

## **IMPACT OF PROBLEMSOLVING STRATEGY ON STUDENTS' 3-D GEOMETRY PERFORMANCE AMONG SSII IN ZARIA LOCAL GOVERNMENT KADUNA STATE NIGERIA**

By

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### **Abstract**

*This study investigated the Impact of Problem Solving Strategy on Students' performance in 3-D geometry among SSII in Zaria Local Government area Kaduna State. In this study, two research questions, two null hypotheses were formulated to guide the study. The population of the study comprises fifteen public coeducational senior secondary schools all within Zaria Local Government with the total number of 4,021. The sample size of four senior secondary schools was drawn from the parent population having total of 134 male and 163 female. The research design for this study is pretest-posttest quasi experimental non-equivalent control design. The instrument for this study is 3-D geometry Achievement Test (GAT) which was developed in order to ascertain the reliability coefficient and performance of students. The reliability coefficient was found to be 0.70 by the use of Cronbach alpha ( $\alpha$ ), the data collected was analyzed by the use of both descriptive and inferential statistics. Results from testing hypothesis two shows that problem solving strategy does not differentiate the academic performance of both male and female students taught 3-D Geometry in senior secondary schools in Zaria Education zone.*

### **Introduction**

Mathematics is a fundamental branch of science that represents the study of basic concepts of numbers, space and quantity as well as application of these concepts in the field of physics and engineering (Ale, 2006). Mathematics can also be applied in a broad spectrum of fields ranging from Agriculture, space research, medicine, meteorology, biology and zoology. Mathematics is a very important, unique and divine school subject. It is one of the few subjects that is studied at all the Nigerian tiers of education. Mathematics is one of the oldest and most important academic discipline (Okeagu, 2013). It is a compulsory subject for all students from nursery, primary and secondary schools. Admission into any tertiary institutions to study sciences and science related courses is based on a requirement for a pass at credit level in mathematics at the West African Examination Council (WAEC), Senior Secondary School Examinations (SSCE), and National Examination Council (NECO) among others. Despite its importance, performance in mathematics is generally poor especially in the finishing examinations of WAEC or SSCE and NECO. Many variables had been identified by Iyekekpolor (2007), Imoko and Agwagan (2009), as responsible for poor performance in mathematics. Such variables include curriculum, examination bodies, teachers, students, environment and textbooks. Lack of interest by students toward mathematics also contribute a lot in poor performance. The study of mathematics is making tremendous impact on all aspect of our lives for the following reasons:

1. It helps one to study well;
2. Architecture would be a chaotic mess without the use of measurement provided mathematics;

3. Most modern cities are planned using mathematical tools, it is impossible to even imagine a structured society without the knowledge of mathematics;
4. Mathematics algorithms are responsible for the advanced technologies that we have on our disposal in the form of super-fast computers and digital processors. In fact the binary number system is the language that is used to interact with computer this binary code is a provision made by mathematics. Without this, a computer would just be a metallic junk.

Prominent science subjects such as physics and chemistry would be rendered incomplete without the aid of mathematical theories. The human race enjoys a superlative position in the ecological set up this, is because humans are able to apply their mind and logical reasoning to handle their troubles and problems, apart from having the skill to foresee and anticipate the probabilities of the future.

Bakie (2008), opined that the knowledge of mathematics is needed, if students are to achieve high score in the sciences. These qualities would be hard to stand-in without the inclusion of mathematics as a compulsory subject for students. Business houses use statistical interpretation of data, which enables them to deduce out hidden patterns from raw data, thus enabling them to make appropriate changes in their workings, in order to achieve the desired results. In recognition of the importance of mathematics in national development the federal government of Nigeria made it compulsory for students' enrolment into universities.

The federal government policy in promoting the study of mathematics cannot be realized when there is nonperformance in mathematics. Also, the teaching cannot be achieved when students consistently perform poorly in mathematics subject. Mathematics is dynamic so it grows as the need of the people arises. According to Hassan (2007). This age-old discussion is far from being conclusive, rather, it is evolving as each thinker contribute his/her view of looking at the different facet which mathematics present as a discipline.

