



Activity Based Teaching Method and Students' Academic Achievement and Retention in Graphical Solution in Mathematics in Onna Educational Area

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ABSTRACT

The study investigated the Activity-based Method and Students' Academic Achievement and retention in graphical solution in Mathematics in Onna educational Area. Three (3) research questions and Three (3) null hypotheses were formulated to guide the study. Quasi-experimental research design was adopted for the study. The population size comprises of 2,174 Senior Secondary two (SS2) Mathematics Students. Sample size of 115 senior secondary two (SS2) Mathematics Students was drawn from two public secondary school out of nine public secondary schools in Onna Local Government Area of Akwa Ibom state using simple random sampling Technique. 20- Item Student Mathematics Achievement Test was used for data collection. It yielded a reliability of 0.88 for instrument stability and 0.93 for internal consistency using the Pearson Product Moment Correlation and split half method respectively. Data gathered were analyzed using mean and standard deviation to answer research questions and Analysis of Covariance (ANCOVA) statistics was used to test the hypotheses at .05 level of significant. The result of the study showed a significant difference between the mean achievement scores of students taught Graphical method using Activity based method and those taught using Lecture method. Students taught using Activity based achieved significantly better than those taught using Lecture method. From the findings of the study, it can be concluded that using Activity based teaching method in teaching graphical method gave the students first-hand experience which enhance their achievement better than the Lecture method. Based on these findings, it was recommended that Mathematics teachers should embrace the use of Activity based method in teaching Graphical method

Keywords: Activity Based, Students Achievement, Retention, Mathematics.

INTRODUCTION

Years ago the approach to education is increasingly steering towards more student centered approach of which Activity based is one of the parts. The reason for this is that they have been found to bring curiosity and motivation in students to analyze and make sense of information they encounter. This in turn results in better achievement and retention. Mathematics is one of the compulsory subjects that students offer in primary and secondary schools in Nigeria. All courses in tertiary institutions require at-least a credit pass in mathematics in order to be offered admission. It is a subject that is applicable to all fields of life and it is applied in all aspects of human endeavors. Nigeria Educational Research and Development Council (NERDC, 2012) divided senior secondary school mathematics into the following areas of study; Number and Numeration, Algebra, Geometry, Statistics and introductory calculus. Algebra is defined as a branch of mathematics which deals with symbols and the rules for manipulating those symbols, just as sentences describe relationship between variables (Coolman, 2015). These branches of mathematics include the following concepts: equations; linear, quadratic and simultaneous equation. Graphical representation is very important concepts of Algebra. This concept includes the linear method.

Linear means straight and a graph is a diagram which shows a connection or relation between two or more quantity. So, the linear graph is nothing but a [straight line](#) or straight graph which is drawn on a plane connecting the points on x and y coordinates. We use linear relations in our everyday life, and by graphing those relations in a plane, we get a straight line.

Simultaneous Linear and Quadratic Graph

The point (or points) of intersection of a simultaneous linear graph give(s) the solution(s) to graph simultaneously. This is because at the point of intersection the two equations are equal to one another and therefore the values of the variables satisfy both equations. One key difference with simultaneous equations containing a quadratic element that, is we can expect multiple answers. This is because of the way linear and non-linear functions can intersect. Here a linear graph is intersecting a quadratic graph which has a shape known as a parabola. Notice that the **two points of intersection** means that the simultaneous graph have **two valid solutions**. $X + y = 4$; $y = x^2 + 4x - 2$

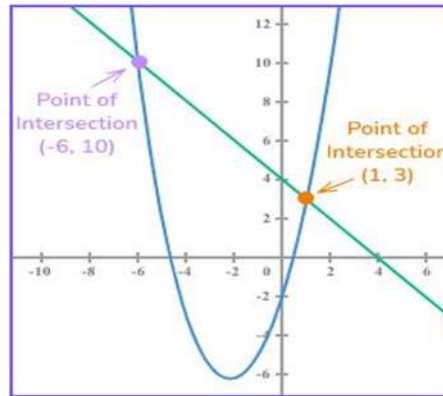


Fig. 1.1: Simultaneous linear and quadratic graph

These two graphs intersect at two points $(-6, 10)$ and $(1, 3)$. Therefore it is known as simultaneous graph which gives two valid solutions. So the solutions to the simultaneous linear and quadratic graph are: $x=-6, y=10$ and $x=1, y=3$

The use of graph to solve equations are called graphical method and they are good in mathematics teaching because; Graphical methods are quick and easy to use and make visual sense, calculations can be done with little or no special software needed, visual test of model (i.e. how well the point line up) is an additional benefit (Angra and Gardner, 2018).

