

# Impact of Problem Solving Approach on Senior Secondary School Students' Achievement in Mathematics

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## **ABSTRACT**

*The study is carried out to investigate the impact of problem solving approach on senior secondary school students' achievement in mathematics. The study is carried out in Owerri North local government area of Imo State. Based on the objectives of the study two research questions and two hypotheses guided the study. Quasi-experimental research method was applied in carrying out the study employing the pre-test post-test control type. A sample of 155 students was selected for the study from two purposively selected schools. A 25 item researcher made objective test question entitled "Mathematics Achievement Test" (MAT) with reliability co-efficient of 0.73 determined through Kuder-Richardson method (KR20) was used in data collection. The data were analysed using mean and standard deviation to answer research questions while the hypotheses were tested using t-test statistical tool. The result of the study reveals that problem solving approach of teaching mathematics enhanced students achievement. Based on the findings, it is recommended that appropriate problem solving approach should be applied by mathematics teachers in teaching so as to enhance students' achievement in the subject.*

**Keywords:** *Problem solving, students' achievement, mathematics, approach.*

## **INTRODUCTION**

Mathematics, undoubtedly, is the pillar of all sciences, and the scientific and technological attainment of any nation solely revolves around the mathematical base of that nation. According to Ogwuche and Kurumeh (2011), mathematics is the backbone of science and technology and no nation can hope to achieve any measure of scientific and technological advancement without proper foundation in school mathematics. Okereke (2006) states that mathematics is the science of things that have a pattern of regularity and logical order and finding and exploring the regularity. Mathematics is the foundation of science and technology and the functional role of mathematics to science and technology is multifarious, that no areas of science, technology and business enterprise escape its application. Irrespective of the rich importance of mathematics, it is observed that it is one of the most poorly taught, widely hated and abysmally understood subjects in secondary schools. Ale (2003), Obodo, (2004), and Ifamuyiwa (2007) variously note that despite the important

role of mathematics, it still remains one of the subjects in which many students at all levels of the school system persistently perform very poorly. Okereke (2006), further attributed students' poor performance to factors such as the society view that mathematics is difficult, shortage of qualified teachers, lack of mathematics laboratory and lack of attractiveness and novelty in teaching method. Most mathematics teachers still adopt the unpopular and unproductive traditional methods of teaching mathematics which is teacher centred than students centred. Ogwuche and Kurumeh (2011) note that most teachers adopt the conventional approach in the teaching of mathematics. The approach focuses on what is being taught and as such, it is a teacher or subject centered approach. This situation has continued to diminish the achievement of students in mathematics and as such, endangered the scientific and technological quest of the nation Nigeria. The need to reposition the achievement of students in mathematics requires that attention should be given to student-centred approaches such as the problem-solving approach.

Obodo (2004) notes that problem solving technique comprises the identification and choosing of mathematical problems which grow out of the experiences of individual students, placing these problems before the students and guiding them in their class in solving the mathematical problem as a group. These techniques encourage students to arrange and clarify facts or data as well as allow students to learn from their success and failures, since it permits the students to participate in their learning. In the problem based learning model, the students turn from passive listeners of information receivers to active, free self-learner and problem solvers. It also shifts the emphasis of educational programs from teaching to learning. It enables the students to learn new knowledge by facing the problems to be solved instead of feeling bored. The technique affects positively certain other attributes such as problem solving, information acquisition and information sharing with others, group works, and communication etc. The basis and foremost aim of this learning approach is acquisition of such information which is based on facts (Yuzhi, 2003 and Mangle, 2008). According to Chris (2005), problem solving, in any academic area, involves being presented with a situation that requires a resolution. Being a problem solver requires an ability to come up with means to resolve the situation fully. The ultimate goal of any problem solving approach is to improve students' performance at solving problems correctly. Learning to solve problem is the principal reason for studying mathematics (Nekang, 2013). Stannic and Kilpatrick (1988) opine that mathematics is synonymous with problem solving (doing word problems, creating patterns, interpreting figures, developing geometric constructions, pulling theories' and so on). The specific goals of problems-solving in mathematics are to:

- i Improve students' willingness to try problems and improve their perseverance when solving mathematical problems.
- ii Improving students' self-concepts with respect to the abilities to solve mathematical problems.
- iii Make students aware of the mathematical problem solving strategies.

