# JUNIOR SECONDARY SCHOOLS STUDENTS' ACHIEVEMENT IN MATHEMATICAL PROBLEM-SOLVING AND INTELLECTUAL ABILITIES IN ONDO STATE, NIGERIA

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## ABSTRACT

*The study was aimed at establishing the relationship between the achievement of junior secondary school students in mathematical problem solving and their achievement in intellectual ability test using factor analysis. The study population consisted of all the students in Junior Secondary Schools (JSS) in Ondo State. Out of this population, a sample of 206 students were randomly selected from three senatorial districts of the State. Seven evaluation tests (six on intellectual abilities and one on mathematical problem solving) were administered on the sample. The findings of the study showed that a significant relationship existed between mathematical problem solving and intellectual abilities (verbal, induction and numerical abilities) of the students. Thus, teachers should provide avenue for students to improve their intellectual abilities of verbal, induction, numerical, retention and other abilities. This could be done by enriching the learning environment, provide different instructional materials and activities in the classroom.*

***Keywords:*** *Mathematical Problems, Intellectual Abilities, Achievement, Junior Secondary Schools, Students*

## INTRODUCTION

Surveys of students' attitude towards Mathematics and students in class performance and their performance in public examinations provide evidence of students' poor attitude and decline poor performance in Mathematics (Igbokwe, 1997). A number of factors had been identified by various researchers and educators as being responsible for poor achievement in Mathematics such as students' characteristics, instructional/classroom characteristics, teachers' characteristics, societal factors and school factors. Other factors, often cited, include lack of motivation and poor self image (self concept) of primary school teachers, lack of innovative teaching methods, lack of teaching facilities, poor school climate, lack of incentives and motivation, poor remuneration, poor condition of service and students' poor problem-solving abilities (Munro, 1979; Ubani, 1983; Aina 1986; Nwoji, 1999)

Many studies have also revealed other problems of learning and teaching Mathematics in Nigerian schools. They are sex stereotyping, transfer of poor attitudes of older students to the younger ones, poor self concept towards mathematics and the failure of mathematics teachers to digest properly and utilize research findings (Munro, 1979; Ubani, 1983; Aina 1986; Nwoji, 1999). There are difficulties associated with specialized language of the subject and students lack of necessary skills for

learning the problem solving process (Adetula, 1988). Most of the views and comments expressed by researchers, educationists, parents and others seem to have been based on the fact that the students turned out at the end of the educational "pipeline" are not the kind of people that the present day technological age require. The ability of the school products is poor and also the general consensus is that students' attitude is that of indifference. Okey (1979) states that students need to be diagnosed for appropriate treatment of learning outcome. Some mathematics educators such as Polya (1957), Bolaji (1984) have spent time to develop some problem solving strategies so that teachers could utilize them in teaching problem solving in mathematics.

Problem solving studies revealed that problem differed in structure, context, complexity and representation. Gick (1986), Jonassen and Henning (1999) have opined that problem solving depend on conceptual knowledge and procedural knowledge available to the learner. Similarly, other factors affecting the learning of problem solving in mathematics have been traced to students' intellectual abilities. Lester (1980) reports that reading skills contribute to verbal problem solving abilities and single element among others such as verbal, numerical, memory and computation abilities are associated with and related to success in mathematical problem solving (Falokun, 1981). Akpan (1988) also reports a significant relationship between mathematical problem-solving abilities and the affective behaviour such as motivation and interest while Ojaleye (1996) also argues that there is a significant relationship between the performance of students in intellectual abilities test and mathematical problem solving test among Junior Secondary School students. The purpose of this study therefore is to establish relationship between intellectual abilities and solving mathematical problem abilities and to subject the items to factor analysis and select items of satisfactory loading to determine the relationship. Hence, the study was designed to answer the following questions:

i Among the intellectual ability test which items are of the greater factor loadings?

ii Among the mathematical problem solving test, which item are the greater factor loadings

iii Which are the common factors that can be inferred?

## METHOD

The sample for this study consisted of 206 JSS III students in the third term of their final year in junior secondary schools who are already preparing for Junior Secondary Certificate Examination in Mathematics. Purposive sampling technique was used in selecting the sample from the three senatorial districts of Ondo State. The research instrument used were seven evaluation tests of which six were intellectual abilities constructed by the researcher and one obtained from Romberg and Wearne (1979) Mathematical Problem-Solving Test which yielded three scores - Comprehension,

Application and Problems Solving. The tests were reviewed and vetted for face and content validity by two experienced secondary school mathematics teachers and two evaluators with mathematics background. The Kuder Richardson formula 20 (KR20) was used to establish the reliability coefficient estimate from 0.678 to 0.718. Intellectual Ability Tests: Verbal Ability Test [0.682]; Induction Ability Test [0.678]; Numerical Ability Test [0.702]; Retention Ability Test [0.680]; Perceptual Speed Ability Test [0.718]; Spatial Relation Ability Test [0.710] and Problem Solving Tests: Mathematics Comprehension Test [0.702]; Mathematics Application Test [0.675] and Problem Solving Ability Test [0.712].

