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EFFECT OF ACTIVITY-BASED METHOD OF INSTRUCTION ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT ON CIRCLE GEOMETRY

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ABSTRACT

The study investigated effect of Activity-Based method of instruction on senior secondary students' academic achievement and retention in circle geometry. Two research questions, and two hypotheses tested at 0.05 level of significance, guided the study. Non-randomized quasi experimental research design was adopted for the study. The population of the study was 1446 senior secondary year two (SS2) students offering mathematics in Awka South Local Government Area in the year 2022. A sample of 85 students obtained using multi-stage sampling procedure was involved in the study. The instrument for data collection was Geometric Achievement and Retention test (GART), validated by three experts. The reliability of the instrument was established using percentage agreement and spearman rank correlation and was found reliable at 70% agreement and 0.9 reliability index respectively. Data were generated for the study through the administration of the instruments with the aid of two research assistants. The data obtained were analyzed using Mean and standard deviation, while ANCOVA was used to test the null hypotheses at 0.05 alpha level. The findings of the study revealed that students taught with Activity-based method of instruction achieved higher and retained the concept of circle geometry more than those taught with lecture method. The study also revealed that gender had no significant influence on students' academic achievement and retention in circle geometry. The study recommended that already serving teachers should be adequately encouraged to employ this teaching method to supplement the traditional method of teaching and learning of circle geometry in secondary schools. This can be achieved by organizing workshops, seminars and conferences for these teachers by concerned government agencies and other professional bodies like Mathematical Association of Nigeria (MAN) and Science Teachers' Association of Nigeria (STAN) in the Schools. Government and professional bodies like M.A.N should organize/sponsor research studies on the effectiveness of Activity-based method of instruction in other subject areas with the aim of improving performance of school students in science subjects in particular.

Keywords: Academic achievement, academic retention, teaching method

Introduction

Education plays indispensable roles for science and technological advancement of any nation by providing individuals with knowledge, skills, and understanding needed to understand and utilize scientific and technological advances. This includes not only the theoretical aspect of science and technology but also the practical skills necessary to design, develop and encourage critical thinking and problem solving skills, which are essential for advancing scientific and technological development. The knowledge of mathematics is essential in the technological advancement.

Alesandrine and Larson (2019) defined Mathematics as the study of numbers, and computation, sizes, shapes and spaces and the science of generalization and measurement. Sylvester (2016) expressed that mathematics is a way of thinking, which encourages the learners to observe, reflect and reason logically about problems that affect them. Mathematics is a powerful tool, which assist in solving problems and in communicating ideas.

For any nation to survive and develop, it has to improve on it technology which to a large extent, depends on effective teaching and learning of mathematics. Mathematics has its own way of communication that is universally accepted as a medium of expression, formulating, communicating and perpetuating scientific ideas and theories. Mathematics specifies, clarifies and establishes concept and laws for the science and technology. Indeed without mathematics there is no science; without science there is no modern technology; and without modern technology there is no modern society, (Ukeje, cited in Yusuf, 2015). Mathematics is taught from nursery school level to secondary school level, to enable students think rationally, critically and analytically (Aims of teaching mathematics). Despite the importance of mathematics, many problems seem to beset mathematics education which resulted in inconsistent performance in Senior Secondary Certificate Examination (SSCE) in mathematics. WAEC Chief Examiners report 2022 reveals some of the areas students find difficult in secondary school mathematics he stated that geometry is one of the areas of students' difficulty in mathematic which when looked upon will cause improvement in mathematics.

Geometry is a branch of mathematics concerned with questions of shape, size, relation, and position of figure and the properties of shapes. The most common types of geometry are the plain geometry which deals with objects like the points, lines, circle, triangle and polygon. Solid geometry dealing with objects like the line sphere and polyhedron, and the spherical geometry dealing with objects like the spherical triangle and spherical polygon. Plane geometry, which is one of the key content domains of the syllabus for the senior high schools, is useful in the development of the students in various ways. Plane geometry contributes to the development of skills such as visualization, critical and logical reasoning, problem-solving and intuition. It also helps the students to understand other areas of mathematics including arithmetic, algebra and statistics Geometry is applied in many fields such as arts, architecture, engineering, robotics, and survey,

astronomy, sculpture, and many more. Students with sound background in geometry can have a career in these fields. The usefulness of geometry for that matter plane geometry cannot be overemphasized.

