



Effects of two Modes of Lesson Study Techniques on Senior Secondary School Students' Achievement in Mathematics in Okigwe Education Zone Two

Ogoke, Chinnemeze James¹ & Okigbo, Ebele Chinelor²

¹Department of Mathematics, Alvan Ikoku Federal College of Education, Owerri,

²Department of Science Education, Nnamdi Azikiwe University, Awka

Corresponding Author: james4justics@gmail.com

Abstract

The purpose of this study is to determine the effect of two modes of lesson study techniques on academic achievement of senior secondary one (SS1) students in mathematics in Okigwe Education Zone Two of Imo Sta. Two research questions and three null hypotheses tested at 0.05 level of significance guided the study. The researchers adopted a quasi-experimental design, specifically, pre-test, post-test non randomized control group was used. The population comprised 2,511 (1252 males and 1259 females) students in the 35 public secondary schools in Imo State. The sample size was 139 students selected through multistage sampling procedure. Trigonometry Achievement Test (TAT) was used for data collection. Learner Lesson Understanding Written Statements (LLUWS) and Teacher Planned Lesson Observation (TPLO) served as instructional tools used for evaluation. Three experts validated the instruments. The reliability co-efficient value for TAT is 0.84 which was calculated using the Kuder – Richardson Formula 20. Experimental group 1 was taught using Planned Lesson Mode (PLM), experimental group 2 was taught using Revised Planned Lesson Mode (RPLM) while the control group was taught with the traditional teaching mode (TTM). Mean and standard deviation were used to answer the research questions while the hypotheses were tested using Analysis of covariance. The results of the study showed among others that students taught mathematics with PLM and RPLM achieved significantly higher than those taught with TTM. Gender and achievement level do not significantly influence the mean achievement scores of students taught mathematics using PLM and RPLM. The study recommended among others that curriculum planners should integrate PLM and RPLM in the teaching and learning of mathematics in secondary schools.

Keywords: Lesson Study, Modes of Lesson, Mathematics, Achievement, Secondary Schools.

Introduction

The role of mathematics education in the lives of individual s and the society is very crucial. It is the gateway to achieving scientific and technological advancement and economic survival. The Federal Republic of Nigeria (2013) in the National Policy on Education made mathematics one of the compulsory subjects for secondary school education. The reason is that mathematics, being the “queen” of all sciences, lays the foundation for science and technology. Hence, mathematics as a science subject is all encompassing for there is hardly any subject

that does not need mathematics for proper functioning (Ogoke, 2016). Today, more than ever, other fields of knowledge are dependent on mathematics for solving problem, stating theories and predicting outcome. Mathematics is the backbone of science and technology and no nation can hope to achieve any measure of scientific and technological advancement without proper foundation in school mathematics (Ohuche & Kurumeh, 2011).

Notwithstanding, the important place of mathematics in secondary school



curriculum, the performance of secondary school students in Mathematics in West African Senior School Certificate Examination (WASSCE) has remained consistently poor. The statistics of performance in mathematics at the SSCE May/ June (2015-2018) fluctuated, some below average. This phenomenon has remained a source of concern to the researchers, parents, education administrators and the Nation at large. However, science education researchers have come up with many strategies and methods for teaching science and mathematics, namely problem-solving method, inquiry – based teaching/learning approach, mathematical game and analogies as advance organizers among others (Okigbo, 2010). Despite all these efforts, the problem of poor achievement in mathematics has continued to be noticed in the public examinations like WASSCE. Therefore, more efforts should be undertaken to improve the situation.

Oyedeji (2012) stated that the use of traditional method whereby the teacher talks about the subject while the students read about the subject is a major cause of the poor performance in mathematics. Traditional method is the method of instruction whereby the teacher dominates the teaching-learning process, projects himself as a repository of knowledge and doles out information uninterruptedly to the passive recipients of knowledge (Mbakwem, 2005). In the traditional method, communication flows in one direction, from the teacher to the learners, hence it is a teacher- centered method. Many mathematics teachers make use of traditional or expository method in teaching mathematics. This is probably because the method allows for a wider coverage of content within a short period of time and teaching large number of students at the same time. Despite these advantages,

it does not always produce positive learning outcomes in many secondary school students. That is to say, students should be given the opportunity to communicate mathematically, reason mathematically and develop self-confidence to solve mathematical problems, through the activity-oriented teaching strategies.