- iv Make students aware of the value of approaching mathematical problems in a systematic manner
- v Make students aware that many problems in mathematics can be solved in more than one way.
- vi Improve students' abilities to select appropriate solution strategies in mathematics.
- vii Improve students' abilities to implement solution strategies in mathematics accurately.
- viii Improve students' abilities to get more correct answers to problem in mathematics.

According to Gallagher, Stephen, Sher and Workman (1999), in a problem based learning environment, students act as professionals and are confronted with problems that require clearly defining well-structured problems, developing hypotheses, assessing, analysing, utilising data from different sources, revising initial hypothesis as the data collected developing and justifying solutions based on evidence and reasoning. Grouws and Cebulla (2000) note that teaching that incorporates students initiative solution methods can increase students learning, especially when combined with opportunities for students' interaction and discussion.

Student achievement and understanding are significantly improved when teachers are aware of how students construct knowledge are familiar with the intuitive solution methods that students use when they solve problems. Structuring instruction around carefully chosen problems allowing students to interact when solving problems, and then providing opportunities for them to share their solution methods result in increased achievement on problem solving measures (Grouws and Cebulla, 2000). Based on the foregoing, it becomes necessary to investigate the efficiency of problem solving approach on students' achievement in mathematics.

Considering the dwindling nature of students' achievement in an important subject like mathematics, it becomes pertinent for teachers and researchers to source for strategies that will sure-up students' achievement in the area and prepare them for the future. Therefore, the main purpose of this study is to determine the impact of problem-solving approach on secondary school students' achievement in mathematics. Specifically, the study aims at determining:

1. Whether students taught mathematical concept using problem solving approach will differ in their achievement when compared with those taught with the traditional approach.
2. The achievement difference between male and female students taught mathematical concept using problem solving approach.

The following research questions guided the study:

1. What is the difference in mean achievement scores of senior secondary school one (SS 1) students taught mathematical concept using problem solving approach and those taught using the traditional approach?
2. To what extent does male and female senior secondary school one (SS 1)

students taught mathematical concept using problem solving approach differ in their mean achievement scores?

The following hypotheses guided the study,

H<sub>0</sub>1: There is no significant difference between the mean achievement scores of senior secondary school one (SS 1) students taught mathematics concept using problem solving approach and those taught using the traditional approach.

H<sub>0</sub>2: There is no significant difference between the post-test mean achievement scores of male and female senior secondary school one (SS 1) students taught mathematical concept using problem solving approach.

### METHOD

This study is a quasi-experimental research design adopting the pre-test, post-test non-equivalent control type to determine the impact of problem solving approach on senior secondary school one (SS1) students' achievement in mathematics. The population consist of all senior secondary one (SS1) students in Owerri north local Government of Imo state. A sample of 155 students consisting of 81 female and 74 male from two coeducational secondary schools purposively selected from Owerri North Local Government area of Imo State participated in the study. The control group was made up of 83 students (40 female and 43 males) while the experimental group was made up of 72 students (41 females and 31 males).

The instrument used for data collection was a 25 item multiple choice questionnaire entitled "Mathematics Achievement Test" (MAT) constructed by the researcher and drawn from Senior Secondary School one (SS1) mathematics curriculum. The test instrument was validated by three (3) mathematics education and two measurement and evaluation experts, their inputs were considered in restructuring the instrument. The instrument had reliability coefficient of 0.73 determined using Kuder-Richardson method (KR<sub>20</sub>). This method was considered appropriate for the study. In administering treatment, both groups were pre-tested as to ensure that, they are of the same cognitive background.

Afterwards, the experimental group was taught mathematics concept (word problems in algebra) by a trained research assistant using lesson plan drawn through problem solving approach. The students were allowed to solve problems in group, discuss with each other, and use different strategies to surmount problem situations. They were allowed to pose problems and proffer solutions to them and compare solution strategies within themselves. They interacted with the teacher when difficulties were encountered. While the control group, was taught by their regular mathematics teacher using the traditional "talk-and-chalk" approach. The treatment period lasted for four weeks after which a post-test was administered on both groups using the re-arranged version of MAT. The text instrument was marked over 100%. The data generated was analyzed using mean and standard deviation to answer the research questions, while ANCOVA statistical tool was used to test the hypotheses at 0.05 level of significance.

