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Effects of Understanding the Problem Statement on Students' Mathematical Performance of Senior Secondary Schools in Borno State, Nigeria

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Abstract
The study assessed the relative effectiveness of understanding the problem statement on students' mathematical behaviours in Borno State Secondary Schools. The study was guided by an objective: to determine the Understanding the problem statement on student's performance in senior secondary school and a null hypothesis: there was no effect of understanding of mathematical problem statement on students' performance in Borno State senior secondary school. Quasi-experimental design was used for the study. Out of 468 senior secondary two (SSII) students, 160 students were selected for this study through random sampling technique. Ten mathematics achievement tests were developed in the area of algebraic process as a research instrument for the study. The experiment was conducted for eighty sessions spread across four weeks. Pre-test and post-test results were used as data. The analysis of the data was done by t-test of independent means. The study revealed that understanding the problem statement has significantly increased on students mathematical behaviours. Therefore, the study recommended that understanding the problem statement technique should be used in teaching mathematical problem solving in secondary education.
Keywords: Understanding, Problem Solving, Mathematical Behaviours and Student Performance

1. Introduction

A well-stocked and well-organized body of knowledge is an asset to the problem solver (Polya, 1973), and a good organization of knowledge that renders the knowledge readily available may even be more important than the extent of the knowledge (Silver, 1982). This shows that knowledge or skill has no such things as expertness without extensive and accessible knowledge (Simon, 1980). Most researchers who are interested in mathematical problem solving have agreed that understanding problem statement is a critical factor to be considered in problem solving research. In order to interpret correctly the problem solving behaviours of an individual who engaged in a mathematical problem solving episode, it is important to have considerable background information about student's knowledge base. Moreover, to understand the problem statement in a particular mathematical problem, it is necessary to know the nature of the understanding into which that student assimilates how to solve mathematical problem.

For several years students have been solving some mathematical problems in an attempt to acquire a better understanding of the problem statement and processes used in solving mathematical problem at the secondary educational level (Ojaleye, 2000; Banus, 2003). Realizing the importance of understanding has led to investigation of the ways in which understanding influences problem solving performance. Thus, there are degrees of understanding the problem statement, some of which come from the problem solvers background and some of which come from attempting to solve the problem. This indicates that understanding the problem statement is impossible to define and does not denote a single set of cognitive processes. For instance, understanding is closely linked to the subjects' internal representation of the problem and is processes of constructing a representation of the object that is to be understood (Greeno, 1977).

Understanding a textual material requires the subject to construct an interpretation of the problem situation with three different kinds of knowledge i) basic world (domain) knowledge relevant for the problem ii) planning knowledge, and iii) strategic knowledge. Understanding has certain criteria which includes a) achievement of a coherent representation b) close correspondence between the internal representation and the object to be understood c) connectedness of the representation to general concepts and procedures in structure of knowledge (Greeno, 1977). Polya (1973) stated that understanding the problem statement requires someone to answer some questions such as: what is the unknown from the problem statement? What are data from the problem statement? What is the condition from the problem statement? Is the problem statement possible to satisfy the condition? Is the condition sufficient to determine the unknown from the problem statement? Or is the condition insufficient from the problem statement? Is the condition redundant from the problem statement? Or is the condition contradictory from the problem statement? Draw /introduce a figure/ suitable notation from the problem statement. Separate the various parts of the condition from the problem statement. Can you write them down from the problem statement?

The paper addresses the hypothesis which stated that there is no significant effect of understanding the problem statement on student's mathematics performance in Borno State senior secondary schools. This study

reports the results of an effect of understanding the problem statement on students' mathematical behaviours in secondary education level. The research attempted to identify a subject of the components of these rather than broad concepts that may be affected by student's mathematical performance.

2. Method

This study is a quasi-experimental design in nature involving independent and dependent variables with pre and post-tests. In the broader study, 160 senior secondary two (SSII) students were randomly sampled. They were distributed among four groups; each group consisted of 40 students (one experimental and one control group in each of the two schools). Ten mathematics achievement tests were developed in the area of algebraic process which serves as a research instrument for this study the experiment was conducted for eighty sessions spread across four weeks.

Before the commencement of the study, the pre-test was administered to the participants of both the control and treatment (experimental) groups. The researchers recorded the scores of the participants. After the pre-test, the experimental groups were taught how to understand the problem statement in a mathematics problem. This involves answering some questions such as: question one:

The result of taking 6 from one- third of n is one less than twice n.

a) Express this statement in algebraic terms
b) Hence find the value of n.