Teaching strategy is seen as the overall plan or large scale of pattern of activities geared towards achieving a goal and guarding the goal. A good strategy guarantees a positive change in behaviour, which has to do with meaningful learning. The learner is at the centre of the teaching and learning processes, hence, learner-centered strategies are mostly needed in the teaching and learning of mathematics. According to Onyemerekeya (2004), learner-centered method is a type of teaching that places the learner at the centre of all teaching activities. This method devotes more time to students' participation and recognizes the fact that no learning is effective unless the child is personally involved in the learning situation. The child must be constantly participating, help his own and his group's activities, engage in discussions, asking questions, seeks solutions and generally take part in an activity. This is possible only with carefully planned activities or techniques that will help students to explain or clarify ideas.

Teaching technique is set of unique activities which the teacher employs to implement a particular teaching method. They are ways of implementing a method (Onyemerekeya, 2004). Therefore, the teaching of mathematics is not about dispensing rules, definitions and procedures- for students to memorize, but engaging students as active participants through discussion and collaboration among students. Learning is meaningful if students



are given the opportunities to explain or clarify ideas. That is, instructional techniques that will make mathematics simple, meaningful and at the same time interesting are required. Based on that, the researcher seeks to find out the effect of two modes of lesson study techniques on the senior secondary school students' achievement and retention in mathematics, with the aim of improving the academic achievement of students in mathematics.

Mode is a cycle that starts from defined lesson to observed lesson implementation to reflection or discussion (that identifies areas of modification) and then to revised section (Dogo, 2017). That is, the first mode has to do with teaching with planned lesson while the second mode is teaching with revised planned lesson. Teaching and assessment are connected; the effectiveness of lesson taught, teaching methods and students' achievement are continuously measured during teacher instruction. This cannot be done without experts in the area of study coming together to observe, critique, modify and direct a lesson, using lesson study techniques.

Lesson study is the process of studying a lesson planned to finding out the best way to impact knowledge. It is a professionally and systematically developed process to examine teaching and learning with the aim of making it more effective (Dogo, 2017). The lesson study involves planning, teaching, observing and critiquing a lesson. It could also be seen as a process that involves a group of teachers who cooperatively plan a lesson and any of the members teaches the lesson by interacting with the students, the others observe the lesson, review and reflect on the lesson and revise the lesson planned. According to Easton (2009), lesson study requires teachers to work collaboratively to strengthen a given lesson until it has been

refined as much as possible and then teach it to get powerful data about how well the lesson works.

Preparing a lesson involves planning for teaching. Planning for teaching is a very important task for the teacher in the education of children. Onyemerekeya (2004) maintained that planning enables the teacher predicts the course of events during teaching. A plan is a blue-print for action. Planning is anticipatory decision making and involves the teacher in making decision on what to do, how to do it, and when to do it. Meanwhile, planning for teaching goes beyond merely writing a lesson notes, but is rather a systematic attempt to foresee the scope and sequence of courses, the content within courses, the units to be taught, the activities and resources required for every phase of teaching and learning of a given content prepared in the advance of teaching (Onyemerekeya, 2004). Using this technique in the teaching of mathematics may help improve the teaching and learning of mathematics in secondary schools, which may lead to improved achievement in the subject.

Achievement is the feeling of getting things done as we desired or getting things that we expected. Okafor (2011) described achievement as the act of accomplishing or finishing something, something accomplished successfully, especially by means of exertion, skill, practice or perseverance. Academic achievement is determined by the level of accomplishment of a given task evaluated by the teacher through achievement test, assignment, etc. Adeyemi (2008) describes academic achievement as the scholastic standing of a student at a given moment which states individual intellectual abilities. Achievement in mathematics therefore identifies how well or bad students have accomplished a given

mathematics task or test. Thus, achievement in mathematics may not necessarily take place unless teachers form solid foundation for solid instruction through effectively planned lesson and activity- oriented techniques.

