimental and Control Groups in Geometry.

Group	Adjusted Mean	S.D	N
Experimental	73.59	10.07	155
Control	55.17	10.56	143

As shown in table 1, the experimental group obtained an adjusted mean score of 73.59 and a standard deviation of 10.07. The control group obtained an adjusted mean of 55.17 and a standard deviation of 10.56. The scores indicated that those students taught geometry using cooperative learning technique achieved more than those taught geometry using conventional method.

Research Question Two

What is the effect of cooperative learning strategy on the mean achievement scores of male and female SSII students in geometry?

Table 2: Mean and Standard Deviation of Achievement Scores of Male and Female SSII Students in Geometry.

Group	Adjusted Mean	S.D	N
Male	75.45	8.97	74
Female	71.20	10.75	81

Table 2 indicated that the male students obtained an adjusted average score of 75.45 and a standard deviation score of 8.97 while their female counterparts had an adjusted average score of 71.20 with a standard deviation score of 10.75. The scores indicated that cooperative learning strategy favored the male students more than their female counterparts. In other words, the male students achieved a bit higher than their female counterparts when taught using cooperative learning strategy.

4.1.3 Research Question Three

What is the interaction effect of method and gender on students' mean achievement in geometry?

Table 3: Mean and Standard Deviation in the Experimental and Control Groups Based on Interaction between Method and Gender.

Group	Gender	Adjusted Mean	S.D	N
Experimental	Male	75.45	8.97	74
	Female	71.20	10.75	81
Control	Male	55.97	9.14	69
	Female	54.43	11.74	74

Table 3, indicated that the male and female students in the experimental group obtained adjusted average scores of 75.45 and 71.20 respectively which are high and their counterparts in the control group obtained 55.97 and 54.43 respectively. This showed that cooperative learning strategy favored both the male and female learners in the treatment group. Also conventional method favored both male and female learners equally because their adjusted mean scores are close to one another.

Testing the Hypotheses

The formulated hypotheses (Ho) were tested at $\alpha = 0.05$ level of significance as follows: **Testing the Hypothesis One**

There is no statistically significant effect between the mean achievement scores of SSII students taught geometry by applying cooperative learning strategy and those taught using conventional approach.

The results for hypotheses 1 and 3 are shown in table 4

Table 4: Analysis of Covariance (ANCOVA) Results of Male and Female Learners Taught Geometry by applying Cooperative learning Strategy.

Source of Variation	Sum of Squares	D.F.	Mean Square	F	Sig.
Corrected Model	9482.707	2	4741.353	117.746	.000
Intercept	10399.216	1	10399.216	258.252	.000
VAR 0001(Pretest)	8996.807	1	8996.807	223.452	.000
Gender	75.281	1	75.281	1.870*	.174
Error	6120.687	152	40.268		
Total	85508.000	155			
Corrected Total	15603.394	154			

*Significant at $\alpha = 0.05$ level

Hypothesis Three

There exists no statistically significant effect between the mean achievement scores of male and female SSII students taught geometry using cooperative learning strategy.

X –Note that you said that table 4 will be used for hypotheses 1&3 why are you talking about table 5 here↓(next line)? Correct appropriately.

The results in Table 5 showed that there is no statistically significant difference between the academic achievement of male and female students exposed to cooperative learning approach. That is, the analysis of covariance result of Table 5 reveals that F calculated = 1.870 was not found significant at P- value = .174 > 0.05. Because the P- value is greater than 0.05, the null hypothesis cannot be rejected; hence we accepted the

null hypothesis and conclude that there is statistically no significant distinction between male and female learners exposed to cooperative learning strategy.

The result in table 2 showed that cooperative learning strategy enhanced the academic achievement of the male learners as well as female learners. That is, achievement was unaffected by sexes. Gender notwithstanding, each student profited almost at the same level from application of cooperative instructional technique. The enhancement received by all the students through application of cooperative learning strategy may have contributed to insignificant distinction observed in the achievement among the male and female students in the experimental group.

X- You were also talking of table 2 above↑ rectify these issues.

