

Problem Solving Strategy on Senior Secondary School Students' Performance and Attitude toward Mathematics in Khana Local Government Area Rivers State.

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Abstract

This study investigated Problem Solving instructional strategy on SS2 Students performance and attitude in mathematics in Khalga Rivers State. A quasi-experiment with pretest-posttest control group design adopted the 2 x 2 x 2 factorial analysis was employed for variable matching. The sample consisted of 116 SSS II students made of 58 males and 58 female students drawn from a population of two thousand four hundred and thirteen students (2,413) of GSS using stratified random sampling by balloting in thirty (23) Government owned senior secondary schools in Khalga Rivers state. The research instruments used were: Mathematics Performance Test (MPT) and Students Mathematics Attitude Questionnaires (SMAQ). These instruments were validated and reliability coefficient estimated as $r=0.98$ and $r=0.86$ respectively. The Three hypotheses were tested and analyzed using ANOVA, and Kruskal Wallis Statistics. All hypotheses were tested at $P \leq 0.05$ level of significance. The findings showed that: (i) there is significant difference among two groups of students when exposed to Problem Solving, and Lecture Method (ii) there is no significant difference in performance between male and female student when exposed to problem solving, method. (iii) significant difference exist among the two groups in mean attitude score toward mathematics when exposed to problem solving, instructional strategy and those taught using lecture method. Based on this finding, it is recommended that problems solving instructional strategy should be adopted in teaching the SSS student because this strategy produced higher mean score in performance among the students. This implies that mathematics teachers should be trained through seminars and workshops on how to effectively design and use the problem solving strategy in teaching mathematical concepts. Conclusively, the problem solving strategies are viable alternatives to the lecture method particularly in teaching mathematical concepts among the SSS students.

Introduction

The importance of mathematics in national development is rated so high that federal Republic of Nigeria enshrine mathematics in the national policy of education as a core (compulsory subject for all primary and secondary students in Nigeria (FRN, 2004). It's also a prerequisite for admission into science and all discipline in Nigerian universities because of the pertinent role in a nation's technological and scientific advancement. (Tyekekpolor & Bulieis, 2009).mathematics is to a nation, what protein means to a youth.

Mathematics as the life wire in the studies of various disciplines. It is this importance of Mathematics that compelled the Federal Government of Nigeria to make Mathematics a compulsory subject from the primary school through to the end of the senior secondary school education. However, literature reviews constantly the low performance of students at all levels of education in the subject (Suleiman, 2010; Serkan 2011; Hassan, 2014, Bello, 2014; Adamu,

2014). Other reports on the same subject matter have over the years indicated poor academic performance and general negative attitudes of students towards the subject (Tali, 2012; Sherax, 2014; Jackson and Martins 2014).

Mathematics contributes immensely to helping students develop the skills of critical thinking, problem-solving ability, conjecturing, deductive reasoning, logical argument and proof. Algebraic representation can be used to help students make sense of other areas of Mathematics. Algebra is an important source of Mathematical thinking. It helps to sharpen man's intuition and ability to think logically as well as kindle his interest in observations. It comprises of theories which could be very interesting if well understood.

Mathematical concepts comprise of topics that require manipulative skills, abstract concepts in the Mathematics curriculum and it is the worst performed subject in all Nigerian external and internal examinations (Tsoho, 2011). Since mathematics involves a lot of applications to real world situations and proofs, it is problem solving strategy that can best handle the difficult and challenging concepts. As a review of the teaching and learning methodology, this study investigated the effect, if any, of problem solving strategy on students' performance and attitude in mathematics. As a result, algebra was used in this study as a topic which poses the greatest challenge to students and its application of the six levels of cognitive domain; knowledge, comprehension, application, analysis synthesis and evaluation.

Mathematics importance cannot be over emphasized and the mode of instructions given to the learners of mathematics by the teachers of mathematics, have to be prioritized based on its importance. There exist a number of teaching methods available for teachers to use, they include lecture method, discussion method, demonstration method, discovery method, laboratory method, and problem solving methods to mention just a few. This study used problem solving as opposed lecture method of teaching Mathematics with a view to determining which of them will be more effective and will result in better learning and greater performance through which the teaching of mathematics at senior secondary schools in Rivers State may be improved.