The functional role of mathematics to science and technology is multifarious, that no areas of science, technology and business enterprise escape its application. Therefore, there should be strategies, techniques and methods that gear towards making its implementation effective to stand the test of time. This can only be achieved if teaching and learning process is not limited to one-man affair. That is to say, lessons should be prepared, studied, discussed, critique, observed collectively in order to make it more effective. The present researcher is motivated to find out the effects of two modes of lesson study techniques on academic achievement in mathematics of male and female students.

Gender issue in science education has been a subject of discourse and concern to science educators. According to Okereke (2006), Mathematics teachers also come to class loaded with a high dosage of sex related stereotypes, which make them treat boys and girls differently. Due to sex role stereotyping, it is generally believed that mathematics is suitable for boys and not for girls. On the contrary, Etsu and Ahmad (2018) reported that there is no significant difference in the academic achievement and retention of students' mathematics when taught with laboratory-based approach. The result agreed with Nwoke (2007), Ogoke (2018) and Shafi (2018), who reported no significant difference in the academic achievement and retention of students in mathematics.

Purpose of the Study

The purpose of this study was to determine the effects of two modes of lesson study techniques on academic achievement of secondary school students in mathematics. Specifically, this study is designed to determine the:

1. differences between the mean achievement scores of students taught mathematics with planned lesson mode (PLM), revised planned lesson mode (RPLM) and traditional teach mode (TTM).
2. differences between the mean achievement scores of male and female students taught mathematics with PLM and RPLM.
3. Interaction effect of teaching modes and gender on achievement in mathematics

Research Questions

1. What are the differences between the mean achievement scores of students taught mathematics with planned lesson mode (PLM), revised planned lesson mode (RPLM) and traditional teaching mode (TTM)?
2. What are the differences between the mean achievement scores of male and female students taught mathematics with PLM and RPLM?

Hypotheses

1. There is no significant difference between the mean achievement scores of students taught mathematics with planned lesson mode (PLM), revised planned lesson mode (RPLM) and traditional teaching mode (TTM).
2. There is no significant difference between the mean achievement scores of male and female students



taught mathematics with PLM and RPLM.

3. There is no significant interaction effect of teaching modes and gender on students' achievement in mathematics

Method

The researcher adopted a quasi-experimental design, specifically, pre-test, post-test non randomized control group was used. The area of the study is Okigwe Education Zone Two of Imo State. The population comprised 2,511 (1252 males and 1259 females) students in the 35 public secondary schools in Okigwe Education Zone Two of Imo State. The sample size was 139 students selected through researchers stratified simple random sampling, simple random sampling and purposive sampling techniques. One instrument was used for collection of data namely; Trigonometry Achievement Test (TAT). Learner Lesson Understanding Written Statements (LLUWS) and Teacher Planned Lesson Observation (TPLO) served as instructional tools used for evaluation. Three experts validated the instrument. The reliability co-efficient value of 0.84 was gotten which was calculated using the Kuder – Richardson Formula 20. The instrument TAT was administered to one intact SS1 class of 30 students in Owerri Education Zone 1. Experimental group 1 was taught using Planned Lesson Mode (PLM), experimental group 2 was taught using Revised Planned Lesson Mode (RPLM) while the control group was taught with the traditional teaching mode (TTM). Mean and standard deviation were used to answer the research questions while the hypotheses were tested using Analysis of covariance (ANCOVA). The null hypothesis (H_0) is rejected at p value less than 0.05.

Experimental Procedures

The researcher prepares the lesson in conjunction with the ideas and experiences of other teachers who are regarded as experts in mathematics education. That is to say, the lesson is prepared collaboratively by selected mathematics teachers. Thus, the experimental procedure is discussed under four stages.