Mathematics (from Greek word "mathema" knowledge, study, and learning") is the quantity, structure, space and change. Galileo (1564-1642) said, "The universe cannot be read until we have learn the language and become familiar with the characters in which it is written. It is written in mathematical language and the letters are triangles, circles and other geometrical figures, without these, one is wondering about in a dark labyrinth. In contemporary education, mathematics education is the practice of teaching and learning mathematics along with the associated scholarly research. The teaching of mathematics started with arithmetic in the southern part of Nigeria brought by the missionaries. This is so, because the white man needed natives who could read, write and calculate (Ma'aruf, 2010). It was made compulsory in primary school grade III and grade II respectively. And compulsory before certification (Tijjani, 2007). Geometry from the Ancient Greek; geo "earth", -metro "measurement" arose as the field of knowledge dealing with 2-D and 3-D relationships. Geometry was one of the two fields of pre-modern mathematics, the other being the study of numbers. Classic geometry was focused in compass and straightedge construction. Geometry was revolutionized by Euclid who introduced mathematical rigor and the axiomatic rigor still in use today. In modern times, geometric concepts have been generalized to a high level of thought and complexity, and have been subjected to the methods of calculus and abstract algebra, so that many modern branches of the field are barely recognizable as the descendants of early geometry. Inekwe (2005), opined that geometry receives a general disfavor among secondary school students. Numerous studies have shown that geometry is of great important than most areas of Mathematics and also,

helps students to understand and love Mathematics (Julie, 2015). Geometry is highly important so much so that, engineers apply its knowledge in construction of houses, cars, chairs and almost all equipment we use in our day to day activities. The earliest recorded beginnings of geometry can be traced to early populates, who discovered obtuse triangles in the ancient Indus Valley, and ancient Babylonia from around 3000 BC. Early geometry was a collection of empirically discovered principles concerning lengths, angles, areas, and volumes, which were developed to meet some practical need in surveying, construction, astronomy, and various crafts.

Galileo (1564-1642), stated that, you cannot teach a man anything, you can only help him to identify it within himself. Thus, Problem solving is the ability to identify and solve problems by applying appropriate skills systematically. Problem solving is a process of an ongoing activity in which we take what we know to discover what we don't know. It involves overcoming obstacles by generating hypotheses, analyzing those predictions, and arriving at satisfactory solutions. Problem solving is essential to mathematics. Problem solving should be the place in which all of the components of mathematics skill converge. It should provide opportunities for student to weave together the aspects of proficiency and for teachers to assess students' performance on all of the aspects. Students need regular chances to engage in problem solving so that they can become mathematically proficient. Mathematical proficiency characterizes learning mathematics successfully in such a way that one develops:

1. Conceptual understanding,
2. Procedural fluency,
3. Strategic competence,
4. Adaptive reasoning.

According to the National Council for Teachers of Mathematics (2010), problem solving facilitates the extension of students' learning and nurtures the development of students' conceptual understanding, communication, and reasoning skills. Problem solving must remain part of day-to-day teaching because, solving problems is essential to doing and learning mathematics. Mathematical Problem Solving is a complex and integrative task. This task requires a learner to understand the information that is presented in the problem. Furthermore, mathematical problem solving requires a person to select and use cognitive strategies and processes that are necessary for task completion (Mayer, 1985). Cognitive strategies and processes for mathematical problem solving are technical methods or tools that help individuals plan and solve a problem. Possible cognitive strategies and processes can include finding the algorithm, estimating the problem, or drawing a diagram. Many problem solving models have been developed over the years to determine the components required for successful problem solving. For example, Polya's (1945) model outlines four problem stages:

- 1 Understand the problem;
- 2 Devise a plan;
- 3 Carry out the plan;
- 4 Check the solution; (as cited in Schoenfeld, 1985).

Problem solving strategies are the steps that one would use to find the solution of problem that are in the way to getting to one's own goal. Rubin, *etal*, (2012), stated that for effective problem solving strategy one should recognize the problem, define the problem, develop a strategy to fix the problem, organize the knowledge of the problem cycle, figure out the resources at the user's disposal, monitor one's progress, and evaluate the solution for accuracy.