A teaching method whereby the student is featured as the active participant, where the teacher assumes the roles of a facilitator, mediator and assessor of learning have been found to be superior in developing students' abilities in applying concepts and personal growth, developing positive attitudes, fostering motivation, and encouraging appropriate group social skills (Welbery, 2009). An approach of instruct through which students interact with their environment by exploring and manipulating object is regarded as problem solving teaching (Ormrod, 2000). Problem solving teaching has been described as a process of allowing the student to take the leading role in his own learning experience. This method encourages students to actively use their intuition, imagination, and creativity because the method starts with the specific and moves to the general. The teacher presents examples and the students work with the examples until they discover the interrelationships. Bruner (1961) believes that classroom learning should take place through inductive reasoning, that is, by using specific examples to formulate a general principle.

For instance, if students are presented with enough examples of equations, they will eventually reason through what the basic rules of equations must be. The teacher therefore acts as a facilitator and guides, making it possible for the learner to reach mutually-agreed upon goals. The teacher serves as a resource person to stimulate, motivate, clarify and explain. The idea is that students are likely to remember concepts they understand on their own.

Problem solving is a method of teaching used to accomplish instructional goals of learning basic facts, concepts, and procedures, as well as goals for problem solving within problem

context. This method encourages pupils or students to probe into a problem. In teaching Mathematics, problem solving strategy is characterized by interactions between students and teachers, Mathematical dialogue and consensus between students, teachers providing just enough information to establish background of the problems, and students clarifying, interpreting and attempting to construct one or more solution process, teachers accepting right or wrong answers in a non-evaluative way, teachers guiding, coaching, asking insightful questions and sharing in the process of solving problems, teachers knowing when it is appropriate to intervene, and when to step back and let the pupil or student make their own way (Lester et al; 1994).

The problem-solving and guided-lecture method instructional techniques were considered in this study because it will give the researcher the insight on the extent to which each of the teaching techniques contributes to the performance and attitude of students in mathematics. Based on this, the researcher is prompted to carry out a research to examine the effects of problem-solving Mathematics instructional strategies on the performance and attitude of Senior Secondary School students in Khalga, Rivers State, Nigeria.

Statement of the Problem

This study was aimed at investigating problem solving strategy will have any effect on attitude and performance towards mathematics among SSS in Khalga, Rivers State. The motivation to conduct this research was based on the experience of the researcher who teaches under the Rivers State Secondary Schools Board for over a Decade and also participates in the coordination and marking of WAEC (Mathematics for both Junior and Senior) for over eight years and observed that students dodge away from attempting to answer questions in mathematics. Also, Students attitude towards mathematics in the Senior Secondary schools are generally decreasing that an urgent attention has to be considered by math's educator if mathematics should continue to be a tool for national development. It was observed that poor performance has become prominent in mathematics especially at West African Examination council (WAEC) see (appendix J) this may be due to the fact that traditional methods like Lecture, Rote learning and unguided discovery are being used by teachers (Kaura, 2014). In particular, West African Examination

Council (WAEC) Examiners' report (2005 & 2013) reveals that students have problem with Mathematics and such problems have been traced to lack of essential rudiments of algebra at lower levels of education. The studies cited that students have difficulty to accurately measure, draw and construct and prove identities or use of formulae in equations, virtually students suffer skills and abilities needed in mathematics. Similarly, research findings on the newly admitted university students offering 100 levels Math and at basic level consistently indicates that algebra and geometry are one of the most difficult areas of mathematics (Adetula, 2005). Again, the researcher observed that students overall performance in SSS Mathematics placement Exam conducted annually in Khalga, Rivers State has generally been very poor and that students rarely or sometimes completely avoid attempting questions in mathematics.

This failure rate may be due to poor method of teaching by some teachers which resulted to negative attitude by some students and lack of good instructional materials that could stimulate the interest of students which may lead to better understanding of the subject. Hence there is the need to develop a strategy that might enhance students' active participation, positive attitude and high academic performance in mathematics such as the problem solving strategy at Senior Secondary schools. Therefore, this study was set to investigate the effect of problem solving teaching strategy on students' attitude and academic performance in mathematics among Senior Secondary Schools in Khalga, Rivers State.

