**THE IMPACT OF INQUIRY-BASED TEACHING METHOD ON SENIOR SECONDARY SCHOOL STUDENTS’ ACADEMIC ACHIEVEMENT IN GEOMETRY IN ONDO STATE, NIGERIA**

**Abstract**

This study investigated the impact of inquiry-based teaching method on the academic achievement of senior secondary school students in Ondo West Local Government area, Ondo State. Two research questions were raised and hypothesized at 0.05 level of significance. The study adopted pre-test, post-test, control group design. A simple random sampling technique was used to select one hundred (100) senior secondary school students from the entire population. The instrument used in gathering data for the study was Geometry Achievement Test (GAT). Data collected were analyzed using sample t-test. The results of the study showed that inquiry-based teaching method enhanced students’ academic achievement in geometry. The findings of the study also revealed that there was no significant difference in the academic achievement of male and female students exposed to inquiry-based teaching method. It is therefore recommended that Mathematics teachers should be encouraged to teach geometry using inquiry-based teaching method.

**Keywords:** academic achievement, inquiry method, secondary school students, geometry, mathematics.

**Introduction**

The contributions which the knowledge of Mathematics has made to economic, industrial and technological growth of modern world are quite obvious to everyone. The discoveries such as the development of supersonic flights, the invention and launching of satellites depends largely on the application of calculus, an aspect of Mathematics. It is not surprising therefore to observe that a background in Mathematics is crucial for many career and job opportunities. Awolola (2003) asserts that no binding forces among the various branches of science, physical biology and social sciences is as good as Mathematics. He added that the knowledge of science remains superficial without Mathematics. Marut, 1999 asserted that Mathematics arose from the need of a system of counting and calculating areas of surfaces and volumes of objects, but it has over the centuries becomes less concerned with practical matters and has turned instead to logical and pure intellectual speculation. Without mathematics there can never be a development of science and technology.

Geometry is an aspect of mathematics that deals with the study of different shapes. The shapes may be plane or solid. A plane shape is a geometrical form such that the straight line joins any two points that wholly lies on the surface. Plane shapes are shapes with only two dimensions (length and breadth), for instance, square, rectangle, triangle, parallelogram etc. A solid shape is bound by surfaces that may not be wholly represented on a plane surface. They are three dimensional figures (length, breadth and height) e.g. cubes, cuboid, cylinder, trapezium among others. Different teaching methods have been used by the teachers in teaching geometry and there is the need to delve into the methods that will promote effective teaching and hence improve students’ academic achievement in Mathematics. Mathematics which appears to be the base of all science subject demands a systematic and interesting method (s) that will attract both teachers and students. It therefore implies that the old teacher center method may not be able to meet the needs of the 21st century teaching/learning process. However, there is a need for the use of inquiry-based teaching method that will not only maximize meaningful understanding of in Mathematical concepts but will provide students the opportunity to improve their learning and understanding of Mathematics. Many methods are adapted for teaching Mathematics some of which are teacher centered, learner centered, concept mapping strategy, cooperative learning strategy e.t.c. One of them is inquiry-based teaching method. Inquiry teaching method is considered as learner-centered

Inquiry teaching method is a style or method of teaching where the learner is seeking to discover and create answers to recognized problems through procedure of making diligent search, sometimes with minimum guidance from the teacher (Adjei Yeboah, 2020; Calson, 2003). Science and Mathematics process skill are based on scientific inquiry and teaching. Mathematics by inquiry involves teaching students Mathematics process skills, critical thinking, scientific reasoning skills used by scientists (Pratt and Itackett, 2008). In inquiry teaching strategy, the students are provided with opportunities to discover new truths, new rules, and new method of solving problems as well as new values for themselves (Esan,1999). Though, this may be very difficult and time consuming but there will be joy of discovery new things on the part of students. This method is good for any aspect of learning especially when we use discovery or inquiry method to mean finding out. Inquiring method involve students studying certain topics comprehensively.

According to Algbonian and lyanic (2001), inquiry-based method is a process through which learners are provided with opportunities to discover new truths, new rules and new method of tackling a problem as well as new values for themselves. Instead of giving them information, the teacher allows the students to find out information themselves. Afolabi (2012) asserted that inquiry method is interactive, democratic and learner centre, the teacher role is to serve as instructor or motivator (Akanmu and Fajemidagba, 2023). Many research works have been carried out in Mathematics and sciences on the effectiveness of inquiry-based method of teaching. Popoola (2003) found out that students who were taught Mathematics concepts using inquiry method out-perform students taught with the conventional method. Obeka (2010) found that inquiry had significant effects on students’ achievement in geography over all other methods. Similarly, Seweje (2004), Oloyede (2010), Igboegwu (2012) in their research found that inquiry-based method is powerful in improving students’ performance in Chemistry compared to those taught using the conventional methods also, Ibrahim (2009) and Nwagbu (2010) also found inquiry teaching methods to have positive effects on students’ performance. Lyang (2001) opined that to successfully adopt the inquiry approach, students must perform certain mental process such as observing, classifying, measuring predicting inferring and hypothesizing. As such a lot of inquiry prevails in the classroom with the teacher acting as a motivator, getting from one point to another to guide the pupils and help them overcome difficulties. The teacher performs the duty of a resource person who guides the learner sources of information. Inquiry learning is crucial for developing critical-thinking skills, scientific, mathematical problem solving and developing scientific content knowledge (Bantalem and Kassie, 2020).