Testing the Hypothesis Two

There is no significant interaction between method and gender on students' mean achievement in geometry**.**

Table 5: Analysis of Covariance (ANCOVA) Results of the Experimental Group as well as Control Group with pre-test scores of Covariates

Source of Variation	Sum of Square	Df	Main Squares	F	Sig.
Corrected Model	47458.359	4	11864.590	377.338	.000
Intercept	15115.497	1	15115.497	480.729	.000
VAR0001 (Pre-test)	21654.839	1	21654.389	688.704	.000
Method (Treatment GP)	7482.369	1	7482.369	237.967*	.000
Gender	83.794	1	83.794	2.665	.104
Method and Gender	1.475	1	1.475	0.047*	.289
Error	9212.758	293	31.443		
Total	13062449.000	298			
Corrected Total	56671.117	297			

*Significant at $\alpha = 0.05$ level

The analysis of Covariance (ANCOVA) results as shown by table 4 indicate that for method, F cal. = 237.967 was found significant at P = .000. Since this P-value is less than 0.05, the null hypothesis (H_{01}) cannot be accepted; thus the null hypothesis is rejected. Therefore, the researcher concludes that there is a significant distinction in the achievement of students between experimental group and control group. The implication is that cooperative learning strategy improved or enhanced students' academic achievement in geometry. This further disclosed that the experimental group achieved significantly more than the control group. Hence, using cooperative learning strategy improves students' achievement more than the conventional method. The analysis also indicated a non significant interaction effect of learning resources (method) and gender on students' achievement in geometry since Fcal, .047 was not found significant at P = .289. Hence, the null hypothesis (H_{03}) which asserts that there was not statistically significant interaction effect between method and gender on students' mean achievement in geometry was accepted. The results in table 3 showed that the interaction did not affect the achievement of the gender of any of the groups.

IV. Discussion Of Findings

The findings showed that there exists a significant difference between the academic achievement of participants taught geometry by applying cooperative instructional strategy and those exposed to conventional method. The result revealed greater adjusted mean scores on the part of experimental group than those of the control group. Hence employing cooperative instructional approach enhances learning geometry more than the use of conventional method.

More so, the cooperative learning strategy has the accountability and interrelationship features incorporated in arrangement that is not seen in the conventional lecture room. In fact, the positive impact produced through cooperative instructional approach revealed the significance of interaction as suggested by Vigotsky (1978).

The outcomes from this research are in consonance with the results by Oloyede, *Adebowale & Ojo* (2012) that got remarkable distinction in learners' achievement among those students taught using cooperative instructional approach as well as those taught without it. Furthermore, the findings from this study are in agreement with findings by Ajaja and Ochuko (2010), Effamdi *et.al., X- Effamdi, list the names of the other authors. Remove et al. it is not listed in the references. Please reference it.* (2013) Igboanugo and Njoku (2015), Odugboyi Otuka & Uzoechi, (2015), and Timaji, Bolaji & Kajuru , (2015) also obtained results which showed remarkable dissimilarity in academic achievements among learners taught using collaborative instructional technique and those taught without it which is consistent with the findings of this study.

The work also indicated that there is no significant effect between the mean achievement scores of the male and female learners taught geometry with cooperative learning strategy. This implies that the dissimilarity in the achievement scores among the male and female learners was very small (3.54). This is confirmed by the analysis of covariance result of Table 5 that F calculated = 1.870 was not found significant at P- value = .174 > 0.05. This shows that the treatment or cooperative learning strategy enhanced both the male and female learners' academic achievement equally in geometry. In other words, each of the learners regardless of their gender gained equally through exposure to cooperative learning strategy.

Iwendi (2012), obtained results in which no remarkable distinction in academic achievement existed among male and female learners in mathematics as a result of treatment. Also, Timaji, Bolaji & Kajuru, (2015) observed no remarkable dissimilarity in achievement scores among male and female learners in geometry as a result of treatment. Ajaja and Aluko (2010) also found no notable distinction in the mean achievement/ assessment scores among male and female learners subjected to cooperative learning strategy. This confirms the efficacy of cooperative instructional in terms of gender. The findings generally, revealed that the academic achievement of both male as well as female learners could be improved equivalently in mathematics and geometry in particular if any good teaching strategy like cooperative learning is adopted.