Objectives of the Study

The objectives of the study were to:-

1. determine the effects of problem solving strategy on SSS academic performance in mathematics and those taught with lecture method
2. determine the effects of problem solving methods between male and female senior secondary students performance in mathematics and those taught with lecture method
3. investigate any difference in mean attitude score between senior secondary school students taught with problem solving method and lecture method

Research Questions

The research work provided answers to the following research questions:-

1. What is the effect of problem solving and lecture method instructional strategies on mathematics performance of students?
2. What is the effect of problem solving and lecture methods instructional strategies on male and female students" in mathematics?
3. What is the mean attitude score between senior secondary school students taught with problem solving method and lecture method.

Null Hypotheses

The following null hypotheses were formulated and tested at the significant level of 0.05

1. There is no significance difference in the mean score of students" performance in Mathematics among students exposed to problem solving teaching strategies and those taught with lecture method
2. There is no significant difference in the mean score of male and female taught mathematics with problem solving instructional strategies and those taught with lecture method
3. There is no significant difference between students attitudes mean scores in mathematics after exposure to problem solving instructional strategies and those taught with lecture method

Research Design

This study used a quasi-experimental research with pretest post test control group design. This was because the independent variables cannot be fully controlled. The design made use of 2 x 2 x 2 factorial analysis for matching variables. The factorial design was used because of the experimental nature of the study such as lacking the complete randomization and to ensure proper matching of the variable involved. The treatment was manipulated at three levels namely, problem solving, and lecture method and the interaction effect of gender at two levels (male and female). The treatment and gender are crossed in 2 x 2 x 2 factorial designs. The factorials design has been chosen because it allow for separate determination of the effect of treatment on the learning outcome (Kerlinger, 1986). The conceptual model of the design is illustrated.

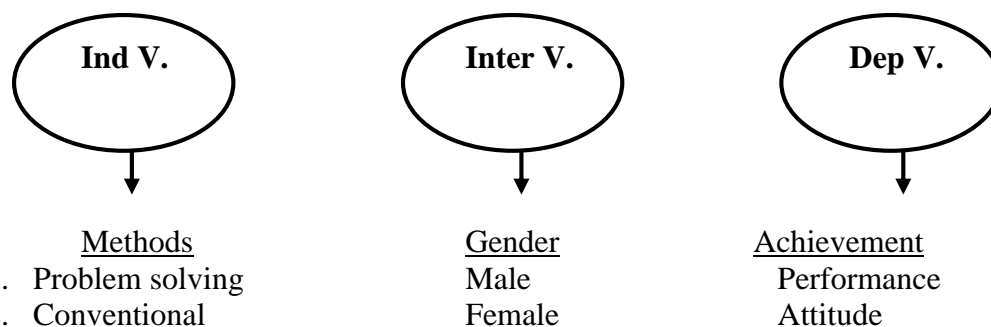


Figure 3.1: Research Design

Ind V. = Independent Variable
Inter V. = Intermediate Variable
Dep. V. = Dependent Variable

3.2 Population of the Study

The study area consisted of 23 Government owned secondary schools in Khalga, Rivers State. The schools were made up of both single and mixed schools. The average age of the SSS 2 students is fifteen years. The population is made up of two thousand four hundred and thirteen females (2,413) comprises of nine hundred and fifty (950) for male and one thousand four hundred and sixty three (1,463) for females one single sex school and twenty two mixed schools. For population details, (see appendix H).

3.3 Sample and Sampling Technique

The subject of the study were four (4) Government Senior Secondary School (SSS II) students from Khalga, Rivers State. All were co-educational. The schools were selected at random using stratified random sampling techniques. The sampling was based on the stratified random sampling four schools out of the twenty three senior Secondary schools in Khalga, Rivers state. In selecting the schools for this study, certain criteria were considered, these were qualification of Math teacher and basic infrastructural facilities in the schools. Eight schools that met these criteria were randomly selected. However, two schools were randomly assigned by balloting to each experimental group and the other schools were for control group.

Table 3.1: Showing Distributions of Respondents Gender

Method	Gender		Total
	Female	Male	
Lecture	30	28	58
Problem- Solving	28	30	18
Total	58	58	16

The sampled schools were grouped into one experimental groups and one control group using random sampling technique (use of balloting) by picking paper from the hat, involving rolling two (2) papers with code 01, 02, representing the schools. In which code 01 for the experimental group while 02 is for the control group.