Researchers like Nwankwo (2012) and Anibueze (2017) have identified inappropriate teaching strategy as major factor responsible for low achievement of students in mathematics. Many mathematics teachers are still using the Lecture method to teach mathematics in most secondary schools in Onna Local Government Area as observed by the researcher. This method makes students to be passive in the teaching and learning process. According to WAEC chief examiners' report of 2017- 2021 which has it that the performance of students in Mathematics is still very poor, candidates either avoid the questions on graphical problems completely or performed badly in it. This poor achievement and abysmal performance is not healthy for national development. Therefore, there is an urgent need to make use of teaching strategies that learners was adequately involved in the teaching and learning process in order to reverse this ugly trend. In another vein, Julie (2015) said that all is not well with the teaching and learning of mathematics. Julie further stated that teachers-students mathematical thinking and the learner centered is the most appropriate approach in Algebra instruction. Furthermore, Philips (2016) opined that delivering of instruction with the Lecture method of teaching enables the teacher to cover enough grounds within the short frame of time. There are many ways the teacher can implement in the classroom to ensure that students gain the targeted skill and knowledge which predicted to prepare them for real life world. According to Bhalli (2014) best teaching and learning methods are those which make the students active contributors in the classroom and one of such method is Activity Based learning.

The activity based can be defined as a fruitful learning that will help students to grasp the required outcomes which are defined by the teacher himself (Kassir, 2013). Singal (2014) described actively based learning commonly as student-centered which aims to provide challenging learning task, engaging and flexible learning for all students. Activity based learning provide scaffolding to students and make them connected to their classmates which enhance effort and motivation positively (Albadi, 2019). According to Quin (2016) activity based learning when used sometimes interchangeably with another method like co-operative learning, collaborative learning. Problem based learning or enquiry based learning typically defined as any educational strategy that engage student actively in the learning process. It includes a wide range of interesting activities. The student was fully involved instead of receiving knowledge passively. The main purpose of activity based learning in contrast to traditional learning is to change the focus from delivery of the content and teacher to the students and active interaction (Kudryashoya *et al.* 2016). Activity based learning has many positive sides such as testing students literacy, engaging them in learning. It was suggested that activity based learning strategies view students as active participant in classroom self-regulatory skills enhance such as active planning monitoring and evaluation (Albadi 2019). Activity based learning engage students intellectually with the contents through adoption of critical thinking, synthesis and analysis. In promoting relationship activity based method help the students to move away from basic comprehension and memorization, shift towards active thinking style such as evaluate, analyze, apply and knowledge which are the top of bloom taxonomy (Edwards, 2015).

The learners participate actively and bring about efficient learning experience. It is a technique in which the learner is actively engaged mentally and physically. This approach is based on the core premise that learning should be based on doing some hands-on experiments and activities rather than just listening to lesson (Esuong, & Udo, 2022). Learning by doing is the fundamental focal point in this method, and the more a person knows and longer he/she retain (Minje, 2013). Activity based learning involves reading, writing, discussion, practical activities and engagement in solving problems, analysis, synthesis and evaluation (Hansraj, 2017). The use of Activity Based method in the teaching process can boost a desirable change in students' role from inactive to participative learners. It likely enhances cognitive, affective and psychomotor domains respectively by giving learners enough chances to perform well. Activity based learning allows learners to learn through experimentation and exploration. The sensory experience and action make education better and more impactful (Shahram, 2018). Mathematics being one of the most important subjects in the curriculum has always been having controversy on which method to use to teach it to become real rather than abstract. One of the researchers such as Mclead (2012) has recommended that traditional ways related to teaching should be substituted by more innovative ones. Among those innovative strategies are the Guided discovery and Activity based

method which are based on the extent of students' involvement in classroom activities under the guidance of a teacher and how much the teacher activated students thinking processes.