On the interaction effect of method and Gender on Students' Academic Achievement in Geometry**,** the findings of this work revealed that there is no significant interaction effect between method and gender on students' academic achievement in geometry. In other words, the results of the research indicated that cooperative learning strategy favored both male and female participants and improved their academic achievement in geometry. This is confirmed by the analysis of covariance result of Table 4 that has the F calculated of .047 was not found significant at P = .289. The implication is that the treatment (cooperative learning strategy) applied on the experimental group enhanced both male and female learners' academic achievement in geometry.

However, Oloyele, *Adebowale & Ojo* (2012) obtained similar result in which insignificant interaction effect was observed among sex as well as classroom interactions. The finding of Ajaja and Ochuko (2010) is also consistent with the findings of this study that there was no significant interaction effect between instructional procedure and gender on students' achievement in geometry.

V. Conclusion and Recommendations

Conclusions drawn from the findings of the research included the following:

Cooperative learning strategy is discovered to be an effective strategy for meaningful learning to occur in mathematics. The students exposed to cooperative learning strategy achieved significantly higher than those taught without cooperative learning strategy.

Cooperative learning strategy enhanced both the male and female learners' academic achievement in geometry. This was supported by the very small distinction between the mean achievement scores of male and female students taught geometry with cooperative learning technique. Therefore, for better achievement in geometry, teachers of mathematics should be encouraged to adopt and adapt appropriate cooperative learning strategy in combination with other suitably selected teaching methods. The use of variety of teaching methods will help to increase the students' understanding of the subject. Thus, better and higher achievement could be maintained and the act of perceiving mathematics as an abstract subject will be reduced.

The findings of this study had supplied useful information concerning the effects of cooperative instructional approach on the achievement of senior secondary students in geometry. It has indicated that application of cooperative learning strategy enhanced the mean achievement scores of students in geometry. In the cooperative instructional category, students progressively accepted responsibilities for one another's education. There is strong communication existing among the participants in the cooperative instructional category. In the cooperative instruction, response, corroboration and (prop up advance) x - I do not understand; recast from student peers in the group. The implication is that during teaching and learning of mathematics in general as well as geometry in particular, teachers should pattern their teachings to put into effect students-students interaction, concepts are presented in comprehensible manner and students have better understanding by exposing them to cooperative learning strategy, they have no option but to enroll into science, technology and engineering courses in their educational career. Thus, quest for scientific and technological breakthrough could be immensely achieved.

Recommendations

The following recommendations are made by the researchers to improve the teaching and learning of mathematics and enhance students' achievement in the subject.

a. Mathematics teachers should adopt the cooperative learning strategies in teaching geometry concepts as it facilitates students' achievement in mathematics.

b. This instructional strategy is also recommended for mathematics teachers to bridge the gap in gender achievement of students because the Cooperative learning strategy enhances the achievement of both male and female students in mathematics.

c. Workshops, conferences, seminars, have to be arranged regularly by the education sectors to educate mathematics teachers on the significance of cooperative learning technique in teaching and learning of mathematical concepts, especially the geometrical concepts.

d. Government through the Evaluation and Supervisory units should encourage the use of cooperative teaching and learning strategy in mathematics instruction in all the schools and at all levels.

e. Teacher education institutes should train the teachers in the use of many teaching strategies amenable to mathematics understanding, especially the application of the cooperative learning strategy in the teaching of geometry concepts.

References

[1]. Ajaja, P. O and Ochuko, U. E (2010). Effects of cooperative learning strategy on junior secondary school two (JS II) students' achievement in Integrated Science. *Elctronic Journal of Science Education,* 14 (1): 1-15.

[2]. Anambra State Post Primary Schools Commission, Aguata Zone (2014). Statistics Department, Aguata Local Government Headquarters, Ekwulobia.

[3]. *Anambra State Statistical Year Book (2011).* National Bureau of Statistics.