Instrumentation

The instruments used for this study were:

- i. Mathematics Performance Test (MPT)
- ii. Surdents' Attitude Questionnaire called Mathematics Concepts Attitude Questionnaire (MCAQ)
- iii. Validation of the Instruments

- iv. The content validation of Mathematics Achievement Test and Mathematics Concepts Attitude Questionnaire were assessed by experts that include the following:
- v. Mathematics education lecturers of PhD status from Mathematics education section, Rivers state University, Nkpolu Oroworukwo, Port Harcourt
- vi. Teachers of Mathematics in the Selected Secondary Schools with B.Ed in Mathematics Education.
- vii. These groups of experts were requested to critically examine the instruments to assure its correctness, clarity, appropriateness, readability and standard for SSS II students.
- viii. **3.6 Reliability of the Instrument**
- ix. The instruments Mathematics Achievement Test and Mathematics Concepts Attitude Questionnaires were pilot tested to determine their reliability. The test retest method was employed for MPT and result analyzed using PPMC calculated to be 0.98. While for SMAQ split half method was used and the reliability found to be 0.86 using Cronbach alpha. This shows that the instruments used were reliable. Appendix K shows explanation of how the coefficients were arrived at.
- x. **Procedure for Data Analysis**
- xi. This section explained the procedure for the statistical analysis used to arrive at decisions for each research questions and the null hypothesis. After the scripts were marked by the researcher, the students' mean performance score of the post test and attitude ranking scores of the MGAQ of all the students were obtained as well as male and female score in each group. The research questions were answered using descriptive statistics of mean and standard deviation, while ANOVA and Kruskal Wallis test were used to test the hypotheses, the following null hypothesis were formulated and tested at $P \leq 0.05$ level of significance:
- xii. H_{01} there is no significant different among SS2 students in mathematics mean performance score when exposed to Problem Solving strategy and those taught using lecture method. The factor variable group were divided while the test variable performance is a quantity variable, hence the appropriate statistical technique is ANOVA one factor.

Data Analysis and Result Presentation:

The mean performance scores and standard deviation of problem-solving instructional strategies and lecture method of teaching the groups raised in the research questions are presented. Table 4.1 and 4.2 present pre-test result of the mean scores, standard deviation and mean difference in problem solving and lecture method group used in the research question on senior secondary school students' mean scores, attitude scores and standard deviation toward mathematics (Algebra).

Research Question 1: What is the effect of problem solving and lecture method instructional strategies on mathematics performance of students?

Table 4:1: Summary of Pre-Test Mean Scores and Standard Deviation among students

Method	N	Mean	Standard Deviation
Lecture	58	6.22	2.261
Problem Solving	58	8.53	2.694
Total	116		

Table 4:1 Shows a Mean of 6.22 and Standard Deviation of 2.261 for Lecture Method Group. And mean of 8.53 and Standard Deviation of 2.694 for Problem Solving Group.

Table 4:2: Summary of Post Test Mean Scores and Standard Deviation among students

Method	N	Mean	Standard Deviation
Lecture	58	10.21	1.956
Problem Solving	58	15.13	2.309
Total	116		

Table 4:2: Shows mean of 10.21 and Standard Deviation of 1.956 for Students Taught with Lecture Method. And Mean of 15.13 and Standard Deviation of 2.309 for Student Taught with problem solving.

Research Question 2: What is the effect of problem solving and lecture methods instructional strategies on male and female students' in mathematics?

Table 4:3: Showing the performance of male and female students exposed to problem solving method

Gender	N	Mean	Mean Diff	Std. Deviation
Female	30	15.132		2.247
Male	30	15.136		2.374
Total	60		0.004	

We agree that there is no mean difference of students taught by problem solving method and lecture method.

Research Question 3: What is the mean attitude score between senior secondary school students taught with problem solving method and lecture method.

Table 4:4: Mean and Standard deviation of attitudes of students taught by problem solving method and lecture method.

Method	N	Sum	Mean	Mean Diff	Std. Deviation
Problem Solving	58	664	4.049		1.197
Lecture	58	530	3.581	0.468	1.125
Total	116				

In Table 4:4: the Mean of 4.049 and Standard Deviation of 1.197 for Problem Solving Group. And the Mean of 3.581 and Standard Deviation of 1.125 for Lecture Method Group.

Hypothesis 1: There is no significance difference in the mean score of students' performance in Mathematics among students exposed to problem solving teaching strategy and those taught with lecture method.