Stage 1 – Briefing research assistants: There were two weeks briefing for the three teachers that were selected for the lesson study and teaching from different schools. One school out of the three schools for the study was selected as the training Centre. On the first day, the research assistants arrived at the Centre at the scheduled time. Indeed, the researcher presented copies of scheme of work, lesson plans and worksheet to them. The researcher explained the meaning of the concepts in the study, objectives and interests of the study to the research assistants. He therefore briefs the research assistants on what they were expected to do in the study, the days of the study, time and therefore pleaded with them to adhere strictly to the rules of the study for better results.

Stage 2 – Pretest administration: Before teaching proper in the three groups of the study, the research participants were given a pretest. The test was administered with the help of the class mathematics teachers of the sampled schools. The scripts were marked by the researcher and scores recorded

Stage 3 – Teaching of participants: One of the briefed teachers in the school selected for the control group taught them normally using the lesson plans and worksheet prepared by the researcher. The control group was taught without any of the teaching techniques, PLM or RPLM. The traditional teaching mode teacher used the traditional way of teaching which is mainly conventional

lecture method. In the experimental group 1, the researcher and the two other trained teachers, apart from the one handling the control group were all involved in the teaching. When one is teaching, others observed using Teacher Planned Lesson Observation (TPLO) tool. The teachers filled in their observations while the teaching was going on. The teachers used this tool to access the effectiveness of the lesson taught in order to discuss and reflect on the better ways of teaching the students. Also, the students were provided with Learner Lesson Understanding Written Statements (LLUWS) tool. The students also used this instrument meant for them to access the lesson, specifying areas that need clarification through their responses. This instructional tool was given to them at the end of each experimental lesson and were collected immediately after responses must have been provided. Also, in the experimental group 2 (taught using revised planned lesson mode), the planned lessons must have been modified using the teacher planned lesson observation (TPLO) and learner lesson understanding written statements (LLUWS). This was done immediately after planned lessons must have been taught for each content of the lesson plans. Meanwhile, revised lesson was taught a day or two days after the planned lesson must have been taught. Hence, each experimental lesson was

taught twice a week in each school in line with the school time table. The researcher and the two other participating teachers apart from the teacher teaching the control group taught this group. As one teacher was teaching, others observed, who were also provided with Teacher Planned Lesson Observation (TPLO) instrument and the students with learner lesson understanding written statements (LLUWS) instrument. The experimental lessons followed student-centred approach, which allows meaningful contribution by the learners, asking questions and freedom of accepting or rejecting ideas or knowledge using sound manners. The questions in worksheet were used for evaluation after each lesson, which is done for only 5 minutes. The lesson continued in this manner till the end of the experimental period.

Stage 4 – Posttest administration: After the teaching periods, posttest was administered to the participants (control group, experimental group 1 and experimental group 2) to ascertain if there is any knowledge gained. The scripts were marked by the researcher and the scores recorded. Intact classes were used in this study to control initial group differences and the three groups were located at different schools far away from each other to avoid possible mass contacts between students' groups, amongst others.

Results

Table 1: Mean and Standard Deviation of achievement scores in Pre-test and Post-test of the Treatment groups

Group	N	Mean Pretest Score	SD Pretest Score	Mean Posttest Score	SD Posttest Score	Mean Gain Score
PLM	59	32.41	8.74	57.89	10.66	25.48
RPLM	49	31.67	9.44	50.37	12.05	18.70
TTM	31	30.58	7.96	46.58	8.36	16.00

From Table 1, PLM group has a mean gain score in achievement of 25.48 while RPLM has the mean gain score of 18.70 and TTM mean gain score of 16.00. This shows that the students in PLM group achieved higher than those in RPLM and TTM group. Thus, the three groups did not achieve equally. Also, from Table 1, RPLM group has the highest

standard deviation score of 9.44 in pre-test and 12.05 in posttest showing that scores from that group is less homogeneous when compared to the other two groups (PLM and RPLM). In general, the table reveals that the standard deviation score for each group is very high in both pre-test and posttest.