Odutunyi (2020) opined that Mathematics should not be viewed as an abstract subject but teachers of mathematics should let students know why the result of any problem is what it is since good instructional method among other factors play significant role in enhancing students' academic performance. This kind of situation therefore, calls for continuous research works on gender and academic achievement. This motivated the researcher to examine the effect of Activity based on students' Academic Achievement and retention using the concept of simultaneous linear and quadratic graph.

Purpose of the Study

The purpose of the study is to examine the effect of Activity Based on students Achievement and Retention in graphical solution in Mathematics in Onna Educational Area. Specifically the study seeks to;

1. Determine the difference of the academic achievement of students taught graphical method using Lecture teaching method and Activity Based teaching methods in Onna .
2. Find out the difference in the mean Achievement score of male and female senior secondary schools students taught graphical method using Activity Based Teaching method.
- 3 Find out the mean Retention scores of male and female students taught graphical Using activity based teaching method

Research Questions

Based on the above stated purpose, research questions were formulated to direct the study;

1. What is the difference in the academic achievement of students taught graphical method using Lecture teaching method and Activity Based teaching method in Onna
2. What is the difference in the mean Achievement score of male and female senior secondary schools students taught graphical method using Activity Based Teaching method?
3. What are the mean Retention scores of Male and Female students taught Graphical method using Activity Based teaching method.

Research Hypotheses

1. There is no difference in the academic achievement of students taught graphical method using the Lecture teaching method and Activity Based teaching in Onna Local Government Area.
2. There is no difference in the mean Achievement score of male and female senior secondary schools students taught graphical method using Activity Based Teaching method.
3. There is no significant difference between the mean Retention scores of Male and Female students taught Graphical method using Activity Based Teaching method.

RESEARCH METHODS

Design of the Study

The research design that was adopted for this study was the non-equivalent control group pre-test post-test quasi-experimental design.

Area of the Study

The study was conducted in Onna Local Government Area of Akwa Ibom State. Onna is located between 4.5812°N, 7.8504°E. Onna has four (4) clans Onniong, Nung Ndem, Awa Afaha and Awa with 42 villages. It has a landmass of 123, 193 sq. metres and population of 495,000 people (Wikipedia). The people of Onna speak 'Ibibio language'. The major occupations of Onna people are fishing, farming and civil service works. The people of Onna by way of worship are predominantly Christians. Onna Local Government Area has a total of 9 public secondary schools and many private schools. The researcher decides to carry out research work was carried out in this area because of its proximity to the researcher.

Population of the Study

The population of this study comprises all the SS 2 students in the nine (9) public/ government secondary schools in Onna Local Government Area of Akwa Ibom State 2022 Session. The population size of the study is 1, 174 students.

Sample and Sampling Technique

The sample of the study consists of 115 Students drawn from the two sampled Schools. One intact class was used in each School. School A was taught using Activity Based method while School B was taught using Lecture method.

Instrumentation

The instruments used for the study include; Students Mathematics Achievement test (SMAT). The researcher developed 20 multiple choice items questions with four options lettered A to D, labeled. Students Mathematics Achievement Test (SMAT) used for data collection. The Students Mathematics Achievement comprises two sections. Section A was on demographic information including class, gender, age, time and instruction while section B had 20 multiple choice test items with four options lettered A to D, scored one for a correct answer and zero for incorrect answer. The instrument was measuring the students pretest achievement in the concept area. A reshuffled version of Students Mathematics Achievement Test labeled (RSMAT) was used for measuring the students' posttest achievement in the concept area. Students Mathematics Retention Test labeled (SMRT) was administered 2 weeks after the post test, to measure the retention level of students on Mathematics concept taught.

Reliability of the Instruments

The researcher used 40 SS2 students that were not part of the main sample for the study to trial test the instrument; Student Mathematics Achievement Test (SMAT). The Split half reliability was used to determine the internal consistency of the instrument. The test was administered to the Mathematics students on the permission of their principal and the Mathematics teachers.

The result was subjected to Pearson Product Moment Correlation and the result yielded the reliability coefficient of 0.88 for stability of the instrument, while using split half method the instrument yielded an internal consistency of 0.93, the instrument was therefore considered to be reliable.