Here the method of understanding the problem statement should include answering the following questions: what is the unknown from the problem statement? What are data from the problem statement? What is the condition from the problem statement? Is the problem statement possible to satisfy the condition? Is the condition sufficient to determine the unknown from the problem statement? Or is the condition insufficient from the problem statement? Is the condition redundant from the problem statement? Or is the condition contradictory from the problem statement? Draw /introduce a figure/ suitable notation from the problem statement. Separate the various parts of the condition from the problem statement. Can you write them down from the problem statement? While the control groups used the traditional method of solving mathematics problems, which does not involves such question.

Descriptive statistics of arithmetic means, variance and standard deviation of the data collected on the responses of ten mathematics achievement test developed in the area of algebraic process were used to compare the pre-test and post-test scores of student's mathematical behaviours. The data were subjected to t-test of independent sample. These statistical values were used amenable to mathematical techniques than other systems of measuring abilities or skills and they have a high degree of accuracy and stability in estimating or approximating the population.

3. Results

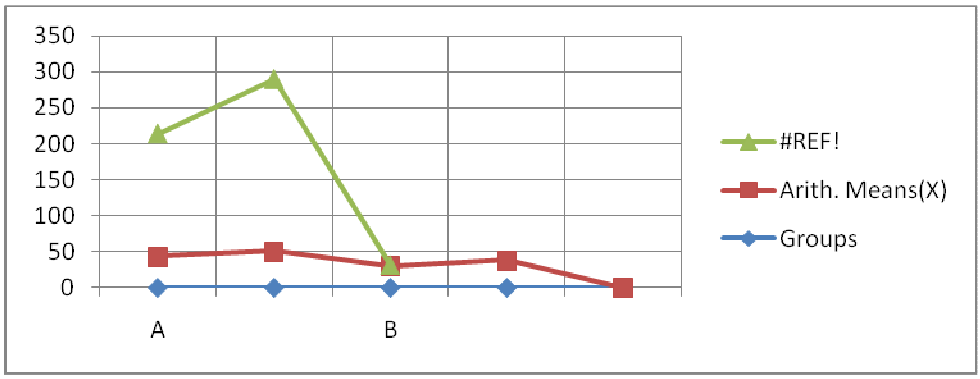
The data analyses are presented and discussed based on the two major comparisons:

i) To confirm whether the students in the two schools started the experiment at the same level?
ii) The pre-test and post-test of the experimental groups in the schools is to be compared to determine whether there is an effect of understanding problem statement on students mathematical behaviour?
iii) The post-tests of the control and experimental groups?

$H0_1$: Students in the two schools did not start the experiment at the same level before the study was carried out.

Table 1: Pre-Test Result of the Experimental and Control Groups

School	Groups	Arithmetic Means(X)	Variance (S^2)	Std. Dev. (S)
A.	Control	27.9	245.2	15.66
	Experimental	27.3	245.1	15.66
B.	Control	18.5	150.42	12.26
	Experimental	19.2	149.16	12.21



Result of t-test on the difference between pre-test of the control and experimental groups' scores of the students in the two schools started the study at the same level before the experiment was carried out and was computed to be 0.021, where the arithmetic mean of 46.4 and 46.5 were realized from the control and experimental groups respectively. These figures revealed that there was no significant difference between pre-test of the students in the two schools that started the experiment at the same level. Therefore, the hypothesis, which stated that students in the two schools started the experiment at the same level before the study was carried out, is accepted in respect of the pre-test result.

$H0_2$: There is no influence of understanding the problem statement on students' mathematical behaviour

Table 2: Post-Test Result of the Control and Experimental Groups of the Two Schools

School	Groups	Arithmetic Means(X)	Variance (S^2)	Std. Dev. (S)
A.	Control	43.35	365.48	19.12
	Experimental	50.57	371.25	19.27
B.	Control	30.5	170.85	13.07
	Experimental	38.0	239.58	15.48