Table 4:5: Summary of ANOVA on Significant Differences between Students taught Problem solving method and Lecture method

Variable	Sum of Squares	df	Mean Squaren	F. Ratio	F-Critical	P Value
Between Group	1886.723	1	1886.723			
Within Group	1431.556	114	4.618	408.566	3872	0.0002
Total	3318.279	115				

We reject the null hypothesis that there is no significant difference between Students taught using Problem solving method and Lecture method. The calculated F.Ratio of 408.566 is greater than F-Critical of 3.872. Showing that there is a significant difference between the problem solving method and lecture method.

Hypothesis 2: There is no significant difference mean score of male and female students taught using problem solving instructional strategy and those taught with lecture method.

Table 4:6 Summary of ANOVA on Significant Differences among Male and Female Students taught Problem solving method

Variable	Sum of Squares	df	Mean Squaren	F. Ratio	F-Critical	P Value
Between Group	0.001	1	0.001			
Within Group	869.048	60	5.364	0.00017	3.900	0.989
Total	869.049	61				

The calculated F. Ratio of 408.566 is greater than F-Critical of 3.872. Showing that there is a significant difference between the problem solving method and lecture method.

We accept the null hypothesis that there is no significant difference among Male and Female Students taught by Problem solving method. Table 4:7: shows that the F. Ratio of 0.00017 is less than the F-Critical of 3.900. We hereby accept the hypothesis that there is no significant difference among male and female students taught with problem solving method.

Hypothesis 3: There is no significant difference in the mean attitude of students taught with problem solving and lecture method.

Table 4:7: Summary of Kruskal-Wallis Test of mean attitude scores towards problem solving methods

Groups	N	Mean Rank	H-Value	DF	P-Value
Problem Solving	58	176.53			
Lecture	58	134.30	18.793	1	P <0.05
Total	116				

We reject the null hypothesis that there is no significant difference in the mean attitude of students taught with problem solving and lecture method. Since the H-Value of 18.793 is greater than the H-Critical. We conclude that there is a significant difference.

Summary of Findings

In this study the following findings were made:

- 1 There was significant difference between the students taught using problem solving and those taught with lecture method. Therefore, in this case, the null hypothesis is retained.
- 2 There was significant difference between male and female subjects in their performance when taught with problem solving strategy.
- 3 There was significant difference between the students' attitude in mathematics (Algebra) concept before and after exposure to problem solving.

Conclusion

The findings of this study led to the following conclusions:

Instructional strategies that teachers use in teaching mathematics (Algebra) have significant effects on student performance in mathematics.

The use of either problem solving can facilitate learning of mathematics in the senior secondary schools.

Mathematic (Algebra) performance test according to gender reveals that both sexes in the experiment I, II groups show no significant effect when exposed to treatment.

The finding on students' attitude after exposure to problem solving strategies showed influence on their attitudes. The students enjoyed teaching and learning of mathematics using problem solving strategies, since these allowed them to have interaction, discussion before coming to an acceptable possible solution of a given problem. This strategy kept every learner very active and involved at every stage of finding solutions to problems. Thus attitude of learners is favorable and this in turn improved their mathematics (Algebra) performance.

Therefore, either the problem solving or the guided discovery instructional strategies could be used by Mathematics teachers in the teaching of geometry.

5.3 Recommendations

In this study, some recommendations were made based on the findings and conclusions. They are as follows:

The teaching of mathematics at the senior secondary school should be conducted in a manner that students will effectively understand and learn the concept taught.

The views and ideas of the students since students' participation plays greater role in learners' performance.

The fact that higher mean was recorded in students' performance through the use of problem solving strategy, calls for teachers to acquaint themselves with the characteristics of this teaching method with a view to enhancing students' performance and outcomes in learning. This could be done through seminars, conferences and workshops to be organized by State government and professional bodies.

The findings of this study had also generated the need for further research of this type to be undertaken to replicate the present study using a wider geographical area.

From time to time, the State government and the Local Education Authority should liaise and organize workshops for Mathematics teachers to educate them on the need for the use of various instructional strategies. This is to complement the efforts of the Millennium Development Goals (MDGs) for retraining Mathematics teachers.

5.4 Contributions to Knowledge

The study has contributions to knowledge as follows

- The study has brought with it Problem Solving instructional strategies teaching Module; which were used in teaching mathematics (Algebra) learning activities that were developed. This is capable of contributing in no small measure to knowledge in the area of research. Consequently students and researchers will find this work useful for further research.

In various studies, attitudinal changes were left out and was used in this study and found that positive attitudinal change was attained us

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