Method of Data Analysis

Mean and standard deviation was used for answering research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses. The choice of ANCOVA was in line with the use of pre-test as Covariate to control for the effects of non-equivalent groups.

Decision Rule

The hypotheses were tested at 0.05 level of significance. Null Hypotheses was rejected when calculated p-value was less than 0.05 set as level of significance and retain when the calculated p – value was greater than 0.05

RESULTS AND DISCUSSION

Research Question One: What is the difference in the academic performance of students taught graphical method using Lecture and Activity Based teaching in Onna Local Government Area?

Table 1 : Mean, Standard Deviation and Mean Gain Scores of Students' Pretest and Posttest Taught Graphical Method Using Lecture and Activity Based Teaching Methods.

Teaching Methods	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Lecture	57	9.09	2.93	11.21	2.46	2.12
Activity Based	58	10.26	3.62	13.84	3.27	3.58

Results in Table 1 shows that students taught graphical method using Lecture and Activity Based teaching methods had a mean score of 9.09 and 10.26 respectively in their pretest while they had a mean score of 11.21 and 13.84 respectively in their posttest. The table also reveals a mean gain score of 2.12 and 3.58 respectively for students taught graphical method using Lecture and Activity Based teaching methods. The result indicates that students taught using Activity Based method had the highest mean gain score than those taught using Lecture method.

Research Question Two: What is the difference in the mean Achievement score of male and female senior secondary schools students taught graphical method using Activity Based Teaching method?

Table 2: Mean, Standard Deviation and Mean Gain Scores of Male and Female Students' Pretest and Posttest Taught Graphical Method Using Activity Based Teaching Method.

Gender	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	31	9.61	3.10	13.55	3.33	3.94
Female	27	10.78	4.13	14.19	3.24	3.41

Results in Table 2 shows that male and female students taught graphical method using Activity Based teaching methods had a mean score of 9.61 and 10.78 respectively in their pretest and had a mean score of 13.55 and 14.19 respectively in their posttest. The table also reveals a mean gain score of 3.94 and 3.41 respectively for male and female students taught graphical method using Activity Based teaching methods. The result indicates that male students taught using Activity Based method had the highest mean gain score than their female counterparts.

Research Question Three:

What are the mean Retention scores of male and female students taught Graphical method using Activity Based teaching method?

Table 3. Mean, Standard Deviation and Mean Gain Scores of Male and Female Students' Posttest and Retention Taught Graphical Method Using Activity Based Teaching Method.

Gender	N	Posttest		Retention		Mean Gain
		Mean	SD	Mean	SD	
Male	31	13.55	3.33	16.29	2.94	2.74
Female	27	14.19	3.24	15.93	2.80	1.74

Results in Table 4.5 shows that male and female students taught graphical method using Activity Based teaching methods had a mean score of 13.55 and 14.19 respectively in their posttest and had a mean score of 16.29 and 15.93 respectively in their retention test. The table also revealed a mean gain score of 2.74 and 1.74 respectively for male and female students taught graphical method using Activity Based teaching methods. The result indicates that male students taught using Activity Based method had the highest mean gain score than their female counterparts.

Hypothesis One: There is no difference in the academic achievement of students taught graphical method using Lecture teaching method and Activity Based teaching methods in Onna Local Government Area.

Table 3: Analysis of Covariance (ANCOVA) of Students' Posttest Scores Classified by Teaching Methods with Pretest as Covariate.

Source of Variation		Sum of Squares	Df	Mean Square	F	Sig. at P<.05
Covariates	Pretest	253.36	1	253.36	28.41	.00
Main Effects	Methods	253.78	2	126.89	14.23	.00
Residual		1480.49	166	8.92		
Total		1987.62	169	11.76		

In Table 3, the calculated Probability value (P-value) .00 of the main effects (Methods) is less than the significance level (.05). Therefore, the null hypothesis is rejected. This implies that at $P < .05$, there is significant difference in the mean achievement scores of students taught Graphical method using Activity Based teaching methods and Lecture teaching method. The result reveals that Activity Based Teaching method is more facilitating than the Lecture Method.

Hypothesis Two

There is no significant difference in the mean Achievement score of male and female senior secondary schools students taught graphical method using Activity Based Teaching method.