Gender is a socio-cultural category that sorts and organizes the social relationships between women and men; it plays a significant role in an educational setting that could militate against learners’ superior achievement in mathematics (Akinsola &Igwe, 2002; Johnson, 1984).

**Statement of the Problem**

The problem of poor achievements of students in Mathematics is of great concern to Mathematics educators and relevant stake holders in education. Researches have shown that students do not perform very well in geometry which is an important aspect of Mathematics. Geometry is useful and relevant to every other discipline. It helps to understand and describe the fundamental properties of the physical world. Despite the importance of geometry, students’ interest and attitude towards this topic has affected their performances in both internal and external examinations. Reasons given by some stakeholders of education are unstable method and techniques used by teachers to teach the subject which seem to have resulted into poor academic performance, lack of interest, poor attitude of students towards the subjects. Most teachers used conventional method in teaching geometry which seems not to make the students to understand the various mathematical concepts and develop their analytical reasoning (Stison 2004). There is therefore the need to make use of adequate and proper teaching method in order to enhance good academic performance of students in Mathematics.

**Purpose of the study**

 The main aim of this study is to investigate the impact of inquiry-based teaching method on senior secondary school students’ academic achievement in geometry. Also to find out whether gender influence students’ achievement in geometry.

**Research Questions**

The following research questions were raised to guide the study:

1. What is the effect of inquiry-based teaching method on students’ academic achievement in geometry?
2. Will gender influence student academic s’ achievement in geometry?

**Research Hypotheses**

Ho1: There is no significant difference in the academic achievement of students taught geometry using inquiry based teaching strategy and conventional method.

Ho2: There is no significant difference in the mean achievement scores of male and female students taught geometry using inquiry based teaching strategy.

**Methodology**

The design of this study is quasi-experimental, employing a non-randomized pre-test - post-test control group design. The independent variable for the study is instructional strategies (inquiring based teaching strategy and conventional method) while the dependent variables of the study is achievement scores in geometry. Gender (male and female) is the moderating or intervening variables.

All senior secondary school two (SSII) students in all twenty-six (26) co-educational public secondary schools in Ondo West Local Government Area of Ondo State in Nigeria formed the population of the study. The size of the population was one thousand four hundred and forty-six (1446) senior secondary school two (SSII) students. The sample consisted of one hundred (100) SSS II students selected from the population. This comprised of 54 male and 46 female students. Simple random sampling technique was used to select two schools for the study. One intact class was assigned to the experimental group (inquiry based teaching strategy) while the other class was assigned to the control group (conventional method). The classes were taught the concept of geometry.

The instrument used to measure students’ achievement was developed by two Mathematics teachers and was validated by Mathematics educator expert. The instrument contained 50-multiple choice items constructed on the aforementioned topics. The instrument was pilot tested to establish the reliability and Kuder-Richardson Formula 20 (KR-20) was used to obtain a reliability coefficient of 0.80. The Geometry Achievement Test (GAT) was initially administered to the treatment groups as pretest and the scores were used as a covariate measures in order to account for possible pre-existing differences in the overall ability between the treatment groups.

**Results**

**Research Hypothesis one:** There is no significant difference in the academic achievement of students taught geometry using inquiry based teaching strategy and conventional method.

**Table 1:** Independent samples t-test of the students taught geometry using inquiry-based teaching method and the conventional method

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | N | X | S.D | Df | t-cal | t-tab | Level of Significance | Decision |
| Inquiry strategy | 54 | 72.36 | 58.12 | 98 | 4.31 | 2.18 | 0.05 | Rejected |
| Conventional Method | 46 | 67.64  | 44.29 |  |  |  |  |  |

Table 1 above shows that there is significant difference in academic achievements of students taught geometry using inquiry-based teaching method and those taught using conventional method. This shows that achievements of students in Mathematics is determined by the teaching method used by the teachers since t-cal which is (4.31) is greater than the t-tab (2.18) with degree of freedom of 98 at 0.05 level of significance

Hypothesis 2: There is no significant difference in the academic achievement of male and female students taught geometry using inquiry-based teaching strategy.

**Table2: t-test analysis of post-test scores of male and female students exposed to inquiry-based teaching strategy and conventional method**

|  |  |  |
| --- | --- | --- |
| Group | Male | Female |
|  | N | X | SD | t-value  | p | Sig | N | X | SD | t-value | p | Sig |
| Inquiry strategy | 32 | 67.43 | 8.46 | 3.56 | 2.65 | NS | 22 | 53.45 | 75.45 | 3.43 | 2.73 | NS |
| Conventional Method | 25 | 50.40 | 8.23 | 21 | 48.71 | 67.82 |

P > 0.05 (Result Not significant at 0.05 level), NS = Not Significant.