Table 2: Mean Achievement scores of male and female Students taught with PLM and RPLM

Group	N	Mean Pre-test score	SD Pre-test score	Mean Posttest Score	SD Posttest Score	Mean Difference.
PLM						
Male	29	31.50	8.20	59.70	9.23	3.60
Female	30	30.60	9.40	56.10	11.70	
RPLM						
Male	23	32.00	8.80	51.40	10.80	2.10
Female	26	31.70	9.70	49.30	13.10	

From Table 2, the mean score in achievement of male students (59.70) is higher than the mean achievement score of their female (56.10) counterparts taught mathematics with PLM with mean difference of 3.60. Also, male students taught mathematics with RPLM had mean achievement score of 51.40 while the female students had 49.30 given a

mean difference of 2.10 in favour of the male students. Table 2 further reveals that female students had higher standard deviation (SD) score before than their male counterparts in the two strategies. In general, male students achieved higher than their female counterparts when taught with PLM and RPLM.

Table 3: ANCOVA Test of significant difference between the mean achievement scores of students in the treatment groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15692.385a	17	923.081	37.285	.000	.840
Intercept	16273.157	1	16273.157	657.299	.000	.845
Pre-test	267.971	1	267.971	10.824	.001	.082
Method	826.267	2	413.134	16.687	.000	.216
Gender	116.144	1	116.144	4.691	.032	.037
Method * Gender	30.283	2	15.142	.612	.544	.010
Error	2995.673	121	24.758			
Total	405016.000	139				
Corrected Total	18688.058	138				



Table 3 reveals that significant difference exists between the achievement scores of students taught mathematics with planned lesson mode (PLM), revised planned lesson mode (RPLM) and traditional teach mode (TTM), $F(2, 121) = 16.687$, $P = 0.000 < 0.05$. Thus, there is a significant difference

between the posttest mean achievement scores of students taught mathematics with planned lesson mode (PLM), revised planned lesson mode (RPLM) and traditional teaching mode (TTM). To obtain the direction of the difference, a Posthoc multiple comparison was conducted and summarized Table 4.

Table 4: Scheffe Post Hoc Multiple Comparisons of Post-test Means (Achievement)

Dependent Variable	(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Post-test	PLM	RPLM	7.53096*	2.07445	.002	2.3968	12.6651
		TTM	11.31766*	2.38083	.000	5.4252	17.2101
	RPLM	PLM	-7.53096*	2.07445	.002	-12.6651	-2.3968
		TTM	3.78670	2.46309	.310	-2.3093	9.8827
	TTM	PLM	-11.31766*	2.38083	.000	-17.2101	-5.4252
		RPLM	-3.78670	2.46309	.310	-9.8827	2.3093

*. The mean difference is significant at the 0.05 level.

Table 4 reveals that significant difference exists between the achievement scores of students taught mathematics with PLM and those taught with TTM in favour of PLM group. Table 4 also reveals that a significant difference does not exist between the achievement scores of students taught

mathematics with RPLM and those taught with TTM. However, Table 4 shows that there is a significant difference between the achievement scores of students taught with PLM and those taught with RPLM. This shows that the PLM is more effective than RPLM.

Table 5: ANCOVA test of significant difference between the mean achievement scores of Male and Female students taught with PLM and RPLM

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	12781.544a	12	1065.129	43.891	.000	.847	
Intercept	15888.456	1	15888.456	654.720	.000	.873	
Pretest	114.588	1	114.588	4.722	.032	.047	
Method	125.267	1	125.267	5.162	.025	.052	
Gender	39.375	1	39.375	1.623	.206	.017	
Method * Gender	9.404	1	9.404	.388	.535	.004	
Error	2305.419	95	24.268				
Total	335656.000	108					
Corrected Total	15086.963	107					

From the result of the ANCOVA test as shown in Table 5, the statement of hypothesis 3 is not rejected; implying that there is no significant difference in the mean achievement scores of male and female students taught mathematics using both PLM and RPLM, $(1, 95) = 1.623, P = 0.206 > 0.05$. Table 3 reveals that there was no interaction between gender and teaching modes (PLM and RPLM) as measured by the mean achievement scores in mathematics, $(2, 121) = 0.612, P = 0.544 > 0.05$. Therefore, hypothesis 3 is up-held. This shows that the achievement of students in relation to both PLM and RPLM is not influenced by gender of the students.