Table 4: Analysis of Covariance (ANCOVA) of Male and Female Students' Posttest Scores Graphical Method Using Activity Based Teaching Methods with Pretest as Covariate

Source of Variation		Sum of Squares	df	Mean Square	F	Sig. at P<.05
Covariates	Pretest	4.62	1	4.62	0.43	.52
Main Effects	Gender	7.48	1	7.48	0.69	.41
Residual		597.51	55	10.86		
Total		609.60	57	10.70		

In Table 4, the calculated Probability value (P-value) 0.41 of the main effects of Gender is greater than the significance level (0.05). Therefore, the null hypothesis is retained. This implies that at $P < .05$, there is no significant difference between the mean Achievement scores of male and female students taught Graphical method using Activity Based teaching method.

Hypothesis Three

There is no significant difference between the mean Retention scores of male and female students taught Graphical method using Activity Based teaching method.

Table 4.13: Analysis of Covariance (ANCOVA) of Male and Female Students' Retention Scores Graphical Method Using Activity Based Teaching Methods with Posttest as Covariate

Source of Variation		Sum of Squares	df	Mean Square	F	Sig. at P<.05
Covariates	Pretest	29.42	1	29.42	3.73	.06
Main Effects	Gender	0.73	1	0.73	0.09	.76
Residual		434.00	55	7.89		
Total		464.16	57	8.14		

In Table 4.13, the calculated Probability value (P-value) .76 of the main effects of Gender is greater than the significance level (.05). Therefore, the null hypothesis is retained. This implies that at $P < .05$, there is no significant difference between the mean retention scores of male and female students taught Graphical method using Activity Based teaching method.

Summary of Findings

The summary of the findings of this study are as follows:

1. Students taught Graphical method using Activity Based teaching method achieved significantly better than those taught Graphical method using Lecture teaching method.
2. There is no significant difference between the mean Achievement scores of male and female students taught Graphical method using Activity Based teaching method.

Discussions of the Findings

The results of the research findings are discussed to show the implication for teaching and learning on the concept of Graphical method. The discussion of findings is done considering the research questions and hypotheses of the study.

Difference in the Academic Achievement of Students Based on Teaching Method.

The findings from the results on the difference among the mean academic achievement scores of students taught Graphical method using Lecture and Activity Based teaching methods indicated a significant difference. Students taught Graphical method using Activity Based teaching methods achieved significantly better than those taught Graphical method using Lecture teaching method. The findings can be attributed to the fact that activity-based learning strategy engages the learners intellectually with the contents through adoption of critical thinking, synthesis and analysis. The findings also agree with that of Albadi (2019), who discovered from the result that activity-based learning had a positive effect on students' achievement. Students believe that activity-based learning enhance understanding, increase a sense of responsibility, create attractive learning environment and increase achievement.

Students Achievement Based on Gender Differences

The findings on the difference between the mean academic achievement scores of male and female students taught Graphical method of solving simultaneous equation – one linear one quadratic using Activity Based teaching method indicated a non-significant difference. The findings on gender and students' achievement scores also indicated a non-significant difference when the students were taught Graphical method of solving simultaneous equation using Activity based teaching method. The findings of the study are also in line with that of Ajai and Imoko (2015), who revealed that male and female students taught algebra using PBL did not significantly differ in achievement and retention scores, thereby revealing that male and female students are capable of competing and collaborating in mathematics.

Conclusion

Based on the findings of this study, it can be concluded that using activity-based teaching methods in teaching graphical method provide the students with first hand experiences, actively involved them in effective hands-on activity and exploration during the learning process which enhance their achievement better than the lecture method. Gender had no significant difference in students' achievement. This implies that activity-based teaching methods are very good teaching methods to enhance students' activities in graphical methods.

Recommendations

Based on the findings, the following recommendations were made:

1. Teachers should engage their learners systematically during teaching and learning process.
2. Educational policy makers such as National Education Research Development Council (NERDC), Curriculum planners and Ministry of Education, should incorporate activity-based teaching methods in the curriculum for teaching graphical method.
3. Mathematical organizations such as Mathematical Association of Nigeria (MAN), Science Teachers' Association of Nigeria (STAN) should organize training programs, workshops and seminars on the use of activity-based teaching methods in classroom for mathematics teachers.