From table 2, the probability of error is greater than 0.05 (P= 2.65>0.05) for the males, and (P = 2.73>0.05) for the females. The results reveal that both males and their females’ counterparts in the two groups were not significantly different. This indicates that the treatment was statistically not significant on either males or their females’ counterparts for better performance towards the learning of Geometry. Therefore, the null hypothesis is retained.

**Discussion**

The result of the study showed that there was statistically significant difference in the achievement of students taught geometry using inquiry-based teaching strategy compared with their counterparts in the control group. The result of this study indicated that inquiry-based teaching strategy improved the achievement of students in Mathematics. This was in agreement with stilson (2004) who found out that inquiry teaching strategy has more effects on students’ academic performance. The improvement in achievement could be due to the fact that students were actively involved in the teaching and learning process. The findings were also in agreement with Afolabi & Akinbobola (2009) and Odutuyi (2012) who found out that treatment had no positive effect on students’ performance based on gender.

**Conclusion**

The study was carried out to determine the impact of inquiry-based teaching strategy on senior secondary school students’ academic achievement in geometry. The study shows that students taught withinquiry-based teaching strategy perform better than those taught using conventional method. The findings further revealed that the use of inquiry-based teaching strategy in the teaching and learning process significantly enhanced students’ achievement in geometry. The study however found no significant difference between the achievement of male and female students in Mathematics when inquiry-based teaching strategy was used. This implied that there is no gender inequality in the use of inquiry-based teaching strategy if properly handled.

**Recommendations**

Based on the findings of this study, the following recommendations were considered appropriate Consequent upon the finding of this study, it was recommended that:

1. Inquiry-based teaching strategy should be practically applied to classroom situations. Teachers should use this strategy to arouse the interest of their students in mathematics learning.
2. The government should render assistance in the area of adequately funding of Mathematics teachers’ education programs that will be fully involved in teaching students with innovative strategy.
3. Teachers’ emphasis should shift from teacher centred approach of teaching to more activity-based learning such as inquiry-based teaching strategy.

**References**

Afolabi, F. A. (2012) Effects of inquiry and action learning strategies on secondary school performance and attitude towards Physics in Kwara State, Nigeria. Unpublished Ph. D, thesis; University of Ibadan, Ibadan, Nigeria.

Afolabi, R.O.,& Akinbobola, A. (2009). Constructivist problem based learning technique and the academic achievement of physics students with low ability level in Nigeria secondary schools. *Eurasian Journal of Physics and Chemistry Education,1(1), 45-51.*

Akinsola, M. K.& Igwe, I. O. (2002). The Relative Effect of the Metacognitive Strategy of Framing on Students’ Achievement in Selected Difficult Chemistry Topics. *Journal of the Science Teachers Association of Nigeria, 37(2), 8-20.*

Awolola S. A. (2003). Effects of computer assisted, cooperative and individual learning on students’ performance. Mathematics problem solving. *International journal of Education and Development 22(1), 163-171.*

Catson, K. (2003). Constructivism what it means for my own Teaching center for Development of Teaching and learning 6(1) and Comparison of student Achievement across constructivist and Traditional Environment. Unpublished Doctoral Dissertation. University of New or land.

Esan, A.O. (1999). Effects of cooperative and individualistic problem solving strategies on students learning outcomes in secondary school Mathematics. An unpublished Ph.D thesis ; University of Ibadan, Ibadan Nigeria.

Igboegwu, K. (2012). Effect of mobility on academic achievement of sixty Grade students. Perceptual and motor skills, 75:547-570.

Johnson, R. (1994). Innovations in algebraic structures. Journal of Mathematical Research, 20(4),300-315.

Lyany G. A. (2001) Alternative assessment in elementary school mathematics. Childhood Education, 74(4), 220-224

Nweagbo, J. U. (2010) Status of secondary school science practical work in Akwa Ibon State, Nigeria. *African Journal in Education and Information 2(1), 12-29.*

Marut, J. (1999). Advances in mathematical theories. Journal of Advanced Mathematics, 15(3),245-260.

Odutuyi, M. O. (2012) Effect of Inquiry based method on senior secondary school students’ academic performance in Chemistry. *Journal of Instructional Social Research 2, 5-16.*

Oloyede, R. E. (2010) When does cooperative learning increase students achievement? Psychological Bulletin 94(3), 429-449.

Seweye, R. O. (2004). The Challenge of science teaching in Nigeria today Journal of Educational foundation and Management.

Stinson, D.W (2004). Mathematics as gate keeper, Heuristical perspectives that aim towards empowering all children with a key to the gate. The Mathematics Educator, 14(1):8-18.

Adjei Yeboah. (2020). The impact of inquiry-based method of teaching on the academic performance of primary education students of Atebubu college of education in general chemistry. European journal of basic and applied sciences, 7(1), 47. ISSN 2059-3058

Bantalem, W and Kassie, S B (2020). Effects of using inquiry-based learning on EFL students’ critical thinking skills.Asian-Pacific Journal of Second and Foreign Language Education 5(1)

Akanmu, M. A and Fajemidagba, M. O (2023). Guided-discovery Learning Strategy and Senior School Students Performance in Mathematics in Ejigbo, Nigeria. Journal of Education and Practice. www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X.