[4]. Andaya, O. J. F. (2014).Factors that affect mathematics achievements of students of Philippine Normal University, Isabela Campus. *Journal of Arts, Science and Commere,* 5(4): 83.

[5]. Anugwo, M. N. (2015). Assessment of problems and remediation of STEM education. *International Technology, Education and Development (INTED) Conference Proceedings,* 9(1):7973- 7978.

[6]. *Atiku, A. (2014). Students' failure is our nation's failure. Vanguard newspaper of 15th August 2014. Retrieved from www.vanguard.ngr.com on 25/3/19*

[7]. Bot, T. D. and Gopep, G . G. (2015). A Study on Effect of programmed instruction on SSII Students' Achievement in Circle Geometry in Pankshin, Plateau State, Nigeria. *Journal of Science Teachers Association of Nigeria, JSTAN,* 50(1): 107-115.

[8]. Etukudor, U. E. (2011). Revolutionizing universal basic education mathematics curriculum: A tool for re-branding Nigerians. *Annual National Conference Proceedings of Mathematical Association of Nigeria*, 189 – 194.

[9]. Federal Republic of Nigeria, (2004). National Policy on Education, Lagos, Federal Government Press.

[10]. Geometry-Definition. Retieved from http:// www.merriam-webster.com/dictionary/geometry. Accessed on 24th March, 2013.

[11]. Igboanugo, B. I. and Njoku, Z. C. (2015). Effect of cooperative learning and peer teachingon senior secondary school students' achievement in some difficult chemistryconcepts. *Journal of the Science Teachers Association of Nigeria* (*JSTAN*), 50(1): 151-160.

[12]. Isiaka, A. G., Moses, J. and Olumorin, C. O. (2013). Effectiveness of video-based cooperative learning strategy on high, medium and low academic achievers: the African symposium. *An online Journal of African Educational Research Network*,13(2): 77 – 84.

[13]. Iwendi, B. C. (2012). Effects of gender and age on the mathematics achievement of secondary school students in Mina Metropolis, Nigeria. *Journal of Science & Technology,* 9(1): 215- 223.

[14]. Iyekekpolor, A. S. O. (2007). Cooperative strategy for combating poor performance in mathematics. Makurdi: Onauvi.

[15]. Johnson, D. W. (2009). *Reaching Out: Interpersonal Effectiveness and Self- actualization,* (10th Ed.): Boston: Allyn & Bacon: 69.

[16]. Johnson, D. W., Johnson, R. T, and Smith, K (2007). The state of cooperative learning in postsecondary and professional settings. *Educational Psychology Review*, 19: 15-29

[17]. Kolawole, E. B. (2008). Effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics. *Educational Research and Review*, 3(1): 033 – 037.

[18]. Kolawole, E .B. and Oluwatayo, J. A. (2005). Mathematics for everyday living: Implications for Nigerian secondary schools. *Abacus, Journal of Mathematical Association of Nigeria,* 30(1): 57.-51

[19]. Kolawole, E. B., Oladosu, C. I and Ajetumobi, O. (2013). Comparability of effectiveness of problem- solving methods on learners' performance in mathematics. *Unique Journal of Educational Research*, 1(2): 12-19.

[20]. Lewis, D, (2014). Why students dislike geometry. Retrieved from www.aplusinhometutors,com/blog/why-students dislike-geometry on 15/4/20

[21]. Melihan, U. and Sirri, C. (2011). The effect of cooperative learning method on students' success and recall levels of the 8th grade students learning in permutation and probability subject. *Journal of Kirsehir Education Faculty*, 2: 1-16.

[22]. Melo, H. S. and Martins M.D.C. (2015). Behaviour amd Attitudes in Teaching and Learning of Geometry. Portugal: University of Azoro

[23]. Obodo, G. C. (2000). Principles and practice of mathematics education in Nigeria. Enugu: *General Studies Division, Enugu State University of Science and Technology Publication*.

[24]. Ochuenwike, G. N. (2014). Mathematics: A Tool for Entrepreneurship Development. *International Journal of Educational Research. Official Journal of Faculty of Education, University of Nigeria Nsukk*a, 13(1): 121.