## RESULTS AND DISCUSSION

Table 1 shows that the experimental group had a mean gain of 19.56 after treatment while the difference of 17.40 existed between the two groups in favour of the experimental group. Table 2 shows that male students had mean achievement of 52.74 while their female counterparts had mean of 48.27. Also, a mean achievement difference of 4.47 exists between them in favour of the male students. Table 3 above shows that  $p < 0.05$  in the method row also, f-value of 71.257 is greater than the critical value at 0.05 level of significance. This implies that a significant difference exist between the mean achievement scores of students taught mathematics concept using problem solving approach and those taught traditionally. Based on the result, the null hypothesis that there is no significant difference between the mean achievement scores of students taught mathematical concept using problem solving approach and those taught using the traditional approach is rejected.

Table 3 also shows that,  $p = 0.05$  on the sex row and the calculated f-value of 2.630 is less than the critical value at 0.05 level of significance. This implies that no significant difference exists between male and female mean achievement scores in the experimental group. Based on the result, the null hypothesis that there is no significant difference between the post test mean achievement scores of male and female students' taught mathematical concepts using problem solving approach is upheld. The result of the study reveals that a mean achievement difference existed between senior secondary school one (SS1) students taught mathematics concept using problem solving approach and those taught using the traditional approach. This was found to be statistically significant and in agreement with the findings of Riasat, Hukamad, Agila and Anawr (2010); Ogwuche and Kurumeh (2011), which showed that, students taught mathematics through problem solving method achieved better than those taught by traditional method.

Also the study showed that, the mean gain in achievement between male and female senior secondary school one (SS1) students taught mathematics through problem solving approach was not statistically significant. This implied that the achievement gap between male and female students in mathematics was drastically reduced by the approach. This result is *in tandem* with the work of Ogwuche and Kurumeh (2011) and Nekang (2013), who variously report no significant difference in the achievement of male and female students in mathematics due to problem solving methods.

## CONCLUSION AND RECOMMENDATIONS

This study was carried out to investigate the impact of problem solving approach on secondary school students' achievement in mathematics. The result of the study reveals that problem solving approach improved students achievement in mathematics and reduces the gap in mathematics achievement between male and

female students. Based on the findings of this study it is recommended that:

- i. Mathematics teachers should apply the problem solving approach in teaching mathematics as to enhance students' problem solving skills.
- ii. Seminars and in-services program should be organized by government, mathematics association education boards to train teachers on the pedagogical approach.
- iii. Mathematics curriculum planners should incorporate the problem solving approach of teaching into the curriculum as to enforce its application in teaching and learning of mathematics in secondary schools.

**Table 1:** Summary of students' achievements

Group	Test	N	Mean	SD	Mean Gain	Diff in mean
EXPT	Post-test	72	50.06	9.13		
	Pre-test	72	30.50	8.70	19.56	17.40
CONTROL	Post-test	83	32.76	8.33		
	Pre-test	83	30.60	9.14	2.16	

*Source:* Quasi-experimentation, 2014

**Table 2:** Summary of male and female post-test achievement

Gender	N	Mean	SD	Diff in Mean
Male	31	52.74	8.62	4.47
Female	41	48.27	9.07	

*Source:* Quasi-experimentation, 2014

**Table 3:** Summary of ANCOVA analysis of students' achievement

Source	Type III sum of squares	df	Mean Square	F	Sig	Rmrk
Corrected model	6313.644	4	1578.411	18.058	.000	
Intercept	12455.429	1	12455.429	142.499	.000	
Pretest	141.085	1	141.085	1.614	.147	
<b>Method</b>	<b>6228.385</b>	<b>1</b>	<b>6228.385</b>	<b>71.257</b>	<b>.000</b>	<b>Sig</b>
<b>Sex</b>	<b>229.889</b>	<b>1</b>	<b>229.889</b>	<b>2.630</b>	<b>.107</b>	<b>N/sig</b>
Method*sex	6.126	1	6.125	.070	.792	
Error	13111.027	150	87.407			
Total	225668.000	155				
Corrected total	19424.671	154				

*Source:* Quasi-experimentation, 2014

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