The following techniques are usually called problem solving strategies':

1. Abstraction: solving the problem in a representative of the system before applying it to the real system;
2. Analogy: using a solution that solves similar problem;
3. Brainstorming: (especially among groups) suggesting a large number of solutions or ideas combining and developing them until an optimum solution is found;
4. Divide and conquer: breaking down a large, complex problem into smaller, solvable problems;
5. Hypothesis testing: assuming a possible explanation to the problem and trying to prove (or, in some contexts, disprove) the assumption;

### **Statement of the Problem**

Over the years, students' poor performance in mathematics has been an issue of great concern to Mathematics educators (Okeagu, 2013). Despite the significance attached to mathematics, poor performance in the subject (Mathematics) has been perennial problem, this has been attributed to:

1. Negative attitude among students toward mathematics and sciences;
2. Poor mastery of teaching and learning content on the part of the teachers;
3. Teaching methodology;
4. Lack of interactive fora for teachers;
5. Failure to develop teaching and learning materials;
6. Administrative factor. (Iliyasu, 2016). This ugly trend defiles the effort made by Federal Government of Nigeria by making the subject compulsory at all stages of learning.

This study investigated the Impact of problem solving strategy on students' 3-D Geometry Performance of SSII in Zaria Local Government Kaduna State Nigeria.

### **Research Questions**

To guide the study, the following research questions were formulated:

1. Is there any significant difference in the mean performance scores of students in SSII taught 3-D geometry concept using problem solving strategy and those taught same concepts using conventional method?
2. Is there any significant difference in the mean performance scores of male and female students in SSII taught 3-D geometry using problem solving strategy?

### **Null Hypotheses**

The following hypotheses were formulated and tested at alpha ( $\alpha$ )= 0.05 level of significance.

**H<sub>01</sub>:** There is no significant difference between the mean academic performance scores of Students taught 3-D geometry concept using problem solving strategy and those taught using conventional method;

**H<sub>02</sub>:** There is no significant difference between the mean academic performance scores of male and female of SSII students taught 3-D geometry using problem solving strategy.

### **Significance of the study**

The study investigated the Impact of Problem Solving Strategy on Students' Performance in 3-D Geometry among SSII in Zaria Local Government Area Kaduna State Nigeria. The findings would provide the mathematics educators with a more innovative way of presenting mathematics topics for easier understanding of the students. Information on this study would get to the teachers through attendance of conferences, workshops and seminars.

The result of the study would benefit the students by providing them with an easier approach on mathematics in general and 3-D specifically, thereby promoting their mastery of the subject for better performance in future examinations. Students would get to know this through the problem solving strategy. The finding of this study would be of great importance to curriculum planners for an innovative planning of instruction on mathematics in future curriculum planning and reforms. The curriculum planners would get to know this through attendance of conferences, seminars and workshops.

**Methodology**

The research design for the study is pretest-posttest quasi experimental non-equivalent control design. The data collected was analyzed by the use of both descriptive and inferential statistics. The population of this study comprises public Senior Secondary Schools Students in SSII within Zaria Local Government Area of Kaduna State, Nigeria. There are Fifteen Public Senior Secondary Schools in Zaria Local Government with the total number, of **4,021** Students out of which **2,427** are males and **1,594** are females.

For the purpose of this study a random sampling technique was used for selecting four public senior secondary schools out of the fifteen schools. The random sampling technique was used in order to select the schools in Zaria local government

The instruments for this study is 3-D geometry Achievement Test (3-D GAT), were developed by the researchers for the purpose of generating and analyzing data. The 3-D GAT comprises ten (10) items of essay test questions, this is because: Essay test allow students to express their ideas with relatively few restraints. Essay involves recall and there are no options to select from, therefore guessing is eliminated. The students must supply answer rather than selecting the good response, thus, it involve descriptive knowledge of students. The posttest in this study is to check the academic performance of the students in SSII on 3-D geometry Concept in Zaria local government.

For the purpose of this study, a test was conducted in order to obtain the data from the preferred School that was pilot tested. The reliability of the instruments was determined by the application of Cronbach alpha ( $\alpha$ ) in order to determine the feasibility of the instruments. The reliability coefficient, was found to be 0.70

**Result**

**Research Question 1:**

Is there any significant difference in the mean performance scores of students in SSII taught 3-D geometry concept using problem solving strategy and those taught with conventional method?