Due to the relevance of geometry, every year, a lot of test items are constructed to assess students understanding of concepts on plane geometry in core mathematics at the West Africa Senior School Certificate Examination (WASSCE). One aspect of geometry on which test items are often constructed is circle geometry.

Circle geometry which is otherwise called the circle theorem includes the concept of tangent, sector, angles, chord of a circle and proofs. Over the years, circle geometry has been one of the student's weakness in mathematics, Some mathematics educators have continued to search for the reason for such achievement of students in geometry, from their findings, it was noted that the method used in presenting the concept to the student may be partially responsible for such. To buttress this, Egbutu and Okeke (2021) noted that the common means of instruction in secondary school is the lecture method.

Lecture method is a teacher- centered instruction approach which characterized by chalkboard, notebook, and textbook in teaching the students. Science teachers embrace lecture method in teaching the sciences because it presumably leads to easy coverage of science syllabus, and can be used to teach any number of students. In this study, the use of Activity-Based teaching method may be a viable option for improving students' achievement and retention in circle geometry.

Activity based teaching is a method adopted by a teacher to emphasize his or her technique of teaching through action in which the learners take interest comprehensively and realize effective learning practices. It is the procedure in which the child is effectively included in taking interest rationally and physically.

Activity-based method acts as a dynamic problem solver for the learners. It improves innovative part of experience and gives reality for learning. It gives various experiences to the learners to encourage the acquisition of information, experience, abilities and qualities. It builds the students self-confidence and creates understanding through works. It creates cheerful relationship and enthusiasm for them. If a child is given the chance to investigate by his own and gave an ideal learning environment, then the learning gets to be cheerful and durable. It inspires the learners to apply their innovative ideas, information and minds in solving problems. Under activity-based method, key focus is on the learner. That is to say that the activity-based method is a learner-centered approach. It can create self-learning ability among the students and allows a student to learn according to his or her ability.

Academic achievement is the examination outcome of students exposed to instruction in the classroom. According to Ikwuka and Adigwe (2021), academic achievement is a product of education or learning which is commonly measured by

examination or continuous assessment. It is the students' results which are assessed by their scores in tests and examination. According to Enoch and Asogwa (2021), academic achievement refers to the overall accomplishment of students which is evident in their scores in standardized examinations.

The analysis of students' achievement in the Senior School Certificate Examination (SSCE) in mathematics by examination bodies like the West African Examination Council (WAEC) has shown that students' performance in mathematics is fluctuating (WAEC Result statistics 2019-2021). The achievement in the subject has continued to be a major cause of concern to the parent and the nation in general. Bernard (2021) observed that of all the subjects studied in the educational system, mathematics is worst hit with several problems affecting its study at all levels of the educational system; also, the West African Examination Council (WAEC) annual reports 2019-2022 shows that candidate's achievement in mathematics is still not good enough. Within this period, out of 1,533,452 candidates in 2020 who sat for WAEC examination, 70% of students passed while 30% scored below Pass, in 2021, 1,561,536 sat for WAEC and 91.2% passed while18.8% scored below pass showing an increase of 21.2% when compared to 2020, again in 2022, 1,222,505 students sat for WAEC and 76.36% passed while 23.6% failed which represent a decrease of more than 15% in performance when compared with 91.2% rate in 2021.(National Bureau of Statistics, WAEC Statistics 2019-2022).. Despite the positive shift, the improvement is still not good enough for a country like Nigeria which is in dire need of scientific knowledge in mathematics. Now, starting with the method of teaching as mentioned above as the reason for the inconsistence achievement in mathematics, this study seeks to find out if the performances of students in mathematics can be improved by the use of Activity-based method of teaching students. To this end, this project sets itself the problem of investigating the effectiveness of Activity-based method of instruction over the conventional didactic method of instruction

Purpose of the Study

The purpose of this study is to determine the effect of activity-based method on the Secondary School Students' Achievement in circle geometry in Awka South Local Government Area in Anambra State.

Research Questions

The following research questions will guide the study:

1. What are the mean achievement scores of students taught circle geometry with Activity-Based teaching method and those taught with lecture method?
2. What are the mean achievement scores of male and female students taught circle geometry with Activity-Based method and those taught with lecture method?