References

- Ajai, J.T. & Imoko, I.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 (IJRES)*, 1(1), 45- 50.
- Albadi, A. (2019). The impact of Activity Based learning on students' achievement. A study among 12 grade school and environment student in public schools in Oman. *Dissertation submitted in fulfillment of the requirement for Master Degree in Education at British University in Dubai*.
- Angra F. and Gardner (2018). Effect of group guided discovery approach on the performance of students in geometry. *International Journal of Multidisciplinary Research and Modern Education*. 1(11), 2454 – 2611
- Anibueze, C. O (2017). Effect of Mathematics scrabble game on junior secondary school students' achievement and interest in mathematical computational skill. *A Master Degree Dissertation of the department of science and computer education of the Enugu state university of science and Technology (ESUT), Enugu*.
- Ayara, N. J (2023). Effects of activity based and guided discovery methods on Students' Academic Achievement and Retention in Mathematics in Onna Local Government Area. *Unpublished Masters Dissertation. Uniuyo*.
- Bahdi, V. (2014). The effect of activity-based learning approach on academic achievement (a meta-analytic and thematic study). *E-International Journal of Educational Research*. 1(1), 39 -55
- Bhalli, M., Sattar, A. & Asif, M. (2016). Teaching strategies; perception of medical students used in basic science year. *The Professional Medical Journal*, (05)23, 614-619.
- Coolman, D. S. (2015). Effect of activity-based instructional strategy on senior secondary school students' retention in circle geometry in Abuja, Nigeria. *European Journal of Education Studies* 8(10), 121 -133
- Edwards, S. (2015). Active learning in the middle grades. *Middle school Journal*, 46(5), 26 – 32
- Edwards, S. (2015). Active learning in the middle grades. *Middle school Journal*, 46(5), 26 – 32.
- Esuong, U. U. & Udo, O. F. (2022). Gender, Text anxiety and academic performance in mathematics among SS3 students in calabar education zone, cross river state Nigeria. *Abacus (Mathematics Education series)* 47(1), 52 – 60.
- Hansraj, M. (2017). Activity based teaching-learning strategy in language. *Scholarly Research Journal for Humanity Science and English Language*. 4(20), 25-29
- Julie, A. M. (2015). The Effect of School Location on Learners' Academic Performance: A case Study of Community Secondary Schools in Makambako Town Council, Njombe. *M.Ed. Dissertation, University of Tanzania, pp. 41 – 42*.
- Kassir, H. (2013). The effectiveness of the Inquiry teaching approach on the students' achievement and engagement in the VAE public schools. *Master Dissertation, British University in Dubai*
- Kudryashova, A., Gorbatova, T., Rybushkina, S. and Ivanovo, E. (2016). Teacher's roles to facilitate active learning. *Mediterranean Journal of Social Science*, 7(1), 460 – 466.
- McLead S. (2012). Zone of proximal development. Retrieved from <http://www.simplypsychology.org/zone-of-proximal-development.html>
- Minje, M. S (2013). Teaching strategy. Retrieved from <http://dorjigss.blogspot.com>
- Nigeria educational research and development council, NERDC (2012)
- Nwonkwo, P. O (2012). Mathematics Education for all in UNESCO (Ed) report on state of education in African UNESCO publications, 95 – 99.
- Odotuyi, M. O. (2020). Effects of Activity-Based Approach and Expository Method On Students' Academic Achievement In Basic Science. *Scientific Research Journal (SCIRJ)*, 7(1), 1-9

-
- Phillips, M. (2016). A place for learning: The Physical Environment-of-classrooms. <http://www.edutopia.org/blog/the-physical-environment-of-classroom-mark-philip>
- Quin, J. (2016). Teacher role as facilitator in learning. *Scholarly Research Journal's for Humanity Science and English Language*. 3(17), 2343 – 3083
- Shahram, W. (2018). Why entrepreneurs need to use Activity Based learning method in education. *International franchise of entrepreneur media, India*. 3(4), 95-100
- Singal I. (2014). Effect of activity based teaching method in sciences, *International Journal of Humanities and management Science*. 2(1), 39 – 41.