[25]. Odugboyi, I. A., Otuka, J. O. and Uzoechi, B. C. (2015). Effect of the jigsaw cooperative learning approaching on biology students' achievement and conceptual change. *Journal of Science Teachers Association of Nigeria, JSTAN*, 50(1): 163-170.

[26]. Ogbonne, U. T.and Offorma, G. C. (2014). Effect of collaborative learning method onsecondary student' achievement in English language tenses. *International Journal of Educational Research. Official Journal of Faculty of Education, University of Nigeria Nsukka*, 13(1): 423-425.

[27]. Olasehinde, K. J. and Olatoye, R. A (2014). Comparison of male and female senior secondary school students' learning outcomes in Science in Katsina State, Nigeria. *Mediterranean Journal of Social Sciences, MCSER, Publishing, Rome – Italy*, 5 (2): 517.

[28]. Oloyede, E. O., Adebowale, O. F. and Ojo, A. A. (2012). The Effects of competitive cooperative and individualistic classroom interaction models on learning outcomes in mathematics in Nigeria senior secondary schools. *International Scholarly Research Network, ISRN Education*. doi: 10.5402/2012/263891.

[29]. Olojo, O. J. and Ojo, A. A. (2011). Effect of cooperative, competitive and individualistic instruction strategies on senior secondary school students' achievement attitude towards mathematics in Ondo State, Nigeria. *Journal of Research in Education and Society*, 2(3): 35 – 43.

[30]. Olunloye, O. (2010). Mass Failure in Mathematics: A National Disaster. Tribune of 07/02/2010. Retrieved from http://www.tribune.com.nig. Accessed on 19/07/2011.
[31]. Quirk, R. (2009). Longman Dictionary of Contemporary English. England: Pearson Education Limited
[32]. Schwatt, I. J. in Melo, H. S. and Martins M.D.C. (2015). Behaviour and Attitudes in Teaching and Learning of Geometry. Portugal: University of Azoro
[33]. Slavin, R. E, (2011). Instruction based on cooperative learning. In R. E. Mayer & P.A. Alexander (Eds), *Handbook of Research on Learning and Instruction*: New York: Taylor & Francis, 344-360.
[34]. Spencer, D. J. (2004). Engagement with mathematics in traditional and online learning environment: Relationship to Motivation, Achievement, Gender and Gender Orientation. *Unpublished Ph.D. Dissertation*, Emory University.
[35]. Timaji, J. A., Bolaji, C. and Kajuru, Y. K. (2015). Effects of jigsaw iv cooperative learning strategy (J4CLS) on academic performance of secondary school students in geometry. *International Journal of Mathematics Trends and Technology (IJMTT)*, 8(1): 12-18.
[36]. Udonsa, E., Abdulqadir, B., Aliyu, W. Dahiru, S. (2015). A practical approach to instruction in solid geometry in the upper basic school using local examples. *Journal of Issues on Mathematics*, 17 (1): 123-131
[37]. Ugama, J. O. (2011). Reform in mathematics through improvisation: A Sure option in a period of economic meltdown. *Science Teachers Association of Nigeria, STAN 52nd Annual Conference Proceedings*, 305-308.
[38]. Vigotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Process*. Cambridge, Harvard University Publishers.
[39]. WAEC, (2009). *Chief Examiner's Report on May/June School Certificate Examination*, Lagos: Lucy Star.
[40]. WAEC, (2011). *West African Senior Secondary School Certificate Examination May/June Chief Examiner's Report*, WAEC, Lagos.
[41]. West African Examination Council, (2012). *waeconline.org.ng/e- learning/mathematics/mathsmain.html.* Accessed on 23/9/2013
[42]. White, H. and Sabarwa, P. (2014). Quasi experimental design and methodological briefs: *Impact Evaluation* 8, UNICEF Office of Research.

Dr. Ochuenwike, et. al. "Effect of Cooperative Learning Strategy on Students' Achievement in Senior Secondary School Geometry." *IOSR Journal of Research & Method in Education (IOSR-JRME)*, 10(3), (2020): pp. 06-13.