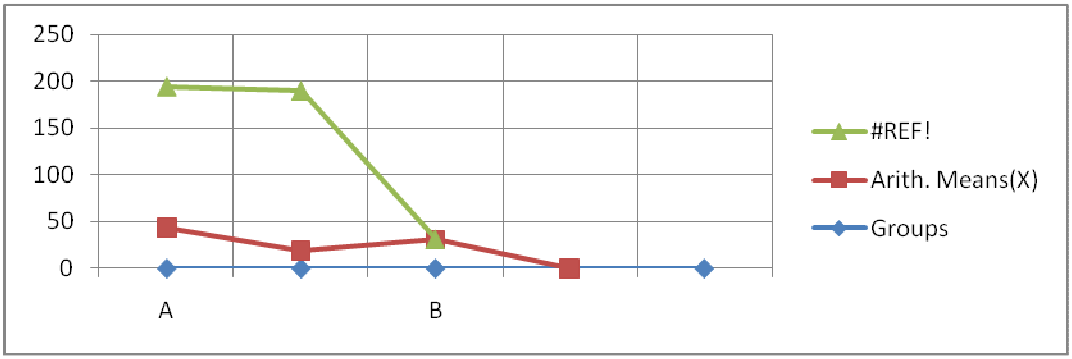


Table 3: Pre-Test and Post-Test of Control Groups of the Two Schools

School	Test	Arithmetic Means(X)	Variance (S^2)	Std Dev.(S)
A.	Pre-test	27.9	245.2	15.66
	Post-test	43.35	365.48	19.12
B.	Pre-test	18.5	150.42	12.26
	Post-test	30.5	170.85	13.07

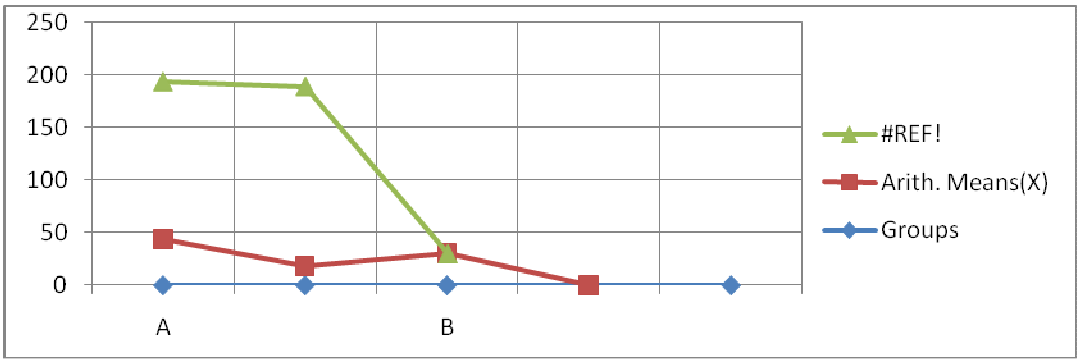
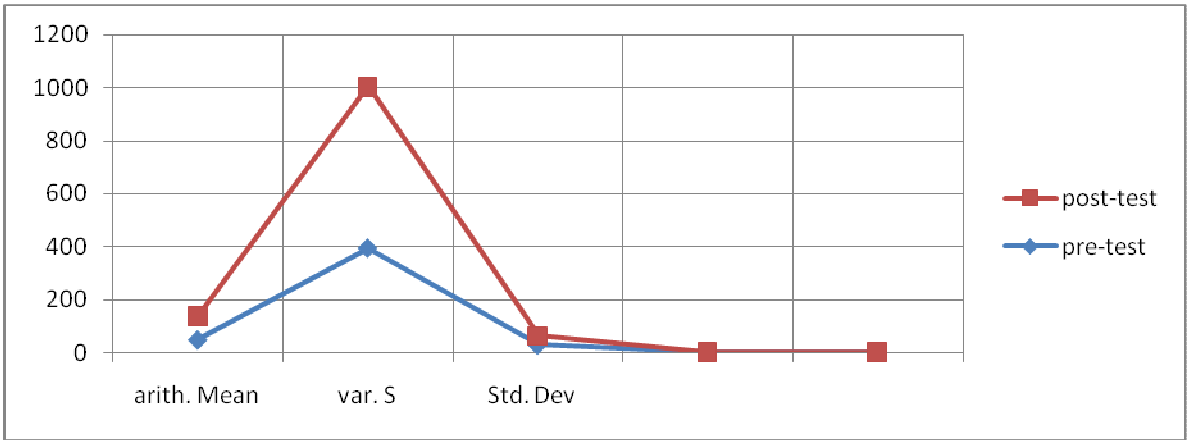


Table 2: Pre-Test and Post-Test Results of the Experimental Groups of Two Schools

School	Test	Arithmetic Means(X)	Variance (S^2)	Std Dev.(S)	School
A.	Experimental	Pre-test	27.3	245.1	15.66
		Post-test	50.57	371.25	19.27
B.	Experimental	Pre-test	19.2	149.16	12.21
		Post-test	38	239.58	15.48



After conducting the pre-test and post-test to the experimental groups of the two schools, the results indicated that the difference between the sum of the pre-test and post-test arithmetic means is 41.67. This was used to compute the t-value to be 78.19. From the result, it could be seen that there was a significant difference between the pre-test and post-test arithmetic mean scores of the two experimental groups. Therefore, the hypothesis, which stated that there was no significant effect of understanding the problem statement on student's behaviour towards mathematical problem solving of senior secondary in Borno state, was rejected. Hence, there was significant effect of understanding the problem statement on student's mathematical behaviour.