Discussion

The result of the study revealed that students taught mathematics with PLM and RPLM achieved more than those taught with TTM; showing that PLM and RPLM are very effective on students' achievement in mathematics. That is to say, the lesson study which involves planning, teaching, observing and critiquing a lesson was very effective. It could also be seen that the group of teachers who cooperatively plan the lesson really did a good work and the interaction with the students was supper. In the two modes, PLM and RPLM, there was an effective preparation since, a plan is a blue-print for action. Planning for teaching is a very important task for the teacher in the education of children. Onyemerekeya (2004) maintained that planning enables the teacher predicts the course of events during teaching.

On the other hands, this lesson study that requires teachers to work collaboratively to strengthen a given lesson until it has been refined as much as possible and then teach it to get powerful data about how well the lesson works was not there in TTM. Also, the

students were not given the chances to be part of the lesson modification in TTM as seen in PLM and RPLM. The findings of this study is in line with Ibraheem (2011), Ozofo (2015) and Sufiyanu and Mustapha (2017) who maintained that two modes of lesson study is effective in achievement in mathematics. Also, the result of the study corresponded with the findings of Dogo, Kyeleve and Kurumeh (2018) who recommended among other things that the two modes of lesson study should be used in the planning and implementing lessons for the various topics in mathematics because it improves students' achievement in mathematics.

This study further revealed that there is no significant difference in the mean achievement scores of male and female students taught mathematics using both PLM and RPLM. This means that achievement of students in relation to both PLM and RPLM is not influenced by gender of the students. Due to sex role stereotyping, it is generally believed that mathematics is suitable for boys and not for girls. Yet, Etsu and Ahmad (2018) reported that there is no significant difference in the academic achievement of students in the use of laboratory-based approach in mathematics. The result agreed with Ogoke (2018) and Shafi (2018), John, Benjamin and Imoko (2015) who reported no significant difference in the academic achievement of students in mathematics. On the contrary, Abba and Habu (2014) discovered the existence of significant difference between male and female performance in Geometry achievement test. The finding of Ezeudu (2005) and Anaekwe (2007) also supported that there was significant gender influence on mean achievement scores. This study has shown that the PLM, RPLM have significant positive effect on students' achievement in



mathematics irrespective of their gender. The PLM and RPLM are more effective than the TTM. Also, it was revealed that PLM was more effective than RPLM, an indication that the teachers prepared the lesson collaboratively, everybody bringing his or her best without reservations.

Conclusion

Based on the findings, the researcher concluded that two modes of lesson study techniques (PLM and RPLM) are both effective in enhancing achievement and that both techniques are gender friendly.

Recommendations

Based on the findings, the following recommendations were made;

- i. The researcher recommended that lesson study should be an integral part of the teaching and learning of mathematics
- ii. Mathematics teachers should adopt the use of lesson study in the teaching so as to allow the students participate in the activities of the classroom.
- iii. Curriculum planners should integrate the use of lesson study when revising mathematics curriculum for secondary schools.

References

- Abbas, M. G. & Haba, G (2014). Effect of gender- related differences in academic achievement and retention of senior secondary school students taught geometry using problem solving approach. *International Conference on Education in Mathematics, Science and Technology*, 1, 484- 488.
- Adeyemi, T. O. (2008). Predicting student's achievement in junior secondary Certificate examination in Ondo State, Nigeria. *Humanity and social Sciences journals*, 3 (1), 26-36.
- Anaekwe, M.C. (2007). *Effects of students' interaction patterns on students' cognitive achievement, Retention and Interest in Computer Studies*. Unpublished Ph.D. Thesis University of Nigeria, Nsukka.
- Dogo, J. D (2017). *Effect of two modes of lesson study on senior secondary school students' attitudes and achievement algebra*. Unpublished PhD Thesis, School of Postgraduate Studies, Benue State University, Makurdi, Nigeria.
- Dogo, J. D., John, L. K & Mary, S. K. (2018). Effect of two modes of lesson study on senior secondary school students' achievement algebra. *ABACUS (Mathematics Education Series) Vol 43(1)* 263 – 271.
- Easton, L.B. (2009). An introduction to lesson study. Retrieved from [http://www.ets.org/flicc/pdf/lessonstudy overview](http://www.ets.org/flicc/pdf/lessonstudyoverview), March 3, 2014
- Ezeudu, F.O. (2015). *Effect of concept maps on students' achievements, interest and retention in Computer Studies*. Unpublished Ph.D Thesis, University of Nigeria, Nsukka.
- Federal Republic of Nigeria (2013). National policy on education (5th ed.). Lagos: NERDC
- Ibraheem, T. L. (2011). Effects of two modes of student teams – achievement division strategies on senior secondary school students' learning outcomes in chemical kinetics. *Asia-Pacific Forum on Science Learning and Teaching*, Volume 12, Issue 2, Article 7, p.1.
- John, T., Benjamin, I & Imoko, I (2015) Gender Differences in Mathematics