Hypotheses

The following null hypotheses will be tested at 0.05 level of significance:

1. There is no significant difference between the mean achievement scores of students taught circle geometry using with Activity-Based method and those taught with lecture method
2. There is no significant difference in the mean achievement scores of male and female students taught circle geometry using with Activity-Based method and those taught with lecture method

Research Method

The study adopted quasi-experimental design. The dependent variable was students' academic achievement in Mathematics. The independent variable was the method of teaching. This research work was carried out in Awka South Local Government Area (LGA) with a population of 1446 SS2 Students in all the 16 government owned co-educational secondary schools in Awka South. This is made up of 617 males and 829 females. Out of that number, a sample of 42 (19 females and 23 males) SS2 students drawn from two out of the 16 co-educational secondary schools in Awka South LGA obtained using multiple stage sampling procedure. Geometric Achievement test (GAT) was used as the instrument for data collection. The researcher administered pre-test and post-test before and after experiment respectively, the scores obtained was used for data analysis. The instrument was validated by three experts in education and the reliability of the instruments was tested using inter-rater method of reliability and was found reliable at 70% agreement and 0.9 reliability index using the spearman. Mean and standard deviation was used in answering the research questions while the hypotheses was tested at 0.05 level of significance using T-test.

Presentation of Results

Table 1: Mean Achievement Scores of Students taught circle geometry using activity-based teaching method and Lecture Method (CLM)

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
ABM	43	21.60	1.95	57.44	2.40	35.84
LM	42	22.98	2.36	43.67	2.06	20.69

Table1 shows that students taught circle geometry using activity-based teaching had a pre-test mean achievement score of 21.60 and a post-test mean achievement score of 57.44 with gained mean achievement score of 35.84, while those taught circle geometry using lecture method had a pre-test mean achievement score of 22.98 and a post-test mean achievement score of 43.67 with gained mean achievement score of 20.69. Students taught circle geometry using activity-based teaching had a more homogeneous score in their pre-test (1.95) than those taught using Lecture Method (2.36). In the post-test, however, students taught circle geometry

using lecture method had a more homogeneous score (2.06) than those taught using Activity-based method (2.40).

Table 2: Mean Achievement Scores of Male and Female Students taught circle geometry using Activity-Based method

Method	Gender	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
ABL	Male	19	23.32	3.53	53.79	3.42	30.47
	Female	24	20.25	2.14	60.33	3.29	40.08

Table 2 shows that the male students taught circle geometry using Activity-Based method had a pre-test mean achievement score of 23.32for male and a post-test mean achievement score of 53.79 with a gain in mean achievement scores of 30.47 while the female students had a pre-test mean achievement score of 20.25 and post-test mean achievement score of 60.33 with gain in mean achievement scores of 40.08, the mean gain was in favour of the female.

Table 3: ANCOVA test of significance of difference in the mean achievement score of students taught circle geometry using ABL and lecture method

Source	SS	Df	Mean Square	F	Sig.	Decision
Corrected Model	1178.504[a]	4	294.626	1.532	.201	
Intercept	998.741	1	998.741	5.194	.025	
POSTEST	1006.138	1	1006.138	5.233	.025	
METHOD	783.071	1	783.071	4.072	.047	Sig.
GENDER	45.984	1	45.984	.239	.626	Not Sig.
METHOD * GENDER	78.759	1	78.759	.410	.524	Not Sig.
Error	15382.79	80	192.284			
Total	58764.00	85				
Corrected Total	16561.24	84				

a. R Squared = .071 (Adjusted R Squared = .025)

Table3 shows that there is a significant main effect of the treatment on students' achievement in circle geometry, $F(1, 80) = 4.072$, $P < 0.05$. Therefore, the null hypothesis is rejected meaning that there is a significant difference between the mean achievement scores of students taught circle geometry using Activity-based method than that of those taught using Lecture method.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students taught circle geometry with Activity-Based method.

Table 5 also shows that there is no significant difference between the mean achievement of male and female students in circle geometry, F (1, 80) = .239, P >0.05. Therefore, the null hypothesis was not rejected meaning that there is no significant difference between the mean achievement scores of male and female students taught circle geometry using Activity-Based Method and Lecture method.