## RESULTS AND DISCUSSION

Table 1: Mean and Standard Deviation of Intellectual Ability and Problem Solving Tests

| | Intellectual Ability Tests | | | | | | Problem Solving Tests | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAT | IDAT | NAT | RAT | PESAT | SRAT | MCT | MAT | PSAT |
| Mean | 10.88 | 7.70 | 9.65 | 12.27 | 10.76 | 8.90 | 5.54 | 13.94 | 10.07 |
| S. D | 5.45 | 4.08 | 2.75 | 5.14 | 5.59 | 3.62 | 6.18 | 4.52 | 7.71 |

Table 1 shows the means and standard deviations of intellectual abilities and mathematical problem solving ability tests. From table 1, the mean scores of tests X1 to X6 ranged from 7.70 to 12.27 while that of tests X7a to X7c ranged from 5.54 to 13.94. Similarly, the standard deviations for tests X1 to X6 ranged from 2.75 to 5.59 while that of tests X7a to X7c also ranged from 4.52 to 7.71.

**Table 2:** Factor Analysis of Tests Scores and their Communalities

| TESTS | FACTOR 1 | FACTOR 2 | COMMUNALITY |
|---|---|---|---|
| VAT [X1] | 0.2889 | 0.7530 | 0.5794 |
| IDAT [X2] | 0.2899 | 0.7092 | 0.5162 |
| NAT [X3] | 0.2457 | 0.8445 | 0.6611 |
| RAT [X4] | 0.3352 | 0.3955 | 0.2289 |
| PESAT [X5] | 0.2585 | 0.3735 | 0.0859 |
| SRAT [X6] | 0.7867 | 0.0382 | 0.5138 |
| MCT [X7a] | 0.3288 | 0.7612 | 0.4709 |
| MAT [X7b] | 0.6872 | 0.7965 | 0.8562 |
| PSAT [X7c] | 0.9868 | 0.0673 | 0.9848 |

Number of students = 206; $P < 0.001$

The result of the factor analysis on Table 2 showed that the Spatial Relation Ability Test [X6], Application Ability Test [X7b] and Problem-Solving Ability Test [X7c] load on factor one while Verbal Ability Test [X1], Induction Ability Test [X2], Numerical Ability Test [X3] and Comprehension Ability Test X7a load on factor two. One can inferred that most of factor one was primarily mathematical problem solving test while factor two was principally intellectual ability test.

The communalities obtained in table 2 revealed that tests X1¸ X2, X3, X6 and X7 had 40 - 60% of their variances explained while tests X7b and X7c had over 70% of their variances explained. The results of this study revealed that students' performance in intellectual abilities tests X1 to X6 provide a strong and significant relationship between it and their performance in mathematical problem solving test

in secondary schools. This can be explained as the comparable common factors (communalities) found for one factor were over 40% but less than 60% of their variances, loading on that factor principally (intellectual abilities) while two of the tests have over 70% of their variances explained by common factors of mathematical problem - solving. In particular, the application tests appeared to be more highly related to the intellectual ability of secondary school students. These findings agreed with the findings of Meyer (1978), Munro (1979) and Ojaleye (1996) who reported that intellectual abilities are related to mathematical problem solving for various sexes at grade 4 to 7.

## CONCLUSION

Based on the findings of this study, it is suggested that teachers should take into cognizance the significant intellectual abilities that would improve the teaching / learning of mathematics in the junior secondary schools. Hence, teachers should provide avenue for students to improve their intellectual abilities of verbal, induction, numerical, retention and other abilities and this could be done by enriching the learning environment with different instructional materials and activities which enables the students to participate actively in the classroom. Similarly, government should encourage and motivate the teachers by giving them incentives and remunerations that will in turn propel them to put in their best. Finally, teachers should be exposed to constant and continuous workshops and seminars to learn new strategies in problem solving to meet the demand of the subjects and encourage professionals' mathematics educators to write books which emphasize the use of different strategies of mathematics problem-solving.

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