**Mean and Standard deviation of students of experimental and control group**

Group	N	Mean	Standard Deviation	Mean difference
Experimental	70	28.83	6.524	
				8.01
Control	83	20.82	3.727	

The table above showed that the mean performance scores of experimental group is greater than that of control group with the mean difference of 8.01

**Research Question 2:** Is there any significant difference in the mean performance scores of male and female students in SSII taught 3-D geometry using problem solving strategy?

**Mean Performance of Male and Female Students in the Experimental Group**

Sex	N	Mean	Standard Deviation	Mean difference
Male	70	30.47	5.677	
				1.61
Female	80	28.86	4.979	

The table above shows that the mean performance scores of Male is greater than that of Female performance scores with the mean difference of 1.61

**Ho<sub>1</sub>:** There is no significant difference between the mean performance scores of Students taught 3-D geometry concept with problem solving strategy and those taught with conventional method;

Group	N	Mean	S.D	df	t <sub>calc</sub>	t <sub>crit</sub>
EG	70	5.35	1.87			
				151	2.53	1.86
CG	83	3.45	1.46			

The table above showed that  $t_{cal}(2.53) > t_{crit}(1.86)$ . Then we reject the null hypothesis (Ho<sub>1</sub>) and concluded that there is significant difference between the Students taught 3-D geometry using problem solving strategy and those taught using conventional method at  $\alpha = 0.05$  level of significance.

**Ho<sub>2</sub>:** There is no significant difference between the mean performance scores of male and female of SSII students taught 3-D geometry using problem solving strategy.

Group	N	Mean	S.D	df	t <sub>cal</sub>	t <sub>crit</sub>
Male	70	5.35	1.87			
				148	1.47	1.96
Female	80	3.45	1.46			

The table above showed that  $t_{cal}(1.47) < t_{crit}(1.96)$ . Then we fail to reject the null hypothesis (Ho<sub>2</sub>) and concluded that there is significant difference between male and female performance when taught 3-D geometry through problem solving strategy at  $\alpha = 0.05$  level of significance.

### Discussion of Results

Result from testing hypothesis one shows that there is significant difference in the mean academic performance scores of SS II students taught 3-D Geometry using Problem solving strategy than those taught same concepts using lecture method. The significant difference found between the two groups is likely to be due to the use of Problem solving strategy (an activity-oriented method) on the experimental group. If the treatment administered has no effect, the two groups are expected to perform equally the same. Since the experimental group performed significantly better, it implies that using Problem solving strategy in teaching of 3-D Geometry among senior secondary Schools Students improves their performance. The result confirms earlier findings of Julie (2012); Fatoke, Ogunlade & Ibidiran (2013) and Okeagu (2013), who found that students exposed to Problem Solving Strategy performed significantly better in the experimental groups than those in the control group.

Results from testing hypothesis two shows that problem solving strategy does not differentiate the academic performance of both male and female students taught 3-D Geometry in senior secondary schools in Zaria Education zone, Kaduna Nigeria. This finding is in agreement with that of Bichi (2002), Umahaba, (2012) and Fatoke, Ogunlade & Ibidiran (2013) who individually found out that there is no gender difference in the academic

performance of secondary School students when exposed to activity-based methods of instruction such as inquiry and problem solving Strategy.

### Conclusion

As a result of the findings in this study, it could be concluded that a better understanding and high level performance of students in 3-D Geometry was provided by Problem Solving Strategy. This is because all SS II students exposed to it, showed better performance when compared to those exposed to conventional method. When the effect of gender on students' performance students was investigated, it was found that there was no significant difference between male and female with respect to performance in 3-D Geometry of mathematics using Problem Solving Strategy. This is however, showed that Problem Solving Strategy model is gender friendly.

### Recommendations

On the basis of findings emanating from this study, the following recommendations are made:

- i. Problem Solving Strategy should be incorporated into the main stream of pedagogy in the teaching of mathematics concepts such as 3-D Geometry in all Senior Secondary Schools of the zone.
- ii. This study showed that gender does not play a significant role in the learning of 3-D Geometry concepts among senior secondary school students taught using Problem Solving Strategy. Hence, the method is recommended, as it is gender friendly and aided learning between male and female.

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