Discussion

The findings of this study have revealed that the activity-based method is a potent strategy to be used in teaching mathematics in schools. The study exposed that students taught circle geometry using activity-based method had higher achievement than the students taught circle geometry with lecture method. This is probably so because the students in the experimental group were allowed to actively participate in the learning and teaching process, they were provided with all the learning materials needed to learn circle geometry. They were also allowed to interact and manipulate their learning materials freely and to think and discover the theorems in circle geometry themselves. This finding buttressed the finding of Oribhabor (2020), which found significant difference in achievement of students in mathematics in favour of the experimental group who were taught mathematics using activity-based method. On the basis of gender, the findings of this study showed that there was no significant difference in the mean achievement scores of male and female students in the experimental group who were taught circle geometry using activity-based method. This indicated that male and female students performed equally when taught circle geometry with the use of Activity-based method. Also, these findings agreed with the reports of Ajai, J.T. & Imoko, I.I. (2015) who investigated on gender differences in mathematics achievement and retention by using Problem-Based Learning (PBL) and revealed that there was no statistically significant difference in the academic achievement and retention of male and female students. However, the finding of this study contradicted that of Oribhabor, (2019), who examined the influence of gender on academic achievement in Mathematics among senior secondary school students in Bayelsa State and reported that there is significant difference in the achievement of male and female students in favour of male students.

Recommendations

The following recommendations were made:

1. Mathematics teachers should use strategies such as the activity-based that would actively involve students in the teaching and learning process of Mathematics because the more students are involved the higher the retention level. It has been found that “the more the senses of learners are stimulated, the more the learners learn which improve their academic achievement.

2. Male and female students should be equally engaged in the teaching and learning of Mathematics when using Activity-based method. Female students should be involved in the classroom activities and should be allowed to manipulate instructional materials freely as their male counterparts since activity-based method is not bias against gender.

3. Since it has been revealed by the study that activity-based method enhances academic achievement better than the lecture method of teaching, it is therefore recommended that government at all levels should organize workshops for mathematics teachers on how to use activity-based in teaching mathematics.

REFERENCES

Alesandrine, K & Larson, L (2019*) Teachers bridge to construction*. The clearing House

Awka South local Government Authority (July 2023) *Number of secondary school schools, the students population* in Awka South Local Government Area of Anambra State. Awka.

Benard, A.F.(2021). Mathematics in Technological Development: *Focus on the next millennium-implication for secondary education Abacus 25 (1).*

Boaler, J. (2002). Experiencing School Mathematics: Traditional and Reform Approaches to Teaching and Their Impact on Student Learning. Lawrence Erlbaum Associates.

Egbutu, R.N. and Okeke, S.O.C. (2021).Effects of computer animation and inquiry method on chemistry students' critical thinking and achievement in Onitsha Education Zone. *Journal of Research & Method in Education, 11*(2), 42-48.

Enoch, J.U. and Asogwa, V.C. (2021).Teacher-student relationship and attitude as correlates of students' academic achievement in agricultural science in senior secondary schools. *African Educational Research Journal, 9*(2), 600-605.

Freeman, S., et al. (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences, 111(23), 8410-8415.

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics, 66(1), 64-74.

Ikwuka, O. I. and Adigwe, J. E. (2021).Comparative effects of power point and video instructional packages on crs students' academic achievement. *Higher Education of Social Science, 20*(1), 46-52.

Oribhabor, C. B. (2020). Evaluating the effect of activity-based method of teaching mathematics on Nigerian

secondary school students' achievement in mathematics. Puissant – *A Multidisciplinary Journal*, 1, 77-87. https://puissant.stepacademic.net

Piaget, J., & Vygotsky, L. S. (1962). Thought and Language. MIT Press.

Schoenfeld, A. H. (1985). Mathematical Problem Solving. Academic Press.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive Science, 12(2), 257-285.

Strobel, J., & van Barneveld, A. (2009). When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. Interdisciplinary Journal of Problem-based Learning, 3(1), 44-58.

Sylvester, K. O. (2016). Sex differences in Mathematics performance among senior high students in Ghana. Retrieved on August 13, 2020. https:/en.wikipidea.ord/wiki/definition of mathematics