- Achievement and Retention Scores: A Case of Problem-Based Learning Method. *International Journal of Research in Education and Science, Volume*
- Mbakwem, J.N. (2005). *Teaching and Learning: What Principle? What Methods?* Owerri: ON II Publishing House.
- Nwoke, B.I. (2007). Effect of Computer Assisted Instruction on Senior Secondary School Students' Performance in Mathematics. *Journal of Issues on Mathematics* 13, 19-24.
- Nworgu, B. G. (2015). *Educational research, basic issues and methodology (3rd ed.)*. Nsukka: University Trust Publishers.
- Ogoke, C.J. (2016). *Effect of cooperative and competitive learning strategies on the achievement of secondary school students' in mathematics*. Unpublished master thesis). Nnamdi Azikiwe, Univeristy, Awka. Retrieved from <http://www.naulibraary.org>.
- Ogoke, C.J. (2018). Effect of immediate reinforcement learning strategy on the senior secondary school students' achievement in mathematics. *The Journal of the Mathematical Association of Nigeria*, 43(1), 202- 209.
- Ohuche, S & Kurumeh, M.S (2011). Effect of two problems solving models on Junior secondary school students. Achievement on Algebra. *Journal of Mathematics Education*, 6(1),38-35
- Okafor (2011). Effects of cooperative and individualized system of instruction on the senior secondary school students' achievement in mathematics. (Unpublished Doctorate Dissertation). NnamdiAzikiwe University, Awka. Retrieved from www.naulibrary.com.
- Okereke, S.C. (2006). Effect of Prior knowledge of implementing of mathematics tasks concepts to career types and gender on students Achievement, interest and re-function. *Nzewi proceeding of the 47th Annual conference* 253-259
- Okigbo, E. O. (2010). Comparative effectiveness of mathematical game and instructional analogy as advance organizers on students' achievement and interest in mathematics. (Unpublished Doctorate dissertations). Nnamdi Azikiwe University, Awka. Retrieved from <http://www.naulibrary.org>.
- Onyemerekeya, C. C. (2004). *Principles and methods of teaching and learning*. Umuahia Versatile Publishers Ltd.
- Oyededeji, K.T. (2012). Effects of self-instructional learning strategy on students' Achievement in solving mathematical word problems. *European Scientific Journal*, 9(10), 1977-1981.
- Ozofor, N.M (2015). Effect of two modes of computer aided instruction on students 'achievement and interest in statistics and probability. *International Journal of Education and Research*. Vol. 3(1), 89 – 102.
- Shafi, A. & Areelu, F. (2010). The Effect of Improvised Instructional Materials on Students' Performance in Solid Geometry. *ABACUS. The Journal of the Mathematical Association of Nigeria (MAN)*. 35 (1) 46-52.
- Sufiyanu, H.J. and Mustapha, A. G. (2017). The effect of two modes of computer assisted instruction on students' achievement in simultaneous linear equation. *International Journal of Education and Evaluation*, 3(11), 9-19.
- The West African Examinations council (2015 - 2018). *Annual Reports*. Retrieved from <http://www.joeyreports.com.ng>