4. Discussions

The first hypothesis raised in this study was concerned with finding out whether understanding the problem statement in mathematical problem solving has significant effect on students' mathematical behaviour. The result of the t-test of related samples, which tested the significance of the arithmetic mean difference between the pre-test and post-test of the two experimental groups in the two schools was computed. From the computed results, it was evident that understanding the problem statement in mathematical problem solving has significant effect on student s behaviour in mathematics at the secondary education level. This finding agrees with the earlier study of Silver (1982), who found significant effect in the student's cognition as mediators of the effectiveness of small group learning and knowledge organization and mathematical problem solving.

The second hypothesis of this study is concerned with finding out the differential effectiveness or influences of understanding the problem statement on student's behaviour towards their performance in mathematics. The result presented in table 2 showed that there was significant difference in the effectiveness of treatment condition called "How to understand problem statement" on students behaviours in mathematical problem solving. Elshort, Jansweigner and Wielinga (1986) agree with the findings of this study. The findings of this study as supported by other related literatures revealed that understanding problem statement has significant effect on student's behaviours in mathematical problem solving at the secondary education level.

Therefore, the findings of this study supported the theoretical framework of reference of polya's model

of solving mathematical problems called" how to solve it" on which this study was based. The theoretical framework of reference proposed that problem solver should able to understand the problem statement. In other, the student's behaviour at the end of solving mathematical problem shall relate to the problem task of problem statement (Polya, 1973).

5. Conclusion

The study has revealed that understanding problem statement was seen as a force of improving the student's behaviour in solving mathematical problem. Therefore, contrary to the hypothesis tested, the conclusion was made from the study that understanding the problem statement was effective in helping students when solving mathematical problems.

6. Recommendation

Based on the results of this research, it is recommended that the mathematics teachers should teach idea of how to understand the problem statement in mathematical problem solving to students so that their level of performance in mathematics education will be improved. The results of this study would help to improve the prevailing situations and circumstances of poor performance of student in solving mathematical problem as variety of processes are employed by different mathematical problem solving experts to achieved the goal of have solutions to problems that are either mathematical in form or not. Government and non-governmental organizations should organize a seminar, workshops or otherwise for mathematics teachers and other concerned bodies on how to understand problem statement in any given problem.

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Appendix

Mathematics Achievement Test

Instruction: Attempt all questions. Each question carries equal marks

1. The result of taking 6 from one- third of n is one less than twice n.
   a) Express this statement in algebraic terms
   b) Hence find the value of n

2. Solve the equations a) $\frac{5d+2}{8} + \frac{3d-1}{4} = 0$ b) $2(3x-1) = 7x-3(x-2)$

3. A certain number is subtracted from 3 and 4 is subtracted from the number; the product of the two numbers obtained is 2.
   a) Express the statement in algebraic terms
   b) Hence find the two numbers.

4. If a certain number is squared and 3 times the number is subtracted from it. The number becomes a perfect square.
   a) Express the statement in algebraic terms

b) Hence find the result of the square in a bracketed expression

5. a) What must be added to x^2-5x to make the expression a perfect square?
b) Find, correct to 2 decimal places, the results of the equation $2y^2$-11y-13=0

6. Solve the equation a) 2m-n=-5, 3m-2n=-21; b) x-$y/_2$= -2, -$x/_3$-$y/_2$ =2 1/2.

7. In a two-digit number, the sum of the digits is 2. The difference between this number and the number with the digits reversed is 24. What is the number?

8. 7 cups and 8plates cost #630. 4 cups and 5plates cost #645. Calculate the cost of a cup and of a plate.

9. If 2 is subtracted from both the numerator and denominator of the fraction, the fraction becomes 3. If 1 is added to both, the fraction becomes -1/4. What is the fraction?

10. Adamu invested #200 at x% and #27000 at y%, his annual income is #13000. If he invested #100 at x% and #30 at y%. He still owes Audu #172